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THE COMPLETE HANDBOOK OF MODEL RAILROAD OPERATIONS

How to operate and run your model railroad system like a real-life prototype!

BY PAUL MALLERY

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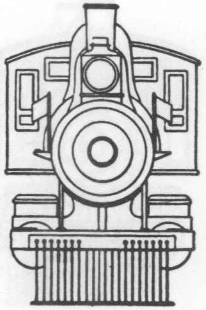


Preface

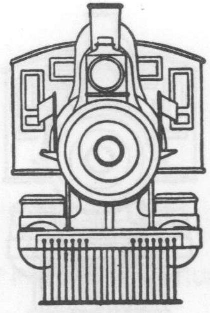
This Handbook provides information of the methods used by the prototype railroads for transporting freight and passengers and of the means which have been successfully used to duplicate such prototype activities on a model railroad. It is intended as a reference work. To maximize the information included, cross-references are used extensively and a detailed index has been supplied for extracting information.

Because different layouts place different requirements on an operating system and because modelers have different interests, all methods known to be successful are described. This is not a book on how one or two layouts are operated.

In the interest of preserving some of the history of the hobby and to give credit where credit is due, the earliest-known publication or demonstration of a significant advance in model railroad operation is cited. If any reader knows of an earlier disclosure than that cited, the author would appreciate being so informed.

Since Handbooks are written in the hope that they will be updated with later editions, the author would also appreciate being informed by any reader who feels that an error has been made in this edition or has a suggestion for including additional information in the next edition.

Paul Mallery



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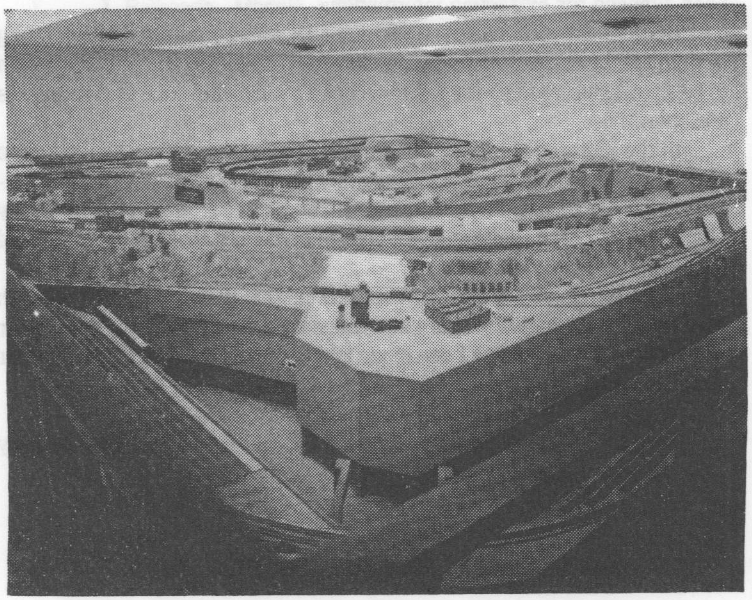
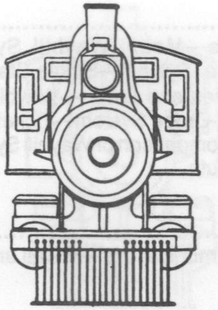
The author wishes to acknowledge the great assistance given by many in contributing information and checking the accuracy of the manuscript. These include brakemen and other railroad employees, who were willing to discuss the fine points of signals and rules, and also club members who provided information of the operating systems at their clubs and then checked the results. In particular, thanks go to Bill Jambor, Dispatcher, Conrail, for indispensable help both in providing information and in making a detailed review of the manuscript, and to Cliff Robinson and Mark Eskew for their review of the manuscript.



The first section of the HO layout of the Model RR Club, Inc., March, 1978. This layout is designed to be operated in the prototype manner and is used for many of the examples in this book. (Courtesy Bob Cosman)



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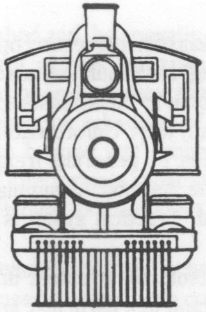


Chapter 1
Introduction to Operation

Model railroading stands out among hobbies in its great variety of interests. These range from collecting locomotives, through model building from kits or raw materials, to specialized subjects such as signaling and computer control. But perhaps the most important feature is one unique to this hobby: rails which provide a precise means for guiding and controlling trains. This precise control can be exploited in many ways—from merely running trains around a track to duplicating the operation of the real railroads. Experience has shown that the greatest interest is generated when a model railroad has a realistic appearance and, in addition, is operated in a realistic manner. The latter implies following the rules and procedures of the prototype to simulate true-to-life transportation service. Trains do not just run, they are delivering freight and moving passengers.

To build a model of a car from raw materials, a modeler must have plans and other information about that car. The modeler must also know how to convert that information into a scale model, know which materials to use, and know how to use the necessary tools. In a like manner, to operate a model railroad in a realistic, interesting manner, the modeler must know how railroads operate and how to simulate the prototype methods, rules, and procedures in a practical way. Certainly paper work, such as that necessary for accounting and billing on the prototype, is not desired. Nevertheless, a modeler, does want to achieve the visual effect that such paperwork creates. An example of a shipper ordering a car which will be loaded and then directed to a consignee. This Handbook provides information of prototype operation and presents methods which have been used successfully to duplicate such operation on a model.

FACTORS OF OPERATION

Operation of the prototype is directed towards just one end, revenue from the transport of passengers and freight. The cars, trains, and track are merely tools. The key to realistic, interesting operation of a model railroad is to move freight and passengers. Simulating passenger service presents few problems as passengers come to the stations to board trains and, if they do not come, the trains run anyway. Unfortunately, on a model there are no shippers and no consignees to generate freight traffic. So, to duplicate prototype operation, some method of simulating the orders placed by shippers must be installed. Practical systems to this end are covered in Chapter 7.

The model railroad itself, for greatest impact, must be a believable whole. Real railroads are built in a particular area, serve a particular need, and exist at a particular time. In contrast, a modeler has complete freedom in selecting those factors which, taken together, form the concept of the railroad. Ideally, a believable concept suitable for the space available should have been set before the layout was designed, but any existing layout can have a concept adapted to it. Serious consideration given to the way a particular layout can best represent a real railroad often will disclose minor changes which will increase operating interest. An example is combining alternate routes between two terminals into a longer single route between the same two points. The importance of adopting a realistic concept cannot be overstated. It is the framework upon which everything else hangs.

Closely akin to concept is the purpose of the model railroad. Is it primarily for the display of moving trains to visitors, or is it only for the enjoyment of its owner? Often a slight modification of the tracks allows continuous running of trains for shows and also allows realistic operation at other times. The ideas relating to concept and purpose are explored in Chapter 2.

Once the concept of the railroad has been established and the purposes of its operation selected, the time has come to consider the operation itself. On the prototype, operation is characterized by many simultaneous yet independent actions. The interplay among the various operators such as enginemen and towermen is most interesting and can be duplicated quite closely on a model. Even the smallest of layouts can provide operating positions for at least two persons. Typically, however, there just are not enough operators available for each to assume only the functions of a single employee of the prototype. Since modelers want a high level of activity during an operating session, it is desirable to combine several prototype jobs into one on the model. A one-man train crew may be enough, for example. How many positions should be available is a matter of the size of the layout, its configuration, the number of operators, and the concept of the railroad. To make this selection intelligently, it is first necessary to know what operating positions there are on the prototype and what they do. Significant to this selection of operating positions for a particular layout are its controls. If there is going to be an engineman on each train, the control system must be such that a single operator can control a locomotive as it moves about the layout. Information of prototype operating personnel and how their positions can be handled on a model appears in Chapter 3.

With a concept established and the operating positions known, the next step is the actual movement of cars and trains. On the prototype such movements are governed by operating rules, timetables, and signals. There is a lot more to timetables than the schedules of trains, but schedules alone add an intersting dimension beyond just running trains. The methods of constructing schedules and the formats most suitable for a model railroad are covered in Chapter 4. Signals, as they affect operation, are described in Chapter 6.

Not every train is scheduled and even scheduled trains do not always run on time. The methods used to meet such conditions are covered in the book of rules for each particular railroad. To a large extent these rules can be applied directly to a model railroad, as described in Chapter 5.

On the prototype, a freight train is not run for the sake of displaying a moving train. Every car is making a purposeful move from a point of origin to a destination. For a car to be moved there must be an order for the move. A shipper may call for an empty car, load it, then order it to be delivered to a consignee. The car distributor of a railroad may order empty box cars to be concentrated at a particular yard to prepare for an expected large shipment of grain, and so on. These orders for shipments and empty car movements are the whole basis of freight operation on the prototype. However, as mentioned above, it seems most unlikely that modelers have any desire to duplicate the paper work used by the prototype even though they want the operating effects of that paper work. For example, a local freight pulling into a station in Pennsylvania needs to know that a particular box car at the sawmill is loaded and ready to be shipped to a lumber yard in New Jersey. This information must be retained as the car is transferred from the local freight to a through freight and finally to a drill which will spot the car at the lumber yard. On a model, car-movement orders are usually called waybills regardless of the form they take or whether the car is loaded or empty. In contrast to the prototype, where a conductor may have an hour or more between stations to sort out the waybills in preparation for the next set outs and pick ups, on a model there may be only a minute or so between stations. Simplicity is the key to waybill system which is practical on a model railroad. Many suitable systems have been developed and a wide selection is presented in Chapter 7.

Communications are vital to operation on the prototype. Some communications are simple, such as the hand signals of a brakeman to an engineman indicating to move forward or back. Hand signals are described in Chapter 6. Others, such as between the train dispatcher and the block operators, are complex. Except on the very smallest layouts, similar needs exist on model railroads. Practical solutions are presented in Chapter 8.

Figure 1-1 illustrates some of the factors of operation and a few of the operators who are involved in duplicating prototype operation on a model. The important point is that all these operators and equipment are part of a well-regulated system. Everyone and everything is directed toward the movement of freight and passengers.

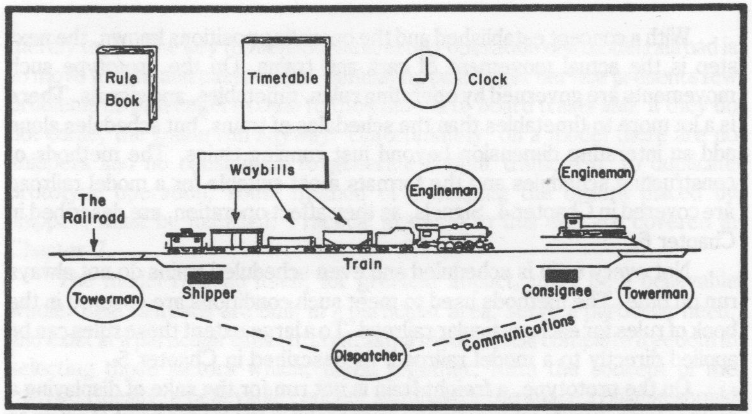


Fig. 1-1. Some factors of operation.

Model railroad operations, of necessity, are carried out on a layout. The quality of design and construction of that layout are extremely important. The finest concept, a great waybill system, superb timetables, and a well-organized operating crew will be of no avail if cars cannot be coupled, trains will not stay on the track, or electrical problems are frequent. The track, the couplers, and the wiring are some of the physical factors which must be considered in establishing interesting operation. Each such factor is a subject in itself. Consult the references given at the end of this Chapter for detailed information. However, Chapter 14 highlights the pitfalls which must be avoided and indicates general solutions to common problems. That chapter also covers the basic principles of layout design as they relate to realistic, trouble-free operation. These basic principles are considered both from the standpoint of designing a new layout and of improving an existing one. In particular, the pitfalls of design are explored.

SIZE OF LAYOUT

The size of the layout has an important bearing on its operation. In this Handbook the adjectives small, medium, and large are used to distinguish layouts by size. A *small* layout is defined as one which must be designed as a complete unit. A major relocation of track at any point affects all other tracks. Operationally, a small layout can have only one major feature, operations at a single station for example. *Medium* implies a layout with tracks which can be relocated in one area without affecting tracks in another area. A medium layout can have two or three operating features. These must be closely related such as a branch line having an interchange yard with a main line. A *large* layout has extensive areas which can be designed essentially independently of all other areas. Such a layout can have several major operating features including independent connecting railroads.

Note that small, medium, and large do not directly imply physical dimensions. If two identical layouts are built, one in O scale, the other in N, the O scale layout would require approximately eleven times the physical space as the N layout, but operationally would be no larger.

TERMINOLOGY

Precision of language is important in transmitting information. Unfortunately, on the prototype railroads, often more than one term exists for the same thing, e.g., a *towerman* on one railroad may be called a *block operator* on another. The same applies to many model-only terms. When alternative terms exist in common usage, all are given at the point where such terms are defined. When a term is defined with precision as in the operating rule books of the prototype but used more loosely by many, for example *siding*, both the precise meaning and the vernacular use are given where the term is defined. At all other points, that term is employed only in its precise sense. Because this is a handbook for model railroad operation, if two or more terms with the same meaning are current on the prototype, the one employed by most modelers is used.

In addition to variations among the prototype railroads, model variations of (or substitutions for) prototype terms exist. Since following prototype language can be considered as much a part of model railroading as using the proper scale dimensions, model variations or substitutions for prototype terms are given only where the terms are defined. Elsewhere only the prototype terms are used.

A glossary of the main terms pertaining to operation, both prototype and model, appears in the Appendix. For a comprehensive listing of all significant railroad and model railroad terms, including slang, and terms of related fields such as bridges, consult *The Railroad Dictionary* which was in preparation for publication by Boynton and Associates in 1978.

GETTING STARTED

Perhaps the single most-difficult thing about duplicating prototype operation on a model layout is getting started. There are just so many factors to consider for a complete operation system that, at the beginning, the task seems overwhelming. A time-proven approach is one-step-at-a-time. As each new feature is added, it should be practiced until it becomes second nature before going on to the next step.

It is not vital which step is chosen as the first step. If trains seem to be rolling well enough, perhaps installing a simple waybill system would be a good place to start. But even as thinking commences concerning the methods of operation, a critical examination of the way locomotives and trains are handled should be made. Are speeds kept to reasonable levels? Yard speeds, for example, should not be in excess of 25 kmh (15 mph). Unfortunately, most modelers run far too fast—some even will insist that scale speeds are too slow. The smaller the scale, the more likely this is to be so. Do not guess; check the speeds by timing against measured distances. Figure 1-2 provides the necessary information. Are stops and starts made smoothly? Can the throttles operate locomotives at constant speeds as low

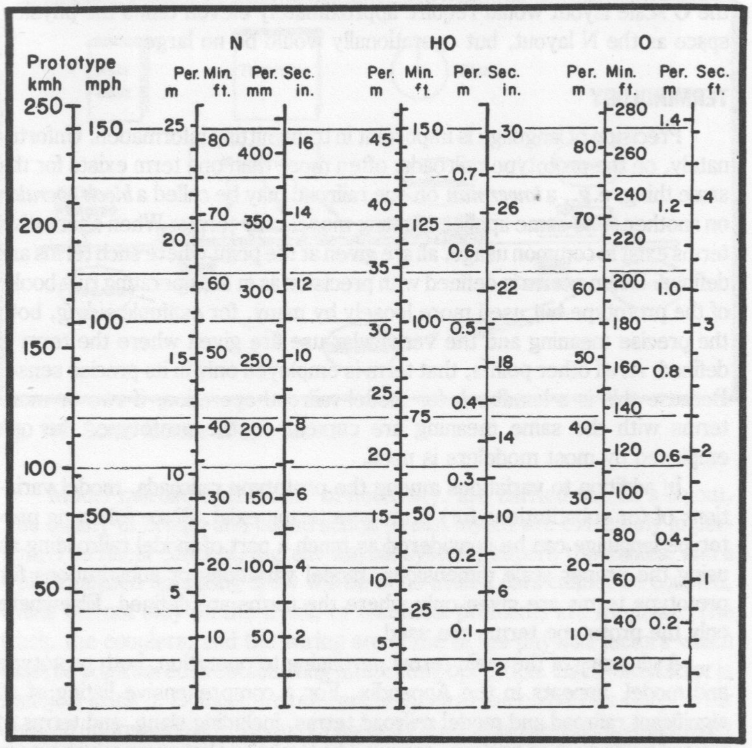


Fig. 1-2. Scale speed.

as 2kmh (1mph)? All these things are independent of the operating system but are necessary for good effect.

IMPROVING OPERATION

When first starting to operate, it is very obvious that many new features can be added to make operation more interesting as soon as skills permit going beyond the precedures already adopted. But, even after a seemingly-complete operating system is in effect, there is always room for improvement. These improvements can be minor, such as eliminating the tendencies to run too fast, or major as replacing a card-order waybill system with waybill-on-car. To a large extent, whether there is a steady progression in operations or not depends upon the superintendent in charge, be it the owner or a club member assigned the task. A major responsibility of the superintendent should be to seek better methods and procedures. Nevertheless, much can be done by the operating crew to help the superintendent in this effort. A method found useful at the Summit-New Providence HO RR Club was the critique. Usually an operating session was terminated somewhat early, most often when things had not gone too well, to provide time for the critique. At that moment the rough spots are still fresh in everyone's minds. The problems were then discussed and possible solutions proposed for the next session. Critiques are excellent for uncovering and correcting problems within a system and even for disclosing problems which need fundamental changes.

Another method of making improvements is interchange of ideas by those interested between operating sessions. All forms of communciations are useful to this end: written notes, informal conversations between two individuals, and meetings. It is this approach which is more likely to lead to fundamental changes, such as revising the wiring system from pass-the-buck to cab control.

In all cases known to the author, the most logical first step toward prototype-like operation was the introduction of hand signals. Such signals have two immediate benefits: first, they put a prototype operating procedure into effect immedicately, one which takes no special preparation or adapting to a particular layout; second, and more important, they reduce the confusion created by all the talking (shouting?) otherwise required. Hand signals are covered in Chapter 6.

After establishing good communications among enginemen and other operators, the next logical step on most layouts is to introduce schedules. Avoid becoming bogged down with any sort of a clock at the very beginning. As explained in greater detail in Chapter 4, start with a sequence schedule. As the name implies, with a sequence schedule all operations take place in a given order regardless of how quickly or how slowly they are carried out. This takes the pressure of time off the operators and allows them to place their full attention to proper operation of the trains. As skills increase a clock can be introduced. A first clock can be the so-called "rubber clock", that is, one whose rate can be varied at will. Thus the clock can be accelerated when things are going well and slowed when they are not. This avoids both boredom and frustration.

Opinion is mixed on whether a rubber clock is a desirable step on the way to a fixed-rate clock. The author feels it is, but Mark Eskew (an experienced operator) strongly disagrees—stating that with a rubber clock it is too easy to cover up problems that should be corrected. The other side of the coin is that slowing the clock itself discloses the problem areas while allowing operations to proceed. An objective should be to work toward a fixed rate on the clock.

Above all, do not get diverted by long discussions which do not bear directly upon getting operation underway. An example of such a diversionary subject is whether a fast clock should be used and, if so, how fast. This is a frosting-on-the-cake type of thing and can await the development of a full system of operation. Use any convenient clock at the beginning.

Along with clocks and schedules comes the urge to run too fast when late. Speed limits should be established and enforced. There is no way a freight train dashing along at 300 kmh (160 mph) is going to look well. Never relax on enforcing the requirements of maximum speeds (and smooth starting and stopping).

If the layout and its operating crew are large enough to justify the position of train dispatcher as a separate operator, get that position into action at an early stage. Dispatching is vital to good operation and it is a job which must grow as the operating system is developed. Having a dispatcher on the job will assist all other operators. If the functions of a dispatcher are assumed as an extra task by one of the other operating positions, define the job early and put it into practice.

The introduction of a true waybill system usually awaits the gaining of skills in operating by schedule with a clock although, as mentioned earlier, it is possible to use waybills as the starting point. In any event, it is important that switching skills be developed early. The substitution system, one in which a freight train entering a station is required to exchange one or more cars of its train for similar cars standing at the station, is a good beginning. The substitution system is described in detail in Chapter 7. After switching skills have developed to where rather lengthy substitutions are required, a sound next step is single-station switching, also as described in Chapter 7. This gets the operators accustomed to spotting cars at preassigned destinations without simultaneously having to identify particular cars.

The final step is the introduction of a true waybill system. The various waybill systems in use should all be examined to determine which is best adapted to the particular layout. Do not allow a preconceived notion about waybills to dominate the choice. Perhaps the most common such preconceived idea is that waybill-on-car systems should not be considered for appearance reasons.

Figure 1-3 shows the steps recommended for getting started with operation. The most important thing is to start with the simple and move toward the complex one step at a time. It sounds trite, but the way to start operating is to start. The least-likely way of installing prototype-like operation on a layout is to attempt to plan it in great detail with the intention of introducing an entire system of timetables, waybills, etc., at one time. The Summit-New Providence HO RR Club, which had been operating with a true waybill system since 1951, found that each time operation had to be suspended for a considerable period of time, it was necessary to resume operation one step at a time, albeit in rapid-fire order.

ADDITIONAL INFORMATION

This Handbook covers the factors of operation. The emphasis is placed on how prototype methods can be applied to increase interest in operation on a model layout. Where prototype rules and methods can be used directly, those methods and rules are cited in detail. However, in many cases (for practical application on a model), the ways of the prototype must be simplified, often to eliminate writing. Safety is not vital on a model and record-keeping normally is not desired except to facilitate maintenance and repair. For those interested in a complete description of prototype train operation, *Rights of Trains* by Peter Josserand published by Simmons-Boardman is recommended. That book covers the Standard Code of Operating Rules, Block Signal Rules, and Interlocking Rules of the AAR. When following a particular prototype railroad, it is best to obtain a copy of the rule book and at least one employee timetable from that road. Often a railroad will modify or eliminate parts of the Standard Code to fit its particular needs. For information specific to passenger operation, *Passenger Terminals and Trains* by John A. Droege, republished by Kalmbach Publishing, is very useful.

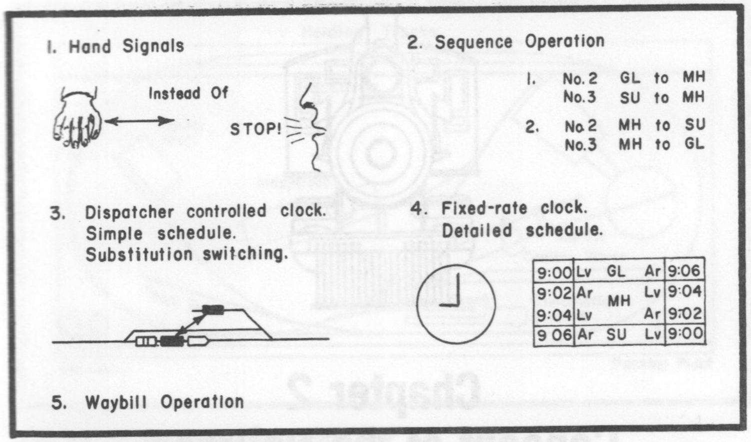
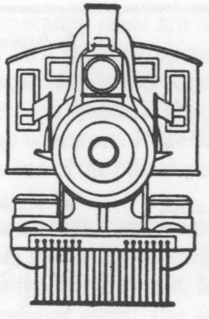


Fig. 1-3. Steps in starting to operate.

There are other matters which, although not strictly operational in themselves, do bear upon operation but are outside the scope of this Handbook. Such matters maybe found in other reference books. Those written by the author of this Handbook are cited below.

Very important to maximizing interest in operation is the design of the layout. If there are no line-side industries, there can be no line-side switching. Methods of designing for interesting operation are covered in the *Design Handbook for Model Railroads*. The electrical circuits for the control of the layout are vital, not only to provide the type of control most suited to the operations desired, but also to provide trouble-free operation. Electrical information may be found in the *Electrical Handbook For Model Railroads*. Both of these Handbooks are published by Carstens Publications, Box 700, Newton, NJ 07860. Since trouble with the track also will degrade enjoyment of operation, sound trackwork is a must. Such matters are covered in the *Trackwork Handbook*. Bridges affect operation primarily as part of the scenic effect. Information on them can be found in the *Bridge and Trestle Handbook*. These last-named handbooks are published by Boynton and Associates, Clifton House, Clifton, VA 22024. The special considerations of street-car and interurban lines are covered in the *Model Traction Handbook*, coauthored by Steven Mallery and published by Vane Jones, 6710 Hampton Dr. E., Indianapolis, IN 46226. Two other excellent books are TAB BOOKS (No. 786) *The Complete Handbook of Model Railroading* and (No. 926) *Model Railroad Electronics*.



Chapter 2
Concept of the Railroad

Concept includes all the assumptions which are needed to give meaning to a model railroad. They encompass everything which would be known about the railroad if it were real. Such things as where it is located, which towns it serves, its connections, and its traffic. To provide a realistic basis for operation, the concept must match the layout. A small layout consisting of but a single station on an oval of track cannot believably represent the entire Chicago- Los Angeles line of the Santa Fe. It could, however, be quite realistic as a minor station on a branch of that same railroad.

PURPOSE OF LAYOUT

The concept adopted should be one which enhances the purpose of the layout. As a general rule, if the purpose is to maximize interest in operation, emphasis should be placed on switching possibilities. Consider the small single-station layout of Fig. 2-1. This station could be assumed to be on a branch line with a very active way-freight service and just enough passenger service to inject the problem of clearing the main track when a first-class train is due. On the other hand, if the purpose is to display moving trains to visitors, the concept could be of a small station on a busy main line with most of the trains merely passing through.

In theory, one can adopt several different concepts for a single layout as a basis for several different modes of operation. To operate well, however, requires considerable practice and usually involves developing operating techniques over a period of time. Having more than one concept will encourage the jack-of-all-trades approach rather than the master-of-one.

A case where two purposes exist is on a layout usually operated by its owner or a club to duplicate prototype operation, but which is also displayed regularly to the public. These two purposes are in direct conflict as the public desires to see trains continuously in motion, but maximizing operating interest to the owner or club requires switching. A solution to this conflict, one which has worked well on many different layouts, is to develop the concept strictly to maximize operating interest and, for public shows, to run trains continuously over all possible tracks regardless of whether the routes of such trains fit the concept or not. On point-to-point layouts this may involve installing track which is used only for show running. Show loops, however, should not be added on mere speculation that they might someday be needed or even if public visitors come at irregular intervals. Unless needed, show loops are not worth the space they take—but, if needed, they are invaluable.

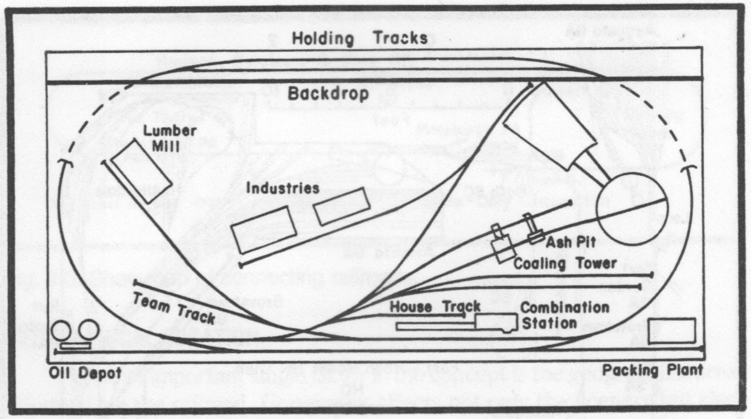


Fig. 2-1. Small single-station layout.

Ideally, provision for show loops should be made at the time the layout is designed. This will minimize the amount of extra track which must be laid. An example is the layout of the Ft. Gordon Model RR Club, shown in Fig. 2-2. Their concept was taken directly from the Georgia RR which served Ft. Gordon and included the main line from Augusta to Atlanta, plus branches. Adding a show crossover, as indicated in the figure, allowed virtually the entire main line to be formed into a loop for show running.

It may be necessary to use more than the main line to create a show loop. Shown in Fig. 2-3 is one of the two show loops existing in 1976 at The Model RR Club. A short line, the Rahway River (which in regular operation has trains only a few cars long) serves as part of the show route for 100-car trains. At this club, two show loops are provided rather than one longer loop, so that trains can keep running even if trouble develops on one of the loops.

The two show loops described above were designed into the layouts initially. But, even when the concept as originally adopted excluded show running, it is usually practical to make a modification of the track to obtain such a loop. The concept of the first layout of the Summit-New Providence HO RR Club was for a point-to-point layout with no loops of any sort. Trains arriving at terminals were broken up and new ones made up in the prototype fashion. When the club introduced public shows it attempted to keep trains

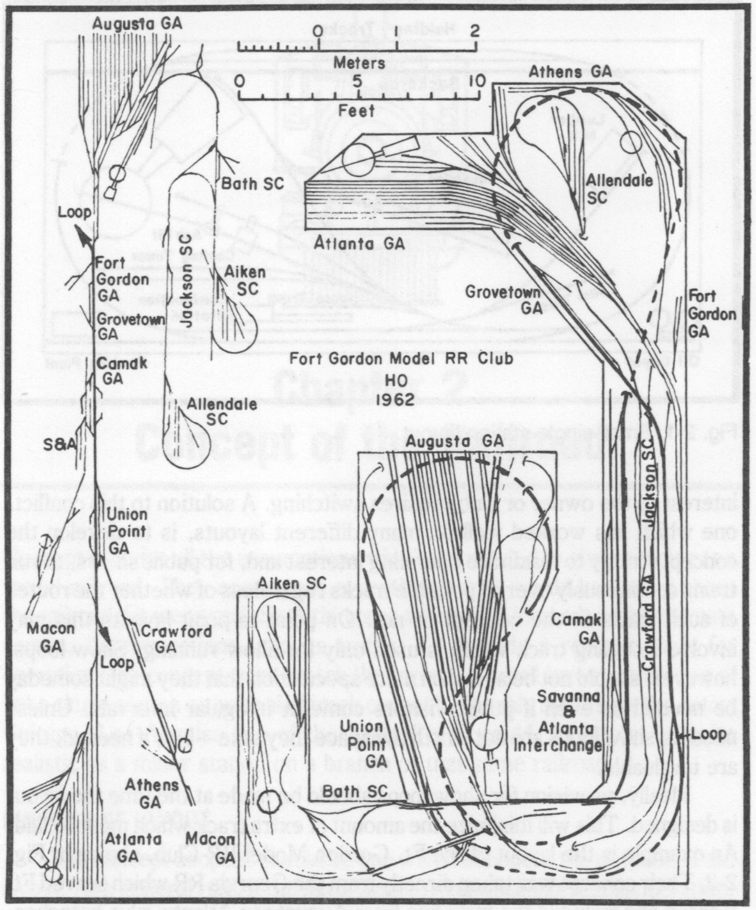


Fig. 2-2. Show loop of main line.

rolling by turning them at terminals. Even though these turnings were made as rapidly as was possible (switchers being used to assist), the public obviously did not appreciate the delays. Therefore, as shown in Fig. 2-4, temporary connections were made to permit all track operational at that period in time to be formed into one big loop. In this case it was necessary to use the tracks of the Trenton Northern, an interurban line, to complete the loop. Certainly the sight of main-line trains negotiating the tight curves of the traction line did not fit the concept of the railroad, but it did suit the public visitors. As the layout grew, the temporary connections were changed until, finally, the interurban line was eliminated from the loop.

It is recommended that the concept adopted be based on the purpose of providing the maximum enjoyment from duplicating prototype operation. Any other purpose, such as public shows, then would be served as best it can without compromising the primary purpose.

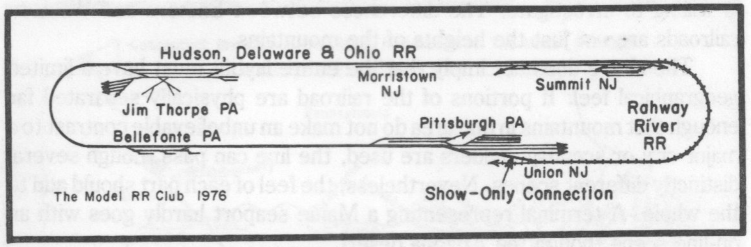


Fig. 2-3. Show loop of connecting railroads.

GEOGRAPHICAL LOCATION

The most important single factor in the concept is the geographical area assumed for the railroad. Geography affects not only the scenery but also the type of traffic the railroad handles. If a concept is being developed for an existing layout, its area may be already established. For example, the buildings, the terrain, even the rolling stock could be pure Western mining, perhaps specific to Nevada. This means that a concept, at least in part, already existed when the layout was constructed. A large number of layouts however, are built without a clear idea of geographical location. The buildings are often chosen because a particular kit was on the market. A New England farmhouse might be standing next to a Western blacksmith. True, it is possible to operate on the basis of a coal road in West Virginia even though the buildings and scenery have no resemblance to that state. Nevertheless, a clash between the appearance of the layout and the geographical concept detracts from realism and, consequently, from interest.

Assuming that layout construction has not progressed to the point where the character of its setting is obvious (or that the owner is willing to remove Swiss chalets and Bavarian castles), careful consideration should be given to geographical location. Since concept is a guide to realism, the area chosen should be either one known to the builder or one which the modeler

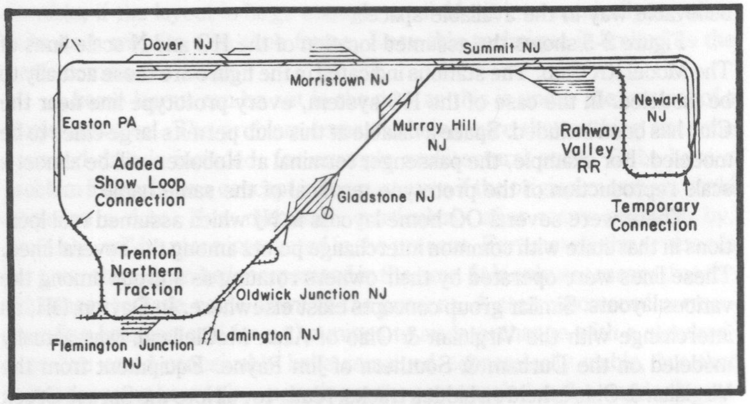


Fig. 2-4. Show loop applied to an existing layout.

is willing to investigate. The differences between Eastern and Western railroads are not just the heights of the mountains.

The above does not imply that the entire layout must have a limited geographical feel. If portions of the railroad are physically separated far enough that mountains in one area do not make an unbelievable contrast to a major city or scenery dividers are used, the line can pass though several distinctly different scenes. Nevertheless, the feel of each part should add to the whole. A terminal representing a Maine seaport hardly goes with an on-line scene though the Arizona desert.

Clubs, in particular, are well advised to base their concept on the local area. It may be that the founding members could agree on a distant location, but the future of any club depends upon attracting new members. Prospective members, and visitors in general to any layout, are always more impressed by models of familiar things, especially if they are able to recognize specific structures.

The station names themselves are part of the concept. An imaginary name permits complete freedom in choosing the railroad facilities, the structures, and the general nature of the town. This freedom, of course, eliminates station names as a guides to realism. More important, if real town names are used in a logical order, the station names not only provide a guide to realism but also give an immediate sense to the railroad. For example, the Scioto Valley Line of the Columbus, Ohio Model RR Club runs from Portsmouth on the Ohio River to Sandusky on Lake Erie. It is likely that visitors and new members will know immediately how the stations are ordered on the line. If arbitrary names had been used, their order would have to be learned from scratch. Worse than arbitrary names are real names which are not in proper order, as they then supply misinformation. Roy Dohn, on his Victoria Northern, chose names in alphabetical order from east to west to make it easy to remember sequence.

When the names of real towns are selected, consideration should be given to the size of the town. In the case of the Columbus Club, Columbus itself is not on their line as that city is far too large to be represented in a believable way in the available space.

Figure 2-5 shows the assumed location of the HO and N scale lines of The Model RR Club. The stations indicated in the figure are those actually to be modeled. In the case of the HO system, every prototype line near the Club has been included. Space available at this club permits large cities to be modeled. For example, the passenger terminal at Hoboken will be almost a scale reproduction of the prototype terminal of the same name.

There were several OO home layouts in NJ which assumed real locations in that state with common interchange points among the several lines. These lines were operated by their owners rotating as a group among the various layouts. Similar group concepts exist elsewhere. In Dayton, OH, an interchange with the Virginian & Ohio of Allen McClelland, was actually modeled on the Durham & Southern of Jim Payne. Equipment from the Virginian & Ohio is held on hidden tracks, ready to roll into the Spruce Creek yard of the D & S.

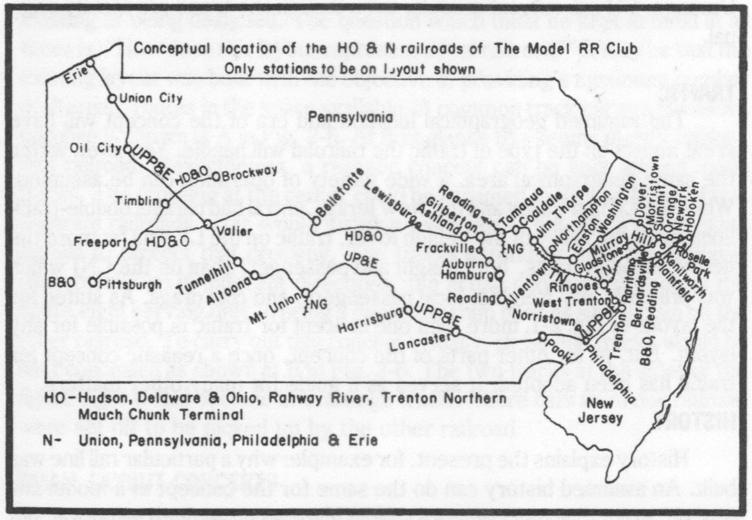


Fig. 2-5. Geographical concept.

ERA

Unlike the prototype, which can operate only in the present, a model railroad can have the appearance and operating procedures of the past. Even on those layouts set in the present there is always a time lag. Although by 1977 the Pennsylvania RR had been some years gone, there were plenty of Tuscan-red models of the Broadway Limited still rolling. Models of steam locomotives still existed in great numbers also. Nevertheless, there cannot be a great contrast in era without doing violence to realism. For example, if both a narrow-gage and a standard-gage line are modeled on the same layout, modern automobiles should not be pulled up before the standard-gage station while horses and buggies wait at the narrow-gage station. It is possible, if the layout is large enough, to divide it into scenically-separate units each with its own time frame. Even this technique is limited as the trains remain the same.

A home layout can be set in the past as this is under the control of a single individual. The problem comes in being sure that nothing after the assumed date is included, for example architectural style. Clubs have a problem if they have a concept in the past even if the original members could agree on a date. New members, particularly after many years go by, probably will be more interested in the present. Fortunately the reverse is not true, the old can be incorporated in the new. It is only necessary that the old appear to have come down to the present. A steam-powered narrow-gage line bringing coal from the mines to an interchange with a standard-gage line could conceivably have remained economically viable, but that railroad must appear to be operating at the same period as the standard-gage line. The cars parked today beside the D&RGW narrow-gage station at

Durango, CO are current models, even though the trains are mostly original.

TRAFFIC

The assumed geographical location and era of the concept will have great impact on the type of traffic the railroad will handle. Yet, even within the same geographical area, a wide variety of operation can be assumed. When the Lehigh Valley and the New Jersey Central had parallel double-track lines down the valley of the Lehigh River, traffic on the LV was far more the heavy (through trains, both freight and passenger) than on the CNJ which was primarily way freights, local passengers, and coal drags. As stated for the layout of Fig. 2-1, more than one concept for traffic is possible for any layout. But, as for other parts of the concept, once a realistic concept for traffic has been adopted, it serves as a guide for many other matters.

HISTORY

History explains the present, for example: why a particular rail line was built. An assumed history can do the same for the concept of a model and tends to make that concept more real. A history can be quite elaborate, but only the assumed background which justifies the location of the railroad, the type of traffic carried, and its method of operation have significant bearing. As an illustration, a condensed history of the Hudson, Delaware and Ohio (the HO line shown in Fig. 2-5) is given.

In 1840, the Delaware and Ohio started building west from the canal town of Easton on the Delaware River with the immediate objective of bringing coal to the canal barges and with the ultimate objective of connecting with barges on the Ohio River. As traffic increased, it became obvious that a terminal on the Delaware was inadequate. A line was then projected through NJ to the Hudson River and the name changed accordingly. A subsidiary line, the Passaic and Delaware, was chartered and construction started. At this point the DL&W, not wanting a competing parallel line, offered trackage rights over its Phillipsburg to Hoboken line. This offer was accepted and the HD&O sold half interest in the P&D to the DL&W, the part already constructed being operated as a joint branch line Summit to Gladstone. The HD&O adopted a policy of purchasing only used motive power. As a result, it still has an excellent roster of steam locomotives, the best from many other roads.

When the HD&O reached the Ohio River at Pittsburgh, it formed a close working arrangement with the B&O for through service, both freight and passenger, to Chicago and St. Louis. Thanks to the direct route, passenger service on these lines remained profitable—so the HD&O did not join Amtrak. With the demise of the CNJ, the HD&O picked up the route to Raritan and operated it as a branch and retained the through freight service south via the B&O, ex-Reading route.

DEVELOPMENT OF A CONCEPT

The various factors which should be considered in developing a concept have been given above. They can be applied in various ways to any layout, existing or being designed. The question which must be kept in mind at all times is, "How does this layout represent a real railroad?" It may be that the existing layout was built with the objective of providing a maximum number of alternate routes in the space available. A common track pattern for such a purpose is shown at A in Fig. 2-6. At first glance this seems utterly unlike a real railroad. Nevertheless, a realistic concept can be built around these tracks. The crossing at the center could be assumed to be a crossing of two separate railroads. This would justify a tower and a full set of interlocking signals to protect that crossing. The tracks extending from the crossing conceptually go in different directions, the actual end curved track of the figure eight serving only to bring a departing train back as a new train on the other railroad. To carry out this concept visually, these end tracks would be best concealed as shown at B in Fig. 2-6. The two tracks at the sides of the figure eight would become interchange tracks where cars from one railroad were set off to be picked up by the other railroad.

SMALL LAYOUT CONCEPTS

Perhaps the most common design for a small layout is an oval of track with just one station. An example is given in Fig. 2-1 and another at the top of Fig. 2-7, the latter having a double-track oval as a main line. A particularly

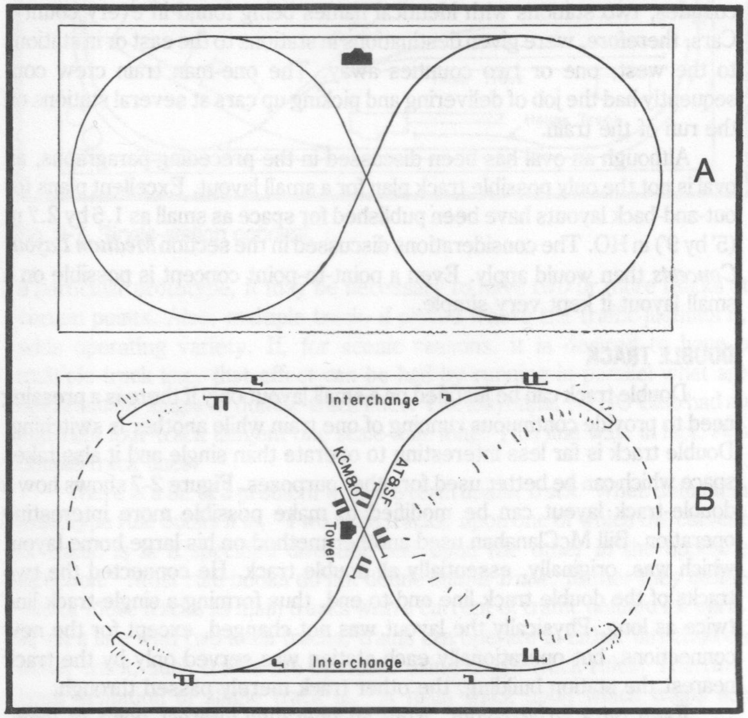


Fig. 2-6. Concept for a figure-eight layout.

effective concept for such layouts is to assume you are at the station and can see only the activity at that station. Trains arrive either from the east or west and depart to the opposite direction. It matters not from where they came or to where they are going. For this concept, the side of the oval opposite the station serves only to permit departing trains to arrive as new trains. Thus such tracks are better concealed. In Fig. 2-1 a backdrop was used for the purpose. At the bottom of Fig. 2-7, the tracks to the rear have been placed in a tunnel. Note that the double-track line of the original design has been converted into single track, the remaining parts of the extra track being used as a siding and switching leads at the station, and also as a holding track in the tunnel. As explained in the next section, double track is extremely questionable on a small layout. The space made available over the hidden tracks has been used to add extra switching tracks which are reached via a switchback. When switches are placed in a tunnel as in Fig. 2-7, easy access to such switches must be provided for maintenance. In the figure, removable buildings cover openings over the switches.

Instead of a station-oriented concept as above, a train-oriented concept is also possible for a small layout based on an oval of track. As an example, Fig. 2-8 shows the layout of the Summit-New Providence HO RR Club as it was in 1951 when operations using waybills started. The railroad at this stage was conceived as a long, single-track railroad extending through many counties, two stations with identical names being found in every county. Cars, therefore, were given destinations in stations to the east or in stations to the west, one or two counties away. The one-man train crew consequently had the job of delivering and picking up cars at several stations on the run of the train.

Although an oval has been discussed in the preceding paragraphs, an oval is not the only possible track plan for a small layout. Excellent plans for out-and-back layouts have been published for space as small as 1.5 by 2.7 m (5′ by 9′) in HO. The considerations discussed in the section *Medium Layout Concepts* then would apply. Even a point-to-point concept is possible on a small layout if kept very simple.

DOUBLE TRACK

Double track can be justified on a small layout only if there is a pressing need to provide continuous running of one train while another is switching. Double track is far less interesting to operate than single and it also takes space which can be better used for other purposes. Figure 2-7 shows how a double-track layout can be modified to make possible more interesting operation. Bill McClanahan used another method on his large home layout which was, originally, essentially all double track. He connected the two tracks of the double track line end to end, thus forming a single-track line twice as long. Physically the layout was not changed, except for the new connections, but operationally each station was served only by the track nearest the station building, the other track merely passed through.

Even on a large layout, from an operating-interest point of view, multiple track is less interesting than single track. Nevertheless, if following a particular prototype, it may be necessary to have two or more tracks at certain points. Also, multiple track, if placed where the traffic justifies it, adds operating variety. If, for scenic reasons, it is desired to have a multiple-track line, that effect can be had by running in parallel what are operationally single or double-track lines. The Bayonne, NJ HO Club had an apparent four-track tangent one scale-mile long. This line was, in fact, two double-track lines.

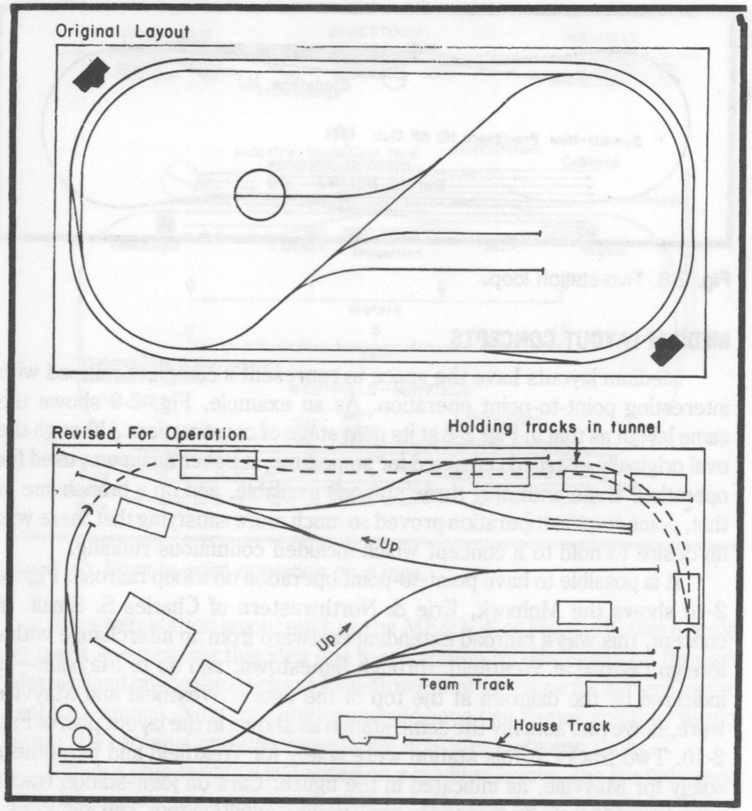


Fig. 2-7. Single-station concept.

There is a bit of a problem with the term *double track*. When defined in prototype rule books it is, “Two main tracks, upon one of which the current of traffic is in a specified direction and upon the other in the opposite direction.” Most rule books do not define *double track*. Rather they define two or more tracks as main tracks with a current of traffic defined for each. If, on a line with two main tracks, trains can operate in either direction on either track, such tracks are operated using single-track rules. The rule-book definition of single track is, “A main track upon which trains are operated in both directions.” Nevertheless, modelers will call any two parallel tracks double track.

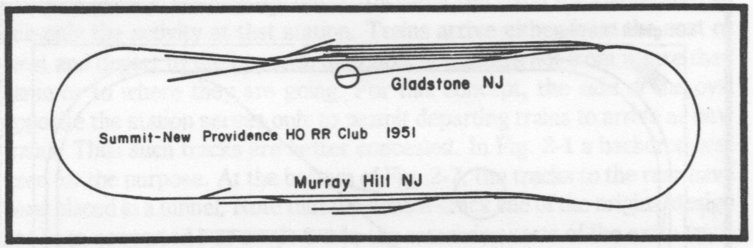


Fig. 2-8. Two-station loop.

MEDIUM LAYOUT CONCEPTS

Medium layouts have the space to represent a complete railroad with interesting point-to-point operation. As an example, Fig. 2-9 shows the same layout as that in Fig. 2-8 at its next stage of construction. Although the oval originally installed remained for some time, it never again was used for operation. Even with only three stations available, and on a branch line at that, point-to-point operation proved so much more satisfying that there was no desire to hold to a concept which included continuous running.

It is possible to have point-to-point operation on a loop railroad. Figure 2-10 shows the Mohawk, Erie & Northwestern of Charles S. Small. In concept, this was a railroad extending eastward from an interchange with a foreign railroad at Westfield, through Jamestown, and on to Mayville—as indicated by the diagram at the top of the figure. Westfield and Mayville were, however, actually the same station as shown in the layout plan of Fig. 2-10. Two tracks at this station were solely for Westfield and two others solely for Mayville, as indicated in the figure. Cars on joint-station tracks were kept separate by means of a card-order waybill system, see Fig. 7-23.

The drill from Westfield picked up and delivered cars at the interchange tracks. These cars were classified and those destined for Jamestown and Mayville were forwarded on a way freight. Any car at Mayville destined for interchange had to go via Jamestown and Westfield.

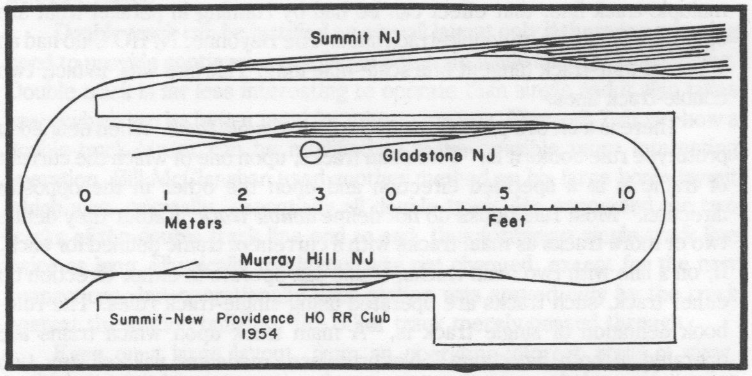


Fig. 2-9. Point-to-point layout.

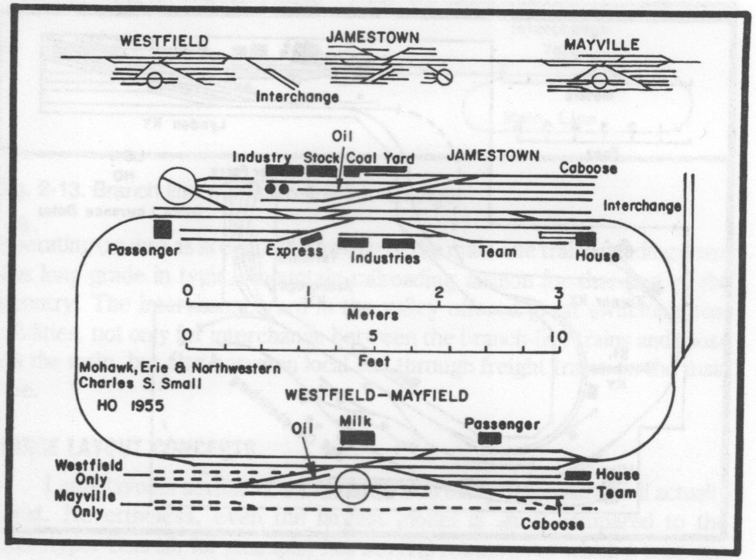


Fig. 2-10. Point-to-point operation on a loop.

On a two-station layout such as the ME&NW of Fig. 2-10, there could be merit in extending this idea one more station by continuing on through Mayville and giving the tracks at Jamestown another name for serving as the eastern terminal. Now both stations would have two names and they would divide the terminal and the way-station activities between them.

When a true terminal is desired on a medium layout, the limited space available usually makes it impractical to build two large terminals. For a concept based on the operation of a large terminal, there is much to recommend constructing only one terminal, the departing trains returning to it at a later time. The single-station concept can be applied in such cases as illustrated in Fig. 2-11. Trains departing from the terminal disappear into the distance and onto some sort of holding tracks. Then, as needed, they return as arriving trains assumed to be completely different from the ones which departed.

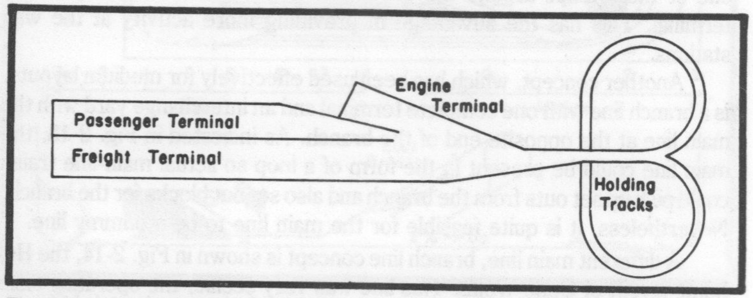


Fig. 2-11. Large-terminal concept.

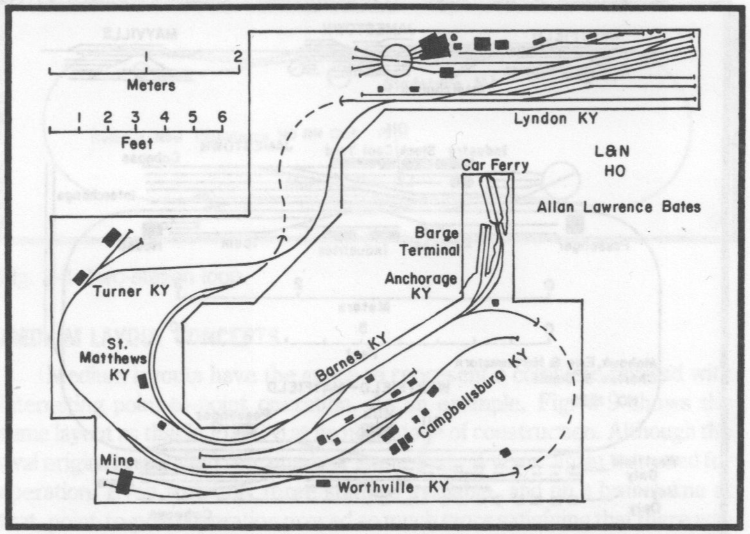


Fig. 2-12. Out-and-back concept.

More often, when a teminal is desired, modelers will choose an out-and-back concept which involves some line running and, usually, a station or two on the line before the train returns to the terminal. The HO scale L&N of Allan L. Bates is such a layout and is shown in Fig. 2-12. From an operation point of view, of particular interest are the branch line through Campbellsburg (actually a double switchback between points on the main line) and the car ferry and barge terminal at Anchorage, KY. The latter is a fine example of the use of a narrow benchwork to provide destinations for freight cars. A car ferry is an especially good destination as it can realistically receive any type of car.

The layout of Fig. 2-12 does not have a show loop. Often on out-and-back layouts, a connection is made to permit continuous running by diverting trains returning to the terminal to the other outbound track. Some modelers use such a loop to extend the run of the train by requiring each train to make one or more loops around the continuous track before returning to the terminal. This has the advantage of providing more activity at the way stations.

Another concept, which has been used effectively for medium layouts, is a branch line with one complete terminal and an interchange yard with the main line at the opposite end of the branch. As indicated in Fig. 2-13, the main line could be present in the form of a loop so actual main-line trains could pick up set outs from the branch and also set out blocks for the branch. Nevertheless, it is quite feasible for the main line to be a dummy line.

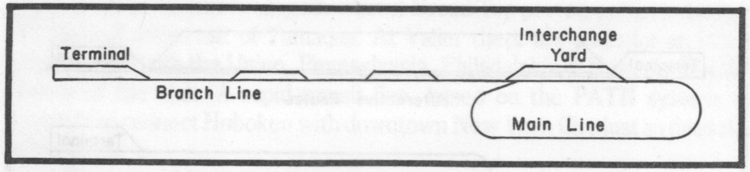


Fig. 2-13. Branch line with main-line interchange.

A different main line, branch line concept is shown in Fig. 2-14, the HO home layout of Gene Wolfe. This line was very scenic, the operating aisle being the valley between two mountain ridges in Pennsylvania. Major operating (as well as scenic) features were the main-line trains winding down the long grade in typical mountain-railroading fashion for that part of the country. The interchange yard in the valley offered great switching possibilities, not only for interchange between the branch-line trains and those on the main, but also between local and through freight trains on the main line.

LARGE LAYOUT CONCEPTS

Large layouts permit a concept for which many of the parts will actually exist. Nevertheless, even the largest model is small compared to the prototype. Conrail, for example, has several routes over which a train can move from New York to Chicago. Years ago, a popular concept for large point-to-point layouts was to have such alternate routes between the terminals. Often this concept included a double-track main line and a single-track so-called "mountain division." The layout a Columbus, Ohio club once had in the old interurban station originally was as indicated at the top of Fig. 2-14. When they modified the layout to connect the two alternative routes end to end to make a longer single line between the two terminals, the club found the result much better.

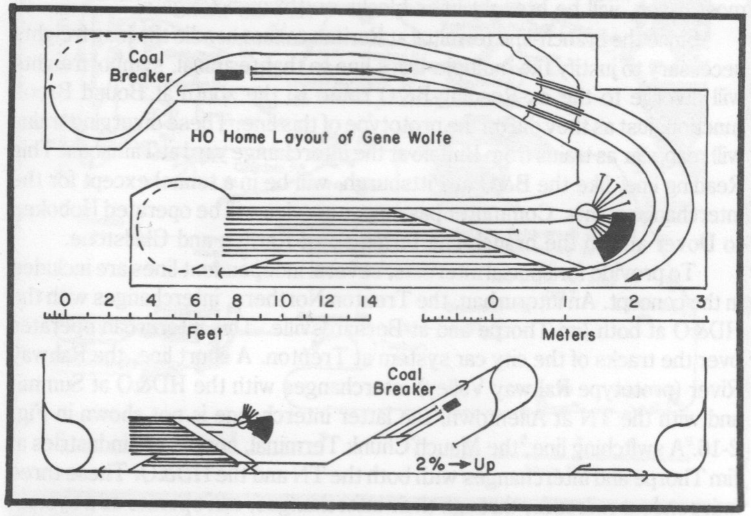


Fig. 2-14. Interchange yard concept.

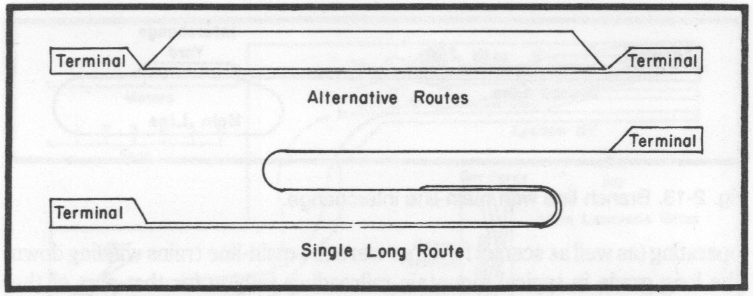


Fig. 2-15. Combining alternate routes.

Large layouts can include many different operating features. To illustrate the possibilities, Fig. 2-16 shows what is probably the largest model railroad ever attempted to date, the HO layout under construction in 1977 by The Model RR Club. The assumed geographical location of this line is shown in Fig. 2-5 and its assumed history was given in HISTORY. Its era is the present. Where space permits, actual prototype trackage is being modeled.

The main extends from a near-scale Hoboken, NJ (ex-DL&W) to Pittsburgh, PA (P&LE station). Heavy main-line operation is conceived with 100-car freight trains. Since the Pittsburgh terminal is much smaller than Hoboken, Pittsburgh serves as an interchange with the B&O, the latter road actually being a three-track reversing loop more than two scale miles around and, except for the interchange point, is completely concealed. All the switching of through freights at Pittsburgh (except for setting out or picking up a block) is presumed to be done by the B&O. Way freights to Brockway will originate at Pittsburgh. The cars for these way freights, in most cases, will be brought in as blocks on through freights.

Since the branch-line terminal at Raritan cannot handle the long freights necessary to justify the multiple-track line to that terminal, symbol freights will diverge to the ex-Reading-B&O route to the south at Bound Brook Junction, just as they did on the prototype of this line. These diverging trains will reappear as trains from Buffalo at the interchange yard at Tamaqua. This Reading line, like the B&O at Pittsburgh, will be in a tunnel except for the interchange points. Commuter passenger service will be operated Hoboken to Dover and to the branch-line terminals of Raritan and Gladstone.

To provide for special interests, several independent lines are included in the concept. An interurban, the Trenton Northern, interchanges with the HD&O at both Jim Thorpe and at Bernardsville. This interurban operates over the tracks of the city car system at Trenton. A short line, the Rahway River (prototype Rahway Valley) interchanges with the HD&O at Summit and with the TN at Allentown, the latter interchange is not shown in Fig. 2-16. A switching line, the Mauch Chunk Terminal, serves the industries at Jim Thorpe and interchanges with both the TN and the HD&O. These three independent railroads, through their interchanges, can operate as a system when the HD&O is not operating. Another, larger switching line is planned for Auburn and a narrow-gage line (East Broad Top prototype) is to operate to the coal mines out of Tamaqua. At Valier there are plans for an interchange yard with the Union, Pennsylvania, Philadelphia & Erie, the N scale layout of the club. A rapid-transit line, based on the PATH system, is planned to connect Hoboken with downtown New York City just as does the prototype.

Because of its large size, the layout of Fig. 2-16 is being built in sections. Each section to be added will require an addition to the building. At the time of writing, (1977) the first section, containing over 1,000m (3,400′) of HO track was nearing completion.

Obviously the larger the layout, the greater the number of operating possibilities. Unfortunately, the larger the layout, the greater the maintenance problems become. Not only are there many more places to develop problems on a large or complex layout, but also the need to have fewer problems per foot of track and per train increases with layout size. It is one thing to have a derailment on a layout any point of which can be easily reached by a single operator and quite another if the nearest operator to a derailed train is 15m (50′) away. So as the size of complexity of the layout goes up, so must the quality of construction. Most important, the layout should never become so large as to exceed the capabilities of its owner, be it individual or club, to keep it at a high state of operating efficiency.

NAME, HERALD, COLOR SCHEME

An overworked expression is, "There is a prototype for everything." Within a reason this is true but, at any given location on a railroad, the

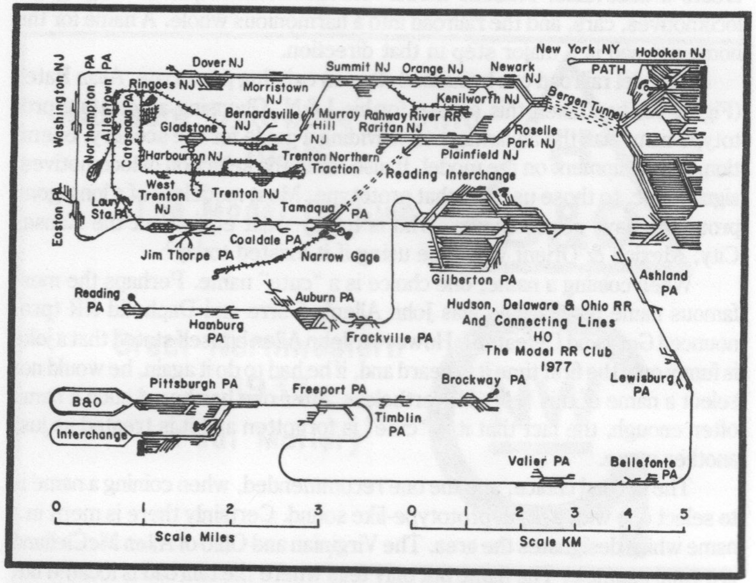


Fig. 2-16. Large HO layout with many operating features.

unusual is rare. This applies as much to railroad names, heralds, and color schemes as it does to other concept factors such as era and location.

Name

Excepting terminal railroads, the preponderance of locomotives, cabooses, and passenger cars (pre-Amtrak) visible on the track of a given railroad would be those belonging to that railroad. Foreign locomotives and cars usually had some obvious reason. For example, Erie-Lackawanna and Delaware & Hudson locomotives regularly appeared at the Boston engine terminal of the B&M as they were part of the pool for Boston to Chicago through freights. But, these locomotives were used only on those pool through freights, not on B&M local freights. Other examples are when one railroad has trackage rights over another and when foreign equipment must be leased to meet peak traffic demands. In 1959 No. 1 and No. 2, the Royal Gorge, of the D&RGW regularly carried PRR and NYC sleepers during the summer. These examples are, however, the exception and limited in scope.

Foreign freight cars are different in that they are used in interchange service. Nevertheless, freight cars have a regional feel. Cars of eastern roads predominate on eastern railroads, Canadian cars on Canadian railroads, and so on. In contrast with the prototype, many model railroads appear to be a train-collector's display rather than have the feel of the prototype. A Western Pacific locomotive might be pulling a train with a Maine Central caboose. The SP Coast Daylight could follow the PRR Broadway Limited. If it is a display of trains which is wanted, fine. But, it should be recognized that a miscellaneous collection of equipment does not create a believable, realistic model *railroad*... that requires bringing the locomotives, cars, and the railroad into a harmonious whole. A name for the home railroad is a major step in that direction.

A model railroad can be named after an existing prototype. Allan Bates (Fig. 2-12) has taken this course for his L&N. Choosing an existing prototype name has the advantage of providing a guide for the scenery, operation, and equipment on the model. It also limits the selection of locomotives, signals, etc. to those used by that prototype. Most modelers of a long-gone prototype have a free choice. Who is to say what equipment the Kansas City, Mexico & Orient would be using if it existed today?

When coining a name, one choice is a "cute" name. Perhaps the most famous name of this type was John Allen's Gorre and Daphetid RR (pronounced Gory and Defeated). However, John Allen himself stated that a joke is funny only the first time it is heard and, if he had to do it again, he would not select a name of this type. Nevertheless, after one has heard such a name often enough, the fact that it is "cute" is forgotten and it is treated as just another name.

The second choice, and the one recommended, when coining a name is to select one with a solid, prototype-like sound. Certainly there is merit in a name which designates the area. The Virginian and Ohio of Allen McClelland is a good example. The name not only tells where the railroad is located but also infers that it is a coal hauler. Hudson, Delaware and Ohio, the HO RR of The Model RR Club, defines the main line by the rivers on which its terminals are located plus one it crosses. Unfortunately, this name causes confusion to those who interpret Delaware and Ohio to be names of states rather than of rivers.

Names which are misleading should be avoided. A case in point is the author's Great Northwestern RR. When chosen in 1935, the GNW was intended as a Chicago west RR, but in 1941, in moving east, it became a New York west line with the lame justification that the RR was originally a stagecoach line running from Easton, PA to the Northwestern Territory and called the Great Northwestern Territory Stagecoach Line. Invariably modelers, on seeing the name Great Northwestern, assume a western RR.

Convenience is another basis for selecting a name. The HO club in Rocky Hill, NJ calls their road the Pacific Southern as these words were already available in decal form.

Herald

A herald really is a bill-board for the railroad. With the advent of custom-made decals and dry transfers, it became possible to have very intricate designs. It is not obvious that such designs are desirable. One, heralds should be readable from a distance and complex heralds are not. Two, there will be time when it is desired to draw the herald by hand either to obtain one of a different size or to letter a contest model. Both of these points argue strongly for simplicity.

Two heralds which were designed with the idea of a distinctive shape easily recognized on small-scale models are shown in Fig. 2-17. Both can be made easily completely by hand or with ordinary dry transfer letters. In

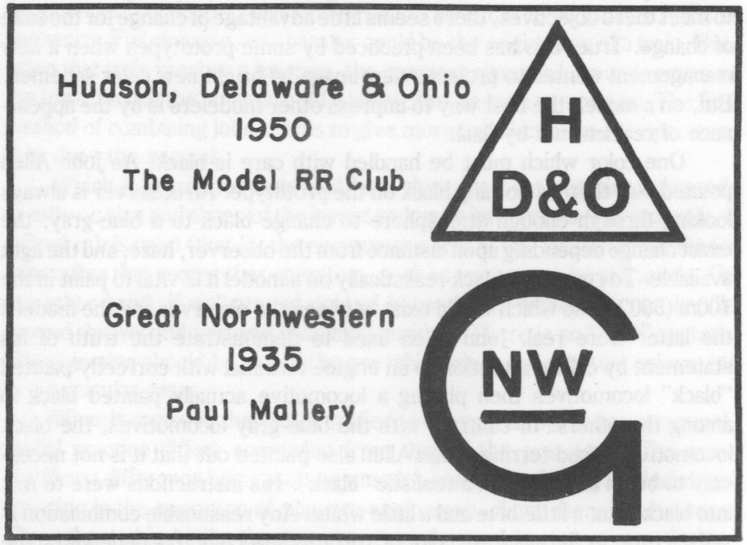


Fig. 2-17. Model railroad heralds.

neither case were line widths specified, as these can be varied over a rather wide range without eliminating recognition of the herald.

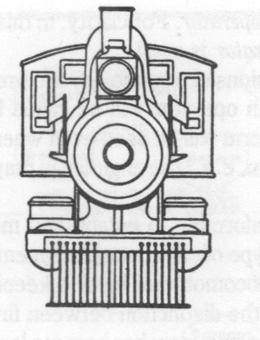
Since the future of a club depends upon attracting new members, an easily-recognized, well publicized herald can be considered an advertising tool, not an important one but nevertheless useful. It is important, therefore, that once a suitable herald is adopted, that herald be kept reasonably uniform as the years pass. A danger exists that as the membership changes some new member will feel a "better looking" herald can be adopted. This process then can be repeated over and over, as "better looking" is a matter of opinion. Changes should be justified by inadequacies of the original design. Otherwise some of the value of a herald is lost.

Color Scheme

The color scheme for the cars and locomotives, like the railroad name, helps to tie a model railroad together into a believable whole. If a prototype name has been chosen, then, obviously, so has the color scheme. If the name was coined, the choice of the color scheme is wide open. There is merit to distinctive colors and markings, particularly on Diesel locomotives. But, for freight cars, it is questionable if the color scheme should be either bright or flashy. In most cases there will be more cars of the home road on the layout than of any foreign railroad. If the home cars dazzle, the effect may be more toy-like than real.

Color schemes seem to suffer the same fate at clubs as do heralds. As the years pass, a new member wants a "better" color scheme. Later, that new scheme will be replaced by a "still better" scheme. The important thing is that the color scheme meets the following objectives: 1—Easy to apply; 2—Realistic; 3—Distinctive; 4—Pleasing. Unless the existing scheme fails to meet these objectives, there seems little advantage of change for the sake of change. True, this has been practiced by some prototypes when a new management wanted to project a new image by bright new color schemes. But, on a model, the best way to impress other modelers is by the appearance of realism, not by flash.

One color which must be handled with care is black. As John Allen pointed out, there is nothing black on the prototype. An observer is always looking through enough atmosphere to change black to a blue-gray, the exact change depending upon distance from the observer, haze, and the light available. To represent black realistically on a model it is vital to paint in the 100m (300′) or so which would exist between the observer and the model if the latter were real. John Allen used to demonstrate the truth of his statement by calling attention to an engine terminal with correctly-painted "black" locomotives then placing a locomotive actually painted black in among the others. In contrast with the blue-gray locomotives, the black locomotive looked terrible. John Allen also pointed out that it is not necessary to be an artist to mix a realistic "black". His instructions were to mix into black paint a little blue and a little white. Any reasonable combination is satisfactory, as the apparent color of a prototype locomotive depends on the type of day and the time.



Chapter 3

Operating Positions

Operation on the prototype is carried out by many individuals, each doing a particular task. To duplicate such operation, it is necessary to know which tasks must be performed and it helps to know which employee handles each task. On a model there are seldom, if ever, enough operators to fill the prototype jobs on a one-for-one basis. Consequently, jobs must be combined. One way is to assign several jobs to an operator to perform during the entire operating session; for instance, serving as the entire train crew (engineman, conductor, and brakeman). The other is to perform jobs in sequence. For example, an operator could be the engineman of a train. But, when that train reaches a junction, the operator changes hats and serves as the towerman at the junction until it is time for the train to move on. The first method of combining jobs seems to give more satisfaction to the operators than does the second.

Which jobs are required and how they are best combined depends greatly on size and shape of the layout and upon its controls. For example, if a fixed cab is used (that is, the engineman stays in one location) it is almost imperative that some other operators, such as towermen, be at lineside. On the other hand, if walkaround control is used, the engineman can handle ground throws and perform switching unaided. There is no "best" system. The objective should be to find the one which gives the greatest enjoyment in a particular case.

When it comes to the names applied to the various operating personnel, model practice differs somewhat from that of the prototype. The most significant difference being that, on a model, *operator* refers to any individual assisting in the operation of a layout: engineman, dispatcher, or whatever. Throughout this book, the term operator is used in that sense. On the prototype, *operator* is short for *block operator*, a job often called *towerman* and sometimes *signal operator*. For clarity, in this book, when *block operator* is intended, *block operator* is used.

Most other variations in terminology are brought about by the combining of jobs. Usually an operator will be called by his primary task, e.g., engineman, and that term will be used even when that operator is performing some other function, e.g., the engineman may also perform the duties of a conductor.

Except when conforming to established model practice, such as the name for a particular type of cab control, engineman is used to designate the individual operating a locomotive. This is in keeping with modern prototype rule books, now that the distinction between fireman and engineer as the two enginemen of an engine crew has become lost. On a model, there never has been a need for a fireman. Further, using engineman eliminates confusion with the term *engineer*, a practitioner of the profession of engineering.

PROTOTYPE PERSONNEL

As far as the operation of a model layout is concerned, the only prototype personnel of interest are those involved in the physical movement of cars, locomotives, and trains, either directly (as in the case of enginemen) or indirectly (as in the case of those who assure that the enginemen know their job). Freight agents are important because they originate and receive the waybills. Employees such as billing clerks, although important on the prototype do not have activities which are modelable in a way of interest to the modeler.

Figure 3-1 shows several of the operating jobs which must, in one way or another, be performed on a model if prototype-like operaton is to be achieved. No matter how these positions are combined to reduce the number of operators required, the tasks remain.

Train Crew

The most important single operating unit is the train crew. On a short line the train crew may well be the entire story. In 1977 a train crew usually consisted of at least three employees: an engineman who drove the locomotive (or MU train), a conductor who was in charge of the train, and a brakeman to assist the conductor. On passenger trains there might be a second man in the cab called a fireman or assistant engineman, and additional trainmen to assist the conductor in collecting fares and handling passengers. In the past, union agreements required a fireman and in steam days one was necessary. There might be a head brakeman (usually riding the locomotive) as well as a rear brakeman, also called a flagman, riding the caboose. In the past, union agreements called for two brakemen. Before the days of air brakes, particularly on mountain railroads, it was not uncommon to have several brakemen on a train.

As described above, the term train crew includes the engine crew. When both the engine crew and the train crew are listed separately, as on the dispatcher's train sheet, the train crew does not include the engine crew.

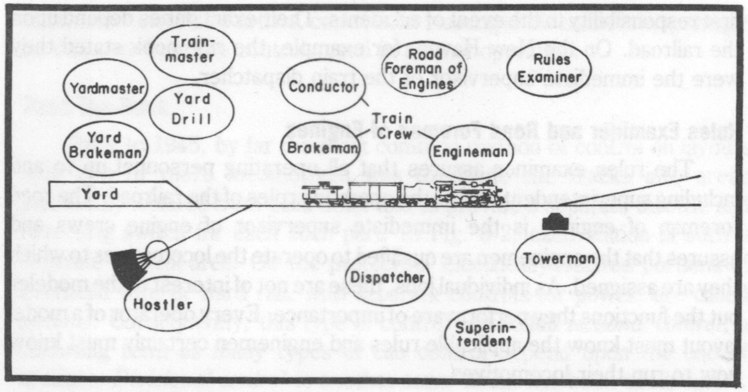


Fig. 3-1. Operating jobs.

The greatest significance of the train crew to a modeler is that the crew gives continuous attention to just one train. This continuity of attention is a very important aspect of prototype operation and is most helpful if included in some way on a model.

Yard Crew

Small yards are worked entirely by the train crews. If a yard exists which is large enough to justify the services of a switching locomotive, a yard crew is provided to operate that yard. The switching locomotive is operated by the yard drill, a crew consisting of an engineman, a conductor, and one or more brakemen. Yard drills operate under the direction of a yardmaster who is in charge of making up and breaking up trains. At small yards the functions of the yardmaster may be performed by the freight agent. Large yards may have two or more yardmasters operating under the direction of a general yardmaster. Switchmen and switch tenders may be assigned to assist the yardmaster.

Dispatcher and Chief Dispatcher

The train dispatcher controls the movements of trains on main tracks and sidings. He directs the towermen at the various interlockings as well as block operators at stations without interlockings. On very busy railroads train directors may be provided to exercise local control to relieve the dispatcher. An example is the train director at Tower A, Pennsylvania Station, New York, who controls all the towers within that area.

The Chief Dispatcher is the immediate supervisor of the dispatchers and, if there is no movement director, supervises the handling of trains and the distribution of motive power, equipment, and crews.

Trainmaster

The trainmaster is local supervision in charge of yardmasters, train crews, and the overall operation of the yard. Trainmasters usually have the first responsibility in the event of accidents. Their exact duties depend upon the railroad. On the New Haven, for example, the rule book stated they were the immediate supervisor of the train dispatcher.

Rules Examiner and Road Foreman of Engines

The rules examiner assures that all operating personnel up to and including superintendents know the operating rules of the railroad. The road foreman of engines is the immediate supervisor of engine crews and assures that the enginemen are qualified to operate the locomotives to which they are assigned. As individual jobs, these are not of interest to the modeler but the functions they perform are of importance. Every operator of a model layout must know the applicable rules and enginemen certainly must know how to run their locomotives.

Hostler and Roundhouse Foreman

A hostler operates locomotives not in train or yard service, typically at an engine terminal or between the engine terminal and the yard or passenger station. Hostlers work under the direction of the roundhouse foreman. This latter job also includes the provision of motive power to meet the needs of trains and switching. Even on a large layout these two jobs are often combined. Another possibility is to combine the jobs of roundhouse foreman and yardmaster.

Superintendent

A superintendent is an employee in charge of a specific area of responsibility, such as the operation of a division of a railroad. The Rutland RR had one superintendent, larger railroads many. If there are many superintendents of the same type, then they are supervised by a general superintendent. From a model standpoint, the importance is that some one individual be in charge of operations. In this handbook, that individual is called the superintendent.

LOCOMOTIVE CONTROL ON A MODEL

Of great impact upon an operating system for a model railroad is the means of controlling the locomotives, as well as which operators do the controlling. Although electrical circuits are outside the scope of this Handbook, the basic differences among the circuits have an important bearing upon operation. Therefore, the various electrical control systems are described to the extent necessary to understand their effects upon operating systems.

Unlike tracks, which are difficult to modify after the layout is finished, it is not unreasonable to make changes in the electrical control at any time. Just changing the panel may result in a significant improvement. Also, it does not follow that only one system of control should be installed. A yard drill and a hostler both work within a restricted part of the layout. The controls for their locomotives might be different from those for trains running from terminal to terminal. Further, controls for running show trains in loops might be different from the controls used in normal operation.

Pass-The-Buck

Prior to 1945, by far the most common method of control on layouts with two or more locomotives was to divide the tracks into areas electrically-isolated from each other and to provide a separate throttle and reversing switch for each such part. In Fig. 3-2, each station is such a separate control area. On the prototype, electrically-isolated portions of overhead wire or third rail, with separate controls for power, are called *sections*. Consequently, this type of control was called *sectional control*, a confusing term as many types of cab control depend upon the use of sections. *Divisional control* is another term which has been used. Later, *pass-the-buck* came into being. This is a very descriptive term as, quite literally, the operator at one station passes the train to the operator at the next station when the locomotive crosses the section break. Pass-the-buck, therefore, is used in this Handbook for this type of control.

Section break is the prototype term for the insulation dividing sections. Modelers often use the terms *gap* or *insulated rail joiner*. In keeping with the policy of using prototype terms when they are applicable, *section break* is used exclusively for the insulation between sections and *gap* for insulation required on a model due to the two-rail system of power distribution. Another model variation is the use of the signaling term *block* for the power distribution term *section*, an ambiguity which can lead to problems, as described in Chapter 6. In this handbook, *section* and *block* are used only in their prototype senses.

The operators in Fig. 3-2 combine the jobs of the train crews and all station-related personnel. From an operational point of view, the penalty is

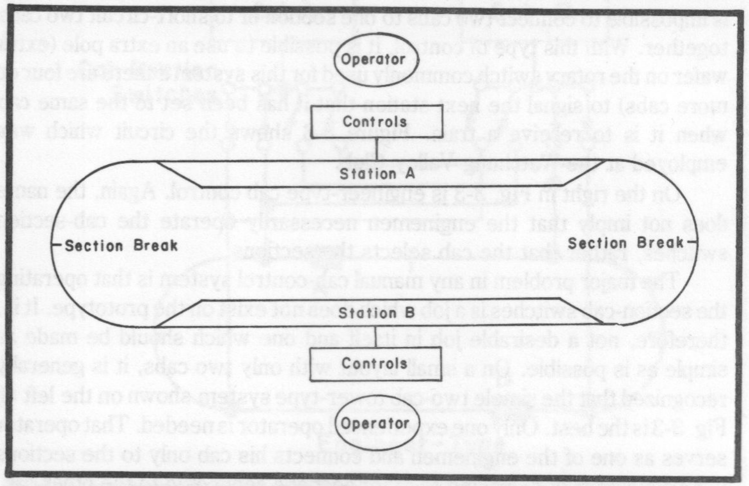


Fig. 3-2. Pass-the-buck control system.

the lack of continuity of control of trains moving between stations. In effect, one train crew jumps off the train and another jumps on at the section break. This not only violates prototype practice, but also raises the possibility of a distinct change of speed as the train moves between sections.

Cab Control

Starting about 1945, interest grew swiftly in the idea of having an engineman control a locomotive for its entire run. Since such controls simulate the controls of a locomotive cab, this type of control system became known as *cab control*.

It is possible to obtain continuity of control over a single locomotive from a particular cab by placing in the locomotive selective equipment which will respond only to signals sent by the cab assigned to that locomotive. Such *selective control* (also called *command control*) systems are in use but will not operate in conjunction with standard DC locomotives and, except for half-wave control, are expensive. In 1977, the great majority of cab-control systems in operation obtained independent control by dividing the layout into sections short enough so that it was practical to keep each locomotive in a separate section. This type of cab control has been called *DC cab control* or *conventional cab control*.

DC Cab Control

Cab control based on sections introduces the task of keeping the cab connected to the section in which its locomotive is located. This task usually is performed manually. The two most-basic forms of manual cab control are shown in Fig. 3-3. On the left is tower-type cab control. That name does not imply that the section-cab switches are operated by towermen (although often the case). Rather, it means that the section-cab switches are associated with the sections and select the cab. A feature of this type is that it is impossible to connect two cabs to one section or to short-circuit two cabs together. With this type of control, it is possible to use an extra pole (extra wafer on the rotary switch commonly used for this system if there are four or more cabs) to signal the next station that it has been set to the same cab when it is to receive a train. Figure 8-3 shows the circuit which was employed at the Watchung Valley Club.

On the right in Fig. 3-3 is engineer-type cab control. Again, the name does not imply that the enginemen necessarily operate the cab-section switches, rather that the cab selects the sections.

The major problem in any manual cab-control system is that operating the section-cab switches is a job which does not exist on the prototype. It is, therefore, not a desirable job in itself and one which should be made as simple as is possible. On a small layout with only two cabs, it is generally recognized that the simple two-cab tower-type system shown on the left of Fig. 3-3 is the best. Only one experienced operator is needed. That operator serves as one of the enginemen and connects his cab only to the sections immediately needed, leaving all other sections connected to the other cab. The Atlas Selector-Connector cab control is exactly this system.

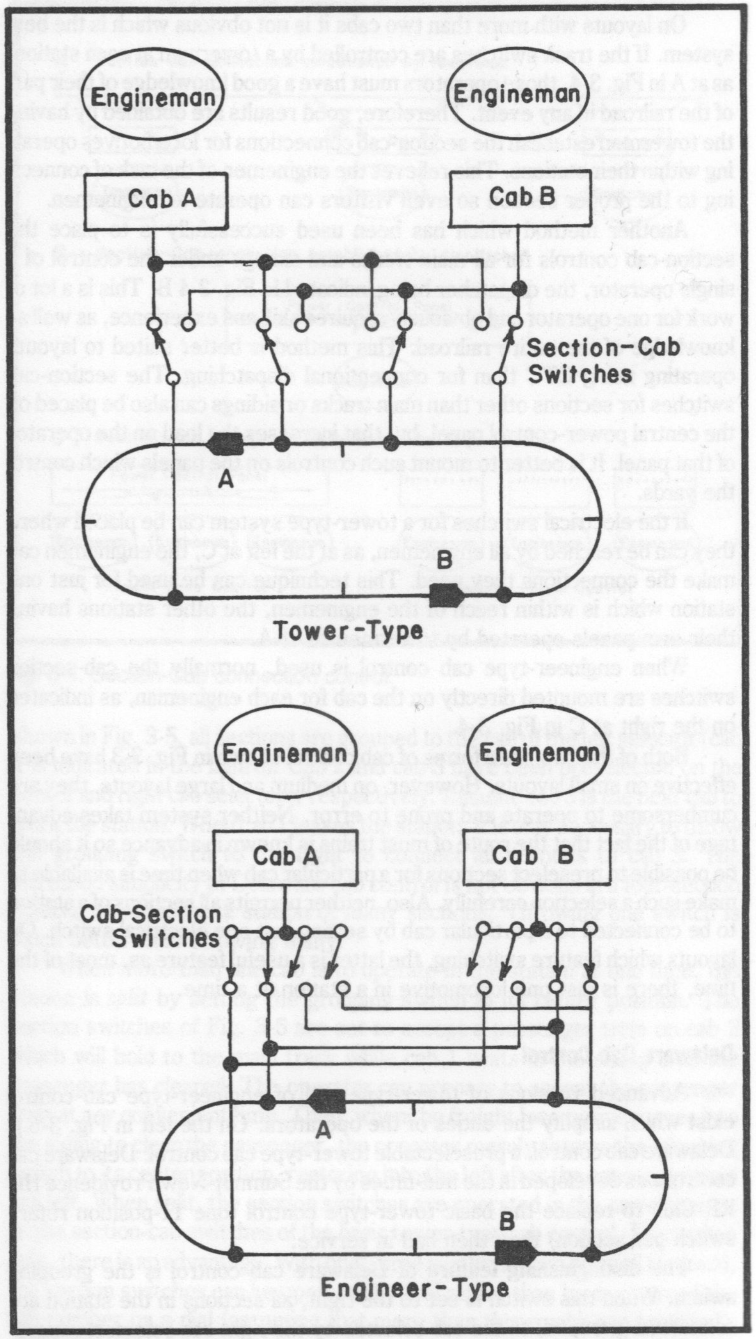


Fig. 3-3. Basic cab-control systems.

On layouts with more than two cabs it is not obvious which is the best system. If the track switches are controlled by a towerman at each station, as at A in Fig. 3-4, those operators must have a good knowledge of their part of the railroad in any event. Therefore, good results are obtained by having the towermen establish the section-cab connections for locomotives operating within their stations. This relieves the enginemen of the task of connecting to the proper section so even visitors can operate as enginemen.

Another method which has been used successfully is to place the section-cab controls for all main tracks and sidings under the control of a single operator, the dispatcher being indicated in Fig. 3-4 B. This is a lot of work for one operator and obviously requires skill and experience, as well as knowledge of the entire railroad. This method is better suited to layouts operating using CTC than for conventional dispatching. The section-cab switches for sections other than main tracks or sidings can also be placed on the central power-control panel, but that increases the load on the operator of that panel. It is better to mount such controls on the panels which control the yards.

If the electrical switches for a tower-type system can be placed where they can be reached by all enginemen, as at the left at C, the enginemen can make the connections they need. This technique can be used for just one station which is within reach of the enginemen, the other stations having their own panels operated by towermen as at A.

When engineer-type cab control is used, normally the cab-section switches are mounted directly on the cab for each engineman, as indicated on the right at C in Fig. 3-4.

Both of the two basic forms of cab control shown in Fig. 3-3 have been effective on small layouts. However, on medium and large layouts, they are cumbersome to operate and prone to error. Neither system takes advantage of the fact that the route of most trains is known in advance so it should be possible to preselect sections for a particular cab when time is available to make such a selection carefully. Also, neither permits all sections of a station to be connected to a particular cab by setting just one electrical switch. On layouts which feature switching, the latter is a useful feature as, most of the time, there is just one locomotive in a station at a time.

Delaware Cab Control

Advanced versions of tower-type and of engineer-type cab control exist which simplify the duties of the operators. On the left in Fig. 3-5 is Delaware cab control, a preselectable tower-type cab control. Delaware cab control was developed in the mid-fifties by the Summit-New Providence HO RR Club to replace the basic tower-type control (one 11-position rotary switch per section) they then had in service.

The distinguishing feature of Delaware cab control is the grouping switch. When this switch is set to the right, all sections in the station are connected (grouped) to the cab selected by the right cab selector, regardless of the positions of the section switches. If set to the left, the position shown in Fig. 3-5, all sections are grouped to the cab of the left selector (cab 1 is indicated in the figure). Cab 2 and cab 3 have been preselected on the center and right cab selectors, respectively. Assume cab 3 is the next cab to work the station. When cab 1 leaves the station, it is only necessary to throw the grouping switch to the right to connect all sections to cab 3. The increased simplicity of Delaware cab control is not obvious in a four-section station, but consider a station of many sections. Throwing one switch is much better than throwing many.

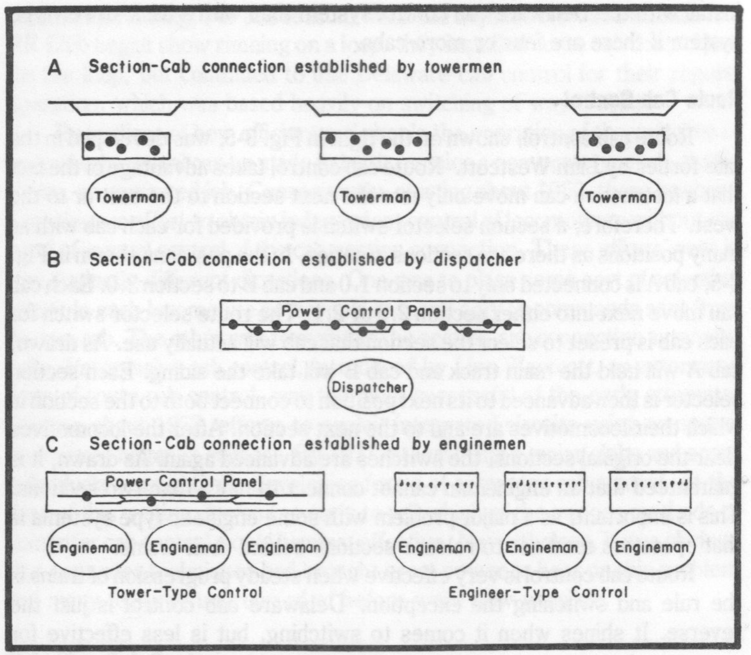


Fig. 3-4. Section-Cab connection control.

When more than one cab is to operate in the station at one time, the station is *split* by setting the grouping switch in its center position. The section switches of Fig. 3-5 are set to accept a passenger train on cab 2 which will hold to the main track while cab 1 waits in the siding until the passenger has cleared. The operator can prepare to accept the passenger train at any convenient time. Then, when the freight locomotive moves into the siding to clear the passenger, the operator merely throws the grouping switch to its center position, restoring it to the left after the passenger train has left. When split, the section switches are operated in the same manner as the section-cab switches of the basic tower-type cab control. Even when split, there is an advantage. With only three positions (two at small stations), the section switches can be operated by feel rather than having to read the cab number on a dial (assuming that more than three cabs are provided). Although not an operational matter, there is considerably less wiring to install with the Delaware cab control system than with a basic tower-type system if there are four or more cabs.

Route Cab Control

Route cab control, shown on the right in Fig. 3-5, was developed in the late forties by Linn Westcott. Route cab control takes advantage of the fact that a locomotive can move only into the next section to the east or to the west. Therefore, a section selector switch is provided for each cab with as many positions as there are sections in series. In the positions shown in Fig. 3-5, cab A is connected only to section 1.0 and cab B to section 3.0. Each cab can move next into either section 2.0 or 2.1. The route selector switch for each cab is preset to select the section that cab will actually use. As drawn, cab A will hold the main track and cab B will take the siding. Each section selector is then advanced to its next position to connect both to the section in which their locomotives are and to the next section. After the locomotives clear the original sections, the switches are advanced again. As drawn, it is guaranteed that an engineman cannot connect to more than two sections. This is important, as a major problem with some engineer-type systems is that operators tend not to release sections behind their trains.

Route cab control is very effective when steady progression of trains is the rule and switching the exception. Delaware cab control is just the reverse. It shines when it comes to switching, but is less effective for continuous running. For this reason, when the Summit-New Providence HO RR Club began show running on a loop, they installed route cab control just for the loop, but continued to use Delaware cab control for their regular operation, which was based heavily on switching of way freights.

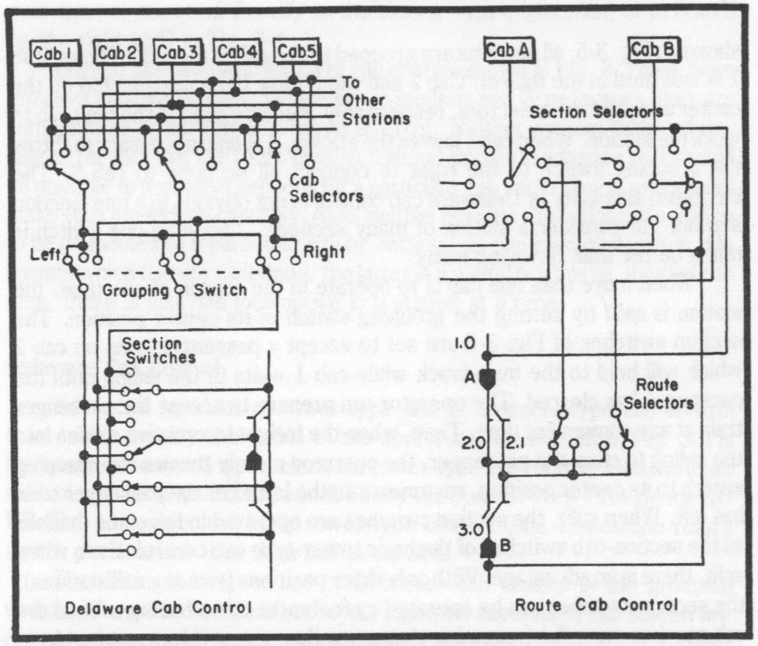


Fig. 3-5. Improved manual cab-control systems.

Regardless of how efficient and simple the operation of the switches of manual cab control can be made to be, it remains a non-prototype job, that is to say, an unwanted job. Consequently, starting about 1950, there has been a continuous effort to obtain independent control of locomotives without the need of manual control of the cab-section connection. These efforts went in two distinctly-different directions. One was to place some sort of selective circuit in each locomotive so it would respond only to commands sent from its own cab. The other was to maintain the section-cab connection automatically. Progressive cab control, introduced by Linn Westcott, an automated form of route cab control, was the most successful of the early attempts. Starting about 1972, efforts to exploit integrated circuits using computer techniques began in earnest. By 1977, at least three major clubs and some individuals were actively developing forms of computer cab control. At the time of this writing, it was too early to tell which of the various methods of computer cab control would be most effective. Nevertheless, it was obvious that computer techniques had brought great power to bear on this problem and many features undreamed of before were now possible.

Selective Cab Control

The other approach, using selective equipment in each locomotive, probably started with placing diodes in series with the motors and running two powered units independently on separate half waves of alternating current. This system goes back to at least 1947 and is still in use for street cars. Frequency control, with one or more separate frequencies assigned to each locomotive was also early on the scene and is still used. Later, digital control with the selective equipment in the locomotives recognizing a unique code for each locomotive was introduced.

Walkaround Control

Walkaround control is any system which allows the engineman to control his locomotive as he physically follows the train. Although not new (Ed Ravenscroft had a well-developed walkaround system in operation on his Glencoe-Skokie RR in 1950), this system has been of increasing interest. Figure 3-6 shows two advantages of walkaround control: there is no need for an overall view, and the enginemen can perform all jobs. These advantages accrue since the engineman does not need to see anything other than the immediate area in which he is operating and he is always close to his train. Therefore, the railroad can be built in more than one room and dividing backgroups can be used. The Rensselear Polytechnic Institute Model RR Club exploits both of these advantages. A limitation of walkaround control is that the layout must be designed so that an operator can physically follow a train. If the layout already exists, it may be impractical to install walkaround

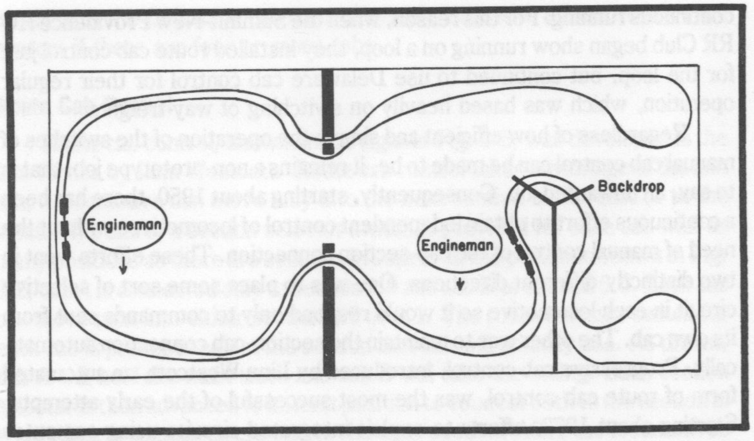


Fig. 3-6. Walkaround control.

control. Other disadvantages on large active layouts are the amount of traffic in the aisles and that some find the continuous walking wearisome.

Electrically, any system of control can be adapted to walkaround control. Among the possibilities are for the engineman to move from one fixed control to another, to have a cab connected by a long cable to the railroad, or to use radio control. From an operation standpoint, the important advantage is that the engineman is close to his train or locomotive at all times.

X Sections

Another control item of an electrical nature which has significant impact upon operations is the *X section* (also called floating section, among other names). An X section is like any other section except that it receives its power automatically from an adjacent section on the same route. Typically, as shown in Fig. 3-7, an X section is short, part of more than one route, and cannot be used without tying up at least one adjacent section. On the left in Fig. 3-7, the X section serves to extend either section 1 or 2 depending upon the route set. Nothing is lost by this automatic connection of power and much is gained. If this X section were connected as a standard section, it would require an additional panel control; a control which would have to be operated often.

On the right in Fig. 3-7, the stub track of a wye has been wired as an X section which assures that the polarity of the rails on the stub are always of the correct polarity. There are many other uses of an X section. From an operating point of view, the chief contribution of an X section is the reduction in complexity in operating the panel controls for the non-prototype job of maintaining the section-cab connection. If a panel control has to be operated distinctly more often than other similar controls, check to see if an X section would help.

TRAIN CREW

As stated earlier, the train crew is the most important single operating unit on the prototype. Any reasonable approximation of prototype operation must assure that the duties of the train crew are assigned to some one operator or definitively divided among specific operators. Figure 3-8 shows four of the ways which have been used on model railroads to carry out the duties of the train crew.

At A in Fig. 3-8, there is an operator at each station to control everything at that station. As far as the control of locomotives is concerned, this is the pass-the-buck system of Fig. 3-2. Not only does the control of the locomotive pass from operator to operator, but also the duties of the conductor and the brakeman. This system completely lacks the continuity of attention to a single train, which is the hallmark of the prototype train crew. Nevertheless, for reasons of visibility or access, it could be the best system for a particular layout.

At B, walkaround control of the locomotive is indicated. Although the operator following the train is usually called the engineman, that operator

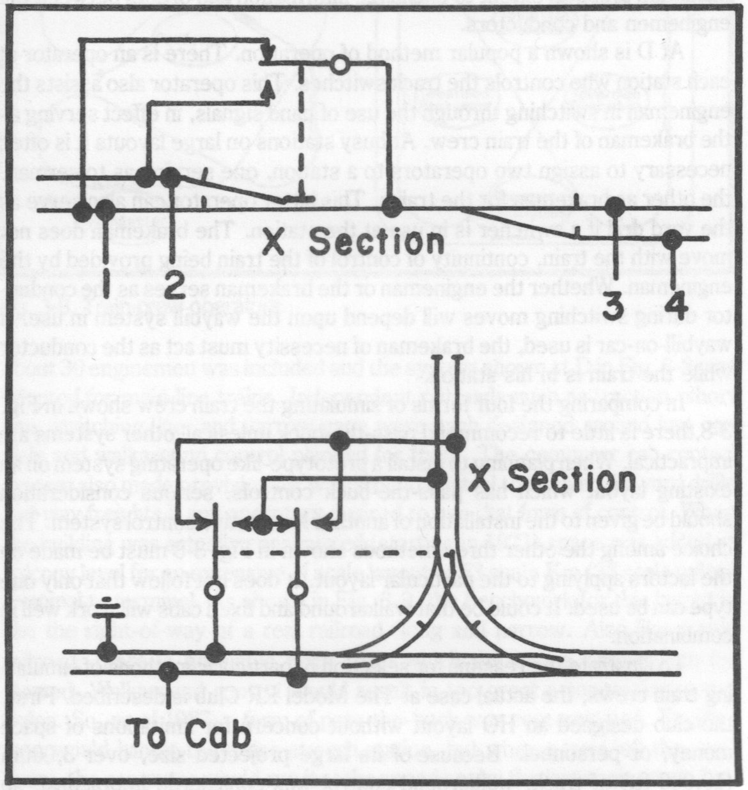


Fig. 3-7. X sections.

serves as the entire crew. Unlike the prototype engineman, on the model the engineman can easily observe the rear of the train or any other point of concern during switching moves. Operationally, walkaround train crews are very desirable. This form of operation is particularly suited to small layouts, as no operators other than the enginemen are required. Physical constraints, however, might prevent this system from being applied. Even when it can be applied, it could be less satisfactory than other forms of control.

When the enginemen can be placed so as to be able to see their locomotives essentially at all points on the layout, it is quite common to locate the enginemen at fixed-position cabs, as shown at C and D in Fig. 3-8. The engineman now needs assistance just as does an engineman on the prototype. One solution, as at C, is to have a conductor move with the train from station to station. Unlike the engineman in walkaround control, the conductor can use the most convenient path to the next station and may either precede or follow the train rather than move with it. Although the operator moving with the train is usually called the conductor, he also serves as the brakeman. Hand signals, rather than voice, should be used to the maximum practical extent to exchange information and orders between the enginemen and conductors.

At D is shown a popular method of operation. There is an operator at each station who controls the track switches. This operator also assists the engineman in switching through the use of hand signals, in effect serving as the brakeman of the train crew. At busy stations on large layouts it is often necessary to assign two operators to a station, one serving as towerman, the other as brakeman for the trains. This latter operator can also serve as the yard drill if a switcher is in use at the station. The brakeman does not move with the train, continuity of control of the train being provided by the engineman. Whether the engineman or the brakeman serves as the conductor during switching moves will depend upon the waybill system in use. If waybill-on-car is used, the brakeman of necessity must act as the conductor while the train is in his station.

In comparing the four forms of simulating the train crew shown in Fig. 3-8,there is little to recommend pass-the-buck unless all other systems are impractical. When planning to install a prototype-like operating system on an existing layout which has pass-the-buck controls, serious consideration should be given to the installation of another locomotive control system. The choice among the other three methods shown in Fig. 3-8 must be made on the factors applying to the particular layout. It does not follow that only one type can be used. It could be that walkaround and fixed cabs will work well in combination.

To illustrate the reasons for selection of particular methods of simulating train crews, the actual case at The Model RR Club is described. First, the club designed an HO layout without concern for limitations of space money, or personnel. Because of its large projected size, over 3,000m (10,000 ft.) of track, walkaround control was considered impractical, so when the building to house the layout was designed, an elevated balcony for about 30 enginemen was included and the system shown at D in Fig. 3-8 was adopted for main-line trains. Independent railroads such as traction, short line, switching line, and narrow gage were each designed around just one aisle and walkaround control planned for them. The computer cab control system also made provision for walkaround control to be used for yard drills and way freights if any operators desired to use that form of control. When the building was actually constructed (starting in 1971) space was added at balcony level for an extensive N scale layout of 53 scale Km (33 scale miles) terminal to terminal. As shown in Fig. 3-9, the benchwork for this layout is like the right-of-way of a real railroad, long and narrow. Also like a real railroad, there is no single point from which the entire railroad can be viewed. Walkaround control would result in too great a congestion in the aisles. So, as of 1977, a form of pass-the-buck was contemplated. Enginemen would handle the trains at each station, but when a train left the yard limits, the computer would run it at the speed set by the last enginemen, but would obey all signals, until the train control was placed on a cab at the next

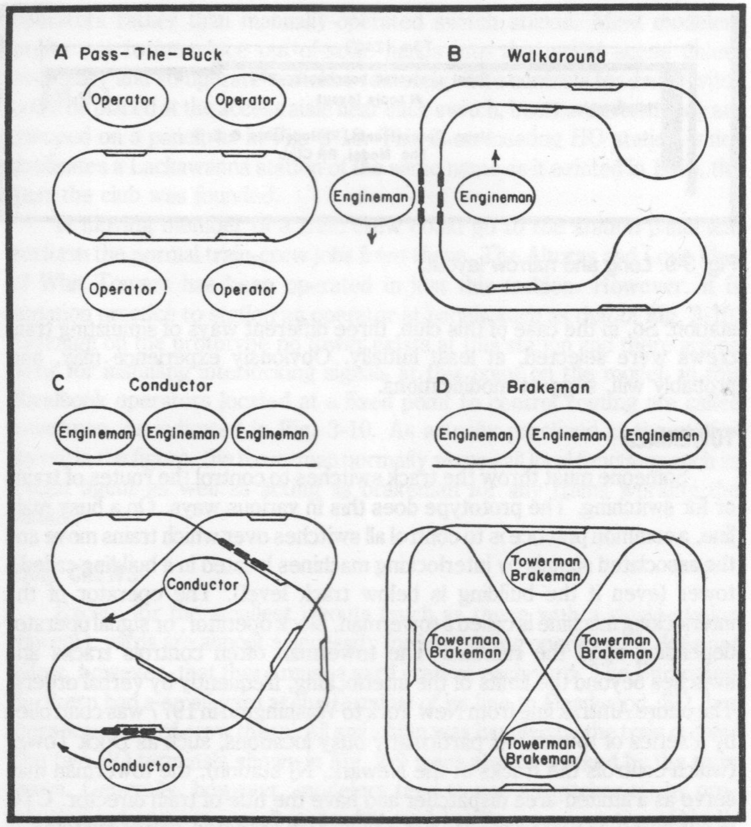


Fig. 3-8. Train-crew operators.

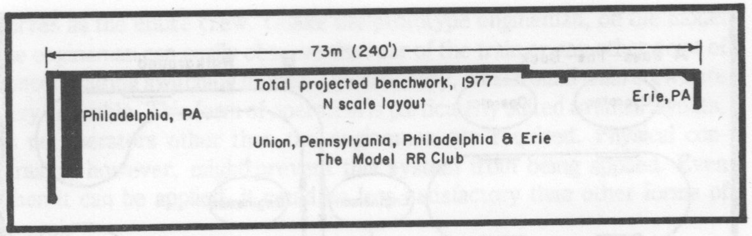


Fig. 3-9. Long and narrow layout.

station. So, in the case of this club, three different ways of simulating train crews were selected, at least initially. Obviously experience may, and probably will, suggest modifications.

TOWERMEN

Someone must throw the track switches to control the routes of trains or for switching. The prototype does this in various ways. On a busy main line, a common practice is to control all switches over which trains move and the associated signals by interlocking machines located in a building called a tower (even if the building is below track level). The operator of the interlocking machine is called a towerman, block operator, or signal operator depending upon the railroad. The towerman often controls tracks and switches beyond the limits of the interlocking, frequently by verbal orders. The entire Amtrak line from New York to Washington in 1977 was controlled by a series of towers. At particularly busy locations, such as Dock Tower (which controls the tracks at the Newark, NJ station), the towerman may serve as a limited-area dispatcher and have the title of train director. CTC (Centralized Traffic Control), also called TCS (Traffic Control System), is really an interlocking machine controlling a major length of a railroad. The operator of a CTC machine may be called the dispatcher or, if a separate dispatcher exists, the CTC operator, or similar term.

Some towers have neither an interlocking machine nor power-operated switches. At such towers the towerman may have switchmen assigned to throw the switches, throw them himself, or the train crew or yard drill may throw the switches in response to signals or orders. An old system once used in congested switching areas, such as the Chicago stockyards, was to assign switchtenders to specific switches who threw these switches as ordered.

Yard switches may be controlled from a tower, as is the case in modern hump yards, but often they are thrown by yard brakemen if there is a yard crew. Otherwise, yard switches and those along the line not under CTC or tower control are thrown by the train crew.

On a model, if a member of the train crew follows the train, operation can be exactly like that of the prototype, the train crew throwing all switches except those of CTC or interlockings and wherever switchmen are available. Unlike the prototype, however, most model track switches have power operators rather than manually-operated switch stands. Most modelers prefer not to introduce out-of-scale hands into the model scene unless necessary and so operate switches remotely. The controls for each switch could be placed at the access aisle near each switch, but more often, they are grouped on a panel, as in Fig. 3-10. This is an existing HO station which duplicates a Lackawanna station of the same name as it existed in 1949, the year the club was founded.

A moving member of a train crew could go to the station panel and perform the normal train-crew jobs from there. The Alturas and Lone Pine of Whit Towers has been operated in just this fashion. However, it is common practice to station an operator at panels such as that of Fig. 3-10. Although on the prototype no tower exists at this station and there are no plans for installing interlocking signals at this point on the model, in this Handbook operators located at a fixed point to control routing are called towermen, as indicated in Fig. 3-10. As actually practiced at the station shown in the figure, the towerman normally serves all local functions such as freight agent as well as acting as brakeman for any trains working the station.

YARD CREWS

Except for the smallest layouts (such as those with a single-station concept), yards are almost a necessity for interesting operation. It does not follow, however, that there must a yard crew at each yard. The Burlington Northern had a small yard at the terminal of its line to Deadwood, SD, but there was no yard crew there. All switching was handled by the train crews. The two HO terminals shown in Fig. 2-9 were always worked by the train crews. Generally, however, modelers tend to use a switcher at, by prototype standards, very small yards. Although hardly representative of North American practice, in Switzerland frequently small four-wheel switching locomotives are located at quite small stations. Whit Towers used this technique on his HO Alturas and Lone Pine. He placed a switching locomotive at each station. Using walkaround control, when the train crew arrived at a way station where there was work to do, the road locomotive was uncoupled and moved out of the way. The train engineman then used the switcher to do the work at the station.

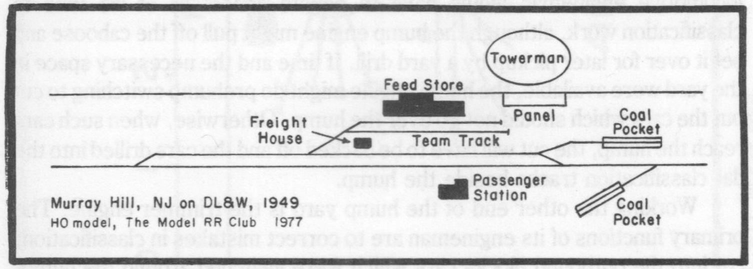


Fig. 3-10. Towerman controlling a station.

The terminal, Lyndon, KY on the HO L&N, of Allan Bates, shown in Fig. 3-11 is typical of the size of model yards. (Figure 2-12 shows this entire layout.) Allan Bates assigns a switching locomotive to this terminal. This engine does the switching at Lyndon plus making the set outs and pick ups from industries within switching limits. Yards the size of Lyndon clearly can be handled by one operator. As indicated in Fig. 3-11, this operator is usually called the yardmaster, although he fulfills all jobs at the terminal, in particular yard brakeman and engineman of the switching locomotive (the yard drill). Enginemen of trains could serve as the hostler in taking locomotives to and from the engine terminal. An alternative would be for the locomotives to be left at any convenient point by the train crew, the yardmaster then acting as hostler when time permits.

It is difficult to show the possible yard jobs using a typical model yard. At small yards, jobs are usually combined into one or two operators. Therefore, a large HO division-point yard is used to demonstrate the range of jobs which can be included. This yard, shown in Fig. 3-12, was under construction by The Model RR Club in 1977. As is often the case on the prototype, but seldom on the model, the Gilberton yard is actually three separate yards: receiving, departure, and classification. Only the receiving yard had been constructed by 1977, so experience has not yet shown how many operators will actually be required to operate this division point effectively. The following description of the various jobs assumes that each is carried out by a separate operator.

Each of the three yards would need a separate yardmaster. With so many yardmasters, a general yardmaster (or terminal superintendent) might be necessary to coordinate activities. In yards of this size, it would seem likely that the yardmasters would have their hands full in planning moves and working with the waybills, so a separate towerman is shown for working the track switches within each yard. All switches on main tracks, as well as the passenger terminal, would be handled by the main towerman. This is the tower with which the dispatcher would be in communication.

Again, because of the size and activity of this yard, it seems unlikely that either the yardmaster or the towermen could handle the switching locomotives. Consequently, separate operators are indicated to serve as enginemen of the two yard drills in the freight yard and one in the passenger yards and station. Two additional enginemen have special jobs. The hump locomotive engineman would have to devote almost all of his time to classification work, although the hump engine might pull off the caboose and set it over for later pickup by a yard drill. If time and the necessary space in the yard were available, the hump engine might do prehump switching to cut out the cars which should not go over the hump. Otherwise, when such cars reach the hump, the cut will have to be backed off and the cars drilled into the flat classification tracks beside the hump.

Working the other end of the hump yard is the trimmer engine. The primary functions of its engineman are to correct mistakes in classification, cut into the outbound blocks cars which were switched around the hump, and move blocks to the departure tracks. At Gilberton, that engineman

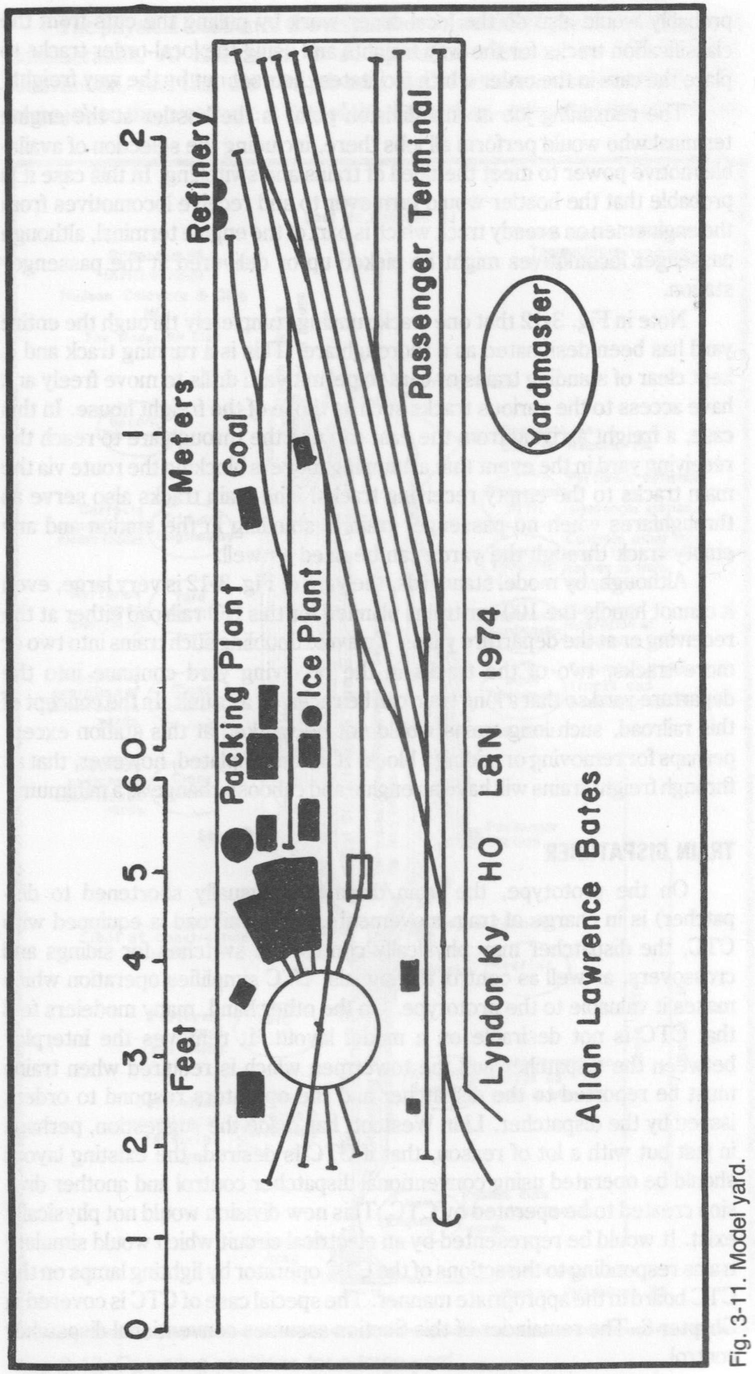


Fig. 3-11. Model yard.

probably would also do the local-order work by pulling the cuts from the classification tracks for the way freights and using the local-order tracks to place the cars in the order which facilitates their set out by the way freight.

The remaining job at this division point is the hostler at the engine terminal who would perform all jobs there, including the selection of available motive power to meet the need of trains and switching. In this case it is probable that the hostler would turn over to and receive locomotives from the enginemen on a ready track which is part of the engine terminal, although passenger locomotives might be picked up or delivered at the passenger station.

Note in Fig. 3-12 that one track running completely through the entire yard has been designated as a thoroughfare. This is a running track and is kept clear of standing trains or cars to permit yard drills to move freely and have access to the various tracks such as those of the freight house. In this case, a freight arriving from the east can use the throughfare to reach the receiving yard in the event that a humping move is blocking the route via the main tracks to the empty receiving tracks. The main tracks also serve as throughfares when no passenger train is standing in the station and any empty track through the yards can be used as well.

Although, by model standards, the yard of Fig. 3-12 is very large, even it cannot handle the 100 car trains planned for this HO railroad either at the receiving or at the departure yards. To avoid doubling such trains into two or more tracks, two of the tracks in the receiving yard continue into the departure yard so that a long train can be received as a unit. In the concept of this railroad, such long trains would not be worked at this station except perhaps for removing or adding a block. It is contemplated, however, that all through freight trains will have an engine and caboose change as a minimum.

TRAIN DISPATCHER

On the prototype, the train dispatcher (usually shortened to dispatcher) is in charge of train movements. If the railroad is equipped with CTC, the dispatcher may physically control the switches for sidings and crossovers, as well as control the signals. CTC simplifies operation which makes it valuable to the prototype. On the other hand, many modelers feel that CTC is not desirable on a model layout. It removes the interplay between the dispatcher and the towermen which is required when trains must be reported to the dispatcher and the operators respond to orders issued by the dispatcher. Linn Westcott has made the suggestion, perhaps in jest but with a lot of reason, that if CTC is desired, the existing layout should be operated using conventional dispatcher control and another division created to be operated by CTC. This new division would not physically exist. It would be represented by an electrical circuit which would simulate trains responding to the actions of the CTC operator by lighting lamps on the CTC board in the appropriate manner. The special case of CTC is covered in Chapter 6. The remainder of this Section assumes conventional dispatcher control.

The physical location of the dispatcher on a model layout is an important consideration. Al Kalmbach, in an operation clinic at the 1950 NMRA Convention, said that the one job on a model which can be identical to the same job on the prototype is that of the dispatcher—provided the dispatcher

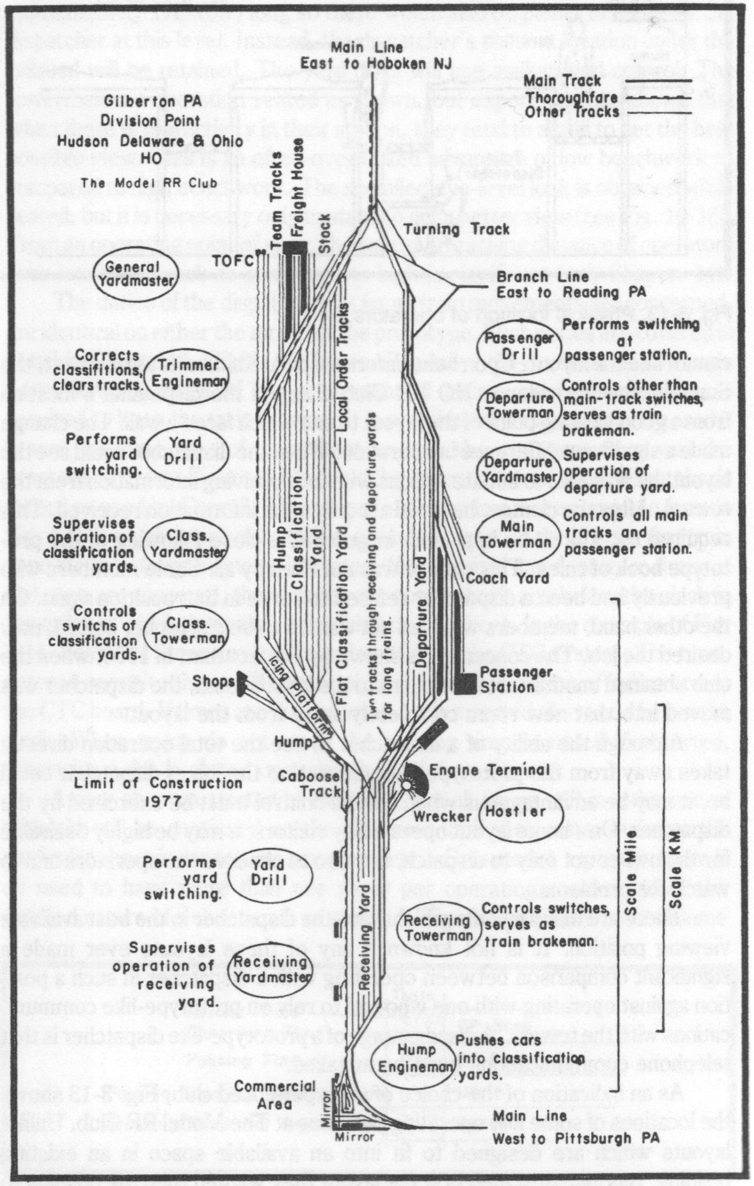


Fig. 3-12. Operating positions for a large yard.

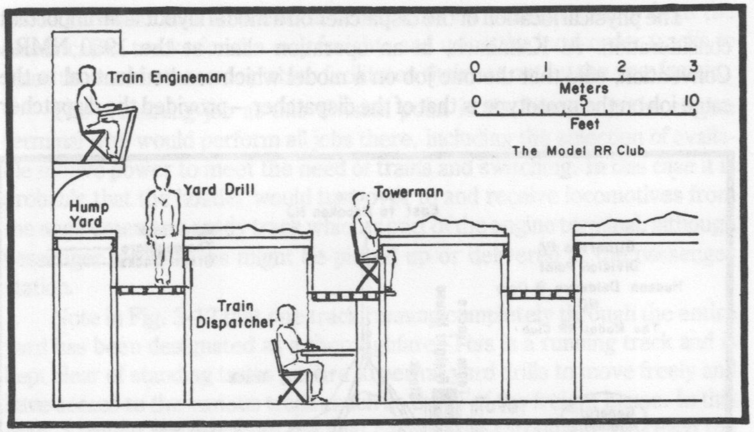


Fig. 3-13. Physical location of operators.

cannot see the layout. Upon being informed of Al Kalmbach's statement, the Summit-New Providence HO RR Club changed the dispatcher's location from a good viewing point of the layout to one which faced a wall. The change made a significant difference in operation. When the dispatcher could see the layout, he was able to initiate actions without receiving information from the towers. After the change, he could act only upon information received. This required records to be kept and, in general, a close following of the prototype book of rules. This change was not liked by all. Some members who previously had been a dispatcher refused to serve in that position again. On the other hand, members who had not wanted to be dispatcher before, now desired the job. The concensus is shown by the fact that, in 1960, when the club obtained another room adjacent to the layout room, the dispatcher was moved into that new room completely away from the layout.

Although the ability of a dispatcher to see the total operation directly takes away from the prototype-like nature that the job of dispatcher could be, it may be advantageous when special control must be exercised by the dispatcher. On a home layout operated by visitors, it may be highly desirable for the owner not only to dispatch, but also to observe the operators and to watch for problems.

There are many layouts which place the dispatcher in the best available viewing position. It is not known if any of these layouts ever made a significant comparison between operating with a dispatcher in such a position against operating with one who had to rely on prototype-like communications with the towers. A disadvantage of a prototype-like dispatcher is that telephone communications must be installed.

As an indication of the choice of an experienced club, Fig. 3-13 shows the locations of some key operating positions at The Model RR Club. Unlike layouts which are designed to fit into an available space in an existing building, this club designed first the layout they wanted then the building to go around it. As a result, they could place operating aisles where and at the height deemed most desirable. The road enginemen were at visitor's balcony level in 1977. When the next building extension is constructed, they will be placed on an even higher enginemen's balcony, as shown at the left in Fig. 3-13. To save space, this balcony is over the hump yard as train enginemen do not have to see classification tracks. This balcony will be approximately 17m (55′) long so there would also be plenty of room for the dispatcher at this level. Instead, the dispatcher's present location under the railroad will be retained. The yard drills will use walkaround control. The towermen can operation seated as shown, but experience has shown that when there is real activity in their station, they tend to stand to get the best possible view. This is an often-overlooked advantage of low benchwork as compared to high benchwork. The so-called eye-level look is obtained while seated, but it is necessary only to stand to get a better view (see Fig. 14-16). From an operating point of view, the superior reaching distance of operators over low benchwork as compared to high is significant (see Chapter 14).

The duties of the dispatcher, as far as train movements are concerned, are identical on either the model or the prototype. Such duties are covered in detail in Chapter 5, Rights of Trains. Basically, they consist of two main parts, keeping track of the movement of trains and issuing orders as required to keep the train moving. It is possible for a dispatcher on a model to use the same type of train sheet as does the prototype to record the progress of trains. Figure 3-14 shows the essential parts of the dispatcher's record as used by Conrail. This record is shown in a more complete form in Fig. 4-9. If a train stops at a station, a slash is placed in the box for that train opposite the station name as indicated. If the arrival and departure times at that stop are reported, these times are noted above and below the slash in the order in which the train is advancing on the sheet. In the example of Fig. 3-14, Boyd and Stone are control points (CP) of the CTC system. The times entered opposite these CP's were obtained by observation of indicators on the CTC board. If times are not reported, xx is inserted above and below the slash. When trains do not stop, the passing time is noted if reported, otherwise a dot is placed opposite that point on the run.

A new sheet is started at midnight, but all trains still in existance at midnight will be continued on the old sheet until their runs, as far as the particular sheet is concerned, are completed. On a model, typically, there is no need to have more than one sheet per operating session. Also, the detailed nature of a sheet such as shown in Fig. 3-14 makes it cumbersome

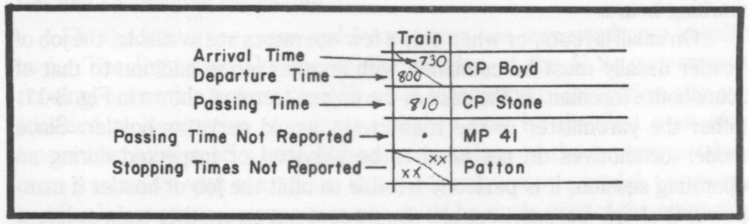


Fig. 3-14. Dispatcher's record.

to read. For model use, noting the progress of trains on a graphical timetable as described in Chapter 4 is recommended. That method is simpler and more easily read than using a prototype-like dispatcher record, yet is entirely satisfactory.

Since the dispatcher may be the only operator in charge of the entire operating session, on a model the dispatcher may be given the duties of several other prototype jobs. On many layouts the dispatcher is responsible for checking that all positions are manned by qualified operators, that the waybill system is ready, and that cars are picked up and delivered properly as required by the waybills. If so, the dispatcher is acting as crew dispatcher, chief dispatcher (or movement director), assignment clerk, and trainmaster. When a dispatcher is in general charge, he is also serving as superintendent. If enough operators are available, there is considerable merit in assigning the duties of superintendent and of trainmaster to some operator other than the dispatcher. These two jobs are performed during the operating session and on a busy railroad the dispatcher should be free to dispatch. There is, nevertheless, no reason to avoid assigning the dispatcher supervisory tasks which are performed before operations start.

HOSTLER

A hostler moves light engines in engine terminals, shops, and to and from yards and stations. On a model, this job can only be justified as a separate operating position if there are enough locomotive movements in and out of the engine terminal to keep an operator busy. However, as explained in Chapter 11 to simulate the proper movements of a locomotive at an engine terminal, particularly steam locomotives, requires considerable time so only a few locomotives per hour can easily create the need for a full-time hostler. But, even on large layouts, the hostler also takes the responsibility of meeting motive power needs and so is also serving as roundhouse foreman.

If moving locomotives within the engine terminal does not take all the available time, the hostler could also serve as a change crew (also called extra-service crew). A change crew moves light locomotives as required, for example from one yard to another or from station to station. If a crew is called for just one movement of a light engine, it may be called a light-engine crew, particularly if the distance involved is great. Change crews remain on duty for a full trick or until they exceed the maximum number of legal working hours.

On small layouts, or when only a few operators are available, the job of hostler usually must be combined with another job in addition to that of roundhouse foreman. In the case of the engine terminal shown in Fig. 3-11, either the yardmaster or the train crews would serve as hostler. Since model locomotives do not need to be serviced or inspected during an operating session, it is perfectly feasible to omit the job of hostler if manpower is short. Locomotives are simply sent out on another train or left at any convenient point when no longer needed.

SUPERVISORY JOBS

There are many supervisory jobs on a railroad which are involved in operation. Some of these positions control the actions of the operating personnel during the actual operation of the railroad. Others are required to assure that operating personnel are capable of doing their tasks. On a home layout, particularly a small one, the owner usually serves as all supervisors. But, whether it is the owner or not, someone must prepare the operating rules and someone must see that the rules are followed.

Unfortunately, there are model enginemen who feel any speed below a scale 160kmh (100mph) is too slow. On the prototype it would be up to the road foreman of engines to disabuse that engineman of such ideas. The owner of a home layout also has a big stick to force proper operation: banishment. This is a difficult stick to wield at a club. Perhaps the most effective way of bringing wayward operators into line is group pressure. Whenever careless or willful acts lead to jack-rabbit starts, brick-wall stops, or too-fast running, all other operators observing such actions direct suitable words toward that engineman. At one club when trains are run too fast, a hue and cry is raised of, "Faster, faster!" Even the most determined fast runner will respond in a short time if the pressure is maintained.

Group pressure can only enforce rules and reasonable performance. It cannot create the rules, instruct the operators, or inspect the equipment. These jobs are the responsibility of one or more specific operators. Again, on a home layout, often the owner assumes all such responsibilities but, on a medium or large home layout, the owner may prefer to assign these jobs to others. In fact, many of the most-successful home layouts have been operated almost exactly as though they were clubs.

The following paragraphs describe jobs which, one way or another, must be performed on a layout attempting to operate in the prototype manner. These jobs are directly concerned with operation. Obviously, a layout cannot operate unless the track is built and the wiring installed with all kept at a high standard by a maintenance program. On a model railroad, such activities take place at times other than at an operating session. Therefore, except for touching high points in Chapter 14, construction and maintenance are outside the scope of this book. It is, nevertheless, an important job of the operators to provide the necessary information to correct any difficulties found during an operating session.

Car and Locomotive Inspection

On the prototype, cars and locomotives are inspected on a regular basis. The Interstate Commerce Commission of the U.S. government requires a monthly inspection (MI) of all locomotives. Inspection pits are provided at locomotive terminals and they may be the first stop of a locomotive coming off a run. Although inspection on the prototpye takes place concurrent with operations, this is not practical on a model. Of course sending locomotives to inspection pits could be made part of the operating procedure, but they will not be inspected there. It is important, nevertheless, that definitive procedures be established to make note or otherwise indicate the car, locomotive, or point on the track which requires maintenance. A convenient yet effective method is covered in Chapter 7.

On any but the smallest layouts, it is a virtual necessity to assure that the cars and locomotives are in good operating condition when they are placed on the layout. It is also important to check from time to time that the rolling stock remains in satisfactory operating shape. In short, whether it is a separate operating position or not, there is the function of equipment inspector. Actually, except for supervising the handling of bad-order equipment discovered during an operating session, the equipment inspector performs his job between sessions. But, since this work is so closely tied to operation car inspection is, without known exception, always considered a function of the operating department.

The work of an equipment inspector can be made more precise and far more easy if the inspector is provided with suitable gages, preferably arranged so that cars can be checked for several things as they roll down a grade. Chapter 14 describes some useful testing equipment in detail. Effort should be made to provide go, no-go gages rather than requiring the inspector to make a value judgment. As a very minimum, a coupler-height gage is needed. The one shown in Fig. 3-15 is for checking the type of HO coupler designed by the HO Standards Committee (NMRA) in 1954. Only if the coupler enters the notch in the gage without striking the gage is height adjustment considered acceptable.

Superintendent

On the prototype there may be many superintendents, each division would have one, but even the largest model railroad is small by prototype standards and all operations can be controlled by just one superintendent. Of course, other titles could be used, such as Operating Vice President, but the fact remains that it is all but necessary to have a single operator in overall charge. In this book that operator is called the superintendent.

On most home layouts the owner, probably without giving the matter a thought, assumes the position of superintendent automatically. However, on club layouts (and often on large home layouts operated as though they were clubs) the superintendent is an operator selected for the purpose. Unlike other operating positions, such as dispatcher, which may be filled by different operators at successive operating sessions, the position of superintendent (at least in the short run) should be the continuous responsibility of a single individual. There are so many operating responsibilities which carry over from operating session to operating session that continuous attention to the operating program is required. Further, to supervise properly several (or many) other operators requires considerable know-how and experience.

Home layouts, typically, are not operated without the owner being present. But at clubs, and on home layouts where the owner is not the operations superintendent it cannot be expected that the superintendent will be able to attend every operating session. Therefore, the superintendent must somehow delegate his responsibility so that there will be adequate supervision of operation at all times.

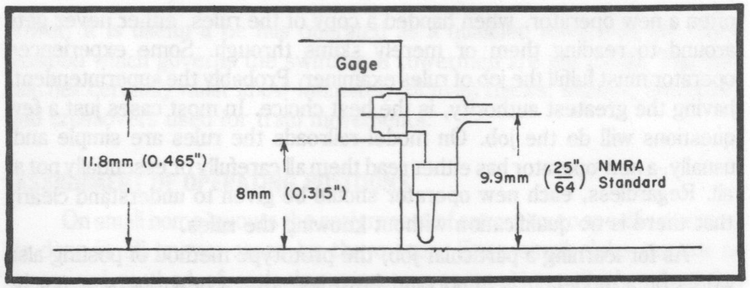


Fig. 3-15. Height gage for one type of HO coupler.

Among the duties the superintendent should perform (or see that they are performed) are the following: Preparation of a rule book and provision of sufficient copies; Preparation of timetable schedules and provision of sufficient copies (perhaps even the placement of such schedules at the operating positions); Qualification of operators in such a way that there are enough for each position to assure that all positions will be filled by qualified personnel at an operating session; Supervision of the operating sessions; Investigation of problem areas and a general seeking of ways of improving operations.

TRAINING AND QUALIFICATION OF OPERATORS

On small layouts, it is sufficient for the experienced operators to explain the operating procedures to a new operator during an operating session. On larger layouts with specialized jobs, this simple method may not be satisfactory way of training a new operator. Some organized method of training and determining when the operator is qualified to handle the job unaided could be more effective.

Usually a new operator shows up first at an operating session. It is then too late to hand him a rule book to read. On all known layouts, fortunately, there has been at least one position in which advance information is not required. New operators can be placed in such a position to operate under close supervision and assistance. On a railroad operating with towermen who also serve as brakemen, a good learning position is that of a brakeman assisting the towerman. Since the new operator is performing part of the duties of the towerman, the latter has time to instruct and supervise the new operator. If one of the operators is particularly proficient at instructing new operators and is willing to do so on a regular basis, an effective training system can be built around that individual.

It is likely that a new operator will already know how to run a train. If the control system is such that an engineman does not have to maintain the electrical connection to the locomotive, engineman of a passenger train also is a good position to start a newcomer.

After starting with some simple task, the next step is to force the new operator to read the rule book. The word force is used advisedly as all too often a new operator, when handed a copy of the rules, either never gets around to reading them or merely skims through. Some experienced operator must fulfill the job of rules examiner. Probably the superintendent, having the greatest authority, is the best choice. In most cases just a few questions will do the job. On model railroads the rules are simple and, usually, a new operator has either read them all carefully or essentially not at all. Regardless, each new operator should be given to understand clearly that there is no qualification without knowing the rules.

As for learning a particular job, the prototype method of posting also works on a model. It is important, however, that a new operator not be permitted to flit from job to job. Rather, once having selected a job to post, the new operator should be required to continue with it until qualified unless there is some good reason to switch to another job. The posting operator works under the direction of a qualified operator at that position. The supervising operator must be satisfied that the student can handle the job unaided before agreeing that the student is qualified. It is necessary to be quite rigid on this and not grant qualification out of kindness. The Summit-New Providence HO RR Club had a most unfortunate experience in the mid-fifties along these lines. An operator was granted qualification as towerman for the terminal of Gladstone, NJ (Fig. 2-9) before he had demonstrated the ability to handle the job skillfully. This operator attended regularly and therefore held the seniority necessary to keep the job after qualification. He never became able to perform the job to the point where the terminal could handle its normal number of trains without delay. It proved necessary to disqualify him. Not granting qualification in the first place would have been far better. It may be helpful to require the concurrence of the superintendent before an operator is granted qualification to assure that minimum standards of skills are met.

How can a qualification system be put into action when a layout is just starting to operate? The recommended method is that, by concensus of all operators, an operator who is among the best at each particular position be considered qualified for that position, perhaps more than one operator if there are more operators at this stage than operating positions. The Watchung Valley Club, when a new yard or tower panel was constructed, considered the builder of that panel as qualified.

It is difficult to define the level of skills which should be demanded to justify qualification. Certainly, as a minimum, the operator must be adept enough to perform all the customary functions of the job in the time normally allotted. Enginemen should know the locations of all section breaks. If the designer of the layout did a good job, most of these will be quite obvious. If they are not, perhaps they can be made obvious. Section breaks which cannot be made obvious, such as those on a main track between two stations, can be identified by some landmark. A good place to record such landmarks is in timetable instructions. A towerman must have an intimate knowledge of the tracks of his station, of the locations of all section breaks, of the panel controls, and of the common movements performed at that tower. Although it is not necessary for a dispatcher to be qualified at every

tower, it is useful if he has operated as a qualified towerman (or other position which governs the switches if towermen are not used). The dispatcher certainly must know intimately all main tracks, sidings, junctions, and crossovers used for train movements.

ASSIGNMENT OF OPERATING POSITIONS

On small home layouts the assignment of operators to specific positions is done in all known cases by the owner. Even small clubs require no organized method of assigning operators to positions. With only a few members, a tacit agreement rapidly develops concerning the manning of the available positions. In addition, on small layouts there is usually little difference among the various positions so all operators quickly become qualified for all of them. However, it does not require a huge layout to generate a problem of operator assignment. The three-station layout of Fig. 2-9 required eight operators. When this stage of construction of the layout was reached, it was found necessary to formalize a method of selecting jobs for an operating session. If this had been a home layout, perhaps the owner would have been willing to take on the responsibility of making the assignments. But even on a home layout, if large, the owner could well prefer to leave the matter of selecting jobs to the operating crew. Even at clubs, one member could perform the function of assignment clerk. Both the Sacramento and the Watchung Valley Model RR Clubs found this method satisfactory. An alternative method is to have members select their own jobs.

To be effective, a job-selection system must be both fair and simple. Fair meaning that when two operators are qualified for a given position, a recognized and accepted priority of choice exists. In actual practice, failure to have a defined right to choose usually results in delays as operators attempt to defer to other qualified operators rather than in arguments between two wanting the same job. Everyone is happier if it is known who has priority, particularly if the operator with the lower priority knows that the one above has earned that position and that there is a chance to move up in priority.

On the prototype, seniority is the basis for job selection—and that is a good basis on the model. The question is how to establish seniority on a reasonable basis. The system which was developed at the Summit-New Providence HO RR Club and used for many years is described below. It is effective for up to about 15 operating positions, enough for most layouts. Attendance during working periods and during operating sessions was the basis for seniority. Originally this club worked and operated on alternate weeks. Then, as a result of a suggestion by John Allen, it switched to operating for two months continuously followed by working for two months continuously. The latter was a great improvement on several counts: The layout stayed clean during an operating period. Cars and locomotives could remain in place for two months. Operating skills became much sharper operating once a week instead of every other week.

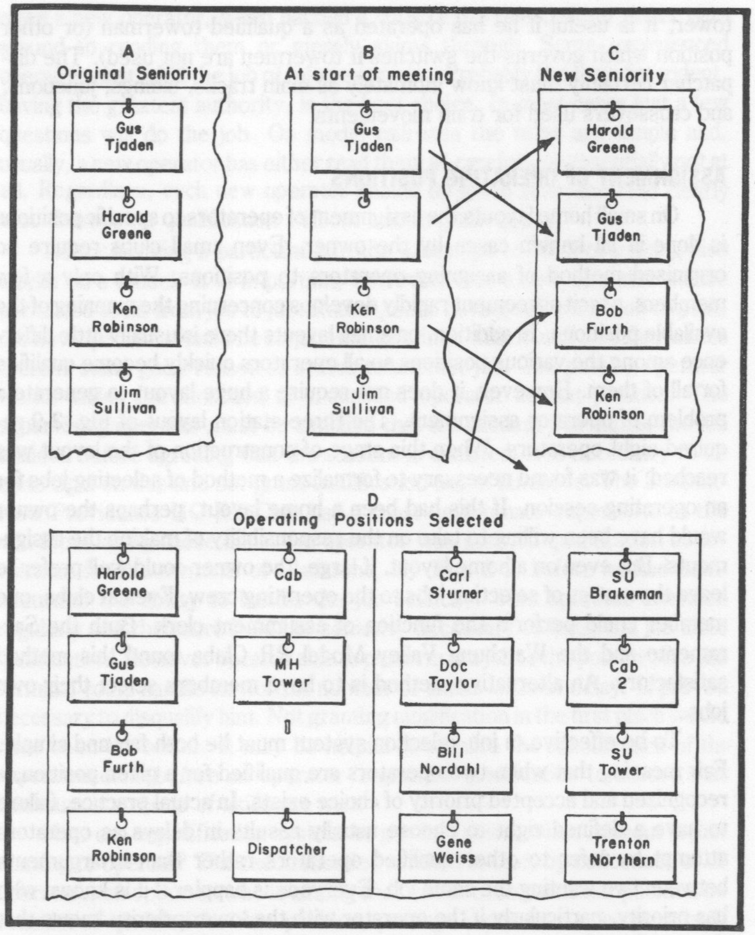


Fig. 3-16. Operating position selection board.

Ordinary 3 by 5 file cards (the kind with the hole at the center near one long edge) were used. Each member had a card with his name. The cards hung from hooks on an operating position selection board, as shown in Fig. 3-16. This board was known as the *call board* at the club.

Initially, all cards hung name-side out, as at A in the figure. A member attending the club at any time during the week would turn his card over as indicated at B. In the case shown, only Harold Greene attended as all other names are still visible at B. At the start of the main weekly meeting, all cards with the name exposed were moved down one position, as indicated at C. Any card with the name turned down advanced as far as possible. At C, Harold Greene had advanced to the No. 1 position and Bob Furth has moved into position No. 3, jumping at least two other names. Thus, it is possible to go down only one position a week, but the opportunity existed (and often realized) to make large jumps upward. This system did not reward the members who attended more than once a week. That caused no difficulty, as such members were always near the top anyhow.

As soon as the cards were reordered at the beginning of an operating session, the operators could choose any operating position for which they were qualified and hang the card for that position next to their name card if the operating position was still available, or was hanging next to a name lower in seniority. Fifteen minutes before the start of operations the cards were frozen and no late comer could take a position away from an operator with lower priority. The dispatcher was responsible for checking the board to see that key positions were manned and that each operator was qualified for the position selected. An exception was a student posting a job. Once an operator selected a posting position, he was expected to keep that position until qualified and could not be bumped by an operator with greater seniority.

This system worked well as long as the layout was small (up to about five stations and five cabs). As the layout grew beyond the point, the handling of loose cards became bothersome and, more important, it became difficult for the dispatcher to check that all positions were manned with qualified operators. Further, if not enough operators were on hand to operate the entire railroad, the usual technique was to abandon one of the lines completely for that session or to cut back on the main line so that branch line could be included in the evening's activities. The information to make this decision was not readily available from the cards. They had to be scanned and the positions remembered.

To meet the needs of an expanding layout, a new type of call board was designed. Before its construction was well under way, the decision to build a new layout at another location was made. Therefore, this call board did not have the test of service applied. But, since this was a design based on years

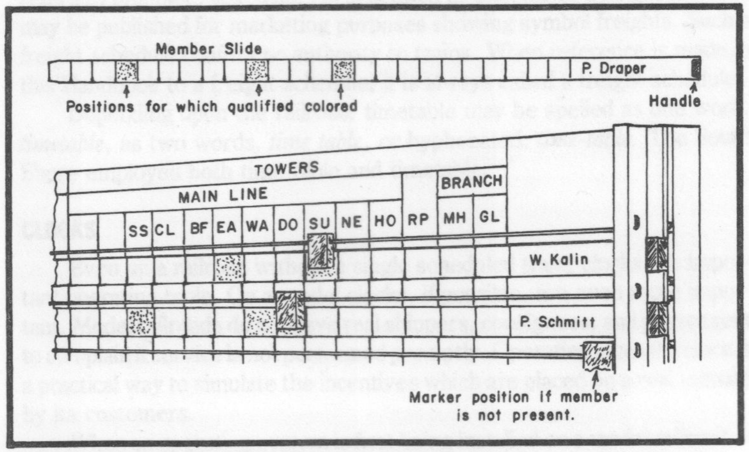
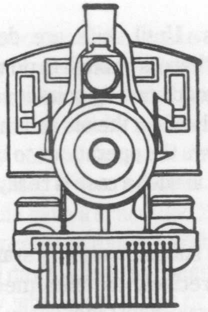


Fig. 3-17. Another operating position selection board.

of experience, its basic idea is given in Fig. 3-17. Instead of a card, each member was to have had a long slide, as shown at the top of the figure. These slides were to fit slots in the call board, as indicated in the lower part of Fig. 3-17. Their relative positions showed seniority and they were to be moved from slot to slot just as were the cards of Fig. 4-16. A sliding marker was to be provided for each member, a block sliding on a rod is shown in the figure, but a marker sliding in the same slot as the member's slide was to have been tested. Just as the cards were turned face up (C in Fig. 3-16), at the start of the main meeting each week, the markers were all to be pushed to the end over the name, as shown by the lowest marker in Fig. 3-17. A member attending at any time during the week had to push his marker away from the end position. The slides were reordered as described for the cards. On an operating night, the marker would be set at the operating position selected. If the operator were qualified for that position, his slide would be colored at that point.

With the growing use of electronics, including the installation of computers at the largest layouts, it seems likely that, in the future, the large layouts will have some electronic aids available to replace the handling of cards or slides. But, in the immediate future, it would seem that once a layout gets too large for informal job selection to work well, the first step should be some simple system such as that shown in Fig. 3-16, or by placing the authority of assigning positions in the hands of a single individual.



Chapter 4
Timetables

On the prototype, *timetable* refers to an extensive document often called by modelers an *employee timetable*, as it has an expression similar to "For Employees Only" or "For the Government of Employees Only" on its cover. As far as model operation is concerned, the most important part of a timetable is the *schedule* which gives, among other things, the class of each regular train as well as its number, direction and times at stations, towers, and other significant points. Modelers and others often call a *schedule* a *timetable*. Indeed, the railroads themselves have published schedules for use by the public and labeled them timetables. For clarity in this Handbook, *timetable* always refers to the complete document including timetable schedule, special instructions, etc. *Schedule*, when used alone, always refers to timetable schedule. As described in Chapter 5, a *freight schedule* may be published for marketing purposes showing symbol freights. Such a freight schedule confers no authority to trains. When reference is made in this Handbook to a freight schedule, it is always called a freight schedule.

Depending upon the railroad, timetable may be spelled as one word, *timetable*, as two words, *time table*, or hyphenated, *time-table*. The South Shore employed both time table and timetable.

CLOCKS

Even on a railroad without a single scheduled train, clocks are important operating tools. On a model clocks, if possible, are even more important. Model railroads do not have real shippers, consignees, and passengers to complain if service is not performed promptly. Operating against a clock is a practical way to simulate the incentives which are placed on a real railroad by its customers.

When an operating system is first being installed on a model railroad, it is important that the pressure which can be applied by a clock not be allowed to frustrate the operators. Until skills are developed and the wrinkles worked out of the system, there is enough to do without adding the demands of an unrelenting clock. A good starting point is sequence operation in which each new action is taken only when the old action is complete. This removes all pressure of time and allows the operations to concentrate on making their moves correctly. The clock in such a case is really the steps of the sequence.

Rubber Clock

Sequence operation is suitable only as a starting point. Since all regular trains, by definition, are precisely on time, meets are always made at the proper siding, etc., so the train dispatcher really has little if anything to do. It is even difficult to create an extra train. So, as soon as the operators are used to moving the trains over the lines, obeying signals, hand or otherwise, and generally following the rule book, it is well to introduce the concept of operating by time, but with a flexible clock. Russell L. Houghton, of the Bay Ridge Society of Model Railroaders, called a clock whose rate can be adjusted a *rubber clock*. That term is apt. Some operator, usually the dispatcher, controls the clock. In the beginning, this may be as simple as announcing the time at appropriate intervals. Placing a large-face electric clock where all can see it and providing a switch to start and stop this clock as required is also a good starting point. Although time is being used to control operations, no one will become frustrated if troubles develop. The clock can be slowed or stopped in such cases. By the same token, if things are going well, the clock can be speeded (or at least allowed to run continuously) so no one will become bored.

Conventional Time

Conventional time, so called here as it is the time used in day-to-day living, is convenient. It is easy and inexpensive to install conventional clocks. Although layouts using conventional time for operation typically build their schedules around the customary starting time of an operating session, say 8 PM (so a layout-room clock which reads standard time can double in duty as the operating clock), it does not follow that the 8PM for operation is standard time. The clock can always be set to 8 PM at the time operation actually starts. Bill Jambor feels that there is an advantage, if real time is used, to have the layout clock differing by hours from standard time. This avoids confusion between layout time and the time on the watches worn by the operators. Such confusion may exist if there is a difference of only a few minutes.

The schedules of prototype railroads start at midnight. Except for the value of following our prototype exactly, there is little to recommend midnight for starting a model schedule. If a 24-hour schedule is established, it means the first quarter of the operating session is mostly inactive and that operations start in the dark. Much better is a time at which activities are starting to build up, i.e., 7AM would be appropriate for a 24-hour schedule.

A definite advantage of conventional time is that operators are used to thinking in its terms. When a dispatcher asks how much longer a train will be delayed, it is natural for the towerman to make an estimate in conventional minutes. Also, if moves are made at scale speeds, drilling a station takes up to half as long on a model as on the prototype. Scale speeds are measured by the scale distance traversed divided by real minutes.

The other side of the coin is that schedules do not look well when prepared in conventional time. If two stations are conceptually 20 miles apart, even a fast train should have a scheduled 20 minutes to make the run. On most layouts, one conventional minute probably is sufficient. Perhaps more important is that a full day's activities cannot reasonably be included as the clock time should show whether it is day or night, off-peak or the rush hour.

On model railroads which feature moving trains rather than switching, a conventional minute may not be a fine enough time division. The schedule on the prototype shows the arriving time at many points other than at station stops. As an example, Fig. 4-1 shows the schedule of train No. 12 as taken from the Cincinnati-Terminal Division, Timetable No. 1, 1969 of the B&O. The mileage figures represent the distances between the points listed. On a model, since distances are much compressed, No. 12 might take only two conventional minutes to go from the Cincinnati Union Terminal to the station stop at Oakley. As a practical case, if times are given only for points where trains will be reported rather than for many intermediate points, such as highway crossings, conventional minutes are quite fine enough. A train certainly should make at least a one-minute station stop and it is hardly significant if it arrives 23 seconds early.

Fast Time

A clock running significantly faster than conventional time is the choice of many modelers. It does provide a finer time division than a conventional clock without having to use seconds or fractions of a minute, makes schedules look better on paper, and can given a 24-hour period. Fast clocks have been obtained by mounting the hour hand on the minute-hand shaft and reversing the gearing to the hour-hand shaft so it would drive the minute hand 12 times faster than the original minute-hand shaft. This results in a clock with a fast minute equal to 5 conventional seconds. Today, digital clocks using integrated circuits offer an easier way. It is only necessary to replace the original clock time-base oscillator with one of higher frequency. This frequency can be supplied by a variable oscillator so the clock rate can be changed at will (a rubber clock). Certainly, if operations get snarled, slowing the clock rather than stopping it has advantages as some operators could well be on time and, with a slower clock, could proceed rather than wait. Note, however, a clock cannot be speeded beyond the rate used for preparing the timetable. Otherwise, the trains would have to race at unrealistically high speeds to keep on time. There are modelers, Bruce Chubb among them, who argue that once a fast clock is adopted, it should always operate at a constant rate so the operators will start to think in the terms of fast minutes.

How fast a fast clock should run is a matter of opinion. Although the term *scale clock* is sometimes used for *fast clock*, it is an unfortunate term as there is nothing scale about fast time. Indeed, realistic running and switching is based on scale speeds and those are measured in scale kilometers (miles) divided by real hours. The ratio of 12:1, which has often been used, seems to be satisfactory as far as through-train schedules are concerned. A two-hour operating session with a 12:1 clock can include a schedule based on a 24-hour day. It might even fit the concept. The N-scale Union, Pennsylvania, Philadelphia & Erie (shown in Fig. 2-5) has a main line whose completed length will be 33 scale miles. The conceptual miles of a line from Philadelphia to Erie is 360, or approximately 11 times greater. Therefore, a 12/1 clock would produce a scheduled running time from terminal to terminal approximately that of the conceptual prototype. Such a fast clock will, by clock time, make drilling a small station seem inordinately long. Fifteen minutes is a reasonable time to work a small station on a model. With a 12/1 clock this becomes 3 hours. A fast clock based on switching times probably should be in the range of 4:1. This, of course, would not be fast enough to give a 24-hour schedule in a normal operating session. One possibility suggested by Bill Jambor is a 6/1 ratio and a 3-hour operation session. This gives a 6AM to midnight schedule, the missing 6 hours being those with minimal activity on the prototype.

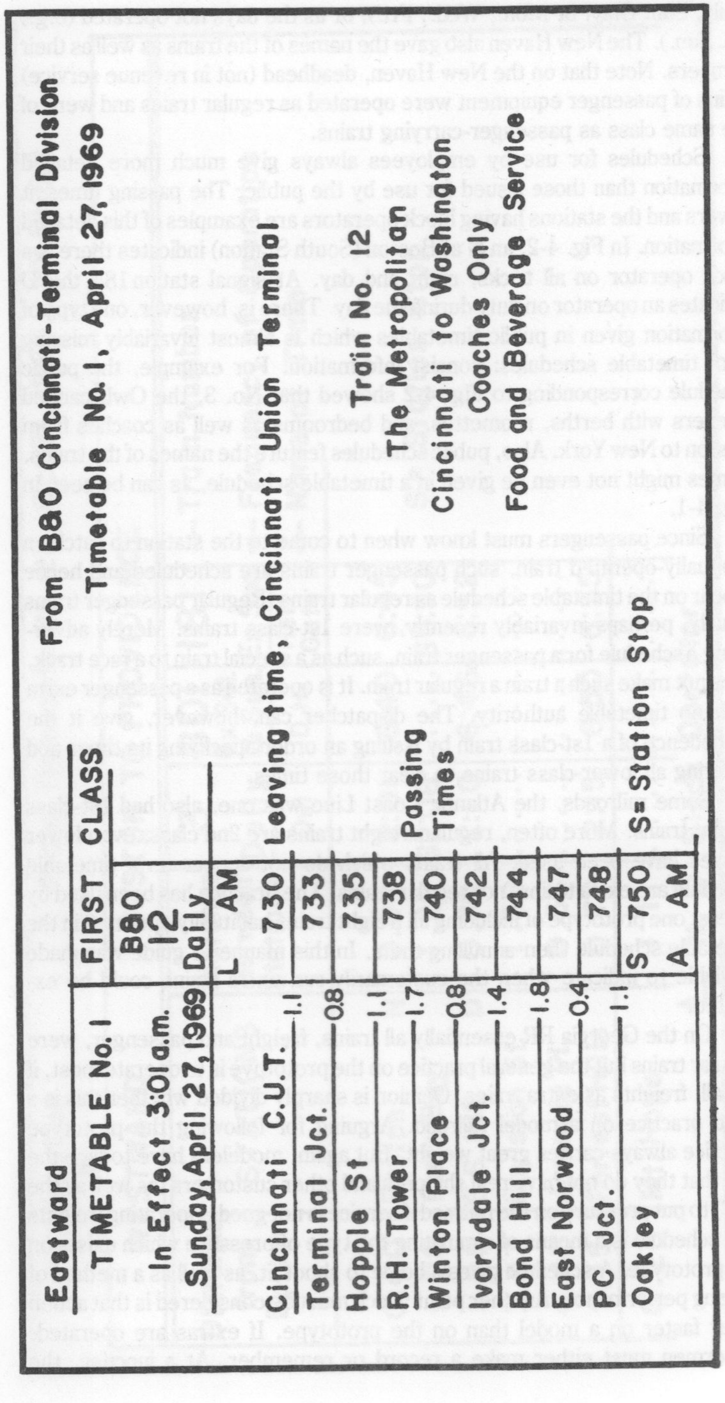
Fast time brings in the concept of a shortened kilometer or mile, the latter being the famous "smile" a term introduced by Frank Ellison. A smile (or skm) has nothing to do with scale, but with fast clock ratio. A model train traveling at a scale 60 mph traverses one scale mile in one conventional minute. It also traverses one smile in one fast minute. So, if a 10:1 fast clock is used, one smile = 0.1 scale mile. Obviously, if a variable-ratio fast clock is used, the length of a smile will change. Another problem is that a smile based on clock ratio may not fit the concept. In the case of the UPP&E cited above, it would be most desirable if the mile posts would show the correct conceptual distance, e.g., mile post 360 would be at Erie, PA. This would be true in smiles only for fast clock with an 11:1 ratio.

SCHEDULE

Schedule is that part of a timetable which specifies the class, direction, number, frequency, and timings of regular trains. When used as the name for a part of a timetable, schedule may be either singular or plural—even though there may be separate schedules for each of the several different lines within one timetable.

Figure 4-2 is an example taken from a 1965 New Haven timetable. That road had only one class of regular trains, so the schedule did not indicate class. Since only New Haven trains were shown, the railroad of the train was not indicated. In contrast, the timetable from which Fig. 4-1 was taken had trains of three different railroads included so the road of each was shown.

The New Haven timetable showed cumulative mileage from the terminal as well as mileage between stations (station not implying a passenger facility). Frequency of operation may be given as the days operated (e.g.,



From B&O Cincinnati-Terminal Division

Timetable No. 1, April 27, 1969

Eastward		
TIMETABLE No. 1		FIRST CLASS
In Effect 3:01 a.m.		B&O
Sunday, April 27, 1969		12 Daily L AM
Cincinnati C.U.T.	1.1	730
Terminal Jct.	0.8	733
Hopple St	1.1	735
R.H. Tower	1.7	738
Winton Place	0.8	740
Ivorydale Jct.	1.4	742
Bond Hill	1.8	744
East Norwood	0.4	747
PC Jct.	1.1	748
Oakley		S 750
		A AM

Leaving time, Cincinnati Union Terminal

Train No. 12

The Metropolitan

Cincinnati to Washington

Coaches Only

Food and Beverage Service

Passing Times

S= Station Stop

Fig. 4-1. Timetable schedule

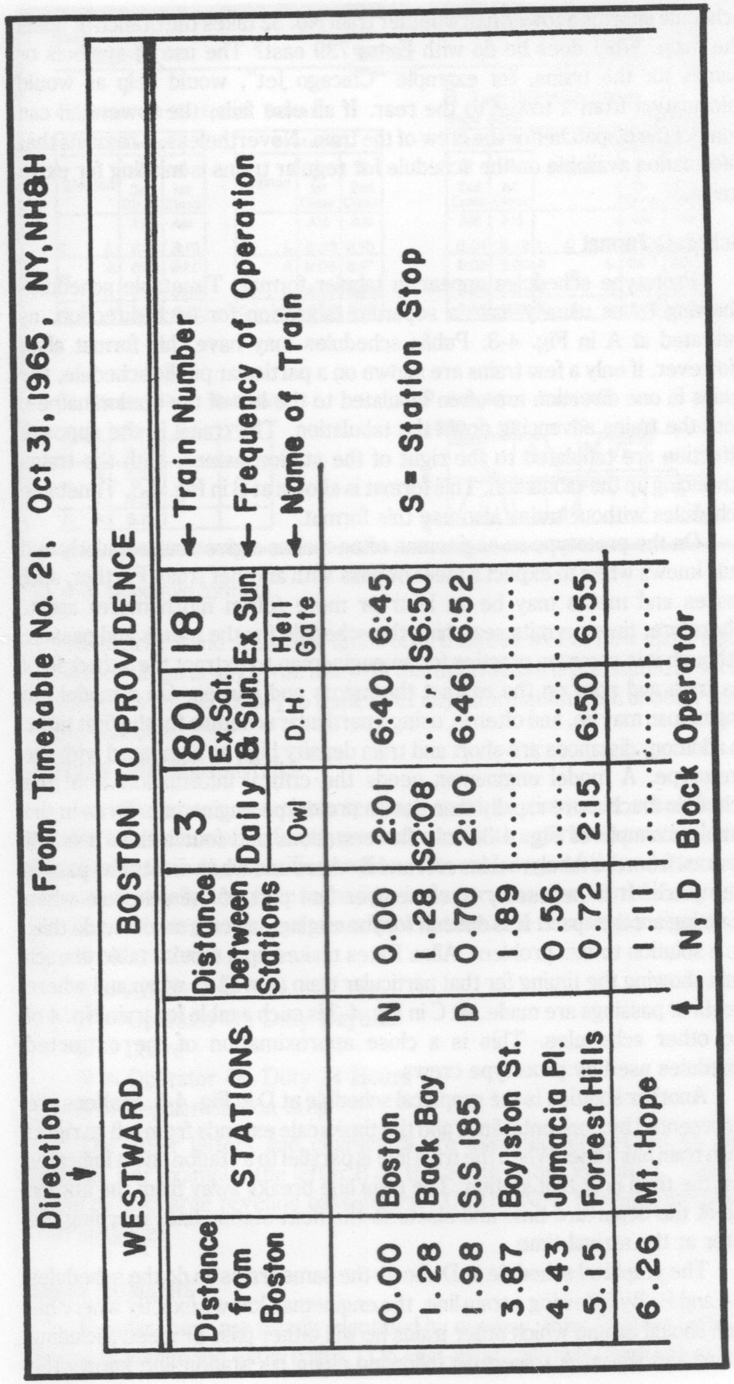
Daily, Sun. Only, or Mon., Wed., Fri.), or as the days not operated (e.g., Ex. Sun.). The New Haven also gave the names of the trains as well as their numbers. Note that on the New Haven, deadhead (not in revenue service) trains of passenger equipment were operated as regular trains and were of the same class as passenger-carrying trains.

Schedules for use by employees always give much more detailed information than those issued for use by the public. The passing times at towers and the stations having block operators are examples of this detailed information. In Fig. 4-2, an N at Boston (South Station) indicates there is a block operator on all tricks, night and day. At signal station 185, the D indicates an operator on duty during the day. There is, however, one type of information given in public timetables which is almost invariably missing from timetable schedules: consist information. For example, the public schedule corresponding to Fig. 4-2 showed that No. 3, the Owl, carried sleepers with berths, roomettes, and bedrooms as well as coaches from Boston to New York. Also, public schedules feature the names of the trains. Names might not even be given in a timetable schedule, as can be seen in Fig. 4-1.

Since passengers must know when to come to the station to catch an habitually-operated train, such passenger trains are scheduled and hence appear on the timetable schedule as regular trains. Regular passenger trains usually, perhaps invariably recently, were 1st-class trains. Merely advertising a schedule for a passenger train, such as a special train to a race track, does not make such a train a regular train. It is operated as a passenger extra with no timetable authority. The dispatcher can, however, give it the precedence of a 1st-class train by issuing an order specifying its times and ordering all lower-class trains to clear those times.

Some railroads, the Atlantic Coast Line was one, also had 1st-class freight trains. More often, regular freight trains are 2nd class; even lower classes have been used. All trains which do not appear on a timetable schedule are extra trains, not regular trains. The practice has been used by at least one prototype of including all freight trains habitually operated in the timetable schedule then annulling them. In this manner, a guide was made available to indicate when the customarily-run extra trains could be expected.

On the Georgia RR essentially all trains, freight and passenger, were regular trains but the general practice on the prototpye is to operate most, if not all, freights as extra trains. Opinion is sharply divided whether this is a good practice on a model railroad. Arguing for following the prototype practice always carries great weight. But again, modelers have to face the fact that they do not have real shippers and other customers (as well as the ICC) to put pressure on the railroad if service is not good. Operating freights to a schedule is a means of simulating the type of pressure which exists on the prototype. A schedule gives a bogie to shoot at, as well as a method of judging performance. Another point which must be considered is that action is far faster on a model than on the prototype. If extras are operated, towermen must either make a record or remember. At a junction, the



From Timetable No. 21, Oct 31, 1965, NY,NH&H

Direction ↓ WESTWARD — BOSTON TO PROVIDENCE

Distance from Boston	STATIONS		Distance between Stations	3	801	181
				Daily	Ex Sat. & Sun.	Ex Sun.
				Owl	D.H.	Hell Gate
0.00	Boston	N	0.00	2:01	6:40	6:45
1.28	Back Bay		1.28	S2:08	......	S6:50
1.98	S.S.185	D	0.70	2:10	6:46	6:52
3.87	Boylston St.		1.89	......	......	......
4.43	Jamacia Pl.		0.56	......	......	......
5.15	Forrest Hills		0.72	2:15	6:50	6:55
6.26	Mt. Hope		1.11	......	......	......

← Train Number

← Frequency of Operation

← Name of Train

S = Station Stop

N, D Block Operator

Fig. 4-2. Another timetable schedule.

schedule informs a towerman whether train No. 32 takes the branch or holds the main. What does he do with Extra 739 east? The use of symbols or names for the trains, for example "Chicago Jet", would help as would information from a tower to the rear. If all else fails, the towerman can contact the dispatcher or the crew of the train. Nevertheless, it remains that information available on the schedule for regular trains is missing for extra trains.

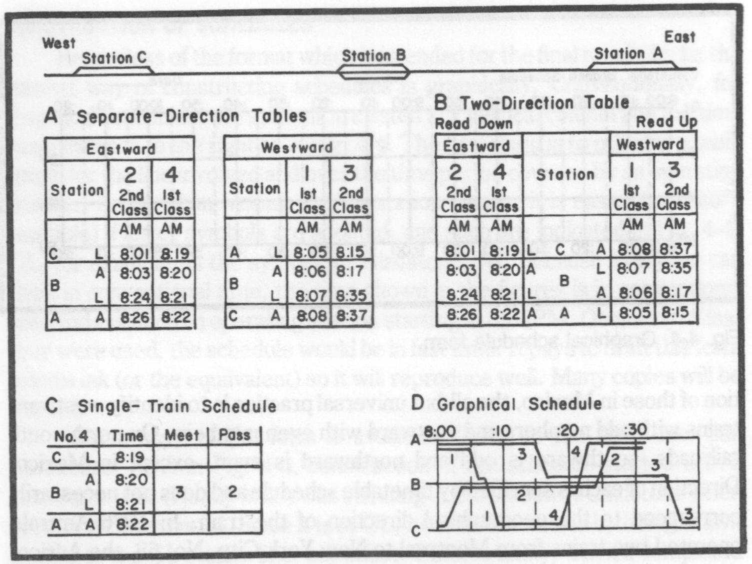
Schedule Format

Prototype schedules appear in tabular format. Timetable schedules showing trains usually have a separate tabulation for each direction, as indicated at A in Fig. 4-3. Public schedules may have this format also. However, if only a few trains are shown on a particular public schedule, the trains in one direction are often tabulated to the left of the station names, with the trains advancing down the tabulation. The trains in the opposite direction are tabulated to the right of the station names, with the trains advancing up the tabulation. This format is shown at B in Fig. 4-3. Timetable schedules without trains also use this format.

On the prototype an engineman often makes a given run regularly and thus knows when to expect a meet or pass with another train. Further, such passes and meets may be an hour or more (often much more) apart. Therefore, time permits searching the schedule for the meets and passes, although it is common practice for an engineman to extract the schedule of his train and note on the extract the meets and passes. On a model, an engineman may be, and often is, using a particular schedule for the first time. In addition, distances are short and train density high as compared with the prototype. A model engineman needs the critical information from the schedule much more rapidly than does a prototype engineman. Even in the simple example of Fig. 4-3, only three stations and four trains, it is not obvious from the tabular tables at A and B where and when meets and passes take place. It is necessary to remember one part of the schedule when scanning another part. It is difficult for the engineman on a model to do this. As a solution to this problem, Allan Bates makes up a tabular table of each train showing the timing for that particular train as well as when and where meets or passings are made. At C in Fig. 4-3 is such a table for train No. 4 of the other schedules. This is a close approximation of the extracted schedules used by prototype crews.

Another solution is the graphical schedule at D in Fig. 4-3. Stations are represented by horizontal lines and the time scale extends from left to right. Each train has a line. When the train line is parallel to a station line it indicates that the train is at that station. The train line breaks away from the station line at the departure time and slants to the next station line, reaching the latter at the arrival time.

The graphical schedule at D shows the same trains as do the schedules at A and B. By following a train line, the engineman knows exactly where his train should be and which other trains he will either pass or meet, including where and when. A towerman following along his station line knows the



A Separate-Direction Tables

Eastward			
Station		2 2nd Class	4 1st Class
		AM	AM
C	L	8:01	8:19
B	A	8:03	8:20
	L	8:24	8:21
A	A	8:26	8:22

Westward			
Station		1 1st Class	3 2nd Class
		AM	AM
A	L	8:05	8:15
B	A	8:06	8:17
	L	8:07	8:35
C	A	8:08	8:37

B Two-Direction Table

Read Down — Read Up

Eastward					Westward	
2 2nd Class	4 1st Class		Station		1 1st Class	3 2nd Class
AM	AM				AM	AM
8:01	8:19	L	C	A	8:08	8:37
8:03	8:20	A	B	L	8:07	8:35
8:24	8:21	L		A	8:06	8:17
8:26	8:22	A	A	L	8:05	8:15

C Single-Train Schedule

No. 4		Time	Meet	Pass
C	L	8:19		
B	A	8:20	3	2
	L	8:21		
A	A	8:22		

Fig. 4-3. Schedule formats.

direction, arrival and departure times of all trains as well as how many trains are in the station at any given time. All this information is presented in such a way that it is not necessary to remember any information from another point in the schedule.

LETTERS AND CHARACTERS

Various letters and characters are used on timetable schedules to provide information specific to a particular train, to a particular station, or to a particular train at a specified station. The meanings of these letters and characters usually are given in the Special Instructions portion of the timetable. The following letters customarily have the same meanings in timetables of various railroads:

A = Arrive
D = Operator On Duty Daytime
L = Leave
N = Operator On Duty 24 Hours
S = Regular Station Stop

The other letters and characters are assigned as desired by each railroad. For example, the letter B on the South Shore indicated, "Stop on signal to discharge revenue passengers." On the New Haven it indicated, "No baggage."

TRAIN NUMBERS

Regular trains are usually identified by number. (See Chapter 5 for the means of identifying extra trains.) On east-west railroads, with the excep-

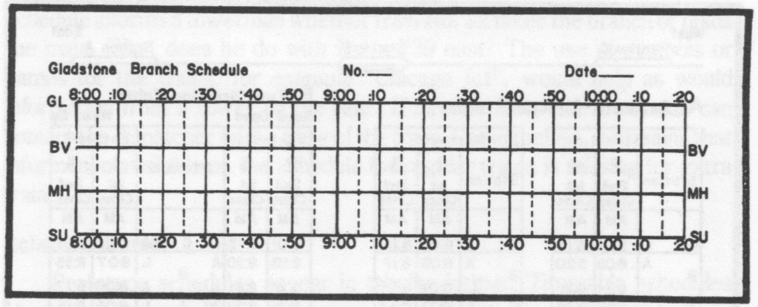


Fig. 4-4. Graphical schedule form.

tion of those in Mexico, the all-but universal practice is to identify westward trains with odd numbers and eastward with even numbers. On north-south railroads, southward is odd and northward is even, except in Mexico. Direction of each is specified by timetable schedule and does not necessarily correspond to the geographical direction of the train. In 1976 Amtrak, operated two trains from Montreal to New York City. No. 68, the Adriondack, had an even number because it approached Grand Central over the line from Chicago and therefore was eastward. The other, No. 61, the Montrealer, had an odd number. It approached Pennsylvania Station on the line from Boston and therefore was westward.

Through trains, which change their timetable direction when passing a station, must be given a new number at that station. On the Southern Pacific, westward means toward San Francisco. Therefore, in 1976, the Amtrak train, the Coast Starlight, Los Angeles to Seattle, was westward Los Angeles to Oakland, then eastward Oakland to Portland, so it had to change from an odd to an even number at Oakland. In public schedules, only one number was listed for the train so that number applied to car reservation numbers also.

Model layouts are seldom large enough to generate problems such as that of numbering the Coast Starlight. Perhaps are only exception is a branch line which has its timetable schedule direction reversed from its geographical direction (for the purpose of establishing superiority by direction) toward the branch-line terminal from the junction.

Train numbers can provide more information than just the direction. Passenger trains can be indicated by the use of low numbers and freights by high numbers. Note in Fig. 4-2 that the New Haven used high numbers for deadheads. Number series also can differentiate between branch and main line, local and express, or short-turn and full-run trains. Numbers also may be used to indicate the turn of equipment from one train to another. These are just some possibilities.

On a model, the control system may be such that operators need to know which cab is operating a particular train. If so, the first digit of the train number can be used to designate the cab, e.g., trains 4, 45, and 401 would all be controlled from cab 4.

CONSTRUCTION OF SCHEDULES

Regardless of the format which is intended for the final result, by far the easiest way of constructing schedules is graphically. Conventionally, for graphical schedules, the stations are listed in a vertical column and the time scale extends to the right as in Fig. 4-4. The first thing is to prepare a basic graph for the line involved and over the time period covered by an operating session. Rather than writing out the station names, it is easier (and more readable) if letter symbols are adopted, and such are indicated in Fig. 4-4. GL, for example, is the symbol for Gladstone, NJ. Because everyone can think in conventional time, the time shown in the figures is in conventional time and assumes an operating session starting at 8:00PM. Obviously, if fast time were used, the schedule would be in fast time. It pays to draft this form in india ink (or the equilvalent) so it will reproduce well. Many copies will be needed.

After a copy of the form is available, laying in the train lines can commence. At A in Fig. 4-5, construction of the schedule started with a passenger train (No. 2) which was standing at the station at Gladstone when operation commenced. Since it is at GL, its train line starts by being drawn parellel to the GL station line, but offset. Unfortunately, when a completed schedule is reproduced, all lines will be of the same color. An offset train line can be followed without confusing it with the station line or other train lines. At 8:02, the train leaves for BV and arrives there at 8:03. Therefore, the train line breaks away from GL at 8:02 and slants down to the BV station line reaching the BV becomes parallel to the BV line for a station stop. Note that 5-minute time lines are sufficient. It is easy to see when the train line breaks directly at a time line. If it breaks between two time lines, it is either closer to a time line or closer to the center and there is little confusion on which side of the center the break is made. Therefore, 5-minute divisions can be read accurately to one-minute increments.

Continuing with the line for train No. 2, after a one-minute station stop at BV, the line heads for MH at 8:04. Since the distance from BV to MH is twice that from GL to BV, the run takes two minutes, the train arriving at BV at 8:06. Again a one-minute station stop is made, the train leaves for SU at 8:07 and arrives at 8:08.

Because the station lines were evenly spaced but the stations were not, even though the train was operated at the same speed between all stations, the slope of the train line was not constant on the graph, being less steep when the distance between stations was greater. Some modelers prefer to space the station lines in proportion to the actual track distances. This has been done at B in Fig. 4-5 and indeed the slopes of all the slants on the train line for No. 2 are approximately equal, indicating equal speed. The offsets from the station lines prevent exactly equal slopes, unless all offsets are equal and in the same directions. One advantage of spacing proportional to distance is that a template cut to the appropriate slope for the speed desired can be used to lay out the slanting lines between stations. A disadvantage is that the space on the graph cannot be used as effectively in terms of readability.

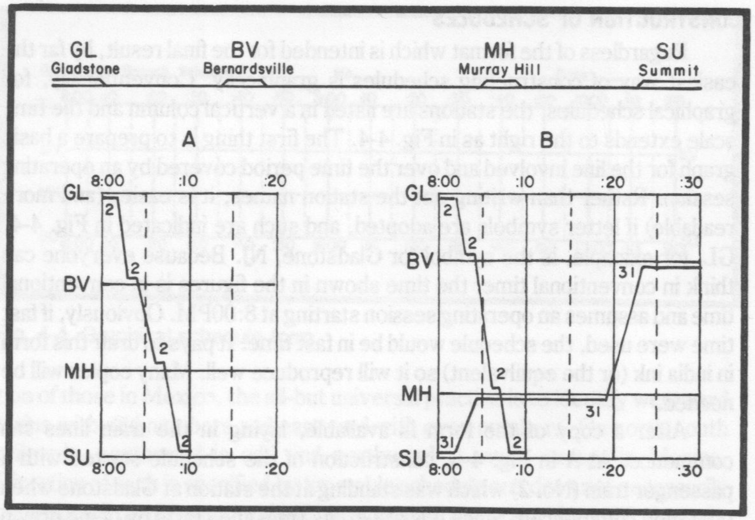


Fig. 4-5. Constructing a graphical schedule.

Note that the train number was drawn near the train line at each station. This is important for ease in reading once the schedule is full of trains. The numbers should not be put in permanently right away, as they may interfere with train lines to be drawn later.

In Fig. 4-5B, a westward freight (No. 31) has been added to the schedule. This train was standing ready to go at Summit when operation started at 8:00PM. Its train line runs parallel to the SU station line until 8:02, when the train departs for MH, arriving at the latter station at 8:04. At 8:06, No. 2 arrives from the west and the two parallel train lines show clearly that there must be at least two tracks at MH to permit this meet. At 8:07, No. 2 leaves, but No. 31 remains to work the station until 8:19, when it leaves for BV, arriving there at 8:23.

On the prototype, the engine, coupled cars, and caboose become a train when its crew is on board, markers are displayed, and the clearance is received which gives the number of orders the train crew should have in their possession. This clearance is the authority to proceed if there is no automatic block system.

Since markers are not normally used on models (at least of the type which can be removed, added, or turned), nor are clearance forms issued, a regular train can be assumed to be a train when it is ready to depart. Hopefully, the train will be ready before its scheduled leaving time. In model practice for freights, if a train crew is waiting for time and knows of no reason not to leave early, the crew usually will request permission to run early. In Fig. 4-5, it is obvious that No. 31 can leave SU for MH as soon as it is ready.

Returning to the prototype, a regular train remains a train until it reaches its final terminal and removes its markers, assuming it is not very late. Regular trains lose all timetable schedule authority and must continue as extras if more than 12 hours late. Some railroads specify a different length of time. To add this feature to model operation, it would be necessary to specify a time which would have significance based on the clock rate and the length of the operation session.

On a model operated by cab control, an important consideration may be what the cab will do next after it brings a train into a terminal. In most cases, the cab is assigned to another train returning from that terminal, particularly if the second train uses the same equipment as the first. This continuity of a cab from one train to the next can be shown by continuing the train line from one train to the next. Figure 4-6 presents the schedule of Fig. 4-5 in a more complete form. Note that No. 21, a passenger arriving at GL at 8:22, has its line continued to No. 20, a train leaving GL at 8:37. This indicates that the crew bringing in No. 21 leaves with No. 20. In this case, the system of using the first digit of the train number to indicate the cab number has been used. Both trains are operated by cab 2.

This same type of connecting line is shown between trains 31 and 30 at GL. Both of these trains are way freights, so the engineman who brought in No. 31 at 8:42 has until 9:02 to set out all the cars on No. 31 in accordance with their waybills and to pick up all the cars ready for No. 30. In this case, the engineman is doing the work for both 30 and 31, so the connecting line is quite appropriate. Nevertheless, between the arrival of No. 31 at GL and the departure time of No. 30, cab 3 is not operating a train. Rather, that cab is operating a locomotive which must remain within yard limits.

As mentioned above, the first digit of each train number shown in Fig. 4-6 indicates the cab which usually operates that train. Depending on the type of control, this information may not be necessary. A case in point would

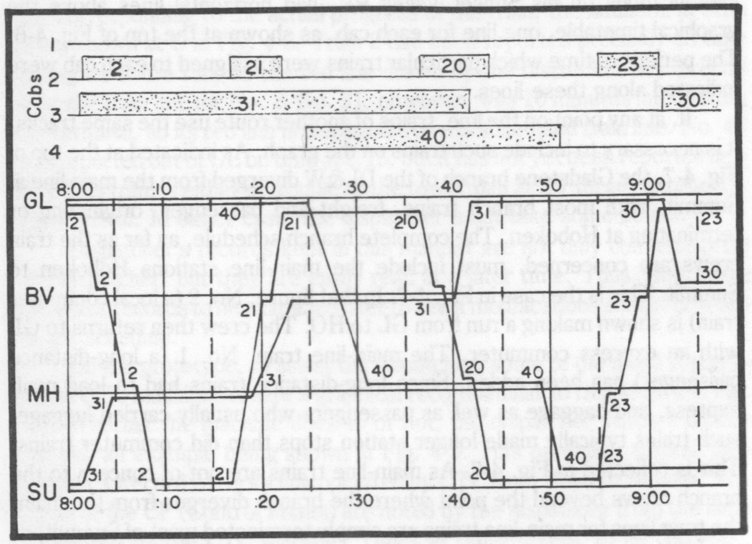


Fig. 4-6. A three-cab schedule.

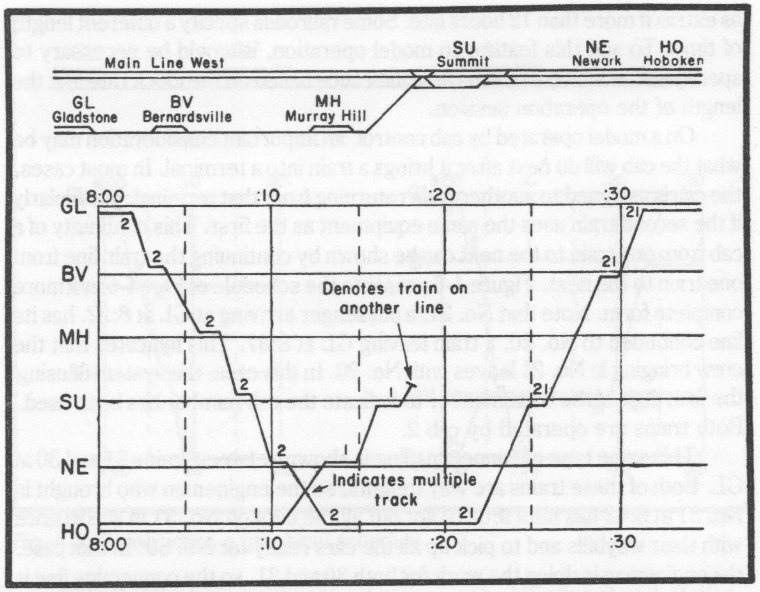


Fig. 4-7. Branch-line schedule.

be if computer cab control were installed. But, for many types of manual cab control, knowledge of the cab which is operating each train is vital. When this is the case and identification by first digit of train number cannot be used (for example, when the cabs are identified by colors rather than numbers), some other means should be installed. Bruce Chubb, who used color as cab identifications on his Sunset Valley RR, had horizontal lines above the graphical timetable, one line for each cab, as shown at the top of Fig. 4-6. The periods of time which particular trains were assigned to each cab were indicated along these lines.

If, at any point on the line, trains of another route use the same tracks, it is necessary to include such trains on the graph. As indicated at the top of Fig. 4-7, the Gladstone branch of the DL&W diverged from the main line at Summit, with most branch trains, freight and passenger, originating or terminating at Hoboken. The complete branch schedule, as far as the train crews are concerned, must include the main-line stations Hoboken to Summit. This is the case in Fig. 4-7. In that figure, No. 2 (a local commuter train) is shown making a run from GL to HO. The crew then returns to GL with an express commuter. The main-line train, No. 1 (a long-distance passenger) has been added. Since long-distance trains had to load mail, express, and baggage as well as passengers who usually carried luggage, such trains typically made longer station stops than did commuter trains. This is reflected in Fig. 4-7. As main-line trains are not of concern to the branch crews beyond the point where the branch diverges from the main, the train lines for main-line trains are simply terminated west of Summit, as indicated for No. 1. Note the crossing of the two train lines between Newark and Hoboken. Such crossing lines can only exist if there is a track for each train. In this case, as can be seen in the diagram at the top of Fig. 4-7, there is triple track between Hoboken and Summit.

Once the graphical schedules have been constructed, they can be used directly by the operators. Alternatively, the timing on the graph can be read then entered into a table format.

USE OF GRAPHICAL SCHEDULES

As described in the preceding section, it is generally regarded that the easiest method of constructing schedules is graphically. Many modelers also feel the graphs to be the most convenient form of schedule for use during operation. As a minimum, using the graphs directly saves the time and effort of converting them into tabular format.

To facilitate the reading of a graphical schedule, it is recommended that a red line be drawn on the schedule copy which is placed at each operating position. This red line directs attention to that part of the schedule of immediate interest to the particular operator. At A in Fig. 4-8, a red overline, indicated by the heavy line, has been drawn over the MH station line. It is the arrivals and departures along this line which are the primary concern of the towerman at Murray Hill. At B, the same schedule has been prepared for use by the engineman on cab 3. The train lines for all trains operated by cab 3 have been highlighted in red. This makes it easier for that engineman to follow his trains on the graph.

A graphical schedule is a very convenient form for the dispatcher to keep a record of train movements as they are reported. At the Summit-New Providence HO RR Club, the dispatcher was furnished with a copy of the graph for each line. When reports were received, the dispatcher drew a red line corresponding to the actual progress of the train, the situation at 8:20 being shown at C in Fig. 4-8. Train 2 had been reported precisely on time during its entire run, so the red line drawn by the dispatcher lies directly over the train line for No. 2. No. 31, however, was 10 minutes late leaving the terminal, so its red line is displaced from its scheduled train line. No. 40 was reported out of GL on time at 8:15, but it has not yet been reported into BV. This train is either in trouble or the towerman at BV forgot to report it upon arrival. In either case, the dispatcher must take some action.

Dispatcher's records kept in this manner are not only convenient for the dispatcher, but they are easily read at a later time. Thus, they make excellent records to be examined later to see if modifications should be made in the schedule.

On the prototype, to assist the dispatcher, some of the more sophisticated CTC machines create a graphical record similar to that shown in Fig. 4-8. Whether the machine does so or not, the dispatcher keeps a tabular record, an example being shown in Fig. 4-9. This particular Conrail Dispatcher's Record covers a line operated by CTC from Boyd to Summit. The times at the CP (Control Points) are noted by the dispatcher from the lamp indications on the CTC machine. Times at other points, to be recorded, would have to be received from the train crew or block operator.

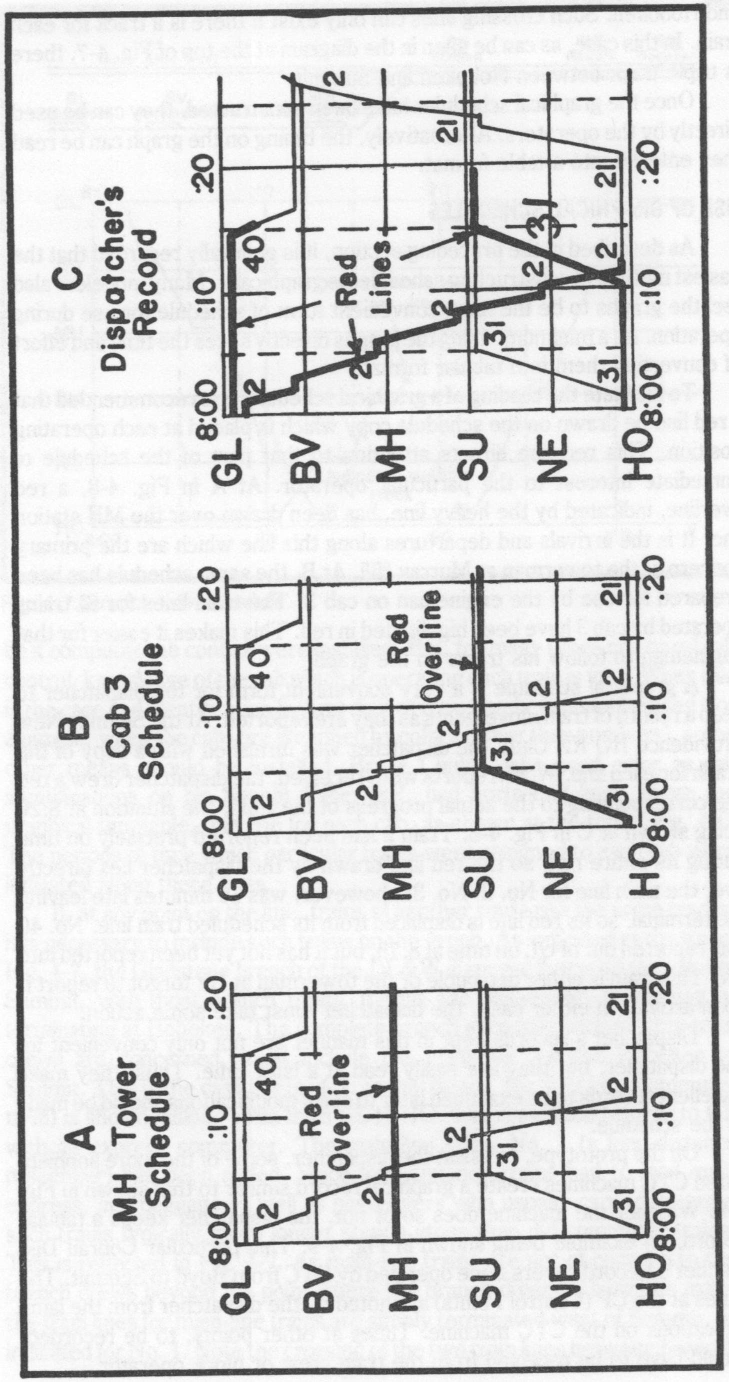
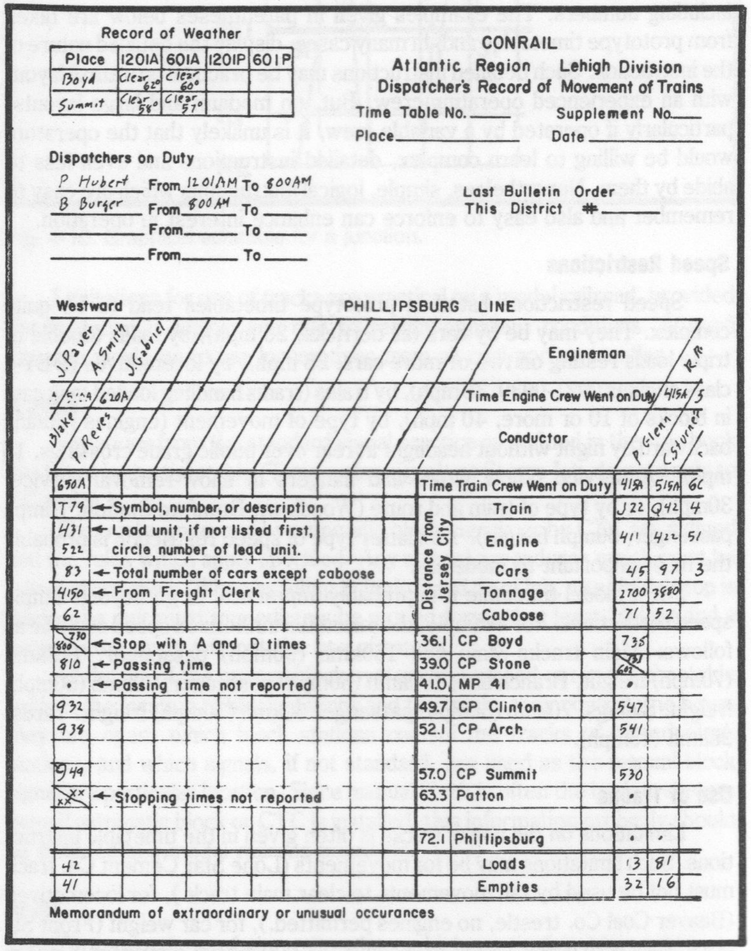


Fig. 4-8. Graphical schedules for specific operators.

The graphical schedules shown in Fig. 4-8 are simply copies of the schedule with red overlines added to make them special to a particular use. At junctions, the schedules of two or more lines would be in effect. This requires the operator at the junction to examine all the schedules. If the junction were busy, it may be advisable to reduce the problems of the towerman there by preparing a special graphical schedule which gives only the information needed at that tower. That information is the lines over which the trains arrive and depart at the junction, the timings at the junction, and the immediate next station on all routes. Figure 4-10 shows a special junction schedule as actually used by the Summit-New Providence HO RR Club for Summit, NJ. As customary for tower schedules, the SU station line was colored red. The Hoboken terminal was still under construction and not



Record of Weather

Place	1201A	601A	1201P	601P
Boyd	Clear 62°	Clear 60°		
Summit	Clear 58°	Clear 57°		

CONRAIL
Atlantic Region Lehigh Division
Dispatcher's Record of Movement of Trains
Time Table No. ____ Supplement No. ____
Place ____ Date ____

Dispatchers on Duty
P Hubert From 1201AM To 800AM
B Burger From 800AM To ____
____ From ____ To ____
____ From ____ To ____

Last Bulletin Order This District # ____

Westward PHILLIPSBURG LINE

Engineman: J. Paver, A. Smith, J. Gabriel … R.R.
Time Engine Crew Went on Duty: 5:10A, 620A … 415A, 5
Conductor: Blake, P. Reves … P. Glenn, C. Sturner

650A		Time Train Crew Went on Duty	415A	515A	6C
T79	← Symbol, number, or description	Train	J22	Q42	4
431 522	← Lead unit, if not listed first, circle number of lead unit.	Engine	411	422	51
83	← Total number of cars except caboose	Cars	45	97	3
4150	← From Freight Clerk	Tonnage	2700	3880	
62		Caboose	71	52	
730 800	← Stop with A and D times	36.1 CP Boyd	735		
810	← Passing time	39.0 CP Stone	731 602		
•	← Passing time not reported	41.0 MP 41	•		
932		49.7 CP Clinton	547		
938		52.1 CP Arch	541		
949		57.0 CP Summit	530		
xx xx	← Stopping times not reported	63.3 Patton	•		
		72.1 Phillipsburg	•	•	
42		Loads	13	81	
41		Empties	32	16	

Distance from Jersey City

Memorandum of extraordinary or unusual occurances

Fig. 4-9. Dispatcher's record.

in service, so the branch line to RP was tied to the main line at RP to form a reversing loop at a scale of 2.5km (1.5m) around to simulate the Hoboken terminal. Eastward trains from Summit always went to RP and returned from NE. A train line for a train approaching Summit started at the appropriate station line, e.g., the line for No. 31 starts at NE in Fig. 4-10. Similarily, the train lines terminate at their next-station line.

TIMETABLE INSTRUCTIONS

The schedule section of a timetable is the part of greatest interest and use to model railroad. Nevertheless, there are many types of instructions which appear in prototype timetables which, if included in a model timetable, could add interest. Timetable instructions on the prototype tend to be very specific to a particular part of the railroad and to classes of equipment, including numbers. The examples given in parentheses below are taken from prototype timetables and, in many cases, display the detailed nature of the instruction. Such detailed instructions may be practical on a small layout with an experienced operating crew. But, on medium and large layouts, particularly if operated by a variable crew, it is unlikely that the operators would be willing to learn complex, detailed instructions and even less to abide by them. Nevertheless, simple, logical instructions which are easy to remember and also easy to enforce can enhance interest in operation.

Speed Restrictions

Speed restrictions listed in prototype timetables tend to be quite complex. They may be by cars (all derricks, 25 mph), by loads (double or triple loads resting on two or more cars, 25 mph), by locomotives (DEY-1 class engines 0921-0930, 35 mph), by trains (trains handling loaded tank cars in blocks of 10 or more, 40 mph), by type of movement (engines running backward by night without headlight at rear over public grade crossings, 15 mph), by service (snow plows and flangers in snow-removal service, 30mph), or by type of train and route (Woodlawn-Branford Station, 70mph passenger, 50mph freight). This latter type of speed restriction is probably the most important to modelers.

For a model timetable it is probably impractical to go beyond simple speed restrictions. For example, the maximum authorized speed could be as follows: Main tracks-Main line 150kmh (90mph) passenger, 115kmh (70mph) freight, Branch line, 100kmh (60mph) passenger, 70kmh (50mph) freight. Sidings, 70kmh (50mph) passenger 50kmh (30mph) freight. Yards, 25kmh (15mph).

Use of Tracks

Limitations on the use of tracks is often given in the timetable instructions. Such limitations may be for movements (Lone Star Cement Co. track must not be used by rail movements to clear main track.), for locomotives (Beaver Coal Co. trestle, no engines permitted.), for car weight (Front St. track, cars with gross weight exceeding 251,000 lbs not permitted.), or for any other reason required to prevent trouble.

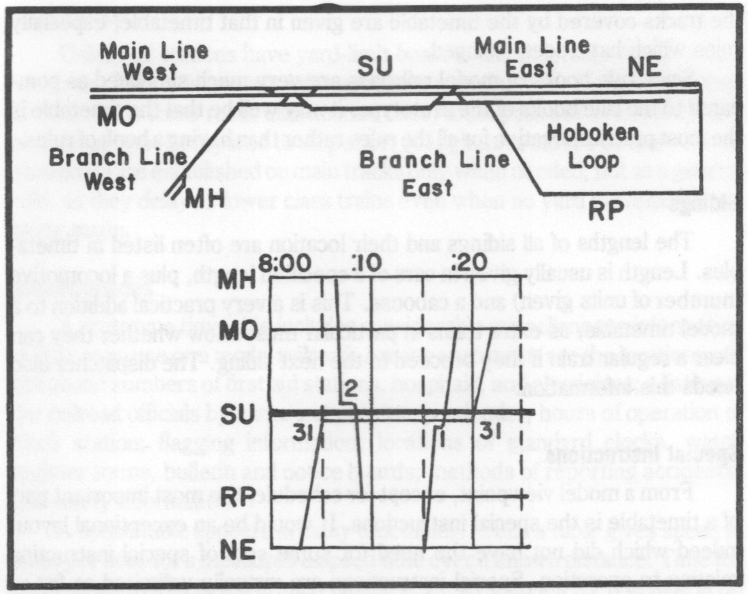


Fig. 4-10. Graphical schedule for a junction.

Limitations for use of tracks are practical on a model railroad, provided the limitation is logical and due to readily-apparent conditions. A good example would be to bar locomotives from all coal-pocket trestles.

Signals

Variations from the standard signal practice as defined in the rule book are listed in the timetable (Train order signals at Storrs Jct. do not apply to PC trains.).

The tracks governed by automatic block signals or by CTC are defined and the rules which apply specified. Any special procedures which must be followed are given (When handling a single Budd Car Unit, after initial stop is made, the unit must immediately be moved forward at least 10 feet and a second stop made without the use of sand.).

All details of the manual block system are spelled out in the timetable such as the location of block stations and the tracks they control, the hours they are open, which block stations control the tracks of closed block stations, and which signals, if not standard, are used as the manual block signal at a particular location. Since manual block is often the backup system even if automatic block or CTC is installed, this information probably should be included in a model railroad timetable.

Rules

Those portions of the railroad to which particular rules apply are defined in the timetable. Often, rules which are of particular importance on the tracks covered by the timetable are given in that timetable, especially rules which have been changed.

Since rule books of model railroads are very much simplified as compared to the rule books of the prototype, it may well be that the timetable is the most practical location for all the rules rather than having a book of rules.

Sidings

The lengths of all sidings and their location are often listed in timetables. Length is usually given in cars of a specified length, plus a locomotive (number of units given) and a caboose. This is a very practical addition to a model timetable, as extra trains in particular must know whether they can clear a regular train if they proceed to the next siding. The dispatcher also needs this information.

Special Instructions

From a model viewpoint, except for schedule, the most important part of a timetable is the special instructions. It would be an exceptional layout indeed which did not have the need for some sort of special instruction relating to operation. Special instructions are virtually unlimited as far as subject matter is concerned and, when permitted by the rule book, supersede the rule book. The following are some typical subjects, with one prototype example for each.

1. Position in which a switch must be left. (Main-track switch at yard office, when not in use for main-track movements, will be lined for NYC interchange track.)
2. Where trains must or must not stop. (Westward freight trains working at Brewster must leave their trains east of passenger station.)
3. Where cars must be carried. (All loaded hopper cars CNJ series 450-456 inclusive must be handled on rear of freight trains at a speed not exceeding 30mph.)
4. How cars must be coupled. (Except in yard or transfer runs, loaded bi-level or tri-level cars must not be placed directly behind open gondola or hopper cars loaded with sand, gravel, coal, or similar commodities.)
5. Provision for special cars. (Except relief or work train, trains having cranes movement on own wheels must have boom secured in trailing position.)
6. Restriction on movements. (All movements must approach switch at Congress St. prepared to stop and must not move through same until proceed hand signal is given by switchman at that point.)
7. Special permission. (Permission must first be obtained from yardmaster or agent to turn engines on wye.)

On a model, there could be special instructions relating to such model-only factors as the operation of cab-control electrical switches.

Yard Limits

Unless all stations have yard-limit boards, the timetable will list those which do. This is important information on a model also. Trains other than first class (on some roads also second class) must pass between yard limits at reduced speed prepared to stop short of engines or cars. For that reason, yard limits are established on main tracks only when needed, not as a general rule, as they delay all lower class trains even when no yard movements are being made.

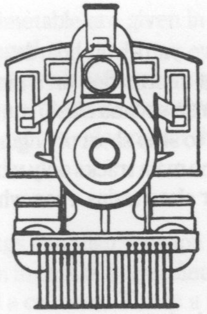
Miscellaneous

A prototype timetable includes considerable miscellaneous information of little or no use on a model railroad. Among such items are the locations and telephone numbers of first aid stations, hospitals, and physicians; a listing of the railroad officials by name and position; a calendar; hours of operation of block station; flagging information; locations of standard clocks, watch register forms, bulletin and notice boards; methods of reporting accidents; and safety information.

A speed table appears in many timetables. Such a table gives speed in miles per hour for a measured elapsed time over a known distance. Time for a mile is always included in such tables, e.g., 45 seconds for one mile is 80 mph, but other distances may be included in the list. If a speed table is included in a model timetable, it probably would be most useful if expressed in practical units for the scale of the model, e.g., 10 seconds for 10 feet is a scale 60mph in HO. Two 40-foot cars per second is approximately 60 mph in any scale. The portion of Fig. 1-2 which pertains to the chosen scale could be used directly as a speed table.

WAYBILL INSTRUCTIONS

Instructions relating to the handling of waybills do not appear in prototype timetables, at least in known cases. Nevertheless, when a waybill system is in use on a model, it is a very important part of the operating procedures and instructions for the use of the waybills must appear somewhere. Placing them in the timetable might be convenient and the most practical solution.



Chapter 5
Rights of Trains

Trains move from terminal to terminal, meet and pass other trains, in accordance with well-established rules and procedures. For the purpose of uniformity, the AAR (Association of American Railroads) has prepared a *Standard Code* of operating rules which covers everything but unusual cases. Each railroad adopts its own book of rules by eliminating the rules of the Standard Code which do not apply to the particular railroad, by modifying Standard Code rules when necessary, and adding others if needed. Even if modified, rules based on the Standard Code retain the number assigned in the Standard Code in most cases. In this book, only rules of specific interest to modelers are covered. A complete description of the Standard Code may be found in *Rights of Trains*, by Peter Josserand, published by Simmons-Boardman. If following a particular prototype, a copy of the rule book of that railroad should be obtained.

Just as prototype railroads adjust the Standard Code to fit their specific needs, so must a modeler tailor the rules to the particular layout. The important thing, for realism, is to use the standard rules in so far as they apply. For this, it is helpful to be precise in language. Many terms, including engine, siding, and train are defined with precision in the rule books, but are used more loosely by many. In particular, in the exchange of information between towers and the dispatcher, terms should be used as defined in the rule book to eliminate confusion. If the dispatcher asks if the siding is blocked, he does not want to know if there are cars standing on the spur to the brick plant.

ENGINES AND TRAINS

By rule-book definition, the least number of wheels together with a superstructure which can move independently, regardless of the source of power, is called a unit. Note that an engineman's cab is not required on a unit. On the other hand, a slug (a form of locomotive which has traction motors, but receives its electrical power from the Diesel-electric unit to which it is coupled) is not considered a unit as it cannot move independently. The term *locomotive* is not used for operating on most railroads, although in the D&RGW rule book (1977), the following definition was for locomotive, not engine.

By rule-book definition, an engine is one or more units coupled, operating under a single control, and in train or yard service. Three Diesel units coupled and operating from a cab on one of the units is an engine (provided it is in train or yard service). Two steam locomotives coupled are two engines for, except possibly on an experimental basis, steam locomotives never operated under multiple unit control. On a model using standard DC locomotives, double-headed steam locomotives do operate under one control. It then becomes a matter of choice whether they would be called two engines, on the basis of that is what they would be if prototype, or one engine since they are operating from one control.

Trains

Still following the rule-book definitions, a train is one or more engines coupled, with or without cars, displaying markers. This definition is too rigid for practical use on a model railroad and, even on the prototype, it is bent. For example, in Chapter 4, a timetable special instruction taken from a New Haven timetable stated, "Westward freight trains working at Brewster must leave their train east of passenger station." Clearly the intent is that the engine, while drilling Brewster, is detached from the cars of the train, those cars standing east of the station. This does not fit the definition of train exactly.

A more practical definition for train on a model railroad (particularly since modelers seldom add, remove, or turn markers) is as follows: "A train is one or more engines coupled, with or without cars, having authority to move between stations or yards." An engine, with or without cars, under the control of an engineman but without the authority to move between stations or yards is not a train and its movements must be confined within yard limits.

There are two types of trains, regular trains and extra trains. A regular train is authorized by timetable schedule. On the prototpye, a set of equipment does not become a train until it has received clearance. Clearance may be either a clearance form showing the number of orders which should be in the possession of the train crew or a signal indication, depending upon the rules which apply. As a practical matter on a model, a regular train could be said to exist when it has been made up, has an engineman, and its scheduled departure time from its initial station has been reached.

An extra train comes into existance when it is created. This could be by train order or by permission of a towerman or dispatcher, the latter being very common in automatic block or multiple-track territory.

With some exceptions, where letter prefixes have been used for special purposes such as designating deadheads, regular trains have numbers.

Except in Mexico, the common practice is that westward or southward trains have odd numbers, eastward or northward trains even numbers. Major passenger trains usually have names in addition to numbers, the names primarily being for identification by the public. A name might be associated with a number; the 20th Century Limited was No. 25 and No. 26 for the entire period a train of that name operated. On the other hand, the Broadway Limited has carried the numbers 28 and 29, 48 and 49, then by 1977, 40 and 41.

Extra trains are identified by their engine number and, except for work extras, direction, e.g., Extra 42 west. Extra trains, through freights in particular, may have symbols (combinations of letters and numbers, usually starting with a letter), e.g., GR-1.

Sections

Two or more sets of equipment can be operated on the same schedule, each having equal timetable authority. Each of these sets of equipment is called a *section* and identified (using No. 4 as an example) as First 4, Second 4, etc. Sections are created by train order, which, among other things, specifies the engine number for each section. Note that section, when applied to trains, is also used in another sense, trains combining to make a single train, i.e., the Washington section and the New York section of the Broadway Limited combined at Harrisburg. But, for operating, the Broadway, Washington to Harrisburg and the Broadway, New York to Harrisburg are two separate trains.

There are two major reasons for creating a second section. One is when the demand for space on a passenger train exceeds the capacity of a single set of equipment train. The other is convenience in handling what otherwise would have to be an extra train. Once-common examples were troop trains operating as sections of scheduled passenger trains. By 1977, many railroads had eliminated the rules for operating sections.

Traditionally, green flags or lights were displayed on the engine of any train with a section following. Penn Central Rule 20 stated: "On portions of the railroad so specified in the timetable, all sections except the last will display two green flags and, in addition, two green lights or flashing green lights by night in the place provided for that purpose on the engine."

On a model, the practicality of displaying green flags and lights is debatable. Operation of second sections is, nevertheless, feasible and adds an interesting variation to the more usual running of individual trains. As on the prototype, the train order creating a second section should include the engine number of both the first and second sections, so the train can be properly identified by all operators concerned. After the sections are created on a model, probably there is no point in continuing to use the engine number—for a section cannot pass a lower-numbered section without special arrangements having been made.

Extra Trains

An extra train is any train not appearing on a timetable schedule. Some railroads divide extra trains into two categories: Extras and Work Extras.

Other railroads use three categories: Passenger Extras, Extras, and Work Extras. Passenger trains require different procedures than do freights. Giving them a special name when run as extras calls attention to those differences. Since on a model, the appearance of a train is probably the most effective identification, certainly the distinction between passenger extras and extras (freight) should be adopted as a minimum. It could well be advantageous, for identification purposes only, to have other identifying terms. An example might be light-engine extra. All such extras would, of course, be handled alike and as if the identifying term were not used.

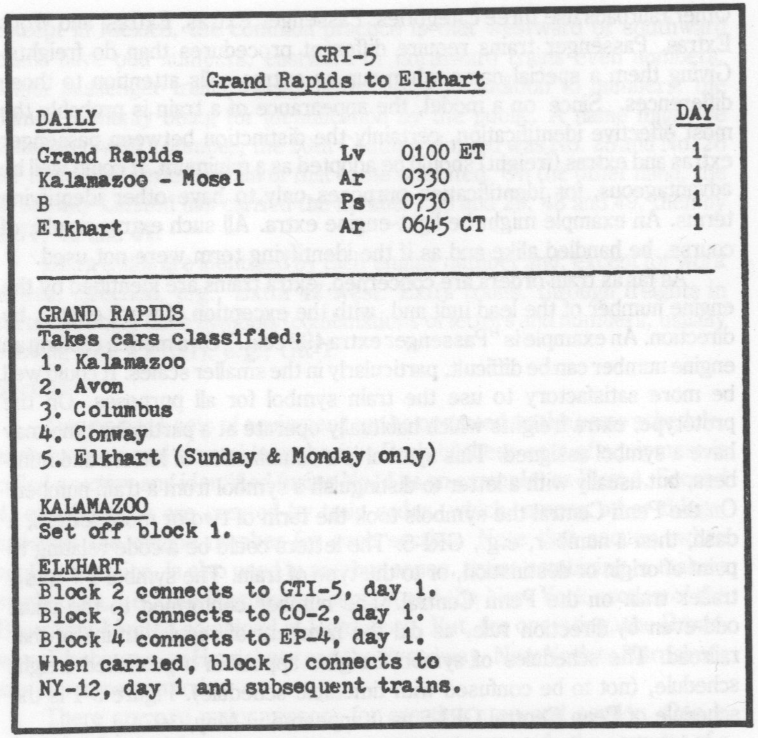
As far as train orders are concerned, extra trains are identified by the engine number of the lead unit and, with the exception of work extras, by direction. An example is "Passenger extra 492 east." On a model, reading an engine number can be difficult, particularly in the smaller scales. It could well be more satisfactory to use the train symbol for all purposes. On the prototype, extra freights which habitually operate at a particular time may have a symbol assigned. This symbol is a combination of letters and numbers, but usually with a letter to distinguish a symbol from a train number. On the Penn Central the symbols took the form of two or more letters, a dash, then a number, e.g., GRI-5. The letters could be a code relating to point of origin or destination, or to the type of train. The symbol TV was a trailer train on the Penn Central. The number conformed to the usual odd-even by direction rule, as did the numbers of regular trains of that railroad. The schedules of symbol freights appear in a published freight schedule, (not to be confused with timetable schedule). Figure 5-1 is the schedule of Penn Central GRI-5 as it appeared in May, 1974.

A freight schedule is in many ways similar to a timetable schedule. It gives the departure time at the point of origin, the arrival time at intermediate stops, and the arrival time and often the departure time at the terminal. In the case of Fig. 5-1, the passing time of a particular tower is also given. The big difference, as compared to timetable schedule, is that a freight schedule confers no authority to the train. Regardless of whether a symbol freight is late or early, no other train has to be concerned with the schedule of the symbol freight. As far as train operation is concerned, it is just another extra train.

On the prototype, a freight schedule is a marketing tool. If a shipper at Grand Rapids, MI wants to know when a car being turned over to the railroad will arrive in Columbus, OH, the agent can check the schedule and find that the car will leave Grand Rapids on GRI-5 in the block for Columbus which, at Elkhart, will be put into CO-2 arriving at Buckeye yard in Columbus at 0945 the second day.

On a model, a schedule for a symbol freight provides an objective which is missing if the freight is simply run as an extra. It must get through in time to transfer cars to a connecting symbol freight. Another useful piece of information on a freight schedule is how the train is to be blocked.

At the time of writing, no significant use of integrating freight schedules of symbol freights with regular trains on a model was known. Although the prototype practice of keeping timetable schedules and freight schedules



GRI-5
Grand Rapids to Elkhart

DAILY			DAY
Grand Rapids	Lv	0100 ET	1
Kalamazoo - Mosel	Ar	0330	1
B	Ps	0730	1
Elkhart	Ar	0645 CT	1

GRAND RAPIDS
Takes cars classified:
1. Kalamazoo
2. Avon
3. Columbus
4. Conway
5. Elkhart (Sunday & Monday only)

KALAMAZOO
Set off block 1.

ELKHART
Block 2 connects to GTI-5, day 1.
Block 3 connects to CO-2, day 1.
Block 4 connects to EP-4, day 1.
When carried, block 5 connects to
NY-12, day 1 and subsequent trains.

Fig. 5-1. Freight schedule for a symbol freight.

completely separate and not (at least officially) using the symbols for operation could be followed on a model, the rapid-fire action on a model might make this undesirable. There is great advantage in arranging the information needed for operation so that it is readily available to the operators. On the prototype, symbol freight GRI-5 takes 5 hours 45 minutes to run from Grand Rapids to Elkhart. On most model railroads a similar run probably would take no more than 20 minutes, even with the switching at Kalamazoo. As a minimum, there certainly seems merit in considering adding the schedules of symbol freights to the graphical timetable schedules shown in Chapter 4. The operators involved then would not have to consult two separate documents to discover where the trains should be at any particular time. Further, the symbol could be used for reporting trains and issuing orders which should reduce strain on the brain per train.

Whether a symbol freight or not, extra trains must have some sort of authority to move down the line as they do not get it from the timetable schedule. Rule 97 states that *unless otherwise provided*, extra trains must not be run without train orders. The *unless otherwise provided* usually means that a signal indication or permission of a block operator can authorize a train to run as an extra. See Chapter 6.

MAIN TRACK, SECONDARY TRACK, AND SIDING

The movement of trains from station to station in contrast to drilling in the yards is primarily concerned with main tracks and sidings. On some railroads secondary tracks are also involved. A main track (rule-book definition) is a track running through yards and between stations upon which trains are operated by timetable, train order, or both, or the use of which is governed by block signals. A secondary track is the same thing except that trains may be operated without timetable authority, train orders, or block signals. Modelers sometimes confuse the term *main track* with *main line*. Main line is the principal route of a railroad or the principal route at a particular place. It is not a rule book term but, nevertheless, one understood by operating personnel. There can be a main track (or more than one in parallel) on either main lines or branch lines.

A siding (rule-book definition) is a track auxiliary to a main or secondary track for the meeting or passing of trains. Note that a siding can be either single ended (blind siding) or double ended, (through siding). It is the use to which the track is put which defines it as a siding. Siding, unfortunately, is one of those terms which is used loosely. In the vernacular, it may be applied to almost any track other than a main track. Therefore, to avoid confusion, some modelers say *passing siding* when they mean *siding* in the rule-book sense. Figure 5-2 shows some examples of main tracks and sidings. Usually, permission is not required to use a siding. In such cases, trains on a siding must proceed at reduced speed (prepared to stop short of obstructions, etc.).

Secondary track is not found on all railroads. If not, the term will not be defined in the rule book of that railroad. Secondary track is most useful on lines with dense traffic, a situation which is the rule rather than the exception on model railroads. Technically, a model railroad which operates trains but does not use train orders, a timetable, or block signals cannot have main tracks outside of yards. It is possible, as do many short lines, to operate on all tracks using yard rules. This means enginemen proceed when they can see the track is clear much as a bus operates over a public highway. However, if prototype practice is followed, operating by yard rules imposes

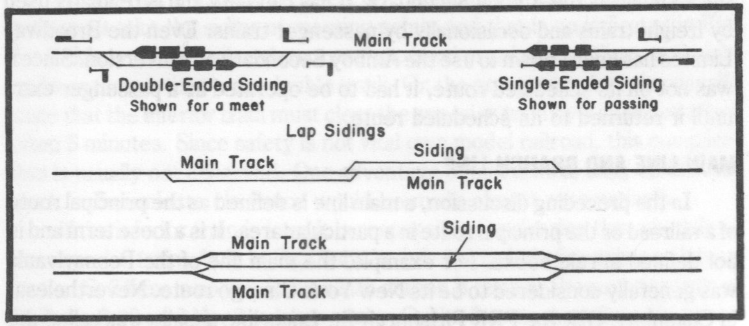


Fig. 5-2. Main tracks and sidings.

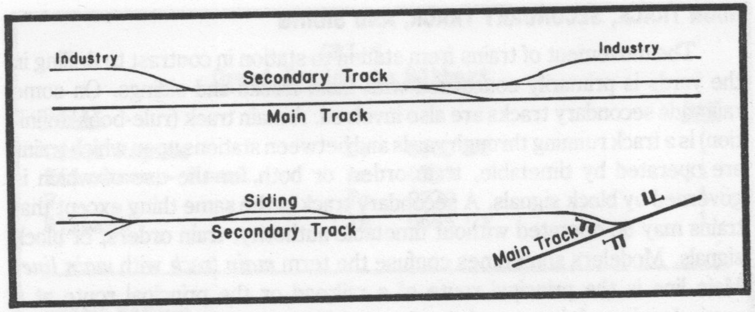


Fig. 5-3. Secondary tracks.

severe speed restrictions, usually a speed limit of 25kmh (15 mph). Designating a track as secondary track is a way of retaining much of the informality of yard operation, yet permitting higher speeds (but not as high as those typically associated with main tracks).

There are two basic ways in which secondary tracks are employed. Both are shown in Fig. 5-3. At the top a secondary track runs parallel to the main track (or tracks) and serves industries along the line. The crew of a road drill simply checks with the operator who controls the secondary track by phone, radio, or in person for permission to use as much of the secondary track as is needed. If the timetable specifies blocks, the operator can either give that train a clear block or a permissive block. The secondary track is also available to the trains which normally use the main track, provided they receive permission first.

At the bottom of Fig. 5-3, a secondary track is serving as a separate line. Any train crew wishing to use this line contacts the operator who controls the line for permission as above. Permissive block, if granted in manual block territory, means that there is a train other than passenger in the same direction already in the block. Trains clearing a manual block at other than interlockings must report that clearing to the block operator who controls the block.

Part of what is left of the old Camden and Amboy RR is now a secondary track known as the Amboy Secondary. It has catenary and is regularly used by freight trains and occasionally by passenger trains. Even the Broadway Limited has been known to use the Amboy Secondary on a diversion. Since it was not on its scheduled route, it had to be operated as a passenger extra until it returned to its scheduled route.

MAIN LINE AND BRANCH LINE

In the preceding discussion, a main line is defined as the principal route of a railroad or the principal route in a particular area. It is a loose term and is not defined in rule books. For example, the main line of the Pennsylvania was generally considered to be its New York-Chicago route. Nevertheless, in Columbus, OH, the PRR Pittsburgh-St. Louis line usually was called the main line in contrast to other lines diverging.

As stated before, the terms *main line* and *main track* should not be confused. A main line includes all the tracks along that line, main tracks, secondary tracks, and sidings.

Loosely, a branch line is a lesser route than the main line. A major line, however, is seldom called a branch, but rather a line as exemplified by the forementioned Pittsburgh-St. Louis line of PRR. In 1977, Conrail defined a *line* as at least one main track carrying passenger service, a *branch* as at least one main track but no passenger service, and a *track* as secondary track away from yards.

SUPERIORITY OF TRAINS

On single-track, or on track operated by single-track rules, such as the center track of triple-track lines, there are three ways in which one train may be superior to another: right, class, or direction. On two or more tracks (that is, tracks on which currents of traffic are established) no train can move in the opposite direction to the current of traffic without right, so there is no superiority by direction on such tracks. Right is conferred by train order only. If there is no order, there is no right. Superiority by class or direction is conferred by timetable. Right always supersedes superiority by timetable.

When there is no right, a train is superior to all trains of lower class. All regular trains are superior to extra trains. For practical purposes, all passenger trains are first class. Some railroads operated first-class freight trains also; the Atlantic Coast Line was one. Usually freight trains, if operated as regular trains, are second class, although lower classes have been used also. Between trains of the same class on single track, superiority is established by direction. Extra trains have no superiority by direction, even with regard to other extra trains.

Superiority by class and direction automatically takes care of train movements when one or more regular trains are running late. This is illustrated in Fig. 5-4. Two trains are indicated in the timetable schedule at the top of the figure. Since both are first class, No. 2 is superior as eastward is the superior direction. Had the superior direction been westward but train No. 1 a 2nd class train, the operation shown in the figure would be exactly the same, as No. 2 would still be the superior train.

At A in Fig. 5-4, both trains are on time. Rule 89 states that the inferior train must take the siding at meeting points and that is so indicated in Fig. 5-4A. Many model railroaders use right-hand running on sidings and main racks as though they were double track. On the prototype, the rules usually state that the inferior train must clear the superior train by a specified time, often 5 minutes. Since safety is not vital on a model railroad, this complication is usually not observed. One advantage of fast time is that, on the fast clock, a five-minute clearance would be made almost automatically.

If the inferior train is late, it is responsible for clearing the schedule of the superior train. At B in Fig. 5-4, the inferior train is five minutes late at station C. There is no way it can reach station B to clear the superior train at B. From 8:10 until No. 2 reaches station C, No. 2 owns the railroad between stations B and C. No. 1 therefore must wait at station C until No. 2 arrives,

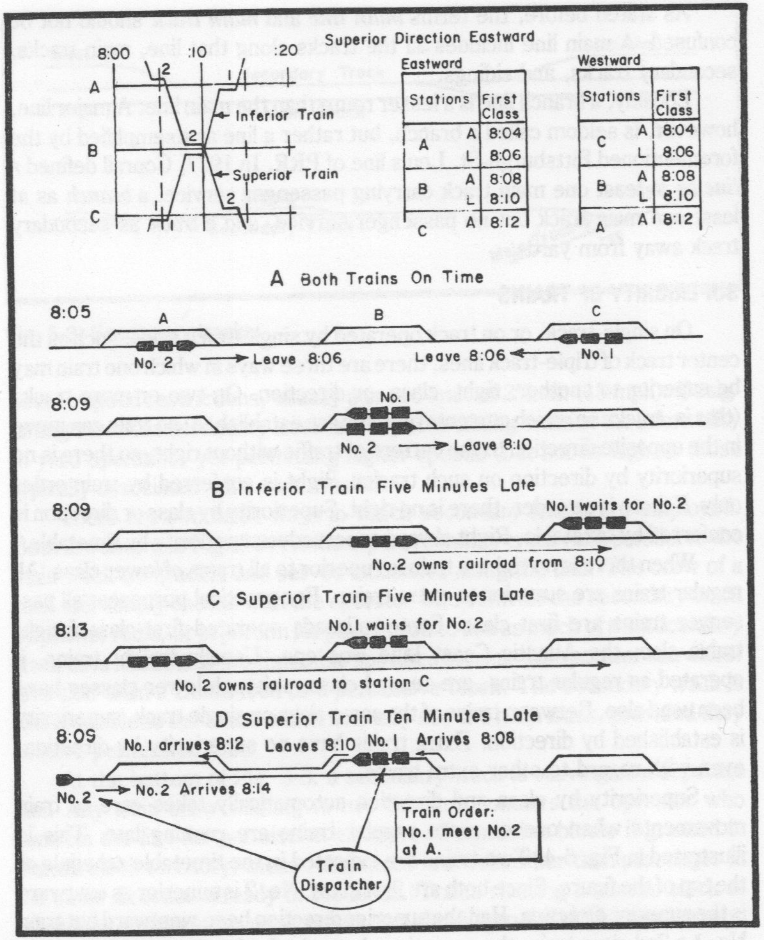


Fig. 5-4. Superiority by direction.

unless orders are issued or No. 2 becomes so late that it loses timetable authority.

If the superior train is late, it owns the railroad up to the point where it is scheduled to be. In Fig. 5-4C, No. 1 has arrived at station B on time, but it cannot leave for station A until No. 2 arrives.

There is a popular misconception among modelers that the dispatcher helps all late trains. But, note in Fig. 5-4C that a late superior train has a clear track and can move as fast as is consistant with speed restrictions. If a superior train becomes significantly late, the dispatcher will move to assist the inferior trains. At D in Fig. 5-4, the superior train is ten minutes late. The dispatcher knows that No. 1 is ready to leave on time and can reach station A in time to clear No. 2. He can, therefore, issue an order to permit

No. 1 to proceed to station A. One possibility is the order shown in Fig. 5-4D, "No. 1 meet No. 2 at A." On the prototype, the engine number would be given for both trains. This order removes the precedence given to No. 2 by timetable and gives right to No. 1 as far as station A. Neither No. 1 or No. 2 can proceed beyond station A until the meet is made. This order must be delivered to both trains or to the block stations controlling the trains.

If the late train were the inferior train, the dispatcher might have to issue orders giving it right over opposing trains to prevent it from losing more time as a result of waiting for superior trains.

When a train is operating in sections, it is not met until all sections have been met. In Fig. 5-5, the superior train is running as two sections. At the top, both No. 1 and No. 2 are approaching their scheduled meeting point. First 2 is on time and clears station B as scheduled. First 2 would give a whistle signal of one long and two short as it met No. 1, calling attention to signals displayed for a following section (on a railroad which displayed signals). No. 1 would answer with a whistle signal of two short blasts. No. 1 must remain at station B until Section 2 arrives, as indicated at the bottom of Fig. 5-4C. Since displaying signals and the above whistle signals hardly can be called practical on a model, all operators concerned must be notified that a train is running in sections.

Superiority by direction can cause a problem on a branch line if a single crew takes to the terminal of the branch, then returns with another train and the returning train is in the superior direction. This condition is shown in Fig. 5-6. If No. 11 is even a few minutes late arriving at station C, it must take the siding and await No. 12, the train of superior direction—but No. 12 in this case is the same equipment and crew as is No. 11. In effect, No. 11 is waiting for itself. The dispatcher cannot solve this problem with a train order addressed to the two trains as the order cannot be delivered to No. 12. A

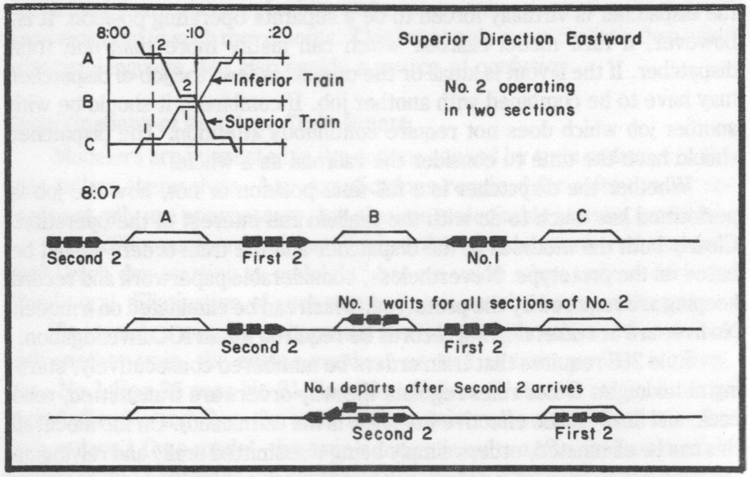


Fig. 5-5. Train operating in sections.

solution is to reverse the superior direction. If that can be done for the entire railroad without affecting some other branch, fine. But if east must remain the superior direction for the rest of the railroad, there are four solutions: One, the timetable could specify that the superior direction of this branch is west. Two, timetable schedule could designate the direction station C to A as eastward. Three, timetable special instruction or even a rule can specify that an earlier train is superior to a later train operated by the same crew. Four, a timetable instruction can make a given train superior by direction to a given opposing train which uses the same equipment.

The superior direction usually is given in the timetable, most often in the timetable schedule, but it may appear in the rule book. The AT & SF was an example of the latter in 1977

TRAIN ORDERS

Train orders are directives issued by a train dispatcher (or train director) to control movements of trains not provided for in the timetable. Train orders supersede authority granted by timetable schedule. On large prototype railroads, there may be several train dispatchers. At extremely busy locations, a train director may be assigned the control of tracks at a single tower or at a group of closely-related towers. Train directors relieve the dispatcher of the detailed work that such complex and busy tracks require. An example is Pennsylvania Station, NY, in which all movements are controlled by train directors. Although seldom is a separate position of train director recognized on a model, if the operator of any interlocking system, real or simulated, makes decisions with respect to the tracks the trains will use, that operator is serving the function of a train director.

On some model railroads, particularly those operated by CTC, the dispatcher may have the function of operating the cab-section selector switches to keep each engineman in control of his locomotive. In such cases, the dispatcher is virtually forced to be a separate operating position. It is, however, a rare model railroad which can justify more than one train dispatcher. If the layout is small or the operators few, the job of dispatcher may have to be combined with another job. If combined, it should be with another job which does not require continuous attention. The dispatcher should have the time to consider the railroad as a whole.

Whether the dispatcher is a full-time position or not, how the job is performed has much to do with the realism and interest of the operation. Clearly both the methods of the dispatcher and the train orders should be based on the prototype. Nevertheless, considerable paperwork and record keeping are required by the prototype, which can be eliminated on a model. No lives are at stake, nor will records be required for an ICC investigation.

Rule 203 requires that train orders be numbered consecutively, starting at midnight. Other rules regulate the way orders are transmitted, read back, and finally made effective (*complete* is the term used). On the model all this can be eliminated, orders simply being transmitted orally and relying on the receiver to request a repeat if the order was not understood. Even on the prototype, simplifications have been made. The 31 order (which required a train to be stopped, also required the engineer and others addressed by the order to read it to the operator, then sign the order) has been dropped in favor of the 19 order. The Jersey Central apparently was the last to use 31 orders (the CNJ is now part of Conrail). A 19 order is delivered without requiring a signature and may be delivered by telephone or radio. In some rule books, even the term 19 order has been dropped, train order is used instead.

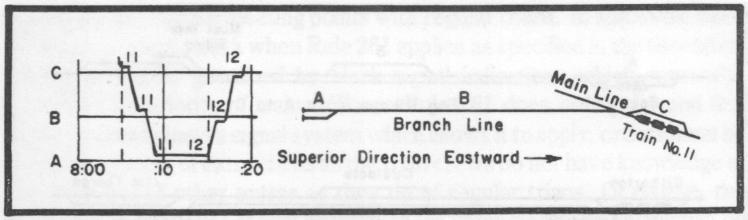


Fig. 5-6. Superior direction on a branch.

Procedures on a Model

When a train order is issued conferring right to a train, it is obvious that some authority must be taken away from at least one other train. Therefore, all operators who are required to take action must receive the order. In Fig. 5-4D, No. 1 was given right to proceed to station A and the timetable authority of No. 2 was removed. If there were no operators at either station A or B, the order must be sent directly to the crews of both trains. If there were operators at both stations, the order would be sent to them and the operator at A would hold No. 2 and the operator at B would send No. 1.

For the sake of clarity, the standard terms and procedures of the prototype, as modified by well-defined simplifications, should be used at all times. Rule 201 states that train orders must be brief and clear, in the prescribed form when applicable, and contain only information or instructions essential to such movements. This is not only more realistic than using arbitrary language, but also avoids a source of confusion.

Simplifications of Prototype Train Orders

Modelers are interested in the actions caused by train orders, not the train orders themselves. Any complications required for safety or for records not only are unnecessary, but also are undesirable to most modelers.

Rule 203, mentioned before, "Train order must be numbered consecutively each day starting at midnight" has no value when train orders are strictly oral. Elimination of such numbering is an obvious simplification.

To identify a regular train on the prototype without fear of confusion with another train, the engine numbers as well as train number is given, e.g., No 1 Eng 25 pass No 31 Eng 26 at Valier. (Note the absence of the period after No and Eng, the usual but not universal prototype practice for train orders.) On a model, the train number is quite sufficient to identify a regular train. Therefore, all examples shown for orders involving regular trains omit the engine number.

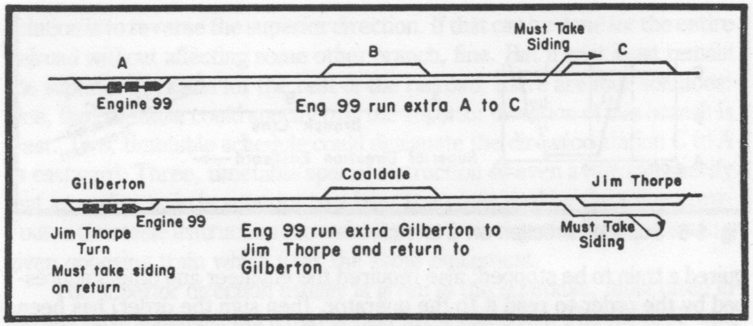


Fig. 5-7. Form G order creating extras.

On the prototype, the engine number is the prime means of identifying an extra train, e.g., Psgr Extra 652 east take siding and meet Extra 231 west at Coaldale. The word "Extra" is never abbreviated in a train order. On a model, if only one extra train is run at a time, the engine number would not be necessary. Should the extra have a name or a symbol, the operators probably would be far more familiar with the name or symbol than with the engine number. The preceding order than might be, "NMRA Special psgr extra east take siding and meet Jim Thorpe turn west at Coaldale." Whether this is a simplification or not would have to be demonstrated on the particular layout. The examples given in the figures of this book identify extras by engine numbers.

Creating an Extra Train

An order creating an extra train gives the engine number and the points between which the extra is to run. At the top of Fig. 5-7, the dispatcher has created Extra 99 east by the order, "Eng 99 run extra A to C." This order confers no superiority to the extra train. It must clear all regular trains. Further, it must take the siding at the last-named station.

For a train which will go down the line then return to the starting point (or any intermediate point), the entire move can be authorized with one order as shown at the bottom of Fig. 5-7. The train must take the siding at the turning point and at the final point. A way freight which habitually makes a return trip from a yard to a station down the line is often called a *turn* or *turner* and bears a particular name. In Fig. 5-7 it is called the Jim Thorpe Turn. Therefore, on a model, instead of the order given at the bottom of Fig. 5-7, it might be more effective to use, "Jim Thorpe Turn run extra Gilberton to Jim Thorpe and return to Gilberton."

Meets on Single Track

The meeting points of regular trains are specified by timetable schedule. As described previously, the rules of superiority by class and direction will adjust the meeting points if necessary when the inferior train is late. Since extra trains must clear regular trains, the extra trains will select the most-appropriate meeting points with regular trains. In automatic block territory on single track when Rule 261 applies as specified in the timetable, all trains will be governed by block signal indications which supersede timetable superiority of trains. Where Rule 261 does not apply, and few model railroads have a signal system which allows it to apply, orders must be issued for meets of extra trains as the train crews do not have knowledge of the locations of other extras as they do of regular trians. Of course, the extended visibility of a model engineman (as compared to an engineman on the prototype) does allow operation to proceed on the basis of the enginemen knowing what the indications of signals, if they existed, would be. Figure 5-8 shows an order for two extras to meet. Once again, on a model, it could be more effective to use the train names or symbols. The same order as in Fig. 5-8 would then be "BR-2 meet FR-1 at Timblin."

Although superiority by direction does not apply between extra trains, the extra train of the inferior direction will take the siding. The Standard Code does not make provision for the dispatcher to specify which train will take the siding, but some roads permit the dispatcher to add "take siding", e.g., Extra 652 north take siding and meet Extra 231 south. Others permit "hold main track" in the same manner. Yet others required the dispatcher to specify which train was to take the siding.. There is no reason why both *take siding* and *hold main track* should not be permitted on a model. Orders such as these underline the importance of the proper use of the term *main track*. Some modelers use the term ***main line*** when they mean ***main track***. A siding alongside the ***main track*** of a ***main line*** is part of the main line and there can be a ***main track*** on a branch.

A dispatcher can use form S-A for meets between any two trains. Figure 5-4D shows this type of order being used to assist an on-time inferior train against a late superior train.

Pass Order

If a train of inferior class is overtaken by a train of superior class, the inferior train must clear the time of the superior train. No train order is required. However, if a train is to pass another train of superior class, a train order must be issued. In Fig. 5-9, a passenger extra is overtaking a regular train. The order, "Passenger Extra 792 pass No. 21 at Lewisburg," not only causes No. 21 to take the siding at Lewisburg, but also confers right to the passenger extra to run ahead of No. 21 from Lewisburg.

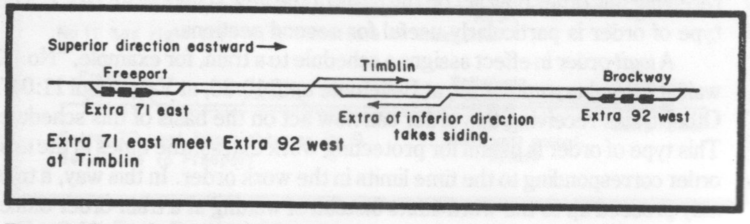


Fig. 5-8. Form S-A order for meet.

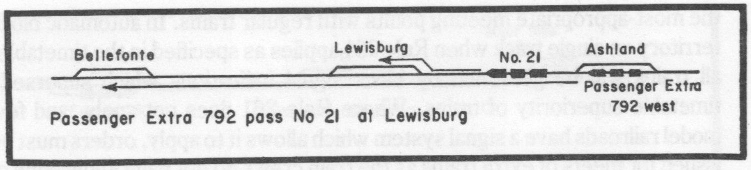


Fig. 5-9. Form B order for pass.

Some railroads have permitted a "pass when overtaken" order. For example, "No 7 pass No 9 when overtaken." The two trains will run according to rules until No. 9 is overtaken when the two trains will arrange for No. 7 to pass promptly. This might be an interesting order to use on a loop railroad.

Giving Right Over Another Train

Right can be given to an inferior train over a superior train. At the top of Fig. 5-10, a regular train has been given right over another regular train. Since the train with right has a timetable schedule, No. 20 is permitted to advance to Valier provided it can clear the time of No. 1.

If the train given right is an extra, as at the bottom of Fig. 10, unless times for that extra were given in the order, No. 20 does not know when Extra 72 west will reach Valier and so must wait at Freeport until the extra arrives.

In a similar manner, right can be given to a following train. At the top of Fig. 5-11, a regular train has been given right over another regular train. No. 9 can proceed as long as it can clear the time of the train with right. At the bottom of Fig. 5-11, it is an extra train which has right. No. 9 must wait at Bellefonte until the extra has passed, then follow it out, as the timing of the extra is unknown.

The advantage of giving right, rather than ordering meets or passes at a designated point, is that the automatic features of the rules are in effect which permit the trains to take the proper action without being completely restricted.

Time Orders

A *run late* order changes the scheduled times of a regular train. For example, "No. 1 run 20 minutes late Gilberton to Pittsburgh". Other trains receiving this order now act on the basis of the new schedule for No. 1. This type of order is particularly useful for second sections.

A *wait* order in effect assigns a schedule to a train, for example, "No. 13 wait at Lewisburg until 9:59, at Bellefonte until 10:36, at Valier until 11:04". Other trains receiving this order can now act on the basis of this schedule. This type of order is useful for protecting work extras, the times in the *wait* order corresponding to the time limits in the work order. In this way, a train may proceed up to the work limits instead of waiting at a train-order office, as would be the case if a *hold* order were used.

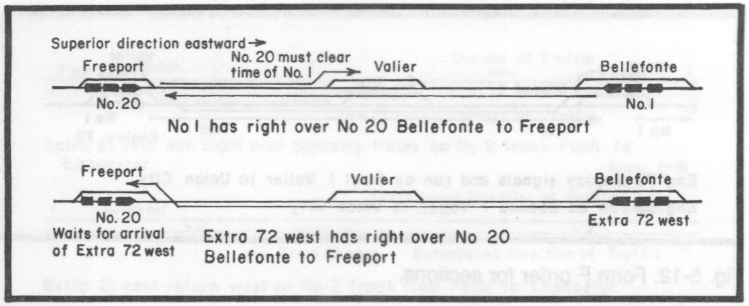


Fig. 5-10. Form S-C order giving right.

Time orders are more involved that the above would indicate, but this is enough on a model. It is unlikely that wait orders would be found desirable on a model as they require writing if more than one or two stations are included to assure that the times stated will not be forgotten.

Sections

To create second section, an order or orders must be issued covering all the sections. In Fig. 5-12, two trains are at Valier. No. 1, which had arrived from the east is designated to be First 1 from Valier to Union City, so the dispatcher can designate the freight train waiting at Valier as Second 1 between the same two points. Now, the freight train can follow First 1. This could save the issuing of several orders. To give definite times when Second 1 should be expected, the dispatcher could issue an order for it to run late, e.g., Second 1 run 30 minutes late Valier to Union City.

The prototype order calls for the displaying of signals (green lights/ flags) on the engine of First 1. Seldom are model locomotives equipped to display such signals, so reference to display of signals probably should be deleted from this type of order on a model railroad.

There are other orders used by the prototype with respect to sections, but on a model railroad, those described will suffice. By 1977, rules permitting operation of sections had been eliminated by many railroads.

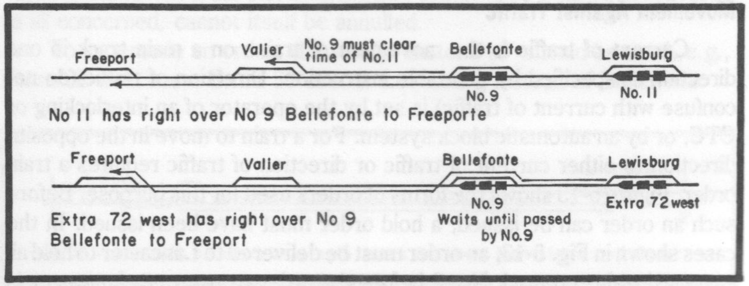
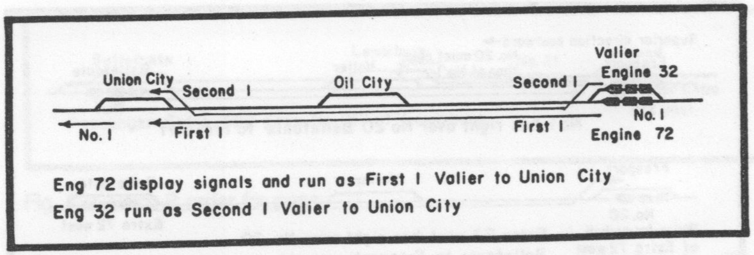


Fig. 5-11. Form D order giving right.



Eng 72 display signals and run as First 1 Valier to Union City
Eng 32 run as Second 1 Valier to Union City

Fig. 5-12. Form F order for sections.

Holding

Hold orders are used both for emergency and also for operating trains. They are addressed to the block operator who will set the necessary signals. Hold orders are quite flexible. The following are examples:

Hold No 2.
Hold all trains.
Hold all westward trains.
Hold all trains clear of No 1 track between Plainfield and Raritan.
Hold all westward trains clear of No 1 track between Plainfield and Raritan.

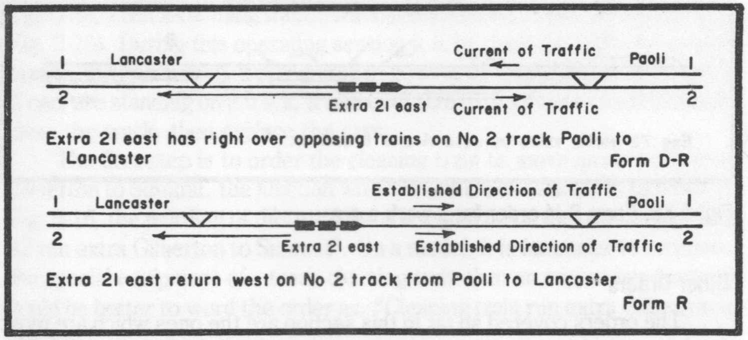
Most prototype railroads identify tracks by numbers or letters. Unless the operating crew on a model is the same from session to session so they can become quite familiar with how tracks are numbered, it is difficult for such operators to remember the track numbers. It is probable that less confusion will result if tracks are called "eastward" and "westward" on double-track lines. This was acceptable practice on the CNJ and the WP, among others.

To release trains by a holding order, that order may be annulled or individual trains released, e.g., No 2 may go.

Similar to a hold order, but addressed to the train are orders directing a train not to pass a named point without permission of the dispatcher. This order is primarily used to protect track cars and is useful for protecting work extras.

Movement Against Traffic

Current of traffic is the movement of trains on a main track in one direction as specified by timetable instruction. Direction of traffic (do not confuse with current of traffic) is set by the operator of an interlocking or CTC, or by an automatic block system. For a train to move in the opposite direction to either current of traffic or direction of traffic requires a train order. Figure 5-13 shows the forms of orders used for this purpose. Before such an order can be issued, a hold order must have been issued. In the cases shown in Fig. 5-13, an order must be delivered to Lancaster to hold all eastward trains on track No. 2 before the order to return to Lancaster is delivered to Extra 21 east.



Extra 21 east has right over opposing trains on No 2 track Paoli to Lancaster

Extra 21 east return west on No 2 track from Paoli to Lancaster

Fig. 5-13. Orders for moves against traffic.

Using Double Track As Single Track

The order shown in Fig. 5-14 requires all trains to use No. 2 track between Morristown and Dover and also places single track rules into effect for that portion of the line.

Annulling

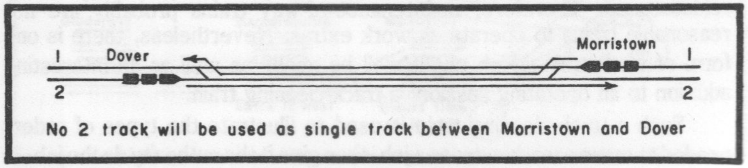
The train dispatcher can annul the schedule of a train or section for all or part of its run. The prototype order would include the date of the train but, unless an operating session spanned two or more days on a fast clock, that information has no value on a model. Form K orders annulling a train or section then would appear as follows:

No. 1 is annulled Gilberton to Pittsburgh.
Second 3 is annulled Valier to Pittsburgh.

The schedule or section annulled becomes void between the points designated and cannot be restored.

An order is annulled on the prototype by specifying the number of the order to be annulled, e.g., Order No. 10 is annulled. It is unlikely that modelers would want to keep track of orders by numbers as this would require paperwork. On a model, the most suitable method appears to be to repeat the order when annulling it, e.g., Order to hold all westward trains at Valier annulled. An order annulling another order, once it has been delivered to all concerned, cannot itself be annulled.

To supersede an order, the words "instead of" should be used, e.g., Extra 72 west meet Extra 31 east at Lewisburg instead of Bellefonte.



No 2 track will be used as single track between Morristown and Dover

Fig. 5-14. Form D-S order to operate as single track.

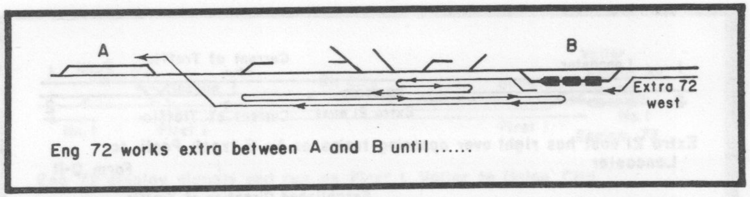


Fig. 5-15. Form S-H order for a work extra.

Other Orders

The orders covered so far in this section are the ones which are most like to be valuable on a model railroad. Many of the complex forms used by the prototypes have been omitted, some on the grounds that it would be difficult to remember complex orders unless written and others because that type of order is unlikely to be useful on models. Since work extras are a special type of train, orders pertaining to work extras are covered in the following discussion.

WORK EXTRAS

A work extra is special in that it is the only type of train which can move in either direction between limits specified in the order which creates the train. One reason for creating a work extra is shown in Fig. 5-15. Extra 72 west, a way freight, has arrived at station B and has much switching to do between stations A and B. This work would be easier if it could move back and forth on the line between A and B. Assuming that the original order for Extra 72 west took it only to station B, the dispatcher can now issue the order, "Eng 72 works extra between A and B until (time)". Now, the way freight can work the spurs in the most efficient manner, but must clear the time of regular trains. On the prototype, it also must protect itself (set out flagmen etc.) against extra trains. Protection in this manner is not used on models. Extra trains which will use this portion of the railroad, upon receiving the above order, will run expecting to meet or pass the work extra between the points named in the order until the time specified in the order has expired. If a time were not specified, the order creating the work extra would have to be annulled by another order. The order creating the work extra could also require the work extra to clear another extra train at a specified time.

Maintenance and construction on a model layout do not normally take place during an operating session and even when they do, a work train is seldom used. Therefore, maintenance-of-way trains probably are not reasonable trains to operate as work extras. Nevertheless, there is one form of work train which might well be useful as well as an interesting addition to an operating session: a track-cleaning train.

Such a track-cleaning train is used to illustrate the types of orders needed to move a work extra to a job, then give it the authority do the job. In Fig. 5-16, a track-cleaning train is stationed at Gilberton (the layout shown in Fig. 2-15). During this operating session it is to clean the entire Gladstone branch. When cleaning, it is required to go over all tracks at least four times. If cars are standing on a track, it must set those cars over to another track, clean the track, then replace the cars.

The first step is to order the cleaning train to move as an extra from Gilberton to Summit, the junction with the branch on which it is to work. In Fig. 5-16, the wording of this order is as it would be on the prototype, "Eng 42 run extra Gilberton to Summit". On a model, it is far easier to recognize the special equipment of a track-cleaning train than an engine number so it could be better to word the order as, "Cleaning train run extra Gilberton to Summit".

In its run to Summit, the cleaning train must clear the times of regular trains. In Fig. 5-16, it has taken the siding at Coaldale to clear No. 1. It also has received an order to meet another extra at Washington. Being of the superior direction, the cleaning train holds the main track for this meet. Finally it arrives at Summit. The dispatcher then issues an order for the cleaning train to work extra on the branch. In Fig. 5-16, the order specified the entire branch. Again, it could be better to word the order, "Cleaning train works extra between Summit and Gladstone until 9:40 PM."

As the cleaning train works, it must clear the times of regular trains. In Fig. 5-16, it has taken the siding at Murray Hill to clear No. 52. Its order could require it to clear an extra train at a given time, but, as shown in Fig. 5-16, it is not so required. Therefore, the order creating the work extra must also be delivered to any extra train which will use the Gladstone branch. Such a train will proceed slowly expecting to stop short of the work extra. In Fig. 5-16, Extra 12 west has caught up with the cleaning train at Bernardsville. The cleaning train has moved onto the siding to let Extra 12 west pass.

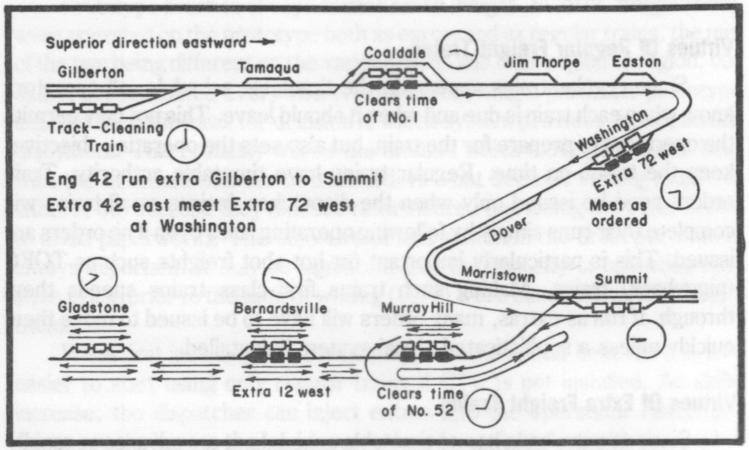


Fig. 5-16. Orders for a track-cleaning train.

To avoid requiring another extra train to watch for a work extra over a long length of track, the dispatcher can, and on the prototype often does, issue a series of orders as the work extra advances. In Fig. 5-16, the order creating the work extra could have been, "Cleaning train works extra between Summit and Murray Hill". When the cleaning train completed that part of the branch, that order would be annulled and a new order, "Cleaning train works extra between Murray Hill and Bernardsville" would be issued—and so on.

When all work has been completed, another order authorizing the cleaning train to return to its home station is issued. In Fig. 5-16, when its work order expired, the cleaning train was in Gladstone so an order was issued for it to run extra Gladstone to Gilberton. Had the cleaning train been able to complete its task and return to Summit before the work-order time expired, the order for the return would be Summit to Gilberton.

Some work extras must, of necessity, block the line. Examples would be a pile driver replacing bents on a timber trestle or a wrecker clearing a blocked line. The order creating that work extra then should give it right, e.g., Eng 32 works extra between Jim Thorpe and Coaldale with right over all other trains. Now, that work extra is not concerned with any other train.

EXTRA VS. REGULAR TRAIN

A controversial point in the operation of a model railroad is whether freight trains should be operated as regular trains or as extras. Some of the arguments have been mentioned before, but this is an issue which deserves a look as a separate subject. All the statements and comparisons made in this discussion are based on model operation, not the prototype. A very important difference between model and prototype are the shorter distances and greater density of traffic on the model. This means less time available per train. Installing a fast clock does not help, as the operators must work in conventional time.

Virtues Of Regular Freight Trains

Since regular trains appear on the timetable schedule, all operators know when each train is due and when it should leave. This not only permits the operators to prepare for the train, but also sets the operating objective: keep the trains on time. Regular trains have timetable authority. Train orders need be issued only when the dispatcher desires as all trains will complete their runs simply by following operating rules even if no orders are issued. This is particularly important for hot-shot freights such as TOFC (piggyback) trains. Making such trains first-class trains speeds them through. If run as extras, many orders will have to be issued to move them quickly unless a sophisticated signal system is installed.

Virtues Of Extra Freight Trains

Since an extra train has no timetable schedule, it can advance as rapidly as its work permits or as slowly as operator's skills require. This is particularly valuable if the signal system permits extra trains to move without the need for train orders (rules 251 and 261 or CTC). A freight schedule can be issued to provide an objective for those extra freights which are habitually run. These freight schedules could even appear on the timetable schedule in such a way that they do not confer any timetable authority to the extra trains.

Disadvantages Of Regular Freight Trains

A regular train must be run unless an order is issued to annul it. An exception is a regular train of the lowest class in the inferior direction when no extras are to be operated. If such a train is not run, no other train will be delayed. If a regular train is scheduled for 20 minutes to work a way station, it must spend that 20 minutes at the station even if there is no work to do unless orders are issued which, for all practical purposes allow the train to run as an extra. On a model, though, the order usually is for the regular train to depart early. If late, the regular freight will delay inferior trains and require the dispatcher to issue orders to assist such trains.

Disadvantages Of Extra Freight Trains

Short of having a sophisticated signal system or multiple track, an order must be issued to create an extra train and for all meets between extra trains. If the railroad is busy, the extra may have considerable difficulty making progress due to clearing the time of regular trains. An order giving right over other trains to an extra will tie up those other trains unless the order specifies a schedule for the extra, in effect making it a regular train. Lacking a schedule, there is no guide for the train crew, no objective or measure for efficient working. This may mask poor switching practices.

Basis For Decision

Prototype practice always carries much weight. In 1977, freight trains were operated on the prototype both as extras and as regular trains, the mix of the two being different on the various roads and from region to region, but extras predominated everywhere. Unless following a particular prototype exactly, the main basis for decision is which system provides the maximum enjoyment. This probably will be the method which moves the trains best with the minimum number of train orders—not because issuing orders is difficult, but because they must be remembered (assuming the usual desire to avoid paperwork). The objective of less strain on the brain per train is always important. It may be significant that the majority of operating systems in use prior to the time of writing (1977) were based on regular freight trains.

When first installing an operating system the author believes that it is easier to start using only regular trains if CTC is not installed. As skills increase, the dispatcher can inject extras into the operation. Passenger extras are the best at the beginning as they do not interfere with the waybill system, are easy to understand, yet require the usual orders for extras. The logical next step is to annul the schedule of a regular way freight and issue an order for it to operate as an extra. In this way its original schedule still remains as a guide. This process could continue with other trains before a final decision is made.

If CTC is installed on the layout, there seems little question that it is easier to start with all trains as extras. Then, no train crew has to worry about schedules, they just follow the signals.

SAFETY SYSTEMS

If the rule books and timetable instructions are sound, no mistakes are made in issuing train orders or in preparing schedules, and all enginemen follows the rules and orders, there would be no accidents involving two trains. However, there are many possibilities for error such as missing or misinterpreting a train order. The railroads, therefore, have safety systems which override the authority of a schedule or right of a train order. These safety systems take the forms of automatic block signals, interlocking signals, CTC, or manual block. Even when an automatic block system or CTC is installed, manual block may be the back-up system.

The prototype has rather involved procedures and rules covering the failure of automatic block systems or CTC. On a model, since no lives are at stake, any convenient way of shifting to another operating system is appropriate.

Any of the prototype safety systems can be installed on a model railroad but only manual block needs no special circuits or equipment. It does, however, require good communications. Since installing manual block on most layouts is simply a matter of adopting the rules and putting them into force, it commends itself as the minimum system to be used on model railroads. Manual block, as well as the other safety systems, are described in Chapter 6.

SAW BY

On both the prototype and model, most meets and passes are accomplished by the train arriving first pulling completely into the clear on either the main track or the siding. Should that train be too long to clear both ends of the siding, it will pull in as far as possible, as at A in Fig. 5-17. When the second train arrives and clears as at B, the longer train will depart which then clears the route for the shorter train as at C. This maneuver is called a *saw by* or *single saw by*.

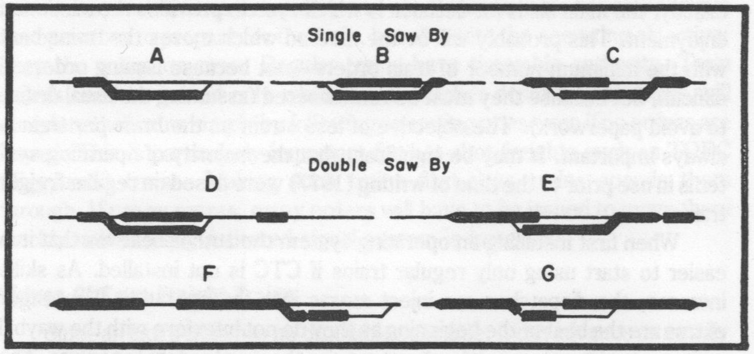
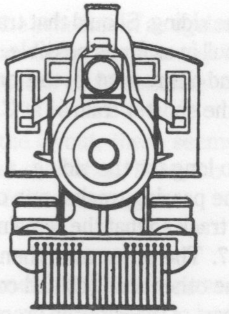


Fig. 5-17. Saw By.

If both trains are too long for the siding, a *double saw by* is required. Before proceeding into the passing tracks, one of the trains leaves enough cars standing on the main track so that the remainder will clear the siding, as indicated at D in Fig. 5-17. The other train then moves ahead clearing the exit for the first part of the other train (E) and couples onto the cars left by the other train. The first part of the cut train proceeds far enough so that the other train can back out onto the main track, while it pulls the rear cars of the cut train into the clear (F). Once the latter train has backed out onto the main track, it proceeds and the cut train backs in to double to its rear cars (G in the figure). Variations of double saw, as shown in Fig. 5-17, exist which may be required if the number of cars handled by the backing train is too great.

Although saw bys could be used for passes as well as meets, it is more practical to let trains follow each other until a siding long enough is reached.



Chapter 6
Blocks, Signals, and Interlockings

When used in the context of controlling trains or engines, the rulebook definition of *block* is, "A length of track of defined limits, the use of which by trains and engines is governed by block signals, cab signals, or both." When used in the context of a train, a block is a group of coupled cars with the same destination. These two definitions of block are applied so differently that no confusion results. Unfortunately, in model railroading, the term *block* is frequently used in place of the prototype term *section* for a length of independently-powered rail or overhead wire. As explained later, regardless of the appearance of model locomotives, they, for the most part, actually are electric locomotives. As both terms, block and section, apply to a length of track, often somewhat the same length of track, the ambiguous use of the term *block* to mean either *block* or *section* does lead to confusion. For clarity in this Handbook, the terms block and section are used rigorously in accordance with their prototype meanings.

For automatic block signals, interlocking, and CTC, the prototype installs track circuits to detect the presence of cars and locomotives. To separate the track circuit of one block from the track circuit of the adjacent block, an insulated rail joint called a *block joint* is installed. If it is necessary to install more than one track circuit within one block, the block is subdivided by additional block joints into *cut sections.* Since these subdivisions of blocks affect only the signal circuits, they do not become confused with sections for the supply of power to the locomotives. The insulation between adjacent sections, either in overhead wire or in rail, is called a *section break.*

Modelers frequently call any insulated break in an overhead wire or in a rail a *gap*. On two-rail layouts there is a need for insulation in the rail to prevent short circuits between the running rails. Since these are needed because it is a model, such insulated rail joints are called gaps in this Handbook. But, for clarity as well as to follow the prototype, insulation to divide the layout into sections for the purpose of controlling and powering and locomotives is called *section break* and insulation to divide the track into blocks or cut sections is called *block joint.*

A block is said to be clear if there is no train, engine, or track car within block limits as indicated at the top of Fig. 6-1. A *clear block* indication can be given by a fixed signal (one permanently mounted at a location), by hand signal, or by voice signal from a block operator. Except for 1st-class and, on some roads 2nd-class trains, when yard limits exist, clear block really applies only beyond yard limits. Within yard limits lower-class trains must proceed at reduced speed prepared to stop short of engines or cars, even if they had been given a clear block.

An *absolute block* is one which can be entered by only one train or engine at a time, as in the middle of Fig. 6-1. All following or opposing trains or engines are excluded from the block, the only exceptions being for emergencies such as sending a relief engine to a stalled train.

A *permissive block* is one which can be occupied by two or more trains or engines proceeding in the same direction, provided that none is a passenger train. At the bottom of Fig. 6-1, a following freight train has been given a permissive block and is being permitted to enter a block occupied by another freight train. Any train given a permissive block must proceed prepared to stop short of the preceding train. Permissive block is a manual block system term and should not be confused with a permissive signal in automatic block systems. The most restrictive indication of a permissive signal is "stop and proceed", which applies to passenger trains as well as to freight trains.

BLOCKS AND SECTIONS

In the preceding discussion it was noted that modelers frequently use the term *block* when refering to an electrically-isolated, separately-controllable portion of overhead wire or rail called a *section* on the prototype. Regardless of the terminology adopted, it is important to distinguish the power-distribution function of a section from the train-control function of a block. Irrespective of outside appearance, the great bulk of locomotives on

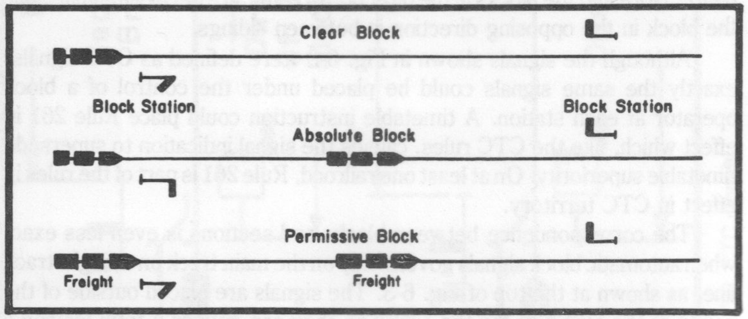


Fig. 6-1. Blocks for control of trains.

model railroads are, in fact, electric locomotives operated from power supplied via feeders to sections, just as on prototype electric railroads. Since locomotives must be able to operate everywhere on the layout, in the yards and in the engine terminal as well as on main tracks, sections must be everywhere. As described in Chapter 3, sections are used on a model not only for delivering power to the locomotives as on the prototype but also, in most cases, for independent control of the locomotives.

Prototype blocks, in contrast to sections, may not exist at all, but when they do it is only on main tracks, secondary tracks, and sidings. They are used to control trains and engines by signals. Where blocks and sections exist on the same track on the prototype, they rarely, if ever coincide. In the case of manual blocks on the model, as shown in Fig. 6-1, they probably do not coincide either.

CTC (Centralized Traffic Control) is a case where blocks exist on both main tracks and on sidings, as shown in Fig. 6-2. A timetable instruction would place CTC rules into effect on these tracks. Among other things, such rules should state that trains will be governed by block signals whose indications will supersede the superiority of trains and will take the place of train orders for both opposing and following movements on the same track. At the top of Fig. 6-2, the CTC operator has set up a meet at station B. The two trains need but follow the signal indications to make this meet.

Note that the blocks shown at the top of Fig. 6-2 in one direction do not correspond exactly with blocks in the opposite direction, nor do the blocks correspond exactly with the sections. In particular, there is only one block on the main track between sidings, yet, to permit independent switching moves at both station, it is necessary to have at least two sections between sidings.

If the distance between sidings is great (unlikely on a model), automatic block signals, called intermediate signals, may be placed between the sidings to permit following movements, as shown at the bottom of Fig. 6-2. These are true automatic block signals and are not under the control of the CTC operator except for direction of traffic. Their most restrictive aspect is stop and proceed. The signals under the control of the operator are absolute. The logical location of intermediate signals is at a section break as indicated in the figure. Note that the blocks in the direction of traffic are between signals, but the block in the opposing direction is between sidings.

Although the signals shown in Fig. 6-2 were defined as CTC signals, exactly the same signals could be placed under the control of a block operator at each station. A timetable instruction could place Rule 261 in effect which, like the CTC rules, causes the signal indication to supersede timetable superiority. On at least one railroad, Rule 261 is part of the rules in effect in CTC territory.

The correspondence between blocks and sections is even less exact when automatic block signals govern only on the main track on a single-track line, as shown at the top of Fig. 6-3. The signals are placed outside of the points of the switches for the siding so they can govern a train leaving a station from either the main track or the siding. Reversing a switch causes

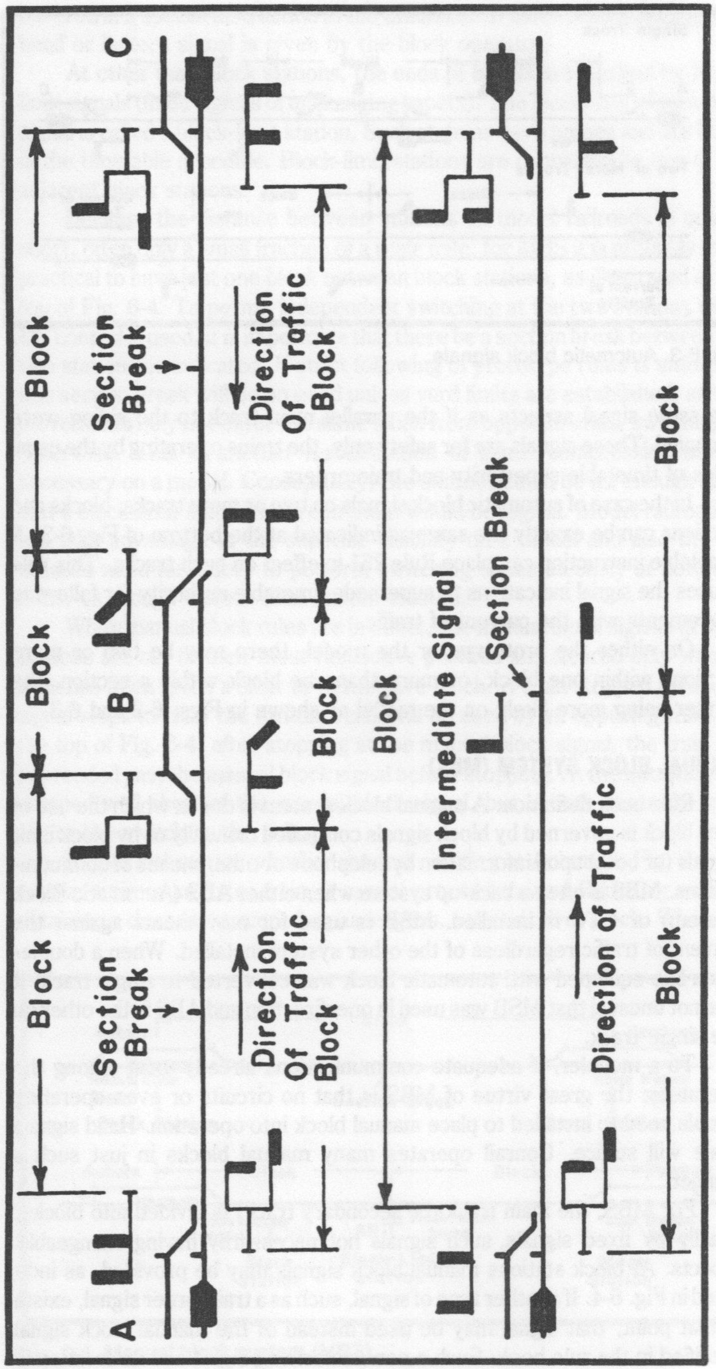


Fig. 6-2. CTC signals.

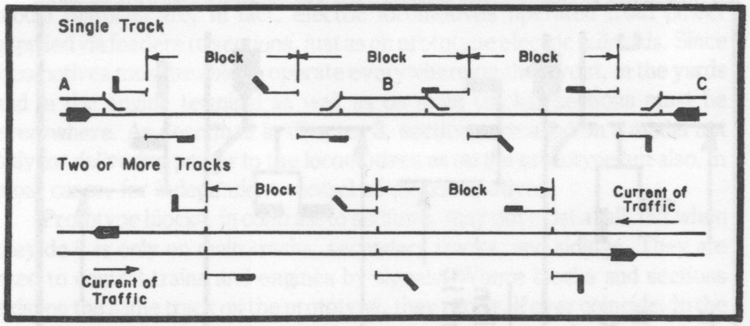


Fig. 6-3. Automatic block signals.

the same signal aspects as if the parallel main track to the siding were occupied. These signals are for safety only, the trains operating by the usual rules of timetable superiority and train orders.

In the case of automatic block signals on two or more tracks, blocks and sections can be exactly the same as indicated at the bottom of Fig. 6-3. A timetable instruction can place Rule 251 in effect on such tracks. This rule causes the signal indications to supersede timetable authority for following movements with the current of traffic.

On either the prototype or the model, there may be two or more sections within one block, or more than one block within a section, the former being more likely on the model as shown in Figs. 6-2 and 6-3.

MANUAL BLOCK SYSTEM (MBS)

Rule book definition: A manual block system is one in which the use of each block is governed by block signals controlled manually or by block limit signals (or both) upon information by telephone or other means of communications. MBS is often a back-up system when either ABS (Automatic Block System) or CTC is installed. MSB is used for movements against the current of traffic regardless of the other system installed. When a double-track line equipped with automatic block was converted to single track, it was not unusual that MSB was used in one direction and ABS in the other on the single track.

To a modeler, if adequate communications already exist among the operators, the great virtue of MBS is that no circuits or even operating signals need to installed to place manual block into operation. Hand signals alone will suffice. Conrail operates many manual blocks in just such a manner.

For MBS, the main track (or secondary track) is divided into blocks, usually by fixed signals, such signals not necessarily having changeable aspects. At block stations manual block signals may be provided, as indicated in Fig. 6-4. If another type of signal, such as a train-order signal, exists at that point, that signal may be used instead of the manual block signal specified in the rule book. Such a non-conforming signal and its location is covered in a special instruction in the timetable. If there is no fixed signal, a hand or lantern signal is given by the block operator.

At other than block stations, the ends of blocks are marked by block-limit signals (fixed signals of unchanging aspect). The location of a block-limit signal is called a block-limit station. Such stations have names and are listed in the timetable schedule. Block-limit stations are controlled by one of the adjacent block stations.

Because the distance between stations on model railroads is usually short, often only a small fraction of a scale mile, for MBS it is probably most practical to have just one block between block stations, as illustrated at the top of Fig. 6-4. To permit independent switching at the two stations when DC control is used, it is imperative that there be a section break between the two stations as indicated. If strict following of prototype rules is enforced, this section break will do no good unless yard limits are established, as two movements may not enter the same block from opposite ends, switching or otherwise. This is another manifestation of space compression always necessary on a model. Conceptually, the stations could be far enough apart that a block-limit station between them would be logical. Model railroaders can take advantage of the superior visibility on a model and also the decreased need for safety to perform switching simultaneously at both stations, as though a block-limit station existed.

When manual block rules are in effect, the manual block signals at open stations are set to their most restrictive position and cleared only when a train has been given a clear or permissive block. A train stopped by such a signal stops to clear the switch which will be used by an opposing train. At the top of Fig. 6-4, after stopping at the manual block signal, the train has proceeded past the manual block signal before stopping. At the bottom it has stopped well short of the manual block signal, but in both cases the train clears the switch to the siding.

It does not matter whether the train waiting at Auburn in Fig. 6-4 is a regular train or an extra train, it cannot proceed toward Hamburg without obtaining a clear (or, except for passengers, a permissive) block. When the

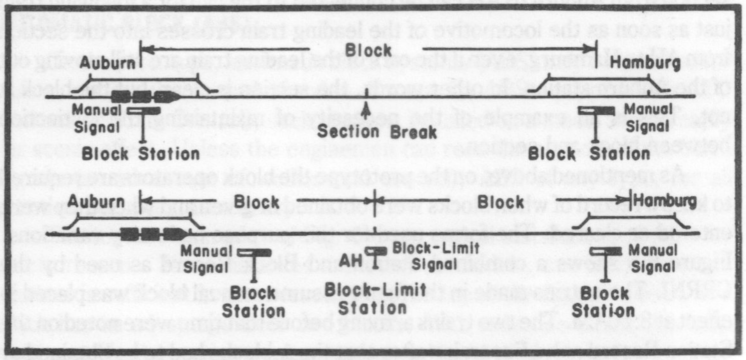


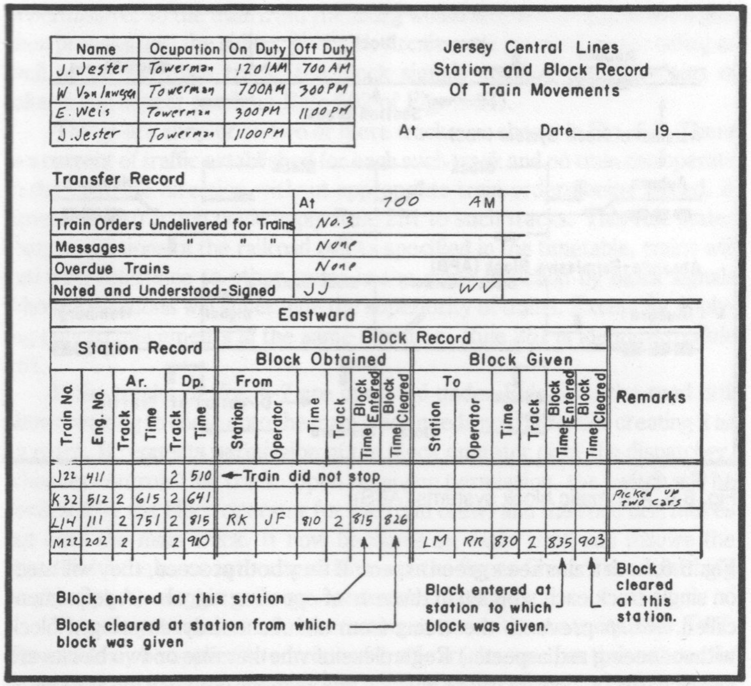
Fig. 6-4. Manual block system (MBS).

train calls for signals or the block operator otherwise knows it is ready to depart, the operator checks with the next block station to determine if the block is clear. If so, the block is placed under the control of the operator at Auburn who then clears the signal or otherwise gives the train a clear block to Hamburg. Since this clear-block signal can be given by voice or by hand signal, it is well-suited to a model. The block operator at Hamburg cannot send any train toward Auburn until the train from Auburn has arrived and cleared the block or reported itself clear at some intermediate point. The operator at Auburn, if the train was not a passenger, can give a permissive block to a following train other than a passenger. The operator at Hamburg must be informed of the following train.

There can be more than one block between block stations as indicated at the bottom of Fig. 6-4. A block-limit signal is placed at the ends of the blocks and a block-limit station name assigned, AH in the case of Fig. 6-4. The logical location for a block-limit signal is at a section break so the engines in each of the blocks can operate independently right up to the block limit. Control of the block-limit station is assigned to one of the adjacent block stations (in Fig. 6-4, assume Hamburg). Now when the train is ready to depart Auburn, the operator there checks with Hamburg to find out if the blocks are clear. If the block from Auburn to AH is clear, but that from AH to Hamburg is not, the train can be given a clear block to AH where it must contact Hamburg before proceeding. If both blocks are clear, the Auburn operator could give a clear block to AH and Hamburg, but both stations must be named when giving the clear block. Unless instructed otherwise, the train will report to Hamburg when it has cleared the Auburn-AH block.

The preceding is prototype procedure with the exception that record-keeping requirements have been eliminated. On a model, the methods can be less formal because, in most cases the operators can see if the block is clear or occupied. Also, if standard DC locomotives are operated by sections, there is inherent protection. The blocks somewhat become absolute blocks as two locomotives cannot operate independently in the same section. They are not absolute if the train is of any length. For example, the section from Auburn to AH can be connected to the cab for a following train just as soon as the locomotive of the leading train crosses into the section from AH to Hamburg, even if the cars of the leading train are still moving out of the Auburn station. In other words, the section is clear, but the block is not. This is an example of the necessity of maintaining the distinction between block and section.

As mentioned above, on the prototype the block operators are required to keep a record of when blocks were obtained or given and when they were entered or cleared. The forms used for this purpose had many variations. Figure 6-5 shows a combined Station and Block Record as used by the CRRNJ. The entries made in the figure assume manual block was placed in effect at 8:00AM. The two trains arriving before that time were noted on the Station Record only. For trains after that time, blocks had to be obtained or given as indicated.



Name	Ocupation	On Duty	Off Duty
J. Jester	Towerman	1201AM	700 AM
W Van Inwegen	Towerman	700AM	300PM
E. Weis	Towerman	300PM	1100PM
J. Jester	Towerman	1100PM	

Jersey Central Lines
Station and Block Record
Of Train Movements

At ________ Date ________ 19__

Transfer Record

	At 700 AM	
Train Orders Undelivered for Trains	No. 3	
Messages " " "	None	
Overdue Trains	None	
Noted and Understood-Signed	JJ	WV

Eastward

Station Record						Block Record												Remarks
						Block Obtained						Block Given						
		Ar.		Dp.		From				Block Entered	Block Cleared	To				Block Entered	Block Cleared	
Train No.	Eng. No.	Track	Time	Track	Time	Station	Operator	Time	Track	Time	Time	Station	Operator	Time	Track	Time	Time	
J22	411			2	510	← Train did not stop												
K32	512	2	615	2	641													Picked up two cars
L14	111	2	751	2	815	RK	JF	810	2	815	826							
M22	202	2		2	910							LM	RR	830	2	835	903	

Block entered at this station

Block cleared at station from which block was given

Block entered at station to which block was given.

Block cleared at this station.

Fig. 6-5. Prototype block record.

It would be an unusual model railroader who would desire to keep a written block record. At the Summit-New Providence HO RR Club, which operated with manual block from 1951 to 1972, the operator merely checked with the block operator in advance, then used either a hand signal or the telephone to give a clear block to the engineman. The smaller the layout, the more likely simplifications of this type will be found.

AUTOMATIC BLOCK (ABS)

On the prototype, automatic block systems (ABS) may be installed for safety, not for the control of trains. Except for ABS equipped with ATC (Automatic Train Control), such systems installed on a model are primarily for scenic effect. Unless the enginemen can read the aspects of the block signals (an advantage of walkaround control), ABS of any type, for all practical purposes, is scenery.

The top two examples of Fig. 6-6 are typical installations of ABS for safety reasons. Since distances are short on models, one block between stations is sufficient in most cases, as at the top of the figure. Indeed, one block has an advantage over two blocks. With only one block, the train waiting at Hamburg sees a yellow aspect and knows it does not have a clear route into Auburn. With two blocks between the stations, as at the middle of

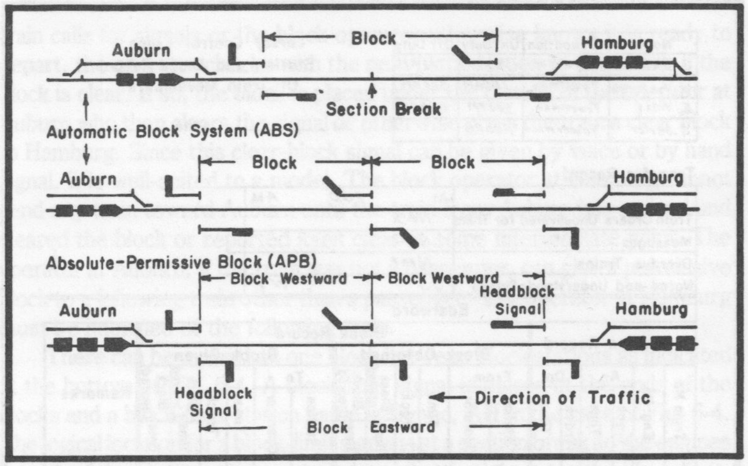


Fig. 6-6. Automatic block systems (ABS).

Fig. 6-6, both trains see a green aspect. If they both proceed, they will meet on single track each stopped in the rear of opposing signals. (A refinement called *overlap* prevents the trains from simultaneously entering a block without seeing red aspects.) Regardless of whether one or two blocks are installed, for DC control, there must be two sections between the stations to permit independent drilling at the two stations.

With ABS of the above type, all rules of superiority by class and direction apply. If the train at Hamburg is inferior to the train at Auburn, it must clear the train from Auburn. A green block signal gives no authority to proceed. It merely means that the block is clear.

At the bottom of Fig. 6-6 an automatic block system, known as Absolute-Permissive Block (APB), is shown. Such a system is capable of establishing direction of traffic depending upon which train arrives first. All signals of the opposing direction on the single track are set to red. The signal governing the entrance to the single track is absolute and is sometimes known as the *headblock signal*. With this system it does not matter which train is superior, only one will have a green signal. The opposing train must wait. A timetable instruction could apply Rule 261 to this track. This rule states that, on portions of the railroad upon tracks specified in the timetable, trains will be governed by block signals whose indications will supersede the superiority of trains for both opposing and following movements on the same track.

Note that, at the bottom of Fig. 6-6, the train from Hamburg will see a red signal as it approaches Auburn. Even if the crew of the train waiting at Auburn had reversed the switch to let the approaching train into the siding, the home signal for Auburn would not clear, as reversed switches for the siding also place the block signals protecting that block at their most restrictive aspect (in the types of systems shown in Fig. 6-6). However, this signal is permissive, so the train from Hamburg would stop to the rear of the signal then proceed into the siding. If a track circuit were installed on the siding as well as on the main track, the block signals could show some sort of take-siding aspect (such as Rule 502 of Fig. 6-14).

Things are simpler on two or more tracks, as shown in Fig. 6-7. There is a current of traffic established for each such track and no train can operate in the opposite direction without appropriate train orders being issued. A timetable instruction could apply Rule 251 to such tracks. This rule states that, on portions of the railroad tracks specified in the timetable, trains will run with reference to other trains in the same direction by block signals whose indications will supersede the superiority of trains. Except for applying only to movements in the same direction, Rule 251 is identical to Rule 261.

If the tracks of Fig. 6-7 are operated under Rule 251, the road drill shown waiting to come onto the main track needs no train order creating it as an extra. It requests permission of the block operator or of the dispatcher, whoever controls that track. Upon receiving permission, the switch will be reversed by the block operator (or the train crew) and the road drill moves out onto the main track. It now becomes an extra train and follows the signals with the same authority as if it were the Super Chief. The same thing would apply to single track operated under Rule 261.

There is yet another rule for creating extras without a train order, D97. This rule may be applied to current-of-traffic tracks, such as those shown in Fig. 6-7. If so, the road drill may still come out after receiving permission of the block operator or dispatcher (whether or not the track is signaled), but must clear the time of any regular train overtaking it.

There are other rules of the safety type governing ABS. An example is Rule 503, which states in part, that once a train has passed beyond the limits of a block it must not reenter that block without a train order. Again, safety is not a governing concern on a model. Because of that, it is entirely possible to operate a model railroad under ABS rules without any signals ever being installed. It is a rare model railroad on which some operator cannot see well enough to determine what the block signals would indicate, if they existed. Since the only purpose of block signals on the prototype is to provide such information to enginemen, except for scenic effect, on a model operation with or without signals could be identical. If the enginemen were so located that they could not read the signals, some other operator would have to relay

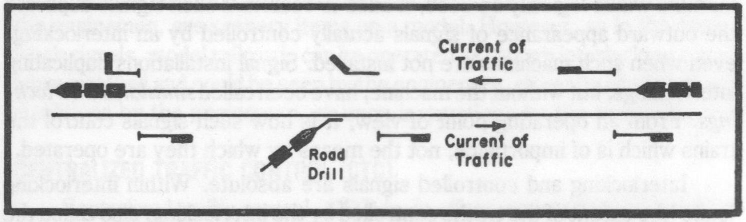


Fig. 6-7. Automatic block on two (or more) tracks.

the information in any event. An alternative is to mount a track diagram which can be seen by all enginemen. The aspects of all trackside signals then could be displayed on this diagram. If the trackside signals were of more than one type, for example position light on one part of the layout and color light on another part, it would seem best to install standardized repeater units on the track diagram so the aspects displayed would be uniform. The Sacramento Model RR Club had just such a diagram board for its trackside signals.

If the automatic block system were fitted for automatic train control (ATC), then the trains could be slowed or stopped automatically by the block system. Such a system could be useful when unattended trains were to be run on the line. But, if each train has an engineman, it is of questionable value to install ATC. A good general rule is that prototype jobs should not be replaced by automatic control unless required by the limitations of manpower.

INTERLOCKING AND CONTROLLED SIGNALS

Wherever routes diverge or intersect, signals may be installed to control the movements of trains and engines. Such signals may indicate the route a train is to take, *route signals*, or the maximum speed permitted on the route lined, *speed signals*. Route signals are the older and speed signals the more modern. On simple interlockings, and seldom does a model railroad need more than that, the differences between route and speed aspects are not significant.

Controlled signals may be set by an operator relying upon the operator to assure that the movement permitted is safe. At busy or important locations, the prototype often installed interlocking machines which guaranteed a safe sequence of operation. For example, the home signal had to be set to stop before a switch on the route protected by that home signal was changed. Some modelers have built operating interlocking machines, both mechanical and electrical, but they are the exceptions. The advent of microprocessors and integrated circuits may, however, change that picture in the future. In 1977, Bill Ridgway was working out the details for a microprocessor to handle all the block signals and all the interlockings at The Model RR Club. At the time of writing, this complete system promised to be more simple than the conventional circuits required to operate the block signals only.

If signals are installed on a model at points where an interlocking machine would logically be used, it adds to realism if such signals duplicate the outward appearance of signals actually controlled by an interlocking, even when such machines are not installed. Signal installations duplicating interlockings, but without the machine, have been called *simulated interlockings*. From an operating point of view, it is how such signals control the trains which is of importance, not the means by which they are operated.

Interlocking and controlled signals are absolute. Within interlocking limits (the extent of the tracks controlled by the interlocking, also called the *plant*), the signals supersede timetable authority of trains. The variety of interlocking signals and how they are used is enormous and cannot be covered in a book devoted to operation.

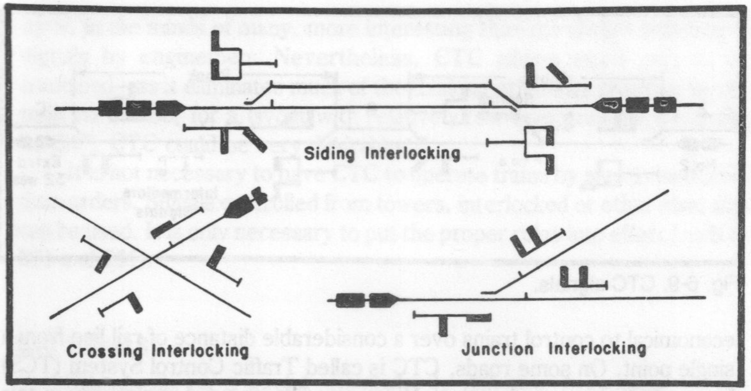


Fig. 6-8. Interlocking signals.

Figure 6-8 shows some typical application of interlocking signals. At the top, interlocking signals control the entrances and exits of a siding and paralleling main track. An obvious advantage of these interlocking signals over automatic block of the types shown in Fig. 6-4 is that the approaching train can enter the station on either the main track or siding (provided the signals are so set) without first stopping at the home signal.

Also shown in Fig. 6-8 are interlocking signals to protect a crossing and to control a junction. The crossing lends itself well to automatic interlocking. At an automatic interlocking, all signals are set to stop initially, the first train approaching will clear its route. A second train is held until the first train clears the crossing.

If an interlocking is in ABS territory, the interlocking signals usually display automatic block signal aspects also. Interlocking signals, on some roads, are normally kept at stop until cleared for a movement and automatically return to stop when a train passes. The signals remain at stop until cleared by the block operator for another movement. Such interlockings are called *stick interlockings*. On other roads, as long as the route is lined, the signals clear in block-signal fashion. Such interlockings are called *non-stick*. On a model, non-stick interlockings have the advantage that any operator observing the signals can determine that a route has been lined and is clear.

Interlocking and controlled signals, unless their aspects can be seen by the enginemen, are scenery items on a model. However, as in the case of block signals, model railroads can be operated as though interlocking signals were installed and could be seen by the enginemen, either by observation of conditions by the enginemen, or upon instructions by the towermen.

CENTRALIZED TRAFFIC CONTROL (CTC)

Centralized traffic control (CTC) is, in effect, an interlocking machine, called a CTC machine, equipped with transmission systems which make it

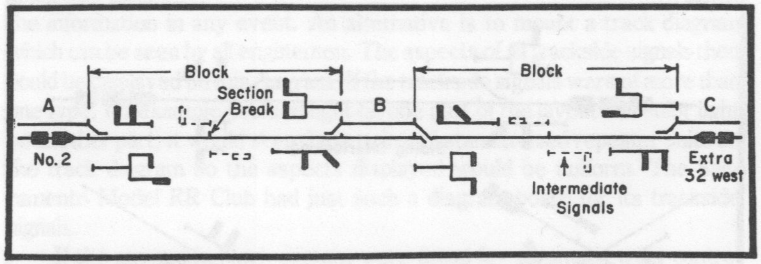


Fig. 6-9. CTC signals.

economical to control trains over a considerable distance of rail line from a single point. On some roads, CTC is called Traffic Control System (TCS) because CTC is a trade name. However, CTC is used exclusively in this book, as it is the term most commonly used by modelers.

The CTC machine may be operated directly by the train dispatcher or a CTC operator working under the direction of the dispatcher. The essential part of CTC, as far as a modeler is concerned, is that trains operate in accordance with signal indicatitns. There is no authority by timetable and train orders are not required except for special movements which cannot be handled by CTC.

In Fig. 6-9, a meet has been established between No. 2 and Extra 32 west at station B. The signals and the switches were set to the positions indicated by the CTC operator. There are, however, CTC installations in which the train crews throw the switches in response to signals. Both trains accept the clear indication of the signal in front of them and proceed toward station B. As a general rule CTC signals are absolute, but automatic block signals, called intermediate signals and shown dashed in Fig. 6-9, may be installed between CTC signals to permit following movements into the CTC block between stations. Such signals are permissive. On a model, the logical lcoation for intermediate signals would be at the section breaks as indicated. When DC control is used, it is necessary to have at least two sections between stations to permit independent drilling at the stations.

If some sort of automatic train control (ATC) system were installed, the trains could be made to obey CTC signals without the need for enginemen on the trains. If there is an engineman controlling each train, such automatic operation is not likely to increase the interest of those enginemen. But, to obey the signals, enginemen must be able to read the aspects. With walkaround control, reading wayside signals is possible. For other types of controls, those described in the following discussion, CAB SIGNALS, are a solution. The Sacramento Model Railroad Club mounted a large track diagram where it could be seen by all enginemen. The aspects of all wayside signals were repeated on that diagram.

As described in Chapter 8, CTC aspects are a powerful means of communication on a model railroad. The need for train orders from the dispatchers to block operators and train crews is all but eliminated. This is not an unmixed blessing. Train operation by rules, timetables, and superiority is, in the minds of many, more interesting than the simple following of signals by enginemen. Nevertheless, CTC allows more jobs to be combined—as it eliminates much of the thinking otherwise required by the train crews. So, for a layout with relatively few operators for the traffic handled, CTC could be very desirable.

It is not necessary to have CTC to operate trains by signals instead of train orders. Signals controlled from towers, interlocked or otherwise, also can be used. It is only necessary to put the proper rules into effect (such as 251 and 261).

CAB SIGNALS

Cab signals on a model are distinctly different from those on the prototype. A model engineman is vitally concerned whether his locomotive can enter the next section, a matter which is of no interest on most prototype railroads. Indeed, on a model, this information is as important in yards as on main tracks—yet prototype cab signals do not operate in yards.

All known installations of cab signals on a model have been based on showing the status of the sections ahead of the cabs. An elementary system is shown in Fig. 6-10. If ahead of a locomotive there is an available section, the cab signal is green. If there is no such idle section, the cab signal is red. A problem with this (and most other simple systems) is that the red signal is displayed immediately upon detecting that a next section is not available. At the bottom of Fig. 6-10, the locomotive has a complete section to run through before it must stop. In some simple systems, the red signal is displayed when there are almost two complete clear sections ahead of the locomotive. This is acceptable, provided the engineman can see the section breaks and knows exactly which section break can be approached before stopping.

More desirable would be a cab signal which could indicate that the proper stopping point had been reached. Three methods to this end have been used and are shown in Fig. 6-11. At A, a track circuit detects that the

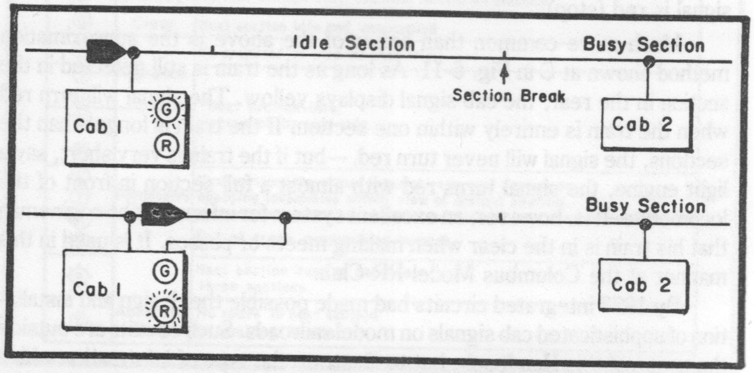


Fig. 6-10. Elementary cab signals.

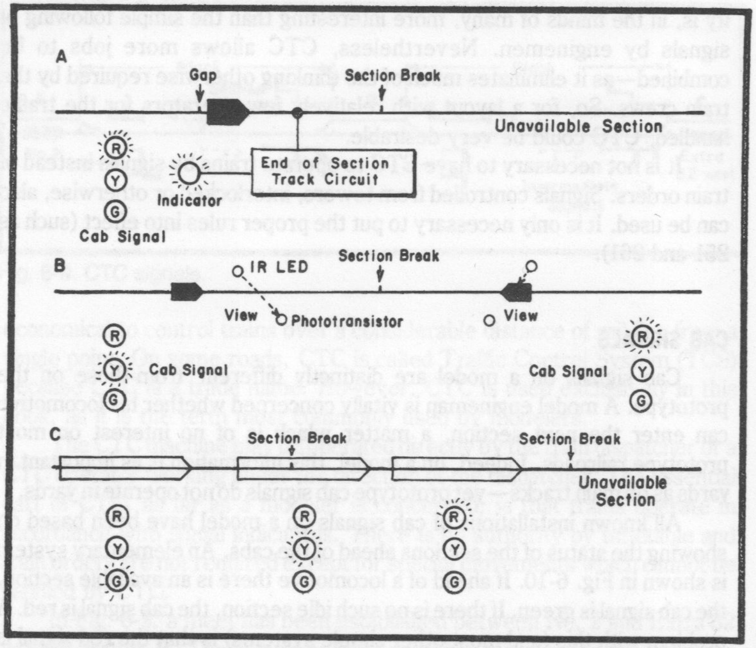


Fig. 6-11. End-of-section indicators.

locomotive is approaching the section break and lights an indicator in the cab. At B is a method developed by Bill Jambor. An optical detector is placed a distance before the section break at the *view*, so called as it is the point where the enginemen will view the aspect of the imaginary signal standing at the section break. In Fig. 6-11B, both locomotives are approaching an imaginary signal displaying red. The locomotive on the left has not yet reached the view, so its cab signal is yellow (run prepared to stop at the next view). The locomotive on the right has already reached the view, so its cab signal is red (stop).

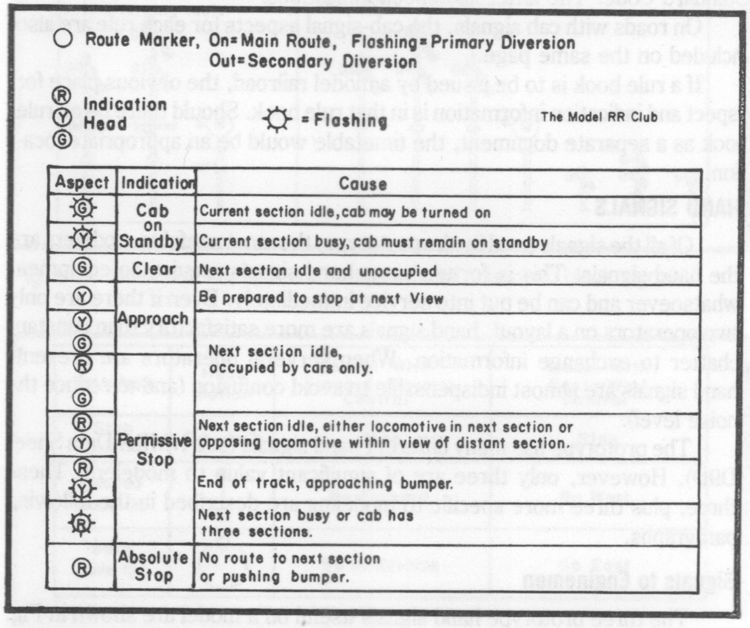
Much more common than either of the above is the approximation method shown at C in Fig. 6-11. As long as the train is still detected in the section in the rear, the cab signal displays yellow. The signal will turn red when the train is entirely within one section. If the train is longer than the sections, the signal will never turn red,—but if the train is very short, say a light engine, the signal turns red with almost a full section in front of the locomotive. It is, however, an excellent system for informing the engineman that his train is in the clear when making meets or passes. It is used in this manner at the Columbus Model RR Club.

By 1977 integrated circuits had made possible the design and installation of sophisticated cab signals on model railroads. Such circuits are outside the scope of this Handbook, but to illustrate the type of information which can be provided by cab signals, Fig. 6-12 shows the aspects and indications of the sysem installed at The Model RR Club. This system uses the Jambor view shown in Fig. 6-11B.

At the beginning of this section, it was stated that, in all known cases on a model, cab signals display the state of the next section. This means such signals are section signals rather than block or interlocking signals. When the cab signals shown in Fig. 6-12 were developed as part of a computer cab control system, considerable effort was made to include separate cab signals showing interlocking and block signals. However, since blocks and sections, are (in general) not identical, it proved complex and expensive to display signals based on blocks by a cab-control system which must, of necessity, operate by sections. Further, after the section cab signals were developed, it was found they also provided virtually all the information which could be obtained from block and interlocking signals. Figure 6-13 includes several comparisons of the aspects of the cab signals of this system with the aspects of the wayside signals.

RULE BOOK ASPECTS AND INDICATIONS

There has always been a great variation among railroads of the aspects displayed by fixed signals. In addition, the indication associated with a particular aspect is not necessarily the same from railroad to railroad. Even on a single railroad the indication associated with a particular aspect may change with time. It is in the rule book that the indications are defined for the standard aspects found on a particular railroad. Non-standard indications or



○ Route Marker, On=Main Route, Flashing=Primary Diversion
Out=Secondary Diversion

Ⓡ Ⓨ Ⓖ Indication Head

☼ = Flashing

The Model RR Club

Aspect	Indication	Cause
☼Ⓖ	Cab on Standby	Current section idle, cab may be turned on
☼Ⓨ		Current section busy, cab must remain on standby
Ⓖ	Clear	Next section idle and unoccupied
Ⓨ	Approach	Be prepared to stop at next View
Ⓨ Ⓖ		Next section idle, occupied by cars only.
Ⓡ Ⓖ	Permissive Stop	
Ⓡ Ⓨ		Next section idle, either locomotive in next section or opposing locomotive within view of distant section.
Ⓡ ☼Ⓨ		End of track, approaching bumper.
☼Ⓡ		Next section busy or cab has three sections.
Ⓡ	Absolute Stop	No route to next section or pushing bumper.

Fig. 6-12. Example of model cab signals.

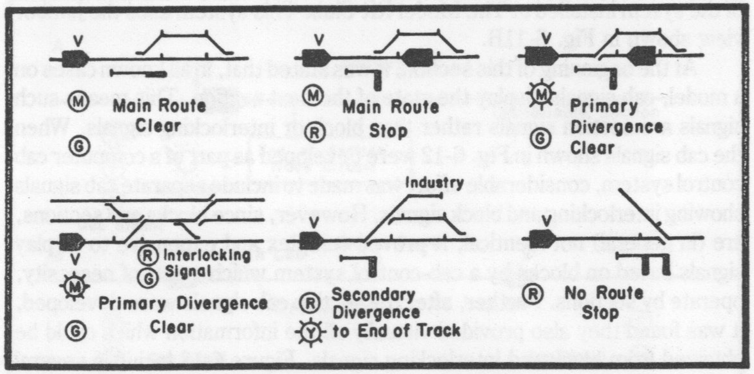


Fig. 6-13. Block and interlocking signals vs. cab signals.

aspects (i.e., different from those in the rule book) are covered in the special instructions of the timetable. Railroads such as Conrail have many different types of signals, so this section of the rule book may be quite involved. As a simple example, Fig. 6-14 shows the automatic block signals as included in the 1932 rule book of the Western Pacific. As actually published, the diagrams were twice the size shown and were printed with red, yellow, and green in the areas indicated by R, Y, and G in the figure. The indications given are route indications and do not correspond with the indications of the Standard Code. The latter are speed indications.

On roads with cab signals, the cab-signal aspects for each rule are also included on the same page.

If a rule book is to be issued by a model railroad, the obvious place for aspect and indication information is in that rule book. Should there be no rule book as a separate document, the timetable would be an appropriate location.

HAND SIGNALS

Of all the signals used by the prototype, the most useful to modelers are the hand signals. This is fortunate, as hand signals require no equipment whatsoever and can be put into service immediately. Even if there are only two operators on a layout, hand signals are more satisfactory than constant chatter to exchange information. When serveral operators are present, hand signals are almost indispensable to avoid confusion (and to reduce the noise level).

The prototype has many different hand signals (see NMRA Data Sheet D9D). However, only three are of significant value to modelers. These three, plus three more specific to modeling are described in the following paragraphs.

Signals to Enginemen

The three prototype hand signals useful on a model are shown in Fig. 6-15. *Stop* (Rule 12a) is a horizontal motion. *Proceed* (Rule 12c) is a vertical

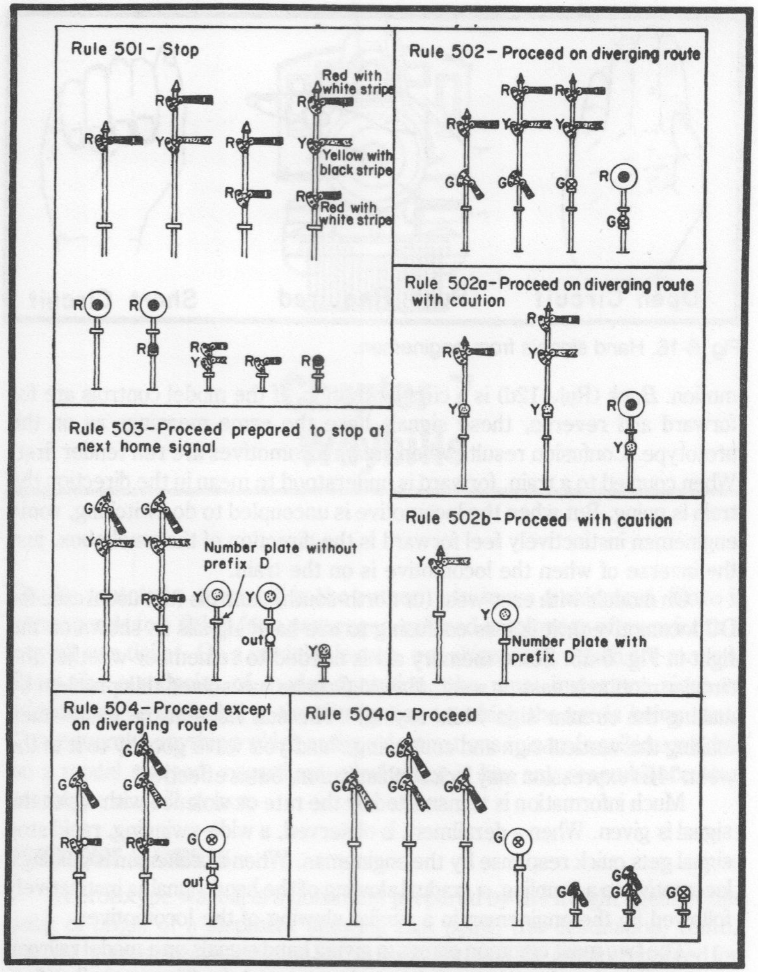
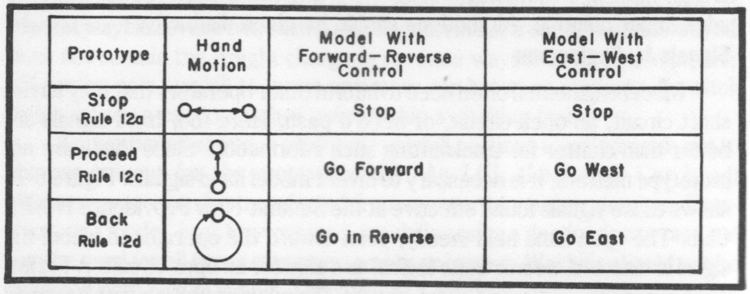


Fig. 6-14. Rulebook aspects and indications of automatic block signals.



Prototype	Hand Motion	Model With Forward–Reverse Control	Model With East–West Control
Stop Rule 12a		Stop	Stop
Proceed Rule 12c		Go Forward	Go West
Back Rule 12d		Go in Reverse	Go East

Fig. 6-15. Hand signals of enginemen.

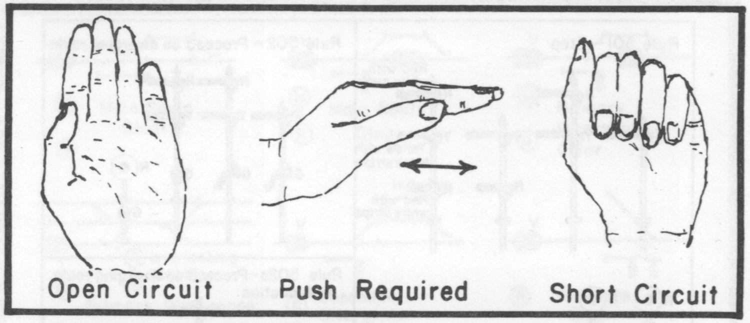


Fig. 6-16. Hand signals from enginemen.

motion. *Back* (Rule 12d) is a circular motion. If the model controls are for forward and reverse, these signals have the same meanings as on the prototype. Confusion results when steam locomotives are run tender first. When coupled to a train, forward is understood to mean in the direction the train is going. But when the locomotive is uncoupled to do switching, some enginemen instinctively feel forward is the direction of the smokebox, just the inverse of when the locomotive is on the train.

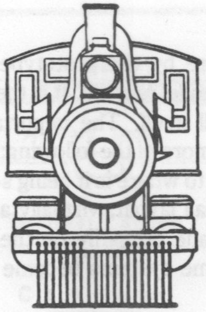
On models with east-west (or north-south) controls (the usual case for DC locomotives), it is less confusing to use hand signals as shown on the right in Fig. 6-15. Some memory aid is needed to remember whether the circular motion is east or west. Harold Greene has solved this problem by making the circular sign while saying, "The sun rises in the east," then making the vertical sign and continuing, "and you wave goodby to it in the west." His expression may lack sophistication, but is effective!

Much information is transmitted by the rate or violence with which the signal is given. When a derailment is observed, a wide-swinging, rapid stop signal gets quick response by the engineman. When a brakeman is guiding a locomotive to a coupling, a gradual slowing of the hand signal is instinctively followed by the engineman in a similar slowing of the locomotive.

The two most common errors in giving hand signals on a model railroad are not directing them toward the engineman and the "limp wrist". When viewed from the side, it is difficult to distinguish a vertical motion from a circular motion. Bruce Chubb suggests giving the circular motion with the index finger pointing. All motions should be given distinctly.

Signals by Enginemen

Model enginemen often need to inform other operators that they have a short circuit, an open circuit, or need a push. Here too, hand signals are better than chatter for transmitting such information. Since these are not prototype matters, it is necessary to invent model hand signals. Figure 6-16 shows those signals found effective at the Summit-New Providence HO RR Club. The open hand held steady, palm toward the operator to whom the signal is directed, seems quite logical as a sign for an open circuit. A fist is a good contrast to indicate a short circuit. The pushing motion with a cupped hand to request a push also is quite logical and easily remembered.



Chapter 7
Waybills

On the prototype, a waybill is the authority to move a shipment. Since it corresponds to a ticket for a passenger, railroad employees often refer to a waybill as a ticket. On a model it is cars, not shipments, which are moved. From the standpoint of model operation, the most important piece of information on a waybill is the destination to which the car is being sent. Consequently, anything which assigns destinations to cars is called a waybill on a model railroad, regardless of whether it has any resemblance to a prototype waybill or not.

PROTOTYPE WAYBILLS

A prototype waybill is a document prepared by the freight agent at the point of origin of a shipment showing that point, the destination, route, shipper, consignee, description of the shipment, and the amount charged for transportation services. A live-stock waybill is a special waybill for shipments of animals, with the waybill including instructions for feeding and watering. A local waybill covers movement over two or more railroads. A blanket waybill covers two or more consignments of freight. A memo waybill does not contain the freight charge; a revenue waybill does. An empty-car bill serves as a waybill to move an empty car between stations. A switch order moves a car to another point within switching limits.

As mentioned above, a prototype waybill pertains to a shipment, not to the car (except for the empty-car bill). An LCL (Less than Car Load) shipment may even be transferred from one car to another enroute. However, on a model, in all known cases, waybills assign a destination to cars and may be used for all types of moves, empty or loaded. Waybills should not be confused with bills of lading. The latter is a contract given to the shipper in exchange for a shipment received by the railroad.

MODEL WAYBILL SYSTEMS

The paperwork require by the prototype waybill system makes it inappropriate for use on a model railroad. It is the effect of the waybill which is desired, not the waybill itself. The important information for model application includes one or more of the following: the present location of the car, when it can be moved, to where is it being sent, and whether the car is empty or loaded. On a small layout, virtually any system of waybills will work, the choice being made primarily on the desires of its owner. As layouts become larger, some systems become more difficult to use than others.

On the prototype when a car is ordered to be moved, the movement itself takes place any time after the car is ready for shipment. It is then up to the railroad to place it in an appropriate train. A model waybill system can be shipper-oriented in this manner. In such a case, the waybill does not specify a particular train, that being part of the operation of the railroad. In contrast, many model waybill systems are train-oriented, that is, the waybill specifies a particular train which will move the car. Such systems simplify operations by eliminating the step of assigning the cars to a train.

Categories of Waybill Systems

As shown in Fig. 7-1, there are five major categories of waybill systems: Card Order; Ticket; List; Waybill on Car; and Computer. At A is the card-order system popularized by Frank Ellison. In this category, a permanent record, usually either a card or an envelope, is provided for each car and remains associated with that car at all times. The major problems of systems of this type are related to moving the records and of finding them if the cars and their records become separated. To avoid the problems associated with a permanent record for each car, Roy Dohn, in 1960, introduced what is called here the *ticket* system, shown in Fig. 7-1B. When a car is to be moved, a temporary record is made for that car. The operation then proceeds as in the card-order system except, when the car is delivered to its destination, the ticket is discarded.

In 1951, the Summit-New Providence HO RR Club started waybill operation. As the configuration of their layout made the movements of cards or other records with the cars difficult, the only waybill system known at that time, they developed the *list system* shown at C in Fig. 7-1. The instructions for the movement of a car were written on a *switch list* at the station where the cars originated. When the car was placed in a train, that information was transferred to the engineman by telephone and entered on the *consist report*. At the destination station, the information again was transmitted by telephone and entered onto the switch list of that station. This system was later used by others with the consist report being carried by the train crew. It is also possible to use preset lists which eliminate the need for writing and transmitting information.

Starting about 1962, several systems were developed in which the waybill is placed directly on the car at the point of origin and removed at the destination. In terms of the number of cars which can be moved, this is the most efficient system developed by 1977, particularly for large layouts. Even systems which use other forms of waybills may use markers on the cars while switching in the yards.

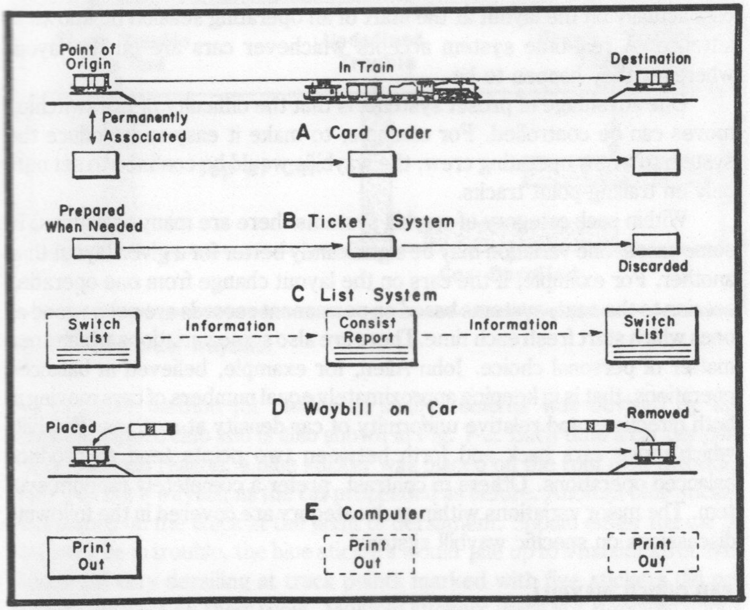


Fig. 7-1. Categories of waybill systems.

Beginning about 1970, various techniques using a computer to assist waybill systems were devised. As of 1977, this was a rapidly-developing field, but computer systems in use or being developed were really list systems or waybill-on-car systems with the computer doing the paper work. The minimum, as shown by the solid-outline print-out in Fig. 7-1E is a list for placing waybills on cars, but the computer can also print out consist reports and lists of cars to be received at the various points, as indicated by the dashed-line print outs. Obviously for a computer system, access to a computer is required.

Preset vs. Real Time

The categories shown in Fig. 7-1 divide waybill systems on the basis of how the waybill is handled. Waybill systems can also be distinguished by when the directives for car movements are prepared. In some systems, all work is done at the time the operators gather and may continue throughout the operation session. Borrowing a computer term, in this Handbook such systems are called *real-time* systems. Other systems depend upon preparations made in advance of the operating session. Here such systems are called *preset systems*. Some preset systems require that the identify of the cars actually on the layout at the start of an operating session be known in advance. A real-time system accepts whichever cars are on the layout wherever they happen to be.

One advantage of preset systems is that the difficulty of the switching moves can be controlled. For example, to make it easy to introduce the system to a new operating crew, the waybills would be confined to set outs only on trailing-point tracks.

Within each category of waybill systems there are many variations. In some cases, one variation may be significantly better for a given layout than another. For example, if the cars on the layout change from one operating session to the next, systems based on permanent records are not as good as ones which start fresh each time. There are also some variations which are a matter of personal choice. John Allen, for example, believed in balanced operations, that is in keeping approximately equal numbers of cars moving in both directions and relative uniformity of car density at stations. Waybills which move cars back and forth between two points tend to produce balanced operations. Others in contrast, prefer a completely random system. The major variations within each category are covered in the following discussions on specific waybill systems.

BAD-ORDER WAYBILL

Regardless of how well cars are checked before they are placed on the railroad, it is likely that some car will develop difficulties during an operating session. To identify this car for future repair work, the original waybill taking it to a destination can be replaced by a bad-order waybill. Regardless of the waybill system in use, the best form of bad-order waybill is one which will adhere to the car even when it is picked up and handled, but which can be readily removed after the repair has been completed. If the bad-order car can still be either pushed or pulled it makes an interesting operating feature if the bad-order waybill takes the car to the nearest bad-order track.

Ed Ravenscroft used a white adhesive label and wrote the trouble information on the label. Another waybill which has been used successfully is a blue wire marker of the type described in a later paragraph, Colorful Operation. Blue is an appropriate color; as a blue flag set out by workmen in or under cars indicates that the car should neither by coupled to nor moved (Rule 26). These blue stickers can be placed on the car in a position code to indicate the nature of the trouble. The code once used by the Summit-New Providence HO RR Club is shown in Fig. 7-2. Coupler trouble was indicated by a blue sticker placed lengthwise at the appropriate end and truck trouble by a sticker placed crosswise over the truck in trouble. Other troubles, or generally poor operation, were denoted by a sticker placed crosswise at the center.

Derailments

If the track and the cars are in good condition, derailments will be infrequent, therefore a trouble spot in the track or a car which derails on occasion will be hard to uncover just by observing and trying to remember.

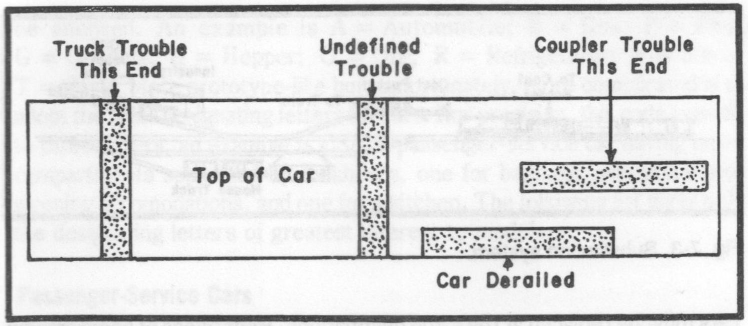


Fig. 7-2. Bad-order waybills.

An effective method for disclosing such problems was devised by the aforementioned club and is also shown in Fig. 7-2. Each time a car derailed for no obvious reason, a blue sticker was placed on the roof near the side. This was not a waybill, as the car proceeded as before. Another blue sticker was placed on the track at the point of derailment. Should either the car or the track be in trouble, the blue stickers would pile up to a maximum of five. Additional cars derailing at track points marked with five stickers did not receive stickers on their roofs. Multiple stickers were not removed until a check was made of the car or track. Single stickers were removed at intervals, the interval depending upon experience. As the track and cars get better, it is necessary to leave single stickers in place longer to catch a repeat of the trouble.

SUBSTITUTION SYSTEM

Throughout this Handbook, it is recommended that operation be introduced on a model railroad one step at a time. This applies to a waybill systems. Since the execution of any waybill system involves switching moves, an excellent step leading to the introduction of waybills is the substitution system, as it will force the planning and execution of switching moves without simultaneously introducing the problems of a waybill. With the substitution system, the requirements placed on the switching can be made more and more difficult as skills increase.

Trains are made up as desired but, usually with, at least one car of each type required to satisfy the destinations available on the layout. When a train arrives at a station, cars in the train are substituted for cars standing at the station. Initially, switching should be kept simple, perhaps just a single car substituted for a car on a trailing-point spur. In Fig. 7-3, the operator has decided that one hopper car in the train is to be substituted for the most-available hopper car on the coal pocket. As the operators become more skilled, more cars can be required to be substituted at each station stop, facing-point spurs can be worked (the oil depot in Fig. 7-3 for example) and the substitutions made for the cars nearest the bumping posts. If cars spotted at destinations must be pulled to reach a car to be picked up, those

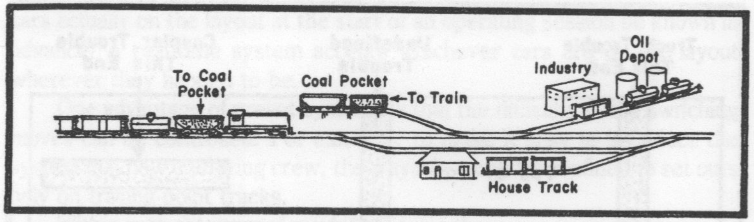


Fig. 7-3. Substitution system.

cars must be replaced at the same destinations. Regardless of how complex substitution becomes, neither the trains nor the stations will run out of cars.

SINGLE-STATION SWITCHING

Another interim step before true waybill operation is switching on a single-station basis. In this system, a list is created of the car types to be placed in each train. Such a list can be just the number of cars of each type, as shown in Fig. 7-4, or a list of cars in the order they should appear in the train. The latter would approximate a prototype *consist report* (also called a *wheel report*). The train is the made up to fill the list using any available cars of the specified types.

At each station on the route the pick ups and set outs are listed. In Fig. 7-4, Train 1 is to set out a box car on the house track and pick up a box car from the industry track at the way station. If a choice of cars exists, as it does in Fig. 7-4, the choice is made by the operator involved.

The single-station system has the advantage that any cars can be placed on the layout as long as a sufficient number of each type are put where they are needed for pick up or to be made into trains. Since cars need only be identified by type, the problem of reading reporting marks is eliminated. This is valuable for small scales such as N.

CAR IDENTIFICATION

For a true waybill system, each car has a point of origin and destination. To assure that the car makes its preplanned move, it must be identifiable at all time. In the larger scales it is usually practical to identify cars using the prototype method, that is, by reporting marks (the car initials showing its owner and the car number). Desirably, each car of the same type and owner should have a different car number. Unfortunately, manufacturers typically supply each type of car with just one number for a particular owner. Therefore, especially at a club, there may be more than one car identical in all respects on the layout. An obvious solution is to modify the car numbers. But, in waybill-on-car systems, this may not be necessary. Some waybill-on-car systems, however, do require that when operation starts cars with identical reporting marks not be on the same originating track.

In any scale it is better if freight cars are identified by type as well as reporting marks. A simple, easily-remembered set of type abbreviations can be adopted. An example is A = Automobile; B = Box; F = Flat; G = Gondola; H = Hopper; O = Ore; R = Refrigerator; S = Stock; T = Tank. More prototype-like but, unfortunately, more complicated is to adopt the AAR designating letters for cars. For precision, this code uses up to three letters, an example is CSA, a passenger-service car having three compartments separated by bulkheads, one for baggage, one fitted with sleeping accomodations, and one for a kitchen. The following list gives only the designating letters of greatest interest to modelers.

Passenger-Service Cars

Class B–Baggage and Express Cars

BE–Baggage Express
BH–Horse Express
BP or BR–Refrigerator Express
BX–Box Express (Box car fitted for passenger service).

Class C–Combination Cars

CA–Baggage and Passenger Combine

Class D–Dining, Buffet, or Cafe Cars

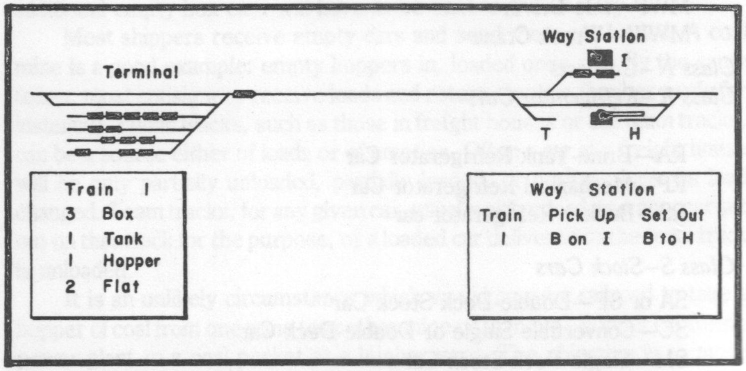
Class E–Electric Cars

Class M–Mail Cars

MA–Railway Post Office
MB–Baggage and Mail
MR–Postal Storage Cars

Class P–Passenger Cars

PB–Coach
PC–Parlor Car
PL–Lounge Car



Train	1
3	Box
1	Tank
1	Hopper
2	Flat

Way Station		
Train	Pick Up	Set Out
1	B on I	B to H

Fig. 7-4. Station-oriented operation.

PO—Observation Car
PS—Sleeping Car
PV—Private or Business Car

Freight-Service Cars

Class F–Flat Cars
FC—Flat Car for trucks and trailers
FD—Depressed-Center Flat Car
FL—Logging Car
FM—General-Service Flat Car
FW—Well-Hole Flat Car

Class G–Gondola Cars
GA, GE, GH, GRA, and GS—Drop-Bottom Gondola
CB—Mill Gondola
DG—Side-Dump Gondola
GT—High-Side Gondola

Class H–Hopper Cars
Several designations depending upon arrangement of the hoppers.

Class L–Special Cars
LF—Flat Car for containers
LG—Gondola Car for containers
LP—Pulpwood Car
LT—Tank Car for dry power or granuals

Class M–Maintenance-Of-Way Cars
MWB—Ballast Car
MWE—Ballast Spreader
MWF—Flat Car
MWK—Snow-Removal Car
MWP—Pile Driver
MWW—Wreck Crane
Class N–Cabooses
Class R–Refrigerator Cars

RA—Brine-Tank Refrigerator Car
RP—Mechanical Refrigerator Car
RS—Bunker Refrigerator car

Class S–Stock Cars
SA or SF—Double-Deck Stock Car
SC—Convertible Single or Double-Deck Car
SM—Single-Deck Stock Car
SP—Poultry Car

Class T–Tank Cars

Class V–Ventilator Cars

Class X–Box Cars
XAR or XMR—Automobile Car
SM—General-Service Box Car

Class Y–Yard-Service Cars
YA—Car-Dropper's Car
YM—Poling Car

In the smaller scales (such as N) it is difficult to read reporting marks; further identification by car description may be helpful. Color and visible features can be used to this end. A box car, red, with outside bracing could be noted as B-R-OB. If the number of cars is not too great, such a system could give a unique description to each car without the need for reporting marks.

EMPTIES AND LOADS

The railroads make their money by carrying freight from a shipper to a consignee. In some cases a consignee will reload the same cars and serve also as a shipper. An example was a television plant near Syracuse, NY which received carloads of cabinets, then reloaded the same cars with completed television sets. Other manufacturers may receive loads in one type of car and return those cars as empties, while receiving another type of car as empties and shipping them loaded. A case in point is an automobile plant receiving gondolas of steel and box cars of parts and other materials, then shipping its product in automobile cars. Even when the same type of car is used both for shipping and receiving, there may be an imbalance. A furniture factory may receive box car loads of wood and ship box cars of furniture. But, the furniture takes far more space than does the wood, so additional empty box cars will have to be sent to that factory.

Most shippers receive empty cars and send them out loaded. A coal mine is a good example: empty hoppers in, loaded ones out. By the same token, most consignees receive loads and return empties (lumber yards for instance). Public tracks, such as those in freight houses or the team tracks, can be a source either of loads or of empties. Often a car at a freight house will be only partially unloaded, partially loaded, or perhaps have its load changed. Team tracks, for any given car, usually either load an empty car set out on that track for the purpose, or a loaded car delivered to the team track is unloaded.

It is an unlikely circumstance which would cause a railroad to take a hopper of coal from one mine to another mine or to move a hopper car from a power plant to a coal pocket at a lumber yard. The objective is to move loaded cars as rapidly as is practical from shipper to consignee. Empty cars, on the other hand, often make moves other than to a shipper for a load. A drill may pick up an empty box car at a lumber yard to take it to the temporary storage tracks so it will be available when needed. The car distributor may concentrate empty cars of a particular type for an anticipated need.

Some car movements will be made depending upon whether the car is loaded or not. Only loaded cars use the track scale. An empty refrigerator car being delivered to a packing plant will first make a stop at the icing platform, an empty refrigerator car leaving a produce terminal for storage will not make a stop at the icing platform.

Whether cars are empty or loaded has a great deal to do with the motive power required, particularly if heavy grades are involved. The length of trains may also be affected. John Allen even required locomotives pulling more than a given number of loaded cars to make an extra water stop on a long grade.

On a model, a true waybill system will take a car from a shipper to a consignee or cause it to make some other prototype-like move. Some model waybill systems distinctly mark the difference between loaded and empty cars. Others do not. These latter systems depend upon the point of origin and of destination to make that apparant. A hopper car sent from a coal mine to the coaling tower at the engine terminal is obviously loaded. A car sent in the opposite direction is obviously empty. Any car sent to or from storage must be empty. This system is not foolproof, however. Is a box car being delivered to a furniture factory a load of wood coming in, or an empty for furniture going out?

For a shippper-consignee car movement to take place entirely on a layout, there must be both a shipper and a receiver of a single commodity actually modeled, for example a coal mine and a coal-burning power plant. Such complementary pairs are possible, but even on the largest of layouts, they cannot be provided for all possible shipments unless the cargoes moved are greatly restricted. Any shipment, however, can be received from or delivered to a foreign railroad via interchange. Further, if only part of the railroad is modeled, shipments can be carried to and from distant imaginary points by the through freights.

Once a car leaves its point of origin, the way it is handled depends entirely upon its destination. This leads to a simplifying assumption that only the destination need be specified, the car starting its move wherever it happened to be. Systems making this assumption are in use. With them, it is likely that a car will originate at one shipper and be sent to another shipper, e.g., from a coal mine to another coal mine, or originate as an empty car, as from a yard, and be sent to a consignee who receives only loads, such as a lumber yard. These systems, like the substitution system, are useful but cannot be regarded as true waybill systems.

One fundamental difference between model and prototype operation is the handling of empties. Unless there is an immediate need for an empty foreign car, it will be routed back to its home road, when practical retracing the route over which it traveled with a load. On a model, even when foreign interchange is modeled, it is difficult to conceive moving every empty foreign car toward the interchange point. Thus, on a model, foreign cars are treated much like home cars. Nevertheless, at interchange points it is possible to assure the home cars to the foreign railroad are loaded. The majority of home cars returning will be empties, but many could be loaded as foreign railroads will seek to load cars returning to their home roads rather than forwarding them as empties.

WAYBILL-ON-CAR SYSTEMS

Waybill-on-car systems are extremely efficient in terms of the effort required to operate. In all known cases where such a system replaced another, approximately twice as many cars were moved per operating session than were handled under the previous system. Except at the initial point, waybills on the car do away completely with the need to identify cars by reporting marks or descriptions. They also eliminate the mental gymnastics of remembering which cars are to be picked up and which set out. The larger the layout, the more powerful this system becomes with respect to other systems. Cliff Robinson points out, however, that a possibility exists of the operators thinking in terms of switching waybills rather than of switching cars.

The waybill itself is a small marker which is temporarily attacked to or placed on the car. If there are yards, particularly in scales smaller than O (or if car must be viewed from both sides) it is impractical for the waybill to be anywhere other than the top of the car. Nevertheless, when a side-mounted waybill is readily visible at all switching points, it can be used. A particularly simple system with such a mounting position was in use (1976) by Bill Tate of the Manchester Club (England) on his O scale home layout, the Millport & Sheffield Ry. His waybill was a small colored rectangle slipped behind a clip at the lower left on the car sides. Unless you looked specifically for them, they were unnoticeable. The color indicates only the station as cars were delivered according to type (a milk car went only to the dairy, for example). Upon reaching its destination, the car remained unless its waybill was removed or a new color substituted. Cars with no waybill were returned to the main yard as empties. To further simplify the waybills, special loads served as waybills. Gondola cars loaded with limestone at the quarry went only to the steel works in another town, and so on.

The simplicity of the above system depends upon having only one destination available for each type of car at each station. On most model railroads it is likely that more than one destination is available at each station, particularly for box cars. Even a small rural station could have a house track, a team track, and one industry track, all of which can take box cars. Therefore, typically, waybills show track as well as station.

Figure 7-5 shows four different forms of waybills, each with its own method of attachment to a car. At A is the waybill tab described by Roy Dohn in 1964. This tab is slipped under a celluloid clip on the top of the car or placed in open cars such as hoppers. At B is the coded tack reported by Ed

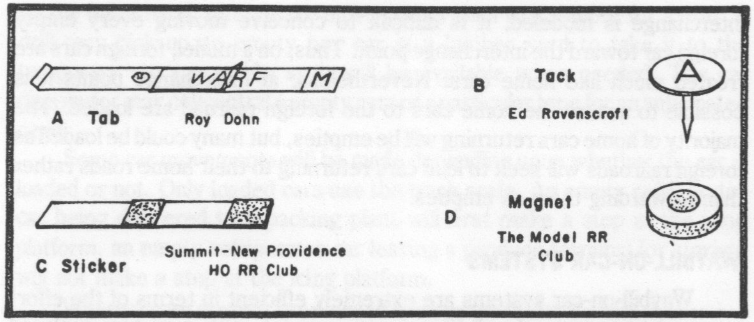


Fig. 7-5. On-car waybills.

Ravenscroft in 1965. The head of the tack is colored and has a letter to indicate the specific point at which the car should be spotted. A hole is drilled in the top of the car to accept the tack. At C is the sticker developed by the Summit-New Providence HO RR Club in 1965. This waybill is made from commercial colored wire markers. Also in 1965, William Doran reported the use in HO of shim-steel waybills, measuring 5 × 6 mm (3/16″ × ¼″), which were held to the side of a car by a permanent magnet cemented inside the car. At D is the type of magnetic waybill which was being considered in 1977 for use at The Model RR Club, the waybill being the magnet and iron being placed in the car. These magnetic waybills also have their information in the form of a color code. The advantage of colors over letters or numbers is that they read the same from any direction.

The tab waybill and the magnetic waybill have the advantage that they can be turned over with a new destination on the other side. For this purpose, when sticker waybills are used, the final destination waybill is placed first and then partially covered with the initial destination waybill. It is possible to stack several waybills in that manner, a specific application being to move a way car from one house track to another in succession.

Each of the waybill types shown in Fig. 7-5 was introduced as part of a specific system. The essential points of the various systems are given under the following headings using the particular waybill introduced with it. It is obvious, however, that any on-car waybill capable of displaying the required information can be used with any system.

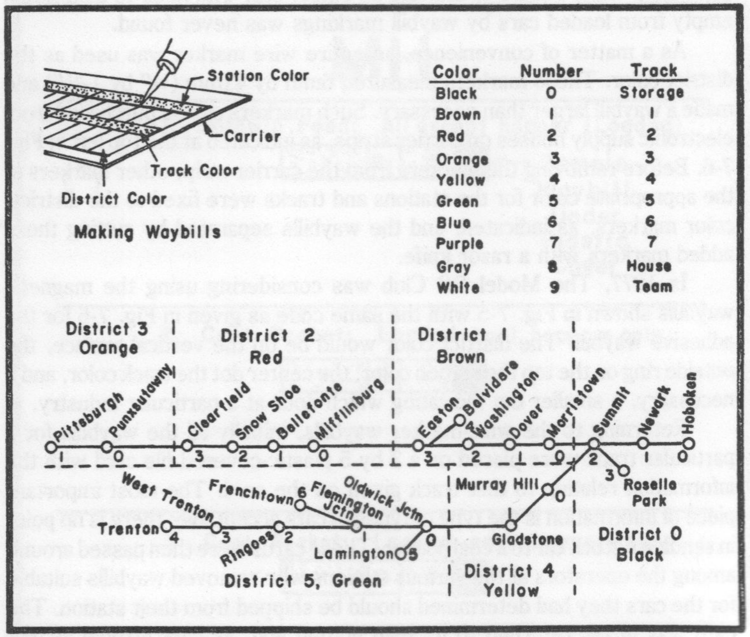
Significant differences among on-car waybill systems lie in when the waybill is placed on the car and when it is removed. Train-oriented systems tend to place all waybills on the cars before operation starts. Shipper-oriented systems tend to place them only when the car is ready to be moved and take them off when the cars are delivered. In such systems, waybills are on the cars only while they are awaiting movement and during movement, a significant advantage as it clearly indicates to the operators which cars are of concern. The disadvantage is that the waybills must be stored before movement in some way that maintains the identity of the car on which they are to be placed.

Colorful Operation

The system known as Colorful Operation was devised in 1965 by the Summit-New Providence HO RR Club using the sticker waybills shown in Fig. 7-5. It is shipper-oriented and a real-time system in that set up takes place during an operating session and destinations can be assigned as the operation progresses. The colors on the waybills are the standard decimal colors used to code the values on resistors and capacitors as shown in the upper right of Fig. 7-6. These colors are available both as paints and as adhesive wire markers. With only ten colors but with more than ten stations, the layout of the club was divided into destination districts, as shown at the bottom Fig. 7-6. The main color on the waybill is that of the destination district, as when a car is outside fo the district in which its destination is located, the district color is all that is needed to direct its movements.

Within each district, the stations along the main line were numbered in order from east to west starting with zero. Branch-line stations within a district took the higher numbers. The number of each station is also shown in Fig. 7-6. If the station color was different from the district color, a square of the appropriate station color was placed at the end of the waybill.

Within each station, each destination track was given a color, track codes being given at the upper right in Fig. 7-6. Black was always a storage track and was not found at every station. Grey was always the house track and white always the team track. Every station had a house and a team



Color	Number	Track
Black	0	Storage
Brown	1	1
Red	2	2
Orange	3	3
Yellow	4	4
Green	5	5
Blue	6	6
Purple	7	7
Gray	8	House
White	9	Team

Fig. 7-6. Destination districts by color.

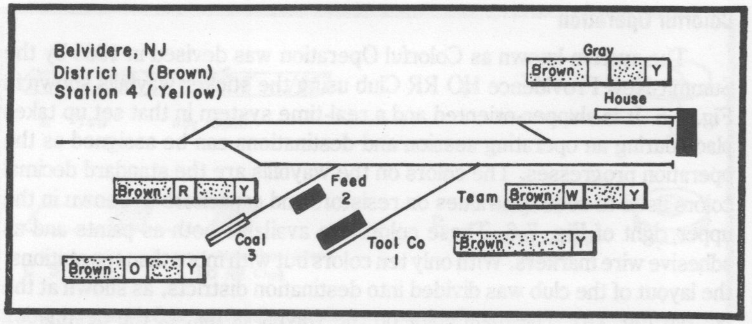


Fig. 7-7. Destination-track waybills.

track. The remaining tracks started with 1 and numbered upward. Figure 7-7 shows the numbering and the waybills for the station of Belvedere, NJ. Before scenery was in place, a wire marker of the proper color was placed between the rails at each destination to mark the spot to set out the cars. As scenery was added, such markers were to be replaced by a sign for the destination, that sign being of the appropriate color. On the waybill itself a square of the track color, if different than the district color, was placed at the center of the waybill as indicated in Fig. 7-7.

Colorful Operation reserved the end of the waybill opposite the station color for a white square to indicate an empty car. The need to distinguish empty from loaded cars by waybill markings was never found.

As a matter of convenience, an entire wire marker was used as the district color. These markers measured 6mm by 41mm (¼″ by 1-⅝″) and made a waybill larger than necessary. Such markers can be purchased from electronic supply houses on carrier strips, as indicated at the top left in Fig. 7-6. Before removing the markers from the carrier strip, other markers of the appropriate color for the stations and tracks were fixed to the district-color markers, as indicated, and the waybills separated by cutting these added markers with a razor knife.

In 1977, The Model RR Club was considering using the magnetic waybills shown in Fig. 7-5 with the same code as given in Fig. 7-6 for the adhesive waybill. The district color would be on the vertical surface, the outside ring on the top the station color, the center dot the track color, and if necessary, a smaller dot indicating which door at a particular industry.

Returning to the wire-marker waybills, initially all the waybills for a particular track were placed on a 3 by 5 plastic-covered file card with the information relating to that track given on the card. The most important piece of information is the type of types of cars acceptable; there is no point in sending a stock car to a coal pocket. These cards were then passed around among the operators at the various stations who removed waybills suitable for the cars they had determined should be shipped from their station. The card was finally returned to its own station and, as cars arrived at that particular track, the waybills were removed from the car and placed on the card. An obvious advantage of a single storage point for waybills not assigned to cars is that the number of waybills available for a specific destination can be limited to the practical number of cars which that destination can handle.

If Colorful Operation were being used as a preset system with all the waybills distributed in advance of the operating system, the single-location for waybills would be entirely satisfactory. However, as used at the club, Colorful Operation was a real-time system which meant that waybills had to be readily available at every station, not only when setting up for an operating session, but during the session itself. The latter was necessary to permit cars arriving early in the session to be given another destination if that proved desirable. Therefore the single-card storage point for the waybills of a particular track was abandoned in favor of a loose-leaf book at each station with a page for every station in every book. Figure 7-8 shows the top portion of the page for Murray Hill, NJ. The information on the page was a Xerox copy on paper with a sample waybill for each destination attached to the paper. Two such pages were enclosed back-to-back in a commercial clear-plastic sheet protector. At each station, the page for that station served as the collecting point for the waybills of cars delivered to that station. All other pages were loaded with waybills for the other stations. Enough waybills were supplied so that several operating sessions could take place before the waybills had to be redistributed from their collecting points to the other books.

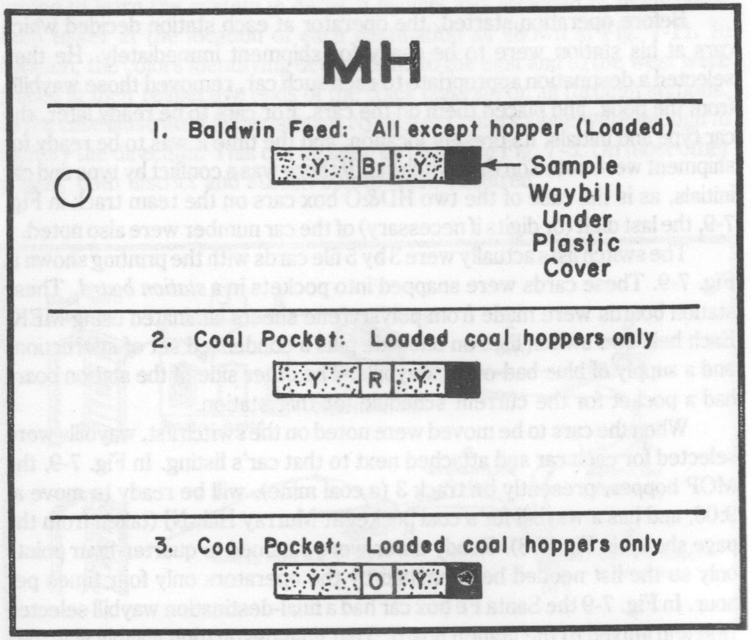
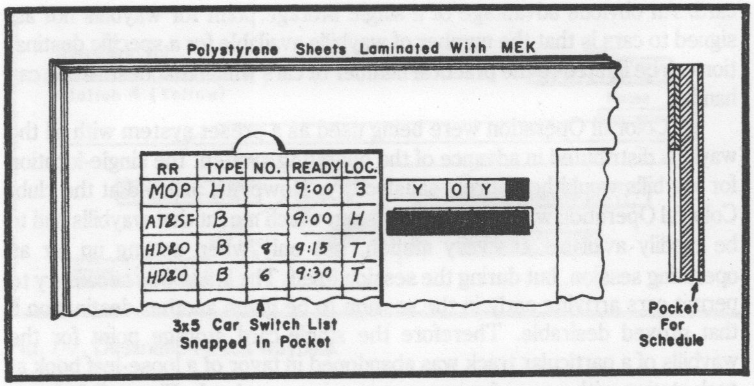


Fig. 7-8. Storage page for waybills.



RR	TYPE	NO.	READY	LOC.
MOP	H		9:00	3
AT&SF	B		9:00	H
HD&O	B	8	9:15	T
HD&O	B	6	9:30	T

Fig. 7-9. Station board.

Since many waybills for each destination were available, it was possible to route more cars to a single destination than that track could handle. In actual practice this seldom happened. When it did, the car was set out on any convenient track at the station, its waybill kept in place for later delivery. On the prototype, this is called *constructive placement,* the free time allowed for loading or unloading commencing with such placement. To make room for such cars, the operator could assign a new destination to the cars blocking that track.

Before operation started, the operator at each station decided which cars at his station were to be ready for shipment immediately. He then selected a destination appropriate to each such car, removed those waybills from the book, and placed them on the cars. For cars to be ready later, the car type and initials, its present location, and the time it was to be ready for shipment were noted on the switch list. If there was a conflict by type and car initials, as is the case of the two HD&O box cars on the team track in Fig. 7-9, the last digit (or digits if necessary) of the car number were also noted.

The switch lists actually were 3 by 5 file cards with the printing shown in Fig. 7-9. These cards were snapped into pockets in a *station board.* These station boards were made from polystyrene sheets laminated using MEK. Each held two switch lists on one side plus a condensed set of instructions and a supply of blue bad-order waybills. The other side of the station board had a pocket for the current schedule for that station.

When the cars to be moved were noted on the switch list, waybills were selected for each car and attached next to that car's listing. In Fig. 7-9, the MOP hopper, presently on track 3 (a coal mine), will be ready to move at 9:00, and has a waybill for a coal pocket at Murray Hill, NJ (taken from the page shown in Fig. 7-8). Ready times were confined to quarter-hour points only so the list needed be examined by the operators only four times per hour. In Fig. 7-9 the Santa Fe box car had a final-destination waybill selected first and affixed to the station board. That final-destination waybill was then partially covered by an all-black waybill, Hoboken storage. Since Hoboken

existed only as a reversing loop at the eastern end of the line, the black waybill would take the car to that reversing loop. There the black waybill would be removed exposing the final-destination waybill.

After operation started, the operator at each station scanned the switch list every quarter hour. Conventional, not fast, time was used. If a ready time had expired, the waybill for that car was transferred to the car. From this point on there was no further need to read reporting marks or even car type. All movements of the car depended upon its waybill. When the car was finally spotted at the destination, the waybill was removed and placed in the waybill book for the destination station on its own page.

Figure 7-10 shows the complete trip and the handling of the waybill for the MOP hopper car shown in Fig. 7-9. At A, a waybill for a coal pocket is taken from the Murray Hill page of the waybill book at Clearfield and placed next to the hopper car's entry on the switch list of the station board. At 9:00, the waybill is taken from the station board and (B) placed on the hopper car at the mine. The first drill after 9:00 takes the car, plus all others found with waybills (C) to the Clearfield yards for classification (D) for an eastward freight. The next such freight takes the car to Summit (E) and set it off for a branch line freight (F). The next branch-line freight picks up the hopper from Summit, and (G) carries it to Murray Hill, setting it out at its destination track (H). The waybill is then removed and placed in the book at Murray Hill (I).

As a memory aid, and to make it possible for a visitor to operate without having to learn the system in detail, a waybill was attached to the panel at each tower at the location of each destination as shown in Fig. 7-11. In addition, the colors identifying destinations to the east and to the west were placed at their respective ends of the track diagram on all through stations. In the case illustrated, Morristown, NJ, district colors alone were enough to identify the direction. This can be seen by checking Fig. 7-6. On most other panels, both district and station colors were required.

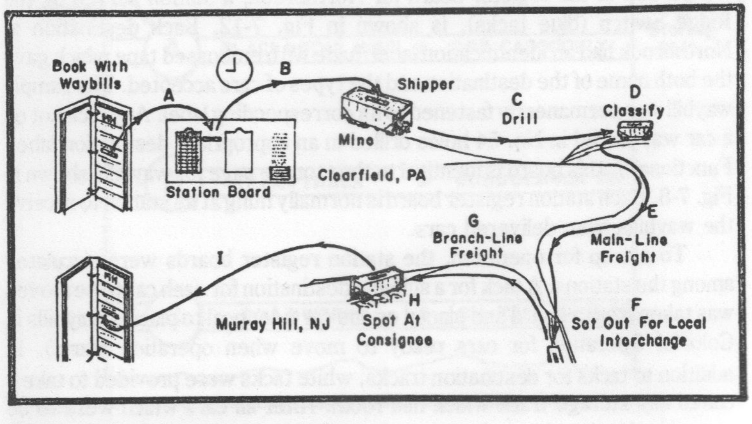


Fig. 7-10. Complete movement of car.

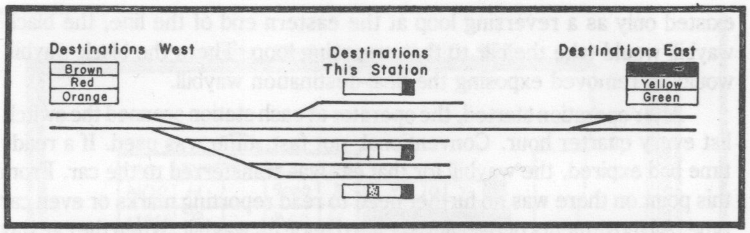


Fig. 7-11. Memory aids on panel.

Tack System

The Tack system, originally called CCT (Color-Coded Tacks), was introduced by Ed Ravenscroft in 1965. The waybills were made from commercially-available colored thumb tacks, A in Fig. 7-12. No. 54 holes were drilled in the roofs of the cars to receive the tacks. The tacks were placed in these holes using a permanent magnet, as shown in Fig. 7-12B. The magnet had a piece of plastic cemented to its pole face to minimize the chance of damaging the surface on the tack. The Tack system was devised as a real-time, train-oriented system.

The color of the track represented the train which was to deliver the car to its destination track. On the Glencoe Skokie Valley, a green tack mean that the Valley Switch would deliver the car. Since the Valley Switch only worked three stations, the color could just as well be said to represent a destination district, such as those shown in Fig. 7-6 for Colorful Operation. The various destination tracks served by a particular train were identified by black 18-point letters of the dry-transfer type placed on the head of the tack.

As many tacks were prepared for each destination as that particular track could handle plus three more. One of these tacks was placed on the layout at the destination to identify it. Another was used as a sample waybill on the station register board which served to hold all tacks not on cars. The top portion of the register board for Northbrook, a station served by the Ridge Switch (blue tacks), is shown in Fig. 7-12. Each destination at Northbrook had an identification label made with embossed tape which gave the both name of the destination and the types of cars accepted. The sample waybill was permanently fastened to its corresponding label. Any tack not on a car was placed in No. 54 holes drilled in an appropriate destination label. Functionally, this board is identical to the storage page for waybills shown in Fig. 7-8. Each station register board is normally hung at its station to receive the waybills from delivered cars.

To set up for operation, the station register boards were circulated among the stations. A tack for a suitable destination for each car to be moved was taken from a board and placed on the car (identical to placing waybills in Colorful Operation for cars ready to move when operation starts). In addition to tacks for destination tracks, white tacks were provided to take a car to any storage track which had room. After all cars which were to be moved had tacks, the register boards were returned to their own stations.

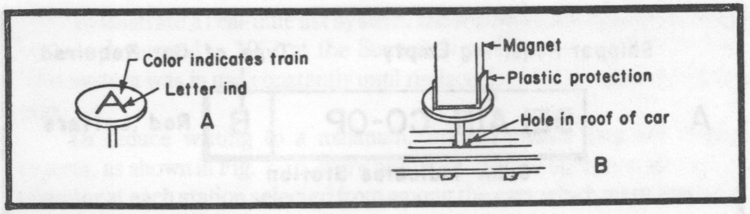


Fig. 7-12. Tack waybills.

With all tacks and register boards in place, operation proceeded exactly as shown in Fig. 7-10, starting at C. When the car was spotted at its destination, the tack was removed and placed in the station register board.

Digit System

The Digit System was introduced by Roy Dohn in 1964 as a shipper-oriented real time system. In this system, he used a reversable waybill called a tab. The tab was a rectangle of card stock measuring 6mm by 38mm (¼″ by 1½″). Its color indicated the station at which the shipper was located. On one side of the tab the name of the shipper and the car type needed was typed in red as shown at A in Fig. 7-13. On the other side of the tab, typed in black, was the destination station and the name of the consignee for the shipment, as at B in Fig. 7-13. After the tabs were typed, a plastic coating was sprayed over their surfaces to make them more durable.

Before operation started, the operator at each station determined which shippers needed empty cars and selected (from the bin of waybills at

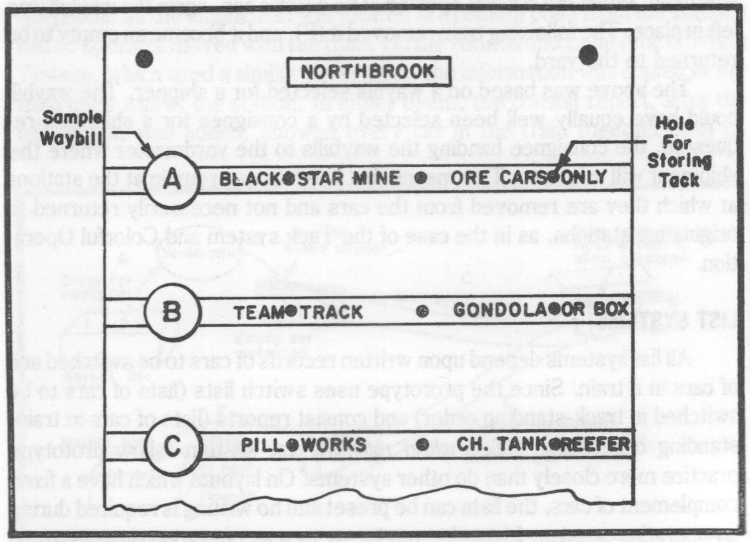


Fig. 7-13. Station register board.

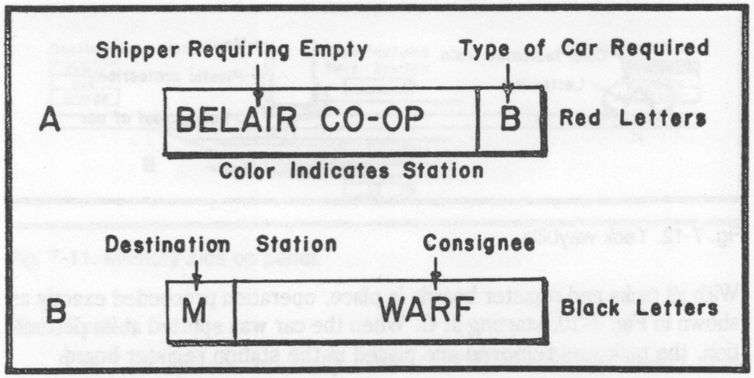


Fig. 7-14. Tab of Digit System.

that station) a tab for each such shipper, A in Fig. 7-15. These waybills were handed to the yardmaster who located appropriate empty cars and inserted the waybills under the clip on their roofs, red letters up (B). The cars then were classified for the train to deliver the car to the shipper in exactly the same manner as if a tack or sticker waybill were used. However, when the car was spotted at the shipper (C), the waybill was left in place. The next train through noted that the car was at its proper empty-car destination and turned the tab over to show the destination for the load, but that train did not move the car (E). The next following train then saw the loaded waybill and added the car to its train. In this manner, a time interval for loading was generated. Again, operation proceeded exactly as if a tack or sticker waybill was used. When the car was spotted at its destination, again the waybill was left in place. The following train removed it (F), and it became an empty to be returned to the yard.

The above was based on a waybill selected for a shipper. The waybill could have equally well been selected by a consignee for a shipment requested, the consignee handing the waybills to the yardmaster where the shipment will originate. This means that waybills can remain at the stations at which they are removed from the cars and not necessarily returned to originating stations, as in the case of the Tack system and Colorful Operation.

LIST SYSTEMS

All list systems depend upon written records of cars to be switched and of cars in a train. Since the prototype uses switch lists (lists of cars to be switched in track-standing order) and consist reports (lists of cars in train-standing order, also called *wheel reports*), list system follow prototype practice more closely than do other systems. On layouts which have a fixed complement of cars, the lists can be preset and no writing is required during an operating session. Lists also can be written as operation progresses to serve in real-time systems.

To illustrate a real-time list system, the following is a description of the system developed in 1951 at the Summit-New Providence HO RR Club. This system was in use constantly until replaced in 1965 by Colorful Operation.

To reduce writing to a minimum, printed switch lists and consist reports, as shown in Fig. 7-16, were prepared. Before operation started, an operator at each station selected from among the cars which were located at that station those which were to be moved during that operating session. The operator wrote the car initials, type, and its track location in the spaces provided on the switch list. In the event of a conflict, the last digit (or digits if necessary) of the car number were also recorded. At this point the information on the switch list was precisely the same as on the switch list for Colorful Operation, shown in Fig. 7-9.

The next step was to select a destination for each car to be moved. Since the Missouri Pacific hopper car at the top of Fig. 7-16 was at a coal mine, this car was presumed to be loaded so a destination for a carload of coal was needed. In this case, one of the coal pockets (track No. 3) at Murray Hill was selected. That destination, and the time at which the car was to be ready for shipment, were noted on the switch list. In the case of the AT&SF box, it was to have been sent first to Hoboken which, as mentioned before, was only a reversing loop. The car therefore needed a final destination and the team track at Dover was selected.

Working from the switch list, the drill at Clearfield picked up the MOP hopper car which then was classified for an eastward freight. When this car and the AT&SF box car were placed in an eastward main-line freight, the information was transferred to the consist report for that train as indicated in Fig. 7-16. At the club, this transfer of information was accomplished by telephone, as the engineman was located at a remote point from the stations and no operator moved with the train. On the Alturas and Lone Pine of White Towers, which used a similar list system, the information was copied as the train crew was at the station. In either event, the consist report, after the information was added, showed every car in the train together with its

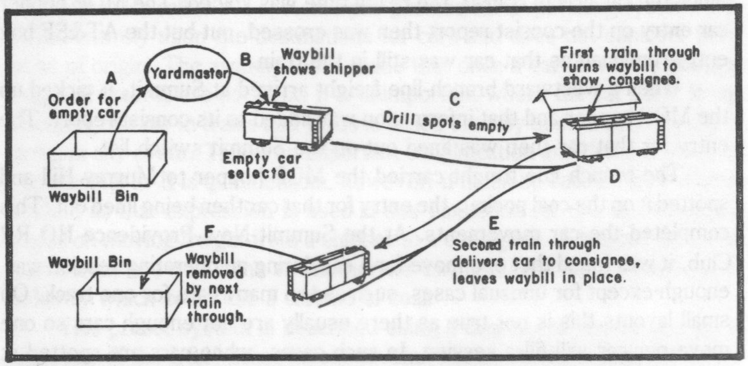
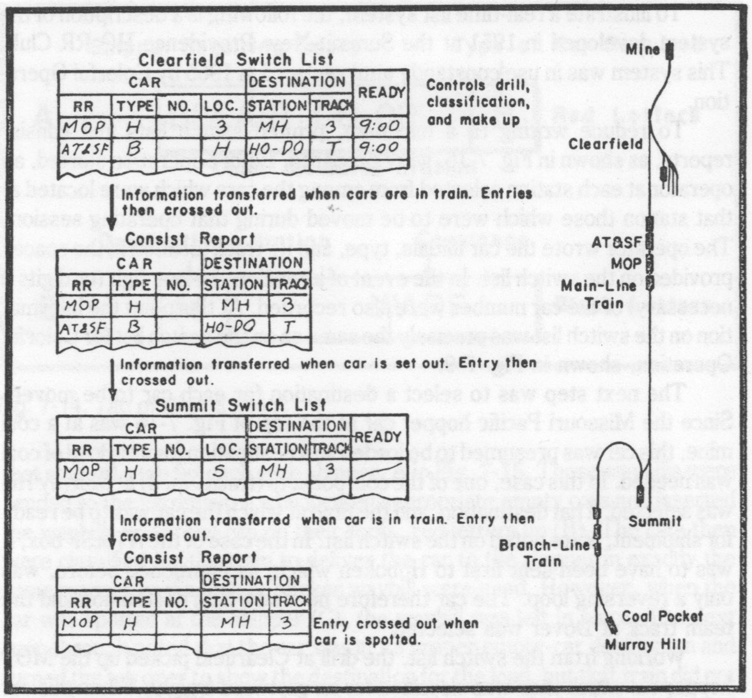


Fig. 7-15. Digit waybill system.



Clearfield Switch List

CAR				DESTINATION		READY
RR	TYPE	NO.	LOC.	STATION	TRACK	
MOP	H		3	MH	3	9:00
AT&SF	B		H	HO-DO	T	9:00

Controls drill, classification, and make up

Information transferred when cars are in train. Entries then crossed out.

Consist Report

CAR			DESTINATION	
RR	TYPE	NO.	STATION	TRACK
MOP	H		MH	3
AT&SF	B		HO-DO	T

Information transferred when car is set out. Entry then crossed out.

Summit Switch List

CAR				DESTINATION		READY
RR	TYPE	NO.	LOC.	STATION	TRACK	
MOP	H		S	MH	3	

Information transferred when car is in train. Entry then crossed out.

Consist Report

CAR			DESTINATION	
RR	TYPE	NO.	STATION	TRACK
MOP	H		MH	3

Entry crossed out when car is spotted.

Fig. 7-16. Movement of car with list system.

destination. Once the car was picked up, it entry on the Clearfield switch list was lined out.

The car movements shown in Fig. 7-16 are identical to those shown in Fig. 7-10 for Colorful Operation. The main-line freight took the MOP hopper to Summit where it was set off for a branch-line freight. The car and its destination information were then entered on the switch list at Summit. Since the car was in transit, the ready time was voided. The MOP hopper car entry on the consist report then was crossed, out but the AT&SF box entry remained as that car was still in the train.

When a westward branch-line freight arrived at Summit, it picked up the MOP hopper and that information was added to its consist report. The entry for that car then was lined out on the Summit switch list.

The branch line freight carried the MOP hopper to Murray Hill and spotted it on the coal pocket, the entry for that car then being lined out. This completed the car movements. At the Summit-New Providence HO RR Club, it was found that one move for a car during an operating session was enough except for unusual cases, such as too many cars for one track. On small layouts this is not true as there usually are not enough cars so one move per car will fill a session. In such cases, when cars are spotted at destinations, those cars can be added to the switch lists at the destination

stations and new destinations and ready times assigned. Such a car then makes an additional move using the same steps as described above.

It is obvious that a train could be made up ready to leave when operations start simply by preparing a consist report showing destinations for cars already standing in the train. In actual practice, this was done at the club in order to get train movements at the start of an operating session and to give early activity at way stations.

The application of the list system as described above is as a real-time, shipper-oriented waybill system. All that is needed to convert it into a train-oriented system is to replace the ready times with train designations.

The Columbus Model RR Club used a different version of the list system for its way freights. That club did not have switch lists at each way station. Instead an operator, called a car clerk, walked the line in advance of the operating session and noted the cars available for pick up. The car clerk then made up the consist reports for the way freights. These consist reports showed both the cars taken from the terminal together with the destination for each car and the cars to be picked up at a way station. This consist report was carried by the conductor from station to station.

Preset List Systems

List systems can be operated as preset systems, provided that a fixed complement of cars remains on the layout from operating session to operating session. The most obvious way is to provide a complete set of switch lists and consist reports for all stations and for all trains. When the moves required by such present lists are completed, the location of each car is known, so new switch lists and consist reports based on those car locations can be prepared and used. If all the moves of the first set of switch lists and consist reports are not completed by the end of the operating session, the next session must start at that point and finish the moves. Cliff Robinson in the early seventies programmed a computer to prepare such lists—the earliest known use of a computer to assist model railroad operations.

In 1974, Allan Bates introduced a new concept for preset list systems which did not require the cars to remain in place from one operating session to another. He called this system a pre-planned car dispatching system. It is based entirely upon the destinations for cars and does not consider their point of origin. The assumption is made that once a car leaves its point of origin, if records are not kept, it is unimportant where the car came from. Handling of a car in trains and yards is based entirely upon where the car is going in any event. This is an important simplification and there is much to recommend it. It is questionable, however, if it can be called a true waybill system as that expression is used in this handbook for this system is not based on moving freight from a shipper to a consignee. A hopper car could move from one coal mine to another for example, not from a mine to an industry which could use a carload of coal.

This preset system is described using a diagram of the out-and-back main line of the L&N home layout of Allan Bates shown in Fig. 7-17. For clarity the branch line has been omitted. A complete plan of this layout

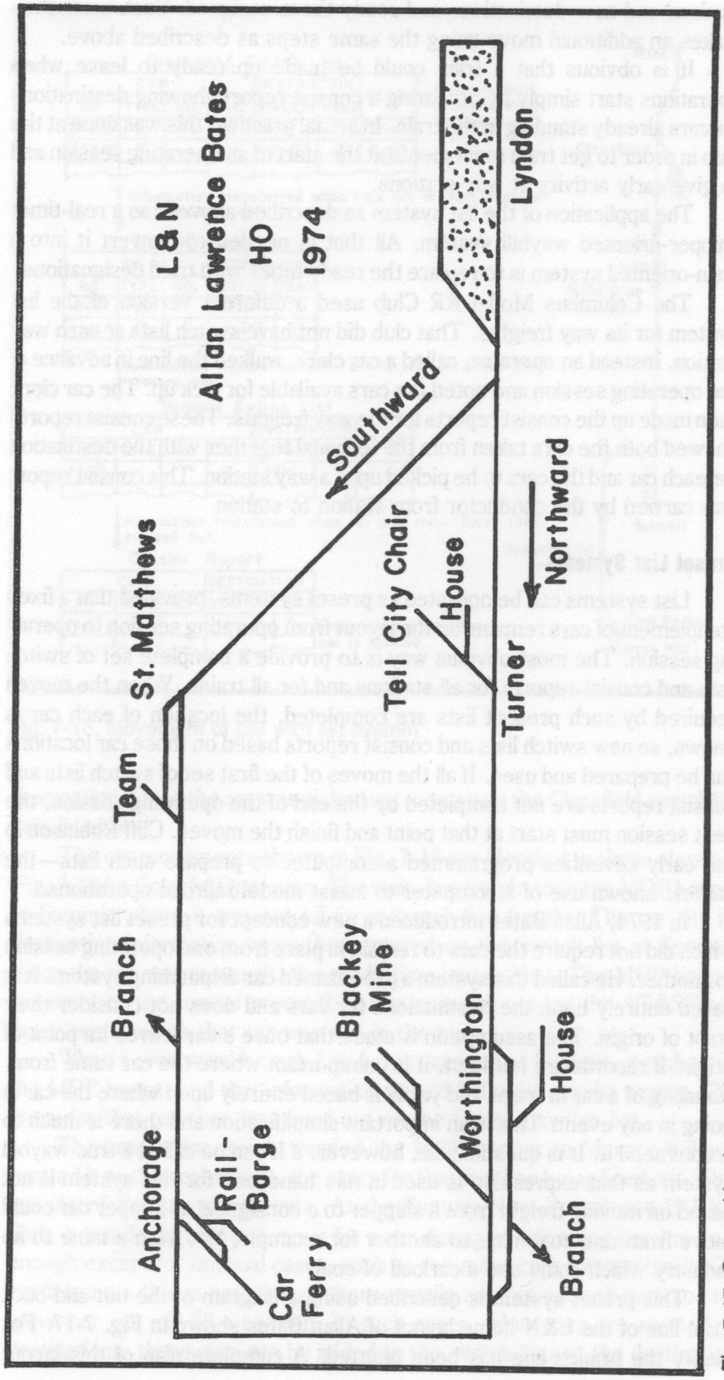


Fig. 7-17. Out-and-back model railroad

	Lyndon					
Manifest 12 Cars	Storage	Refinery 3 Cars	Packing Plant 3 Cars	Roundhouse 1 Car	Cinder Pit 1 Car	Sand Bin 1 Car
Turner		Blackey Mine 10 Cars	Worthington House 2 Cars	Anchorage		St. Matthews Team 2 Cars
House 2 Cars	Tell City Chair 1 Car			Rail-Barge 2 Cars	Car Ferry 4 Cars	

Fig. 7-18. Car assignment chart.

appears in Fig. 2-12 and a detailed plan of the Lyndon, KY terminal in Fig. 3-11.

The system used on the L&N (HO) to assign a destination to each car was as follows: A card was made out for each car. On its face was identification of the car, e.g., B&O 112116 Stock. On the reverse was a list of all the destinations suitable for that car, e.g., packing plant, car ferry, and a through freight called the Manifest. Additional cards were made which had "Vacant, No Car" on the face and all possible destinations on the back. The total number of cards equaled the total number of available spaces on destination tracks.

These cards were then shuffled and dealt face down on a chart such as the one shown in Fig. 7-18. There was a box on this chart for every possible destination. Each card was placed face down on one of the boxes which agreed with one of the possible destinations listed on the reverse of the card. After all cars were dealt, the cards were turned face up and the "Vacant, No Car" cards removed. What remained was the destination assignments for the particular operating session.

The destinations for each car were then recorded on the master list, called the Lyndon Switch List, which is shown in part in Fig. 7-19. The number of lines for cars shown after each destination equals the car capacity of that destination. As this is a train-oriented system, the cars are assigned to a specific train as indicated. Actually, on the terminal switch lists, it is unnecessary to record the destinations for cars unless the yard crew is to place the cars in local order. Several of these switch lists are prepared, each from its own shuffle of the cards. Ten such lists are probably enough to make the system seem so random that the operators will not feel there is a pattern. Indeed, ten lists taken in random order produce many possible combinations of movements.

A separate consist report was prepared for each train to be run. That for No. 75, the Manifest, would be exactly that shown for No. 75 in Fig. 7-19. The consists reports for other trains would have the stations listed in the order that the train reaches them.

Operation commences with the yard drill at Lyndon classifying all the cars at Lyndon. Any cars in Lyndon which appear on the list for the Manifest are placed on track 3, the departure track for that train. Perhaps only five of the ten possible cars will be found. Whatever the number, the crew of No. 75 picks up their locomotive at the roundhouse, the switcher has already added the caboose and the Manifest leaves as scheduled. The Manifest is a through freight running terminal to terminal so it will return to Lyndon with the same cars, since Lyndon is both the north and the south terminal.

In the same manner, the yard crew assembles on track 2 all the cars on the list for No. 86 (a way freight) which were found in Lyndon. Track 2 is the departure track for No. 86. This train then leaves on schedule. However each car on a way freight leaving Lyndon will be set out at a destination before that train returns to the terminal of Lyndon. Should the crew of No. 86 find a car at any station which is on its list for that station but not on the track designated, it moves that car to the track designated on the list. Any car not on the list, or on the list for station already passed, is added to the train and carried to Lyndon. In this way all cars which were not delivered by the first local freights out will be brought to the Lyndon yard. They will again be classified for the next train, those for the Manifest being added to that train. The next local freights out will then deliver the remaining cars to their destinations. A possibility exists, which is sometimes realized, that the first trains out take only a few cars but return with so many that the yard becomes clogged.

As implemented by Allan Bates, the consist report forms were used for many other purposes. The schedule for the particular train was given including any meets and at meets, which of the two trains would take the siding. The engine number and caboose were specified. Special instructions for the train were included. On the back of the consist report were reproduced the operating rules. So, on one sheet of paper, each train crew had all the information needed to operate on the L&N.

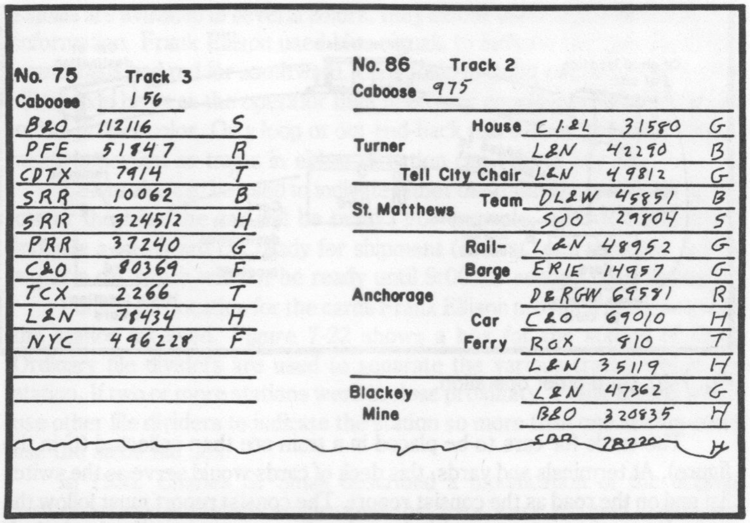
Since this is a preset system which does not depend upon the present location of the cars at the time an operating session starts, it lends itself well to having its paper work done by computer. Mark Eskew, among others, operated in 1977 with computer-prepared switch lists and consist reports using this basic system.

How large a layout can be handled by this system is not known. Allan Bates estimates that the number of cars cannot readily go far over one hundred due to the necessity of examining all cars. Mark Eskew estimates 50 cars in one area is the limit. In locations where there are many cars, such as the yard at Lyndon, some operators add markers on top of the cars while in the yards in the manner of waybill-on-car systems to help keep track of the cars to be switched.

Another form of preset list system which is especially suited to small layouts is described in a later paragraph, Waybill Systems For Small Layouts.

CARD-ORDER SYSTEM

Frank Ellison is generally credited with starting the interest in waybill operation when he introduced the card-order system in 1944. Until 1951, when the List System was developed, card order apparently was the only system in use. In 1977, card order remained one of the popular systems. It is probably most competitive with the other systems on small layouts where its advantages are maximimized and its problems minimized. It is, however, effective on large layouts as witnessed by its use at the Sacramento Model RR Club. Nevertheless, as layout size increases, card order becomes more and more cumbersome. There are examples of layouts switching from card order to other systems, but none are known which changed from another system to card order.



No. 75 **Track 3**
Caboose 156

B&O	112116	S
PFE	51847	R
CDTX	7914	T
SRR	10062	B
SRR	324512	H
PRR	37240	G
C&O	80369	F
TCX	2266	T
L&N	78434	H
NYC	496228	F

No. 86 **Track 2**
Caboose 975

Turner	**House**	C I&L	31580	G
		L&N	42290	B
	Tell City Chair	L&N	49812	G
St. Matthews	**Team**	DL&W	45851	B
		SOO	29804	S
Anchorage	**Rail-Barge**	L&N	48952	G
		ERIE	14957	G
	Car Ferry	D&RGW	69581	R
		C&O	69010	H
		RGX	810	T
		L&N	35119	H
Blackey Mine		L&N	47362	G
		B&O	320835	H
		SDR	28220	H

Fig. 7-19. Master list.

Many variations of card-order systems exist, each seeking to make the system most effective for a given layout or method of operation. All, however, accomplish the fundamental functions shown in Fig. 7-20.

Basic to card order is the permanent association of a car and its card, as indicated at A in Fig. 7-20. This card may take different physical forms including an envelope, but that is only a mechanical difference. Each track location which can hold a car when not in transit also is permanently associated with home location for the cards of cars on that track. This, too, is indicated at A. If the card becomes disassociated from its car, it is necessary to search for the missing member of the pair and reestablish the association. On small layouts with only a few cars, it is easy to find missing cars or cards. As the size of the layout increases this becomes more and more difficult.

When a car is to be moved, a marker of some sort is added to the card to indicate the destination. If the car card were an envelope, this marker usually is inserted in the envelope or, conversely, the destination could be represented by an envelope into which the car card is inserted. For preset systems, the card could carry a list of destinations, the one following the present location of the car being the next destination.

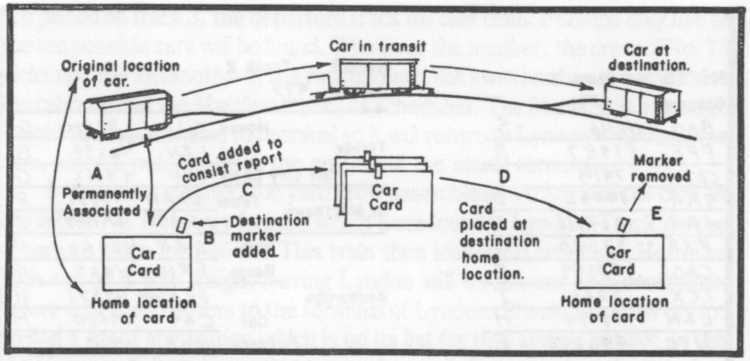


Fig. 7-20. Card-order operation.

The cards for cars to be placed in a train are then collected (C in the figure). At terminals and yards, this deck of cards would serve as the switch list and on the road as the consist report. The consist report must follow the train. If an operator moves with the train, that operator carries the deck. If the operators are close enough to each other, the deck can be passed between operators if none follows the train. Frank Ellison suggested a car behind the locomotive for carrying the cards. Before they developed the list system, the Summit-New Providence HO RR Club considered installing toy trains under the benchwork to carry the cards from station to station. Single-operator layouts obviously have no problems of this nature.

When a car is spotted at its destination, its card is placed in the home location for that track (D in Fig. 7-20) and the marker removed or advanced depending upon the system.

Although Fig. 7-20 illustrates the principles of card order, there are many detailed differences in the way card order has been applied. These differences are noted in the detailed descriptions which follow of card-order systems actually used by modelers.

Original System

The system described by Frank Ellison in 1944 remains viable today, particularly on a small layout. He used standard 3 by 5 file cards as the car card. As shown in Fig. 7-21, the car identification was typed on the face of the card and the destinations typed along the top edge. If there are few enough destinations so all can be listed along the top of the car, as at the top in Fig. 7-21, that is the simplest method. On the Victoria Northern, a large HO layout, Roy Dohn in 1958 used cards of this type for a total of 27 destinations at 10 stations. Frank Ellison had too many destinations so, as at the center, only the stations were listed at the top of the card and a tag giving the track was clipped to the card as indicated. It is also possible to list the stations and the tracks separately as shown at the bottom in Fig. 7-21. Commercial file signals are placed at the proper location(s) at the top of the card to indicate the destination station, often also the track. As these file signals are available in several colors, they can be used to provide additional information. Frank Ellison used blue signals to indicate the cars for northward trains and red for southward. On a point-to-point railroad, such a color distinction helps as the operator then need only consider cards with signals of the proper color. On a loop or out-and-back railroad, such a distinction is more important as trains in either direction can deliver any car.

Colors also can be used to indicate either the train which will pick up the car or the time the car will be ready. For example, a black signal might indicate a westward car ready for shipment (or first train through), a blue signal a car which will not be ready until 9:00 (or second train through).

For a home location for the cards Frank Ellison provided file boxes near the station involved. Figure 7-22 shows a box for the station of Gina. Ordinary file dividers are used to separate the various tracks within the station. If two or more stations were in close proximity, Frank Ellison would use other file dividers to indicate the station so more than one station could use the same file box.

In 1955, Charles S. Small described a modification of the original card-order system which emphasized that cars were shipped loaded and returned as empties. On his Mohawk, Erie & Northwestern there were no coal mines so all hoppers with coal for the coal dock at Jamestown had to come from a foreign railroad through interchange and all empty coal hoppers had to be returned through interchange. In addition he made provision for

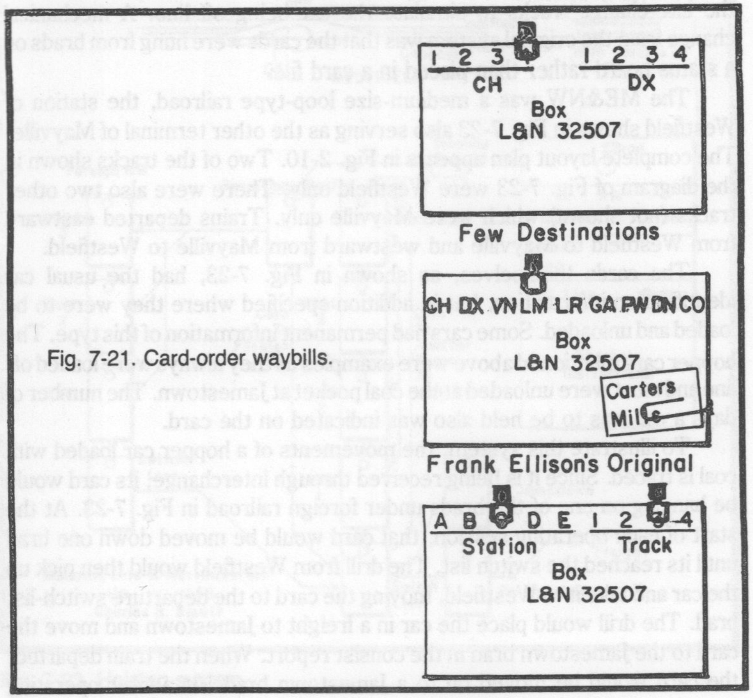


Fig. 7-21. Card-order waybills.

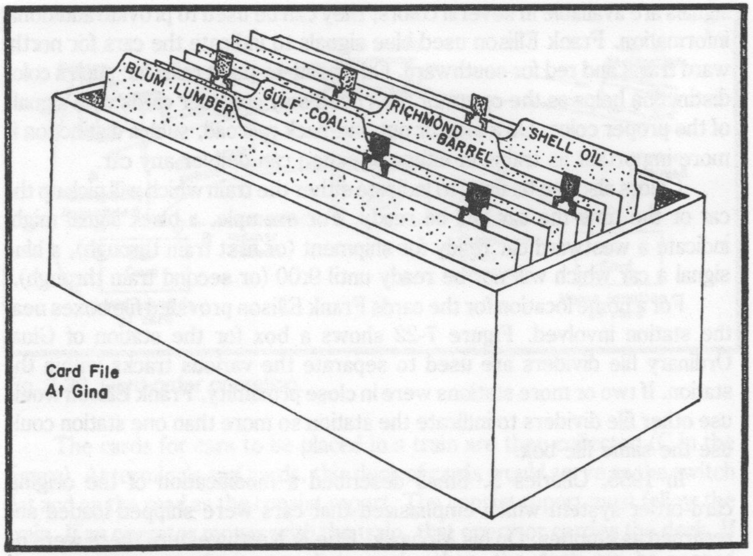


Fig. 7-22. Card-order file.

holding cars at a destination to provide time for loading or unloading and at the interchange tracks to simulate the car being off line. A mechanical change from the original system was that the cards were hung from brads on a status board rather than placed in a card file.

The ME&NW was a medium-size loop-type railroad, the station of Westfield shown in Fig. 7-23 also serving as the other terminal of Mayville. The complete layout plan appears in Fig. 2-10. Two of the tracks shown in the diagram of Fig. 7-23 were Westfield only. There were also two other tracks (not shown) which were Mayville only. Trains departed eastward from Westfield to Mayville and westward from Mayville to Westfield.

The cards themselves, as shown in Fig. 7-23, had the usual car identification information, but in addition specified where they were to be loaded and unloaded. Some cars had permanent information of this type. The hopper cars mentioned above were examples as they always were loaded off line and most were unloaded at the coal pocket at Jamestown. The number of days a car was to be held also was indicated on the card.

To illustrate this system, the movements of a hopper car loaded with coal is traced. Since it is being received through interchange, its card would be hanging on one of the brads under foreign railroad in Fig. 7-23. At the start of each operating session, that card would be moved down one brad until its reached the switch list. The drill from Westfield would then pick up the car and take it to Westfield, moving the card to the departure switch-list brad. The drill would place the car in a freight to Jamestown and move the card to the Jamestown brad in the consist report. When the train departed, the card would be moved on to a Jamestown brad. At a later operating session, when the car was returned to Westfield as an empty, its card would be hung on the interchange brad of the receiving switch list. The drill would then take the car to the interchange tracks and also move the card to one of the hold brads under "Foreign RR," the exact brad being determined by the hold information written on the card.

Preset Systems

About 1950, T. Gerald Dyrar adapted the card-order system to one-operator control of a loop layout. He eliminated the decision-making process of selecting the next destination by adopting a preset routing for each car. This preset system is described using his layout, as shown in the diagram of Fig. 7-24.

As shown in the figure, the car card has a list of all destinations for the car in the order which will be followed. TFS and TFN indicate through freights south and north respectively. A paper clip marks the destination of current interest. When operations started, the SP tank car associated with the card of Fig. 7-25 was on the NYC interchange track and the card was in the corresponding compartment in the file box. As Gerald Dyrar switched only trailing spurs, this car would be picked up by a northward way freight,

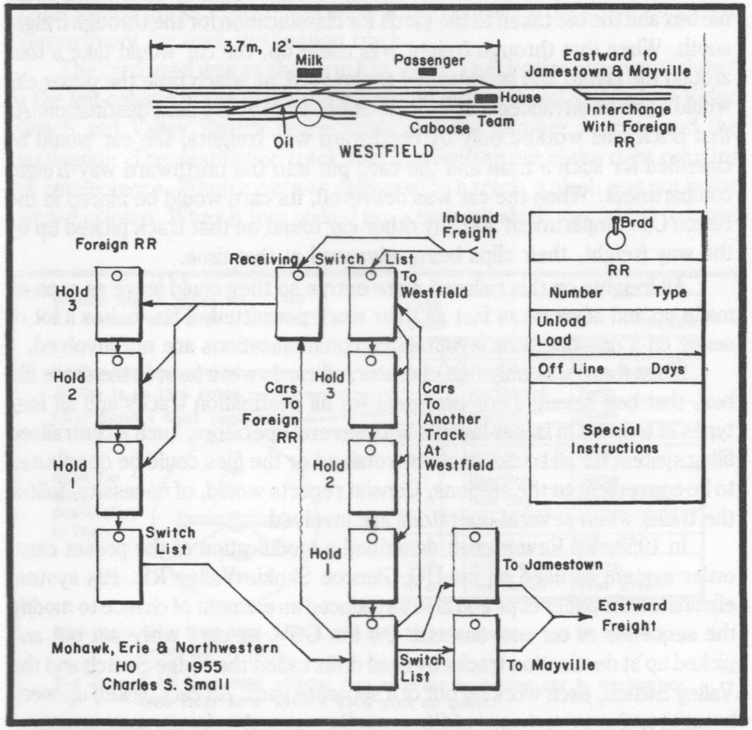


Fig. 7-23. Holding system.

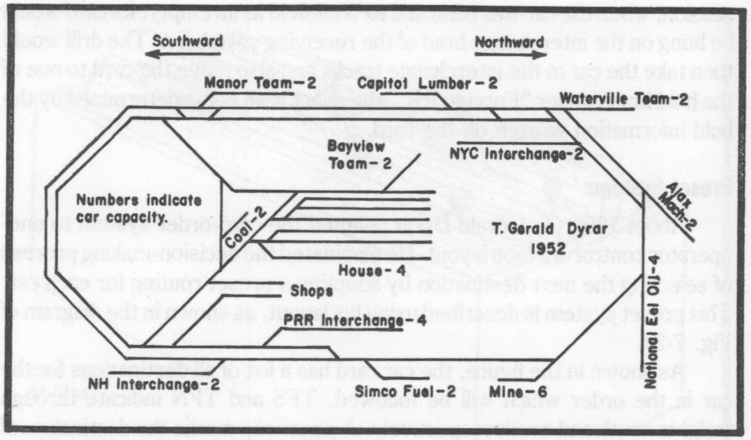


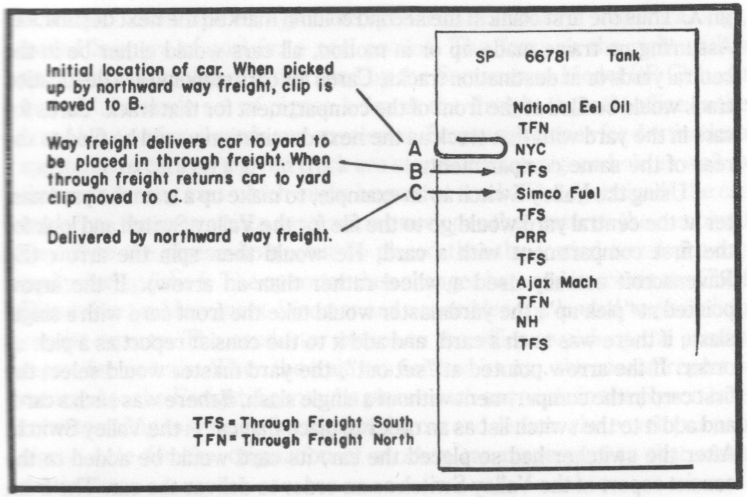
Fig. 7-24. Loop model railroad.

but only by one which was setting out a car on that track. When it was picked up, the paper clip would be slid down one destination, B in Fig. 7-25. The card then would be placed in the through freight south compartment in the file box and the car taken to the yards for classification for the through freight south. When that through freight was made up, the car would take a tour around the layout and be returned to the yard, at which time the paper clip would again be advanced and indicate Simco Fuel as the next destination. As that track was worked only by northward way freights, the car would be classified for such a train and the card put into the northward way-freight compartment. When the car was delivered, its card would be placed in the Simco Oil compartment and any other car found on that track picked up by the way freight, their clips being advanced at that time.

All freights on this railroad were extras so they could leave as soon as made up and advance as fast as their work permitted. This makes a lot of sense on a one-operator layout since communications are not involved.

Since there was only one operator, all cards were kept in the same file box, that box having a compartment for all destination tracks and all four types of trains. On larger layouts with several operators, such a centralized filing system for all tracks could be retained or the files could be distributed to be convenient to the stations. Consist reports would, of necessity, follow the trains when several operators are involved.

In 1958, Ed Ravenscroft described a modification of the preset card-order system as used on his HO Glencoe Skokie Valley RR. His system eliminated the paper clips and also introduced an element of chance to modify the sequence of car movements. On the GSV, all cars were set out and picked up at destination tracks by road drills called the Ridge Switch and the Valley Switch, each working out of a separate yard. All cars picked up were brought to the central yard of Glencoe. Consquently, the car movements to any destination started at the central yard. The home locations for all cards


Initial location of car. When picked up by northward way freight, clip is moved to B.

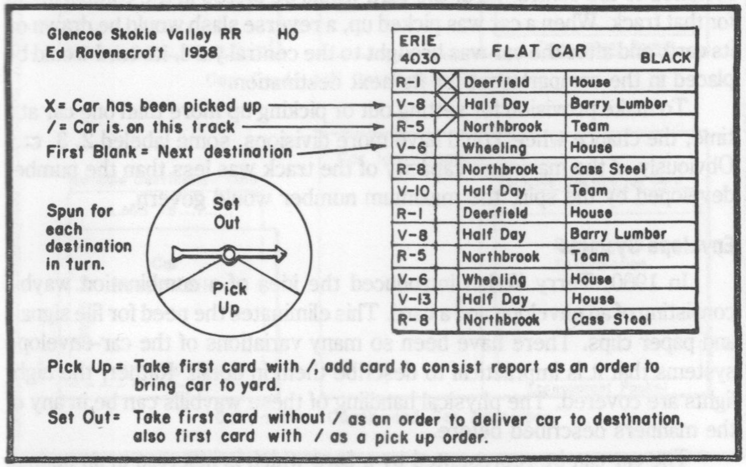
Way freight delivers car to yard to be placed in through freight. When through freight returns car to yard clip moved to C.

Delivered by northward way freight.

Fig. 7-25. Preset car card.

were in two separate card files, one for Valley Switch tracks and one for Ridge Switch tracks. These files were at the central yard and had a separate compartment for each destination track.

The card used was as shown in Fig. 7-26. The destinations were shown in the left column in the order the car would move. R and V stood for Ridge Switch and Valley Switch respectively and the number represented the destination. The destination track also was written out in the right columns for convenience. When a car was delivered to a track, a slash was put in the second column. When it was picked up, a reverse slash was added to make


Glencoe Skokie Valley RR HO
Ed Ravenscroft 1958

X = Car has been picked up
/ = Car is on this track
First Blank = Next destination

Spun for each destination in turn.

ERIE 4030		FLAT CAR	BLACK
R-1	X	Deerfield	House
V-8	X	Half Day	Barry Lumber
R-5	/	Northbrook	Team
V-6		Wheeling	House
R-8		Northbrook	Cass Steel
V-10		Half Day	Team
R-1		Deerfield	House
V-8		Half Day	Barry Lumber
R-5		Northbrook	Team
V-6		Wheeling	House
V-13		Half Day	House
R-8		Northbrook	Cass Steel

Pick Up = Take first card with /, add card to consist report as an order to bring car to yard.

Set Out = Take first card without / as an order to deliver car to destination, also first card with / as a pick up order.

Fig. 7-26. Preset card-order system with element of chance.

an X. Thus the first blank in the second column marked the next destination. Assuming no trains made up or in motion, all cars would either be in the central yards or at destination tracks. Cards for cars standing at a destination track would be filed at the front of the compartment for that track. Cards for cars in the yard with that track as the next destination would be filed to the rear of the same compartment.

Using the Valley Switch as an example, to make up a train the yardmaster at the central yard would go to the file for the Valley Switch and look for the first compartment with a card. He would then spin the arrow (Ed Ravenscroft actually used a wheel rather than an arrow). If the arrow pointed at "pick up", the yardmaster would take the front card with a single slash, if there was such a card, and add it to the consist report as a pick up order. If the arrow pointed at "set out", the yard master would select the first card in the compartment without a single slash, if there was such a card, and add it to the switch list as an order to place that car in the Valley Switch. After the switcher had so placed the car, its card would be added to the consist report of the Valley Switch as an order to deliver the car. The front card in the compartment with a single slash, if one existed, would also be added to the consist report, just as if the arrow had stopped on pick up. This assured that there would be room for the car to be set off. If the arrow pointed to pick up, but there were no cars standing at that destination, (no cards with a single slash in the compartment for that track), the yardmaster would simply move on to the next compartment with a card. Similarly, if the arrow stopped on set out, but there were no cars in the yard with that track as a destination (no cards without a single slash in the compartment for that track), the yardmaster would also move on to the next compartment with a card.

The consist report was carried by the train crew. When a car was set out, a single slash would be drawn on the card for that car and when the crew returned to the central yard, the card would be placed in the compartment for that track. When a car was picked up, a reverse slash would be drawn on its card, and after the car was brought to the central yard, its card would be placed in the compartment for its next destination.

To make provision for setting out or picking up more than one car at a time, the chance wheel could have more divisions, some labeled 2, 3, etc. Obviously, if the maximum capacity of the track was less than the number developed by the spin, the maximum number would govern.

Envelope Systems

In 1960, Terry Walsh introduced the idea of a combination waybill consisting of an envelope and a card. This eliminates the need for file signals and paper clips. There have been so many variations of the car-envelope systems that it is impractical to describe them in detail. Rather, the highlights are covered. The physical handling of these waybills can be in any of the manners described before.

The car can be represented by a card which is inserted in an opaque envelope which gives the destination, as shown at the top of Fig. 7-27. The envelope has the space to give the special instructions for that track, e.g., loaded hoppers of coal for a coal pocket. The form on the right with a transparent pocket is the one used by the Sacramento Model RR Club. At that club, a single set of pigeon holes at the Freight Agent's office is the home location for all cards and envelopes. Empty envelopes for destinations applicable to cars on a given track are stored in each pigeon hole as well as the cards for any cars which might be on that track. The agent loads the car cards into the appropriate destination envelopes then returns the combined waybill to the pigeon hole—but so placed that the loaded envelopes are easily distinguished. The operator then changes hats and becomes the Chief Dispatcher or Movement Director and assembles the loaded waybills into consist reports. The conductor comes to the office to pick up the consist report for his train. When the train has finished its run, the consist report is returned to the Freight Agent who places each car cards in the pigeon hole corresponding to the new location of the car and returns the envelopes to a pigeon hole for the origination of another car movement to that same destination.

At the bottom of Fig. 7-27, the destination is on a card and the car is represented by an envelope. On the left is an opaque envelope. The destination card can have a destination on each of its four edges on both

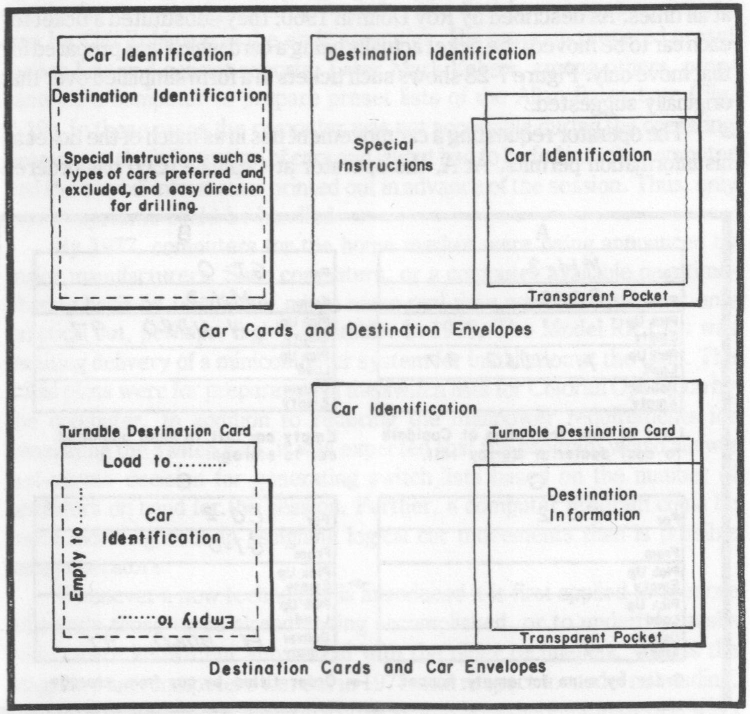


Fig. 7-27. Card-envelope waybills.

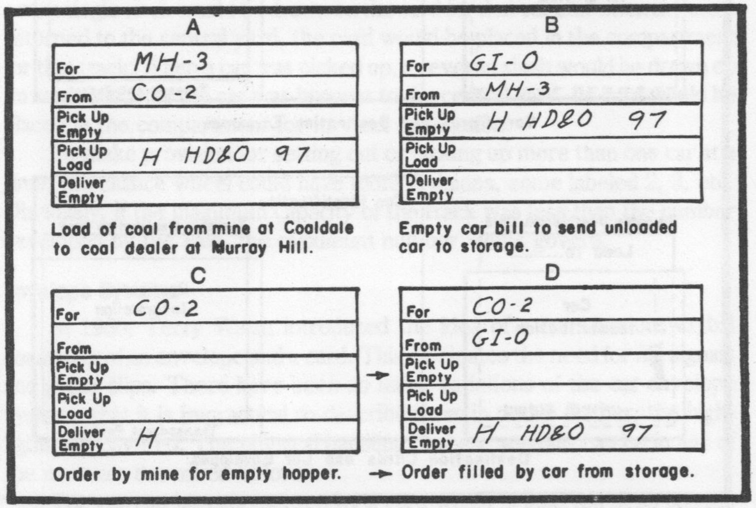
sides, giving a possible automatic sequence of eight moves for the car. Only three are indicated in Fig. 7-27. The one exposed is the destination for a loaded car, for instance a loaded hopper of coal to a coal pocket. When the car is spotted at the pocket, the card can be turned counterclockwise to show the next destination, in this case perhaps return to a yard near the mines. There, the card is turned again sending the car to the mine for another load. Instead of destinations, some of the sides could say "Hold" so the first train through would merely turn the car to expose the destination for the next train, but leave the car there to create a loading or unloading interval. Cliff Robinson used an octagonal rather than a square card to get a possible sequence of 16 moves.

The transparent-pocket type of car-identification envelope permits more information to appear on the destination card than does an opaque envelope. Also, the destination for the car when empty can be placed behind the pocket. This destination will be exposed whenever the destination card is removed.

TICKET SYSTEM

The operating crew of the Victoria Northern, which had been using the preset card-order system with paper clips, devised the ticket system as a means of avoiding the necessity of keeping each car associated with its card at all times. As described by Roy Dohn in 1960, they substituted a ticket for each car to be moved, the ticket actually being a card which was prepared for that move only. Figure 7-28 shows such tickets in a form simplified over that originally suggested.

The operator requesting a car movement fills in as much of the ticket as his information permits. At A, the operator at Coaldale (CO) has ordered that a hopper car (HD&O 97) loaded with coal at the mine (track CO-2) be sent to a coal pocket at Murray Hill (track MH-3). This ticket is complete as written and will be added to the consist report of the way freight which is to pick up the car.



A

For	MH-3
From	CO-2
Pick Up Empty	
Pick Up Load	H HD&O 97
Deliver Empty	

Load of coal from mine at Coaldale to coal dealer at Murray Hill.

B

For	GI-O
From	MH-3
Pick Up Empty	H HD&O 97
Pick Up Load	
Deliver Empty	

Empty car bill to send unloaded car to storage.

C

For	CO-2
From	
Pick Up Empty	
Pick Up Load	
Deliver Empty	H

Order by mine for empty hopper.

D

For	CO-2
From	GI-O
Pick Up Empty	
Pick Up Load	
Deliver Empty	H HD&O 97

→ Order filled by car from storage.

Fig. 7-28. Ticket system.

After the hopper car has been delivered to the coal pocket and there has been time for unloading, the operator at Murray Hill orders the empty hopper car be picked up. The ticket is not yet complete, for no destination has been assigned. The operator serving as car distributer will decide that the empty hopper is most useful if sent to the Gilberton yard for storage as that is the major yard in the coal-mining area. That operator then adds GI-O (Gilberton Storage) to the ticket and it is now complete, as shown at B in Fig. 7-28. When the coal mine needs an empty, an order (as at C) is prepared for an empty hopper to be delivered to the mine. When this order reaches a yard with an available hopper, the yardmaster completes the ticket with the car information, D in the figure.

After a ticket is completed, operation proceeds as in card-order systems. But, when the car is delivered to its destination, the ticket is discarded rather than filed as in card-order systems.

COMPUTER WAYBILL SYSTEMS

The increasing availability of computers has led to their use for replacing the hand work of preparing waybills. The first known such application was by Cliff Robinson in the early seventies. His program prepared preset switch lists and consist reports. Later Mark Eskew, among others, programmed a computer to prepare preset lists of the Allan Bates type (Fig. 7-19). In these cases the computer was not accessible during the operating session, so the information of cars and layout had to be fed into the computer and the waybill information printed out in advance of the session. Thus, only preset systems could be handled.

By 1977, computers for the home market were being announced by major manufacturers. Such computers, or a computer available on a time-sharing basis by telephone, might make real-time waybill system not only practical but, perhaps, highly desirable. In 1978, The Model RR Club was awaiting delivery of a minicomputer system for installation at the Club. The initial plans were for preparation of the switch lists for Colorful Operation by the computer. In addition to reducing the manpower requirements for generating the switch lists, it was expected that the program would allow a last-minute decision for generating switch lists based on the number of operators on hand for the session. Further, a computer program could be much more rigorous in assigning logical car movements than is possible using operators.

Whenever a new technology is introduced it is first applied to do more efficiently those tasks already being accomplished, or to undertake tasks which were known but impractical with the older techniques. This is the stage at which computers were at in 1977 with respect to model railroading, both for waybills and for control. The next step is to apply computers in ways not conceivable with older technologies. When it comes to waybills, certainly automatic car identification and cathode-ray tube (CRT) readouts at various operating positions do not seem beyond the bounds of reason. CRT readouts are available right now. At least, as far as large layouts are concerned, computer waybill systems seem to be the wave of the future.

COMPARISON OF WAYBILL SYSTEMS

Since model railroads neither have the number of operators nor the time available to duplicate the waybill procedures of the prototype, simplifications must be made to create a practical waybill system on a model. A desirable simplification to one modeler, however, may be an anathema to another. It is, therefore, impractical to compare waybill systems on the basis of which is better. Nevertheless, each system has inherent limitations dependent upon the size of the layout, the number of cars on the layout, and the length of trains. These limitations are given in tabular form in Fig. 7-29.

On small layouts, all real-time systems suffer as each car probably will make two or more moves per session and a new destination will have to be assigned for each move. On medium and larger layouts, this limitation for real-time systems disappears as only one move will be made per car as a maximum in most cases. In contrast, with the exception of waybill-on-car preset systems, most preset systems are well-suited to small layouts.

Card-order systems suffer from two limitations as the layout size grows larger. One, it become increasingly difficult to find a missing card or car and the likelihood of such problems arising increases with size and number of cars. Two, the car decks representing consist reports become larger and less manageable with increasing length of trains. Dropping such decks then becomes a non-trivial problem. Ticket systems eliminate the problem of a missing card except while the car is in transit, but do not get away from the problems of a difficult-to-handle consist report for long trains.

If the lists can be produced in an acceptable manner, list systems do not have limitations as size increases. But, in common with card-order and ticket systems, lists do present an increasing memory problem as the number of cars increases. That is, it becomes more difficult to read the list, scan the cars or tickets, locate the cars, and remember which car is to be moved and to where.

In contrast to the other systems, waybill-on-car systems have interent limitations only on small layouts. In Fig. 7-29, appearance is listed as a limitation, but this is really an opinion as it does not represent a limitation on the use of the system. Operators used to waybill-on-car tend to get quite frustrated by systems which do not provide the readily-available information given by the waybill on the car.

Not shown in Fig. 7-29 is the limitation placed on most preset systems that cars must remain at their location between operating sessions. Real-time systems avoid this limitation.

Composite systems are regularly used. Due to the severe memory problem on large layouts imposed by other than waybill-on-car systems, some operators using other systems will place a waybill on the cars during switching operations to avoid having to remember which cars are to be switched and to where. The Brockton O Gage Club placed small flags in specially-prepared sockets on the cars when they entered the yards. These flags gave classification information, not destination track information, as classification information was all that was needed at the yard. Mark Eskew, in following Allan Bate's list system but with computer-prepared lists, used small markers cut from plastic I beams for the same purpose. These markers were simply placed on the roofs of the HO cars. Later he used colored tacks to indicate the stations, but retained the list to show the tracks to which the cars were to be delivered.

		Size of Layout		
		Small	Medium	Large
Moves per Car		Several per Session	1-2 per Session	Less than 1 per Session
Number of Cars		Less than 50	50-100	More than 100
Length of Trains		Less than 10 Cars	10-20 Cars	15-100 Cars
Waybill System	Card Order	If real time, many new destination assignments required per session.	Difficult to locate cars separated from cards. Memory problem drilling. Consist report physically must follow train.	Very difficult to locate cars separated from cards. Severe memory problem. Switch lists and consist reports hard to handle. Consist report physically must follow train
	Ticket	Many tickets required per car.	Memory problem drilling. Consist report physically must follow train.	Severe memory problem. Switch lists and consist reports hard to handle Consist report physically must follow train.
	List	If real time, much writing.	Memory problem drilling.	Severe memory problem.
	Waybill on Car	Several waybills required per car.	Appearance	Appearance

Fig. 7-29. Limitations of waybill systems.

Another form of composite system may be required if a preset waybill system is in use and it is desired to operate additional cars for one session only—say cars brought by a visitor. With the exception of a preset waybill-on-car system, some form of the ticket system added to the preset system will work well. For waybill-on-car systems, it is easy to add real-time waybills to the preset system so no composite system is required.

WAYBILL SYSTEMS FOR SMALL LAYOUTS

The available literature does not provide many examples of waybill systems as applied to small layouts, particularly those of the smallest sizes. The layout shown in Fig. 7-24, although probably classed as a small layout as that term is defined here, is almost at the lower edge of medium layouts.

Small layouts do not have space for many cars. Therefore, to sustain a reasonable level of activity over an entire operating session, the cars, on an average, will have to make several moves each. Any system which requires the next destination to be selected as operation progresses probably would seem troublesome. Fortunately, when there are only a few cars, it is relatively easy to assure that the same cars will be present from session to

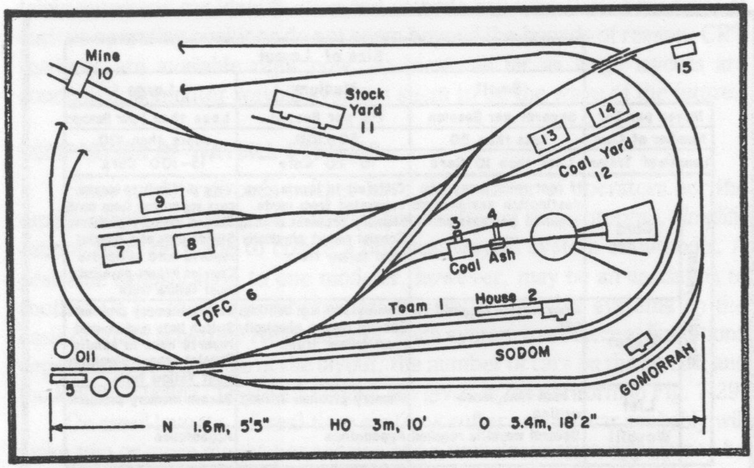


Fig. 7-30. Small layout with many destinations.

session. Thus, preset systems are well adapted to the small layout. The layout shown in Fig. 7-30, a design which maximizes the number of destinations yet also provides a twice-around loop for running, is used as an example. Waybill operation is to be confined to Sodom; Gomorrah is a hold-out point as well as a meeting point between the freights and, if one is operated, the passenger. Assume there are thirty cars and the maximum train length is ten cars.

The first task is to get the cars into a position where the preset waybill system can start. In Fig. 7-31, this is accomplished by a switch list. The cars from both trains are brought to Sodom. One of the locomotives is then used to drill all cars to the positions shown on the switch list. When this is done, two ten-car trains will be made up and the remaining ten cars spotted at known locations. The rest of the list consists of pick ups and set outs which will be made by the two trains each time they return to Sodom. For example, the first time the westward freight returns, it sets out the KCS tank car at the oil depot but picks up nothing. The first time the eastward freight returns, its sets out the C&NW ore car at the mine and picks up the DMIR ore car standing there. If care is taken when making up the lists that a car set out by one train is not picked up by the other train for at least two laps, it will not cause a problem if one freight drills Sodom twice in a row before the other returns.

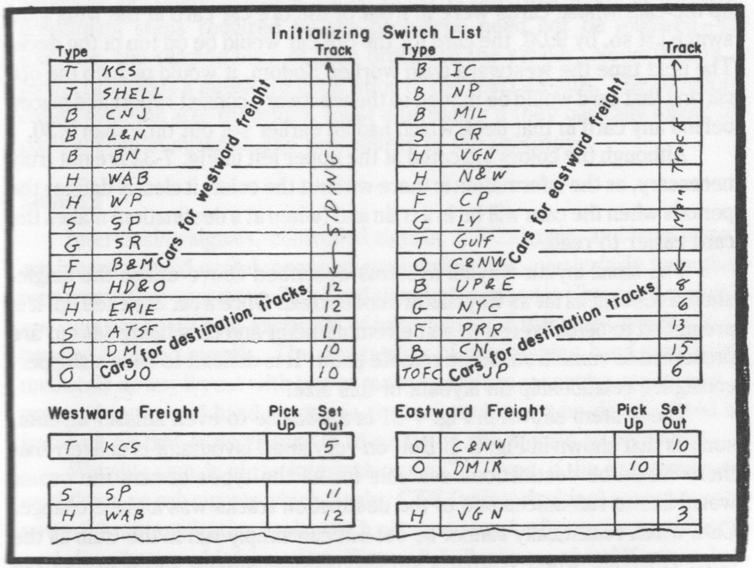
A preset card-order system could also be used with much the similar result. However, some convenient way must be found to replace the automatic sequence of events which comes naturally with the list shown in Fig. 7-31. The method shown in Fig. 7-32 for cards is based on a clock. In Fig. 7-32, a two-hour operating sesson is assumed and that time scale in conventional time is printed along the top edge of each card. The location of each car is indicated on the time scale of its card. On the layout of Fig. 7-30, the car would be in one of three places: at a destination track, or in one of the

two freight trains. At the top left in Fig. 7-32, the card for the C&NW ore car shows that it should be in the eastward train until 8:15, then spotted at the mine, picked up by the westward freight at 9:00 and again spotted at the mine at 9:30.

It is not necessary to have the cars in definite locations when operations start. Considering the C&NW ore car which should be in the eastward train when operations start, if it is on a destination track, it will be picked up by the eastward train the first time that train works Sodom. If it is initially on the westward train, that train will set it off on any convenient track at Sodom to be picked up by the eastward train the next time through. Thus, after the second working of Sodom by the first train through, all cars are located in accordance with their waybills. Should there be only one freight train, as probably the case on the smallest layouts, then all cars will be at the proper locations after the first working of the station.

As indicated at the upper right in Fig. 7-32, the cards are placed in one of four decks. Cars spotted on tracks will have their cards in the switch list for the train which will pick it up next. Cards for cars in the trains will be in the consist report for the particular train. In all decks the cards are arranged in order of the time for the next action.

The handling of the waybill for the C&NW ore car is shown at the bottom of Fig. 7-32. At A the car is in the train. Since it is the next car to be set out, its card is on the top of the consist report. The first time this train works Sodom after 8:15, it sets out the ore car at the mine. The train crew the moves the card to the rear of the switch list for westward trains as that is the train next specified on the card. If there were one or more cards already



Initializing Switch List

Type		Track
T	KCS	
T	SHELL	
B	CNJ	
B	L&N	
B	BN	
H	WAB	
H	WP	
S	SP	
G	SR	
F	B&M	
H	HD&O	12
H	ERIE	12
S	ATSF	11
O	DM	10
O	JO	10

Type		Track
B	IC	
B	NP	
B	MIL	
S	CR	
H	VGN	
H	N&W	
F	CP	
G	LY	
T	Gulf	
O	C&NW	
B	UP&E	8
G	NYC	6
F	PRR	13
B	CN	15
TOFC	JP	6

Westward Freight

		Pick Up	Set Out
T	KCS		5
S	SP		11
H	WAB		12

Eastward Freight

		Pick Up	Set Out
O	C&NW		10
O	DMIR	10	
H	VGN		3

Fig. 7-31. Preset 30-car list.

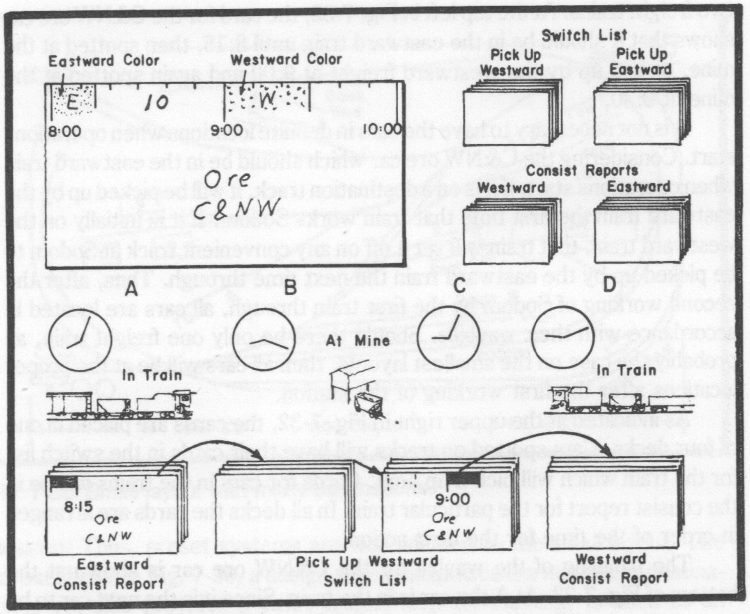


Fig. 7-32. Preset card-order system.

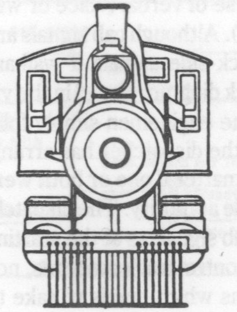
in the switch list with a pick up time later than 9:00, the card for the ore car would be placed in front of those cards.

As the westward train makes its repeated stops at Sodom, it would pick up the cars whose cards were in front of the ore car card in the westward switch list so, by 9:00, the card for the ore car would be on top of the deck. The next time the westward train worked Sodom, it would pick up the ore car and that card would be moved to the westward consist report and placed behind any card in that deck which had an earlier set out time than 9:30.

Although the colors indicated at the upper left in Fig. 7-32 are not truly necessary, as the information is there without the color, it clearly defines the periods when the cars will be in a train and (when at a destination) makes the card easier to read.

The small-layout waybill systems described above utilize the single-station concept as far as waybills are concerned. Once a car is picked up, it is presumed to be delivered to some remote point and cars being set out are presumed to come from some remote point. It is difficult to have a shipper-consignee relationship on layouts of this size.

The system shown in Fig. 7-31 is applicable to even smaller layouts, such as that shown in Fig. 2-1. But, on very small layouts, it is unlikely that there would be destinations available for all the types of cars the owner would like to run unless one of the destination tracks was an interchange. Cars which realistically cannot be set out can simply run in the train all the time. After all, when visiting a small prototype station and watching the operations there, most of the cars stay in the train.



Chapter 8

Communications

Operation of railroads is characterized by simultaneous, independent, yet coordinated actions by many individuals. To enable individuals to work together effectively, there must be communications among them. On model railroads the need for communications will depend heavily upon the number of operators, the size and configuration of the layout, and the type of controls. Of paramount importance on model railroads is efficiency and simplicity of communications. Since safety is not vital, many of the time-consuming steps required by the prototype need not be followed—for example, the reading back of train orders to the sender. Nevertheless, a model railroad is a miniature duplication of the real railroads. The communication systems are, therefore, most interesting if they basically follow the communication systems and procedures of the prototpye.

SIGNALS

Interlocking signals, controlled signals, CTC signals, and hand signals are important and useful means of communications, particularly to enginemen from other operators. The hand signals described in Chapter 6 certainly are superior to a vocal exchange of information of the types which can be handled by hand signals. The desirability of establishing hand signals immediately on any layout with two or more operators cannot be overstated. A great advantage of hand signals is that no equipment or circuits need be installed; all that is necessary is to settle on the signals to be used.

Wayside signals of the interlocking or CTC type, if the enginemen can read them, or cab signals which display CTC (or interlocking) aspects can be powerful communication tools which cut down markedly on the need for the verbal exchange of information. Figure 8-1 illustrates the difference between using CTC indications on cab signals to establish a meet between two extra trains (A), and the use of verbal (voice or written) communications in the form of train orders (B). Although cab signals are indicated, these signals could equally well be track-side signals if walkaround control is used or aspects displayed on a track diagram placed in the view of all the enginemen.

With CTC signals, the enginemen simply follow the indications of the signals. At A in Fig. 8-1, the dispatcher has arranged a meet between two extra trains. It would not matter if one or both were regular trains, as CTC signals supersede timetable authority. The dispatcher can hold a train simply by displaying red on the cab signal, as at the starting point at A in the figure. If the dispatcher also can control track switches, no verbal communication is needed to inform the trains which one is to take the siding. In Fig. 8-1, A Extra 32 east arrives first at Timblin and stops in the rear of the signal controlling the exit from the siding. Extra 92 west never sees anything but green after being cleared by the dispatcher and proceeds. As soon as that train clears switch E, the dispatcher lines the switch for the siding and then can clear the signal to permit Extra 32 east to proceed. Cliff Robinson uses this system of CTC on cab signals for his home layout with excellent results. There is much to recommend communications by signals such as described above when operators are few. Not only is the need for verbal communications reduced, but also the train crews need not be concerned with rules and timetables, as far as meets and passes are concerned.

The very advantages of communications by CTC signals which make them desirable for a few operators also make them questionable when there are enough operators for a crew on each train. These crews might desire to retain the tasks of determining where they will meet other trains and figuring out how they can clear the time of superior trains. Also, the interrelationships between the dispatcher and the other operators by train orders are interesting in themselves.

It is not necessary to install CTC to cut down on the need for verbal communications. An automatic block system which can establish a direction of traffic will also serve, as shown in Fig. 8-1 C. In that figure, the aspects are assumed to be displayed on cab signals of the most elementary type. With Rule 261 in effect, the signal indications supersede timetable authority. Since both trains have proceed indications, they both move toward Timblin. The switches at Timblin are set either by the train crews or by an operator at Timblin. In Fig. 8-1 C, Extra 32 east has entered Timblin first and the switches were lined for a through movement by Extra 92 west. As a result, the enginemen of the latter train never sees anything but green and can proceed right through Timblin.

VOICE COMMUNICATIONS

Communication by voice is another of those aspects of operation which causes few problems on small layouts, but becomes increasingly difficult to handle as the layout grows larger. Even on layouts with just two operators, maximum use of hand signals should be made to reduce the need for words.

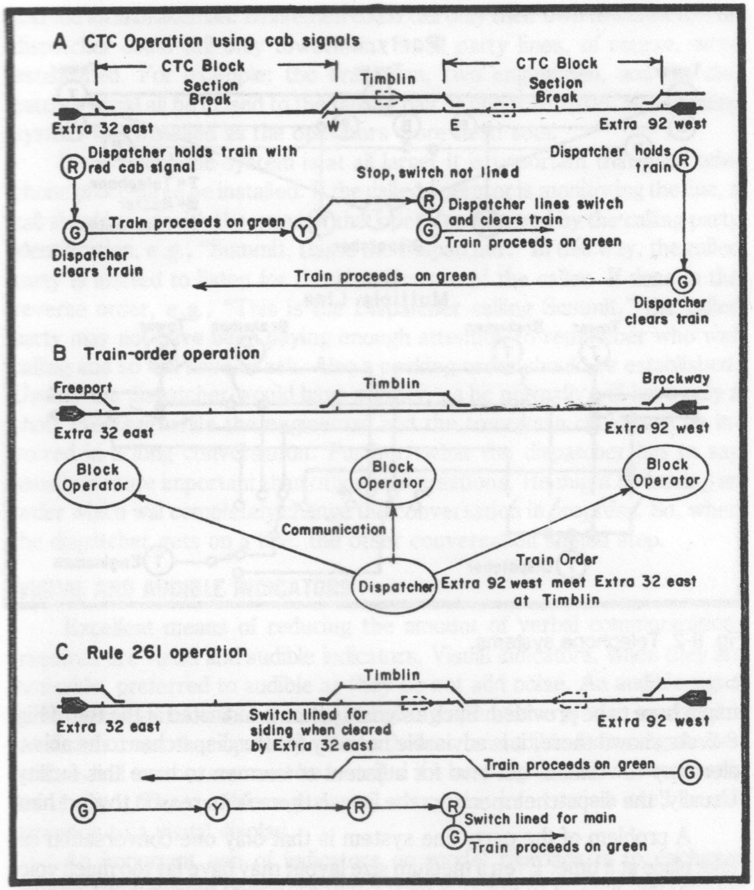


Fig. 8-1. Control of trains.

It does not take many operators present before being able to get a message through to the proper one becomes a problem. This difficulty manifests itself first, in most cases, in the communications between the dispatcher and the towermen or other operators to whom the dispatcher issues train orders. Perhaps CB walkie-talkies could be used effectively for this purpose on layouts whose operators range over considerable territory, as with walkaround control, but the systems so far (1977) have depended upon some form of telephones. Perhaps as important as getting the message to the right operator is that a telephone system immediately reduces the noise and confusion which existed previously. The common basic system is a party line between the dispatcher and the towermen, as shown at the top of Fig. 8-2. As a minimum, all the towermen should have a push-to-talk button to avoid as much background noise as possible being placed on the line, especially their non-telephonic conversations. If each operator wears a headset all the time, merely addressing that operator is sufficient to gain attention. Otherwise, some sort of an alerting system such as buzzers or lamps

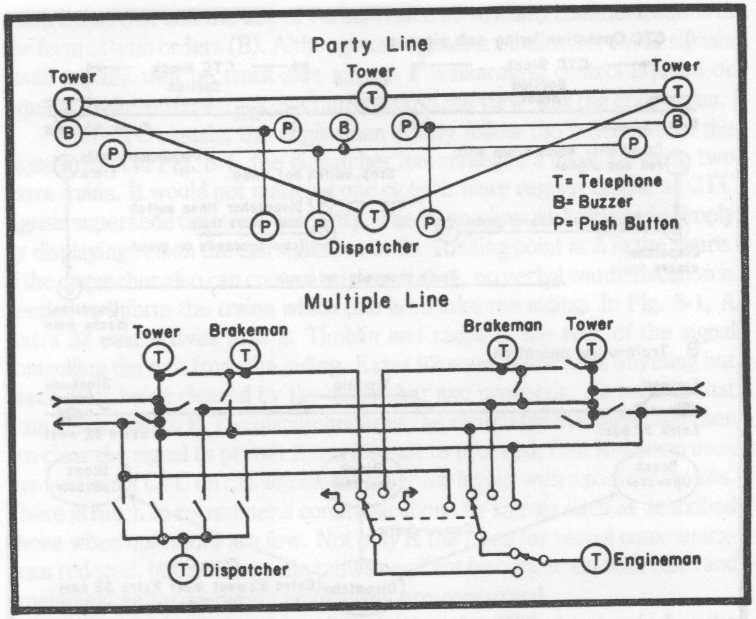


Fig. 8-2. Telephone systems.

might have to be provided. Such a signal system is indicated at the top of Fig. 8-2. As shown there, it is advisable not only for the dispatcher to be able to alert any towerman, but also for adjacent towermen to have this facility. Usually, the dispatcher monitors the line so there is no reason to alert him.

A problem of the party line system is that only one conversation can take place at a time. Even a medium size layout may have far too much voice communication to handle on a single party line particularly if the telephone system is required for waybill operation. About 1952, the West Essex Club installed a switchboard to answer this problem, but that did not prove practical. Due to the rapid action on model railroads, it is necessary to establish and disconnect telephone connections quickly. The multiple-line system shown at the bottom of Fig. 8-2 was developed for the purpose in 1952 by the Summit-New Providence HO RR club. In essence, the talking pair from each operator was taken to any other position whose operator would want to initiate communications with that operator. The operator wanting to make contact merely closed the connection from his telephone to the talking pair of the operator being called. The telephone switches at the engineers positions were rotary switches so an engineman could only talk either to one towerman or to one brakeman at a time. This was to prevent any engineman from tying the system up as one big party line. The telephone keys of the towermen were of the non-locking type so they had to be held operated to communicate, again to prevent tying up the system. Note that towermen could not call enginemen, only the dispatcher, adjacent towers and the local brakeman. Brakemen could call only their own towermen. The dispatcher could call only towermen. Small party lines, of course, were established. For example: the brakeman, two enginemen, and the dispatcher could all be closed to the talking pair of one towerman. No signaling system was installed as the operators wore head sets.

If the telephone system is at all large, it is important that good telephone procedures be installed. If the called operator is monitoring the line, a call should start with the name of that operator followed by the calling party identification, e.g., "Summit, this is the Dispatcher." In this way, the called party is alerted to listen for the identificaiton of the caller. If done in the reverse order, e.g., "This is the Dispatcher calling Summit," the called party may not have been paying enough attention to remember who was calling and so will have to ask. Also a pecking order should be established. Usually the dispatcher would have priority, as he normally will have only a short message while the engineman and the towerman could well be involved in a long conversation. Further, what the dispatcher has to say usually is more important than other conversations. He might be issuing an order which will completely change the conversation in progress. So, when the dispatcher gets on a line, the other conversation should stop.

VISUAL AND AUDIBLE INDICATORS

Excellent means of reducing the amount of verbal communications required are visual and audible indicators. Visual indicators, when they are noticable, preferred to audible as they do not add noise. An audible signal which conveys information to the receiving operator is just so much extra confusion to another operator. Nevertheless, an audible indicating device, such as bell or a buzzer must be installed if a lamp signal will not necessarily be noticed. The audible signal may carry the information itself or call attention to a visual display.

An important use of indicators on model railroads is to exchange information between operators that a train is ready to be sent and permission to send it. A simple case is shown in Fig. 8-3. Each of the two stations is equipped with a SPDT switch plus an LED as the indicator. When either operator has a train to send to the other, that operator throws the SPDT switch to the opposite position, illuminating both LED's. When the other operator is ready to receive the train, that operator reverses the SPDT switch at that station, which extinguishes both LED's. An advantage of this type of exchange of inforamtion, in contrast to the receiving operator lighting a separate LED at the sending operator's station, is that the indicators are ready without further action for the next exchange of information.

The Watchung Valley Model RR Club used the tower-type cab-control system shown in Fig. 3-3. To provide a positive indication that the entrance section into the next station was set to the cab controlling the train, the circuit of Fig. 8-3A was expanded as shown at B. The rotary switches were extra decks on the cab-section switches. When both sections were set to the same cab, both lamps were lit.

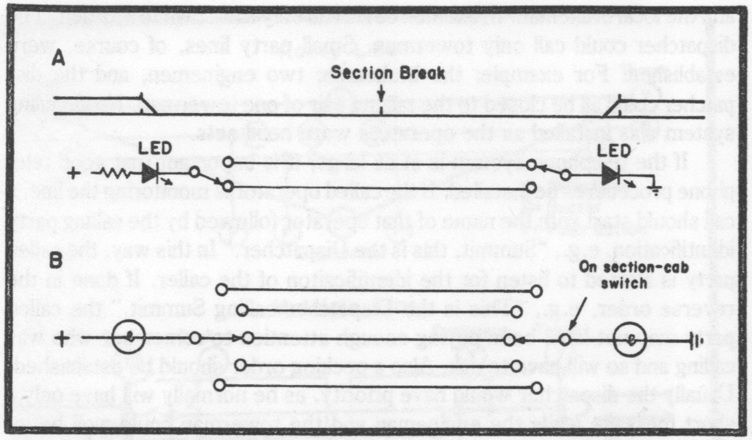


Fig. 8-3. Visual indicators.

Bill Tate, of the Manchester Club (England), used actual British Railway indicators and British-type bell signals to communicate between stations on his home layout.

Which communications can be advantageously handled by indicators depends on the configuration of the layout, its control system, and the method of operation. Certainly layouts operating by pass-the-buck controls can profit by indicators when passing train between operators. In some such cases, the indicators even showed the setting of the speed control to minimize any change in speed as the locomotive passed from one operator to another. Systems such as shown in Fig. 8-3 could replace the telephone communications otherwise needed when operating under manual block rules.

Fortunately, it is easy to add indicators and their controls so it is unnecessary to plan them in detail before control panels and the like are built. The best approach is to observe when fixed information must be sent verbally time and time again. In such cases, it would be well to consider installing some sort of indicators to replace the verbal communications.

Chapter 9

Passenger Operations

Passenger operations are geared to providing transportation for people. The great majority of passenger trains run on regular schedules along definite routes. Typically, the same equipment is used day after day on a particular train. In contrast to freight operation which is car-oriented, passenger operation is train-oriented.

Advantage was taken of the regular schedules of passenger trains and of their faster speeds (as compared to freight trains) to offer mail and express package service in addition to the transport of passengers and their baggage. By 1977 these auxiliary services had declined greatly but were still being provided in some cases.

In Fig. 9-1 are illustrated some of the great variety of facilities and passenger trains once found on the prototype. Only the largest of railroads provided them all.

At A in the figure are facilities which may exist at a passenger terminal. (The particular terminal diagramed is a rough approximately of Hoboken, NJ on the DL&W). The trains operating out of such a terminal can be long-distance trains such as at B, or short-run commuter trains making many stops as at C.

Typically, passenger trains ran from one terminal to another, but there were prototype examples of trains dividing (as at D in the figure) to run down two different lines or for one part to proceed as an express and the other part to follow as a local. Trains might drop or pick up cars either to meet different loading conditions on the various parts of its run or, as indicated at E, to provide a special service. Sleeping cars, in particular, were often set off or picked up to give overnight service to points along the line.

Accomodation train is an old term for a short-run, many-stop local train. Such trains were often used to make a connection with the main-line trains

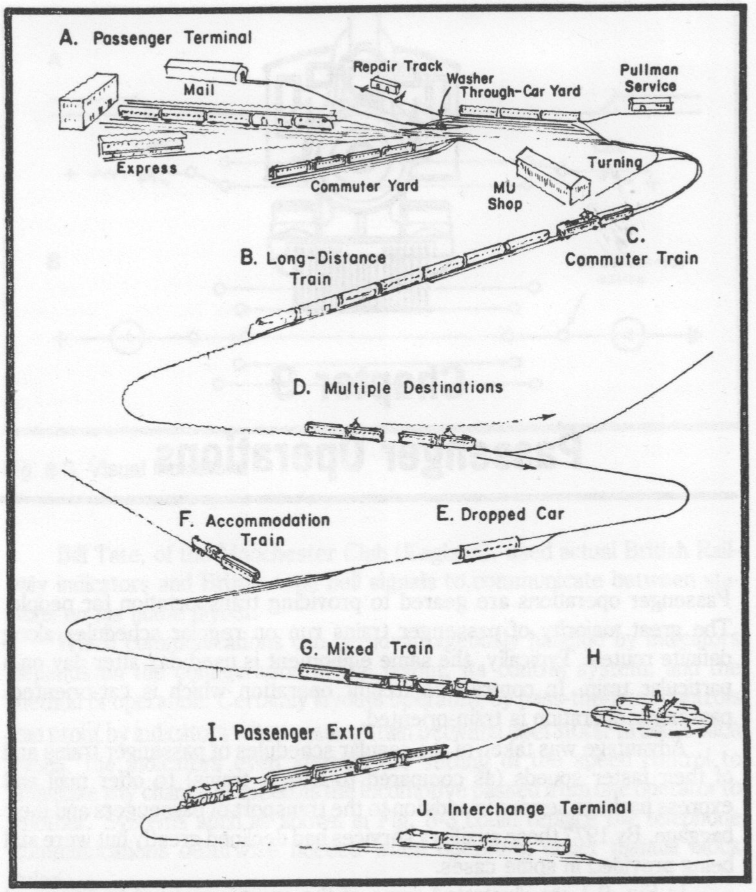


Fig. 9-1. Passenger operation.

(as at F) and there was at least one example still operating in 1977. Sometimes passenger cars were carried on a freight train, the mixed train as at G. There were also examples of passenger trains which, toward the end of their existance, started to carry freight, usually TOFC.

There were a few examples of car ferries which accepted entire passenger trains including the locomotive, as at H. Such ferries could serve as the destination for passenger trains on a model. Passenger extras to football games, to race tracks, and for excursions were once common and still occasionally run. On a model, passenger extras are the most convenient train to add to increase activity on the line when things are running well.

Although most passenger trains begin and end their runs on the same railroad, there were many examples of complete trains being turned over to another railroad at an interchange station as at J. In addition, through cars were transferred between a train of one railroad and that of another.

CONSISTS

Most passenger trains carrying first-class sleepers or parlor cars, coaches, baggage, and mail or express cars were arranged as indicated in Fig. 9-2A. It is not an accident that baggage, mail, and express cars were called head-end cars for that is where they usually were carried. The most common position of the diner was between the first-class cars and the coachs. If a lounge car were carried, its usual position, when open to coach passengers, was on the coach side of the diner. Often one of the sleepers was half sleeper, half a first-class lounge. After the days of the steam locomotive, it was not uncommon to reverse the order of first class cars and coaches with the first class ahead of the diner. This was always true if a coach tail car was provided. In both directions of the New York-Washington run, the parlor cars once were almost always on the south end of the train. This required less walking for the first-class passengers at the Washington Terminal.

When coach sleepers or tourist sleepers were carried, they often were between the diner and the first-class sleeping cars. But, on the Amtrak Broadway, the coach sleepers were carried ahead of the coaches with the first-class sleepers behind the diner.

Notable exceptions to the rule that diners separated the first-class cars from the coaches were the basically coach trains which carried a through Pullman or two (an example was the Phoebe Snow of the DL&W). On such trains, the diner usually was amid the coaches and the sleepers forward as indicated at B in Fig. 9-2. Often the rear car was a coach lounge observation. Other exceptions to the usual diner position were trains carrying two diners. On Amtrak's Southwestern Limited one diner was amid the sleepers, the other amid the coaches as indicated at C. On the Canadian of the CP, there were two diners amid the sleepers and separate facilities for the coaches.

Trains which combined sections for different destinations might combine the cars according to the normal rules. In 1976 the New York and Washington sections of the Broadway were combined at Harrisburg so that the slumber coaches were together followed by the coaches, lounge, diner,

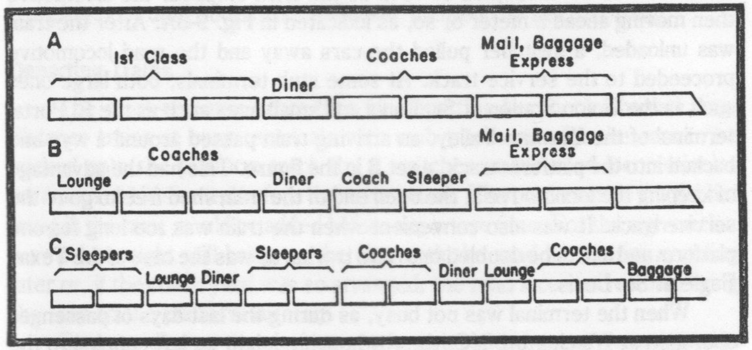


Fig. 9-2. Passenger-train consists.

lounge, and then all the 1st class sleepers. Earlier, however, the Washington section was simply coupled to the rear of the New York section isolating the Washington coach among the sleepers. When the Texas Eagle of the Missouri Pacific had sections to various destinations, it left St. Louis with Pullmans both front and rear separated by diners from the coaches at the center. Note that sections of a train to or from different destinations applies a different meaning to the term "section" than when two trains are operated as sections, e.g.. First 1 and Second 1, using the same timetable authority as described in Chapter 5.

Cars to be set off en route often were carried to the rear. The westward National Limited of Amtrak (1976) set off coaches at Pittsburgh. This train carried its sleepers forward. Baggage, mail, express, and business cars to be set off were often carried on the rear, even on trains with tail cars, much to the passenger's disgust in the latter case.

Mixed trains, if steam was to be supplied to the passenger cars, carried the passenger-service cars behind the locomotives and the freight cars to the rear. The Fast Flying Virginian of the C&O spent its last days in this manner, the freight cars being Railvans. On mixed trains which were basically freight trains and offered passenger service only on an accomodation basis (examples being the branch-line trains of the Georgia RR) a coach, often called a rider coach, serving double-duty as a caboose was usually carried at the rear of the train. From a model point of view, when passengers are carried in the caboose, as in the last days of passenger operation on the SOO, such trains are simply freight trains, the passengers boarding and alighting at the yards.

PASSENGER TERMINALS

Arriving Trains

At most terminals, arriving trains proceed directly to a platform track. The usual, but no means universal, practice at busy terminals for a locomotive-powered long-distance train arriving on a stub track was for the locomotive to be uncoupled as soon as the train stopped, the locomotive then moving ahead a meter or so, as indicated in Fig. 9-3A. After the train was unloaded, a switcher pulled the cars away and the road locomotive proceeded to the service track. At some stub terminals, both large ones such as the Union Station at St. Louis and small ones such as the El Portal terminal of the Yosemite Valley, an arriving train passed around a wye and backed into the platform track, as at B in the figure. This had the advantage of keeping the locomotive at the open end of the train shed free to go to the service track. It was also convenient when the train was too long for one platform and had to be doubled onto two tracks, as was the case of the Texas Eagle at St. Louis.

When the terminal was not busy, as during the last days of passenger operation at Wilmington, NC, the road engine might be left coupled to the cars and at some convenient time, it backed the cars out, turned the

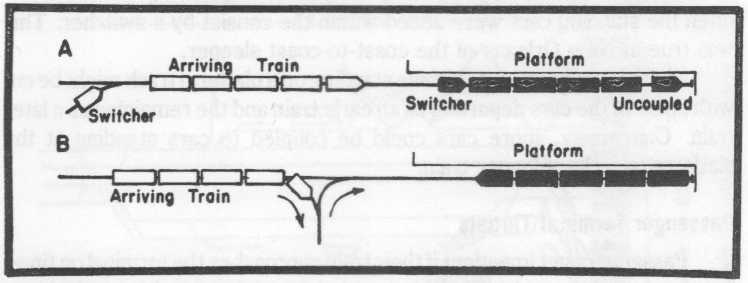


Fig. 9-3. Arrivals on stub tracks.

equipment, and backed onto a platform track ready for the return trip. A push-pull train also did not have its locomotive uncoupled unless the locomotive is to move to a service track or cars are to be added to the train.

When the terminal has through tracks, a long-distance locomotive-drawn train arriving on those tracks may still uncouple its locomotive after the stop at the platform, the locomotive then moving directly to the servicing tracks. An example were trains arriving at Grand Central Terminal on the tracks equipped with loops. If the coach yard were beyond the platform tracks, the road locomotive might remain coupled to the cars and after the train was unloaded, the road locomotive would take the cars to the coach yard. An example was at Pennsylvania Station, NY, where the equipment was moved to the Sunnyside Yards by the road locomotive.

Once common for trains with early arrival times at a terminal was to permit the Pullman passengers to remain in the sleepers to a reasonable hour. For example, on the PRR in 1935 the Edison arrived in Washington at 7:15AM, but the Pullmans could be occupied until 8:00AM. Depending upon the time involved and the need for the tracks, the entire set of equipment might be left standing at the platform track until the Pullman passengers got off or a switcher might set the sleepers over on a convenient track. In 1972 the through sleeper for Los Angeles carried on the Southern Crescent was removed from the Crescent at the New Orleans terminal and set against the bumping post until added to the Sunset Limited the next morning.

Departing Trains

The most-common procedure for departing locomotive-hauled long-distance trains at busy terminals with stub tracks was for the cars to be backed onto the platform track (by a switcher or the road locomotive) a minimum of 15 minutes before departure time. The road engine, if it did not bring in the cars, would be added before departure time. For through tracks, a switcher might still bring up the cars with the road locomotive coupling later or, if the coach yard was so arranged, the road locomotive could bring the cars to the platform directly.

Cars standing on the platform tracks to be added to the departing train are most simply handled by backing the other cars to the standing cars, but often the standing cars were added within the consist by a switcher. This was true at New Orleans of the coast-to-coast sleeper.

Multiple-unit commuter trains standing on a platform track might be cut with some of the cars departing as an early train and the remaining as a later train. Conversely, more cars could be coupled to cars standing at the platform to make a longer train.

Passenger Terminal Throats

Passengers get impatient if their train approaches the terminal on time, but then stands outside the station waiting for a clear track to a platform. Similarly, they dislike standing at a platform after the scheduled departure time. It is, therefore, necessary to have sufficient approach tracks to the platforms (the throat) to handle the rush-hour traffic, including the necessary switching movements. This means a fanning out of the tracks well in advance of the terminal. At the top of Fig. 9-4, a large prototype example is given, the old Jersey City Terminal of the CNJ, which also handled trains of the B&O and Reading. The tracks as shown were those of its last days. At one time there were more approach tracks.

In sharp contrast to prototype practice, there have been several examples of large model passenger terminals built with only the most rudimentary of throats. At the bottom of Fig. 9-4 is a diagram of a terminal similar to those of two large, well-known HO clubs. In terms of prototype-like operation, a terminal such as this can only be considered a design error. Indeed, at the two clubs in question, the passenger trains merely run round the main-line loop and occasionally one would pull into the terminal, make a stop then back out and run again.

Coach Yards

Typically, after an arriving train has been unloaded, the switcher will take the cars intact (except for express and mail cars which are to be delivered to their special tracks) to the turning facility, turn the train and deliver it to the coach yard for cleaning and servicing. This applies particularly to banner trains, such as the North Coast Limited, which kept the same equipment run after run. The cars of a day-coach train probably would go directly to the coach yard as there is no reason to turn such a train.

There may be more than one coach yard for the different types of cars. At Hoboken, NJ, as indicated in Fig. 9-1, there was a separate yard for long-distance cars and another for commuter cars. Actually there were two commuter yards, one for MU cars and the other for locomotive-drawn cars. At St. Louis there was even a separate yard for head-end cars. In the days when the Pullman Co. operated the sleepers, their cars might be brought to tracks near the Pullman service building.

Model railroads seldom have the space for specialized yards. They have to do with just one yard, perhaps just a track or two near the terminal building. An additional problem is the length of major passenger trains. Even a 10-car passenger train is over 1.6m (5.3′) long in N scale, 3m (9.7′) long in HO, or 5.4m (17.7′) long in 0. It takes a big layout to have coach yards long enough to accept such trains on one track. Trains can, of course, be split up. Another solution is to turn the train and back it onto a platform track holding it there until its departs for its return journey. This was the practice of many a prototype when the tracks at the terminal could be so tied up. Another possibility on a model is an interchange terminal as indicated in Fig. 9-1 J. The long trains arrive on the through tracks and are turned over to a connecting railroad to continue their run. Figure 9-5 is a model example of a terminal built in this manner. The arriving long trains on the HD&O are bound for Chicago or St. Louis via and B&O and use the two through tracks. The shorter trains terminating at Pittsburgh use the stub tracks. This model terminal is based on the P&LE terminal at Pittsburgh, except the stub tracks have been reversed to face eastward. There are other prototype terminals with both stub and through tracks, a particularly large example being at Washington, D.C.

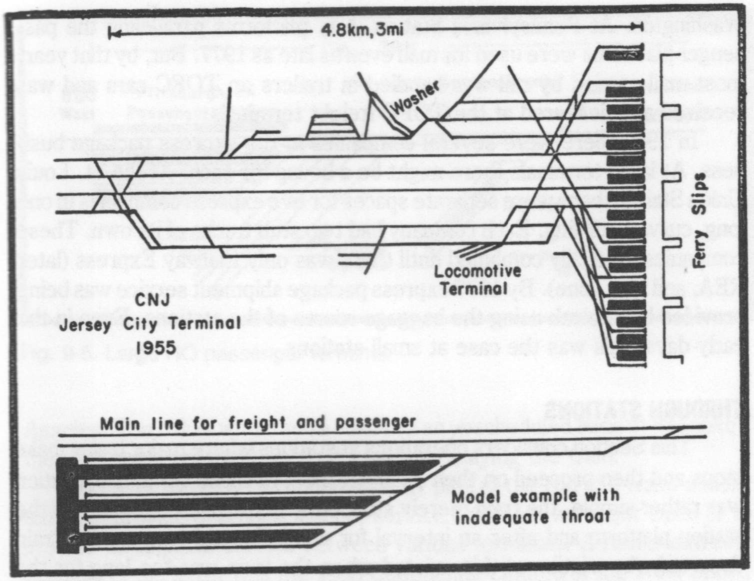


Fig. 9-4. Throats for passenger terminals.

Mail and Express

At small terminals mail and express cars were loaded directly from a passenger platform. Larger terminal tended to have separate tracks for mail cars and other tracks for express cars. Usually the express tracks were at an express house. Figure 9-5 is a model example. The express house might be adjacent to the passenger station as at South Station, Boston, or considerably removed as at Union Station, Chicago.

The mail track might go into a mail shed near the passenger station as was the case at Hoboken (Fig. 9-1) or even directly into a post office as in

Washington. At Pennsylvania Station, NY, platforms paralleling the passenger platforms were used for mail even as late as 1977. But, by that year, most mail carried by rail was handled in trailers on TOFC cars and was received and delivered at the TOFC freight terminals.

In 1900 there were several companies in the express package business. At large terminals there might be a house for each. At the St. Louis Union Staiton there were separate spaces for five express companies in one long, curved building. Each company had two stub tracks of its own. These companies gradually combined until there was only Railway Express (later REA, and now gone). By 1977 express package shipment service was being provided by Amtrak using the baggage rooms of the stations. Even in the early days, this was the case at small stations.

THROUGH STATIONS

This Section considers operations at stations where major trains make stops and then proceed on their runs. At most of these stations operation was rather simple, the train merely stopped with the passenger cars at the station platform and after an interval for unloading and loading, the train departed. A variation of this existed when the train was too long for the platform, a case in point being the Penn-Texas of the PRR. At Newark, NJ, this train stopped with the head-end cars at the platform, the rear two Pullmans standing beyond the opposite end of the platform. Passengers for those cars had to walk through the train. At Columbus, OH, the platforms were even shorter. The Penn-Texas made two station stops there. The first, lasting from 10 to 15 minutes, had the head-end cars at the platform and as many of the passenger cars as would fit. After the head end was worked, the train would move forward and make a second station stop for the rear cars, this one for only a minute or two.

At some through stations the cars were serviced, often the locomotive also. Crestline, OH, was an example of a small station servicing the locomotives. Depending upon the location of the locomotive servicing facilities, the locomotive may be serviced while still coupled to the cars, or it may uncouple and move to the servicing facilities. The latter commends itself to a model railroad as it provides additional modelable operation.

Locomotives may be changed at even very small stations or at no station at all. Chapter 11 covers locomotive changes as well as their servicing.

Car Set Off and Pick Up

Although no longer as common as in the past, in 1977 long-distance trains still set off and picked up cars at intermediate stations on their runs. Coaches, in particular, were added or removed according to traffic demand. Usually this occurred at major stations where considerable traffic originated or terminated. When the Amtrak National Limited was the day train to Pittsburgh, it carried coaches from NY which were set off at Pittsburgh, the remainder of the train continuing on to Kansas City, one sleeper even to Los Angeles. The N&W would add a coach on an unscheduled basis at Roanoke if the train were crowded, even if it meant delaying the train.

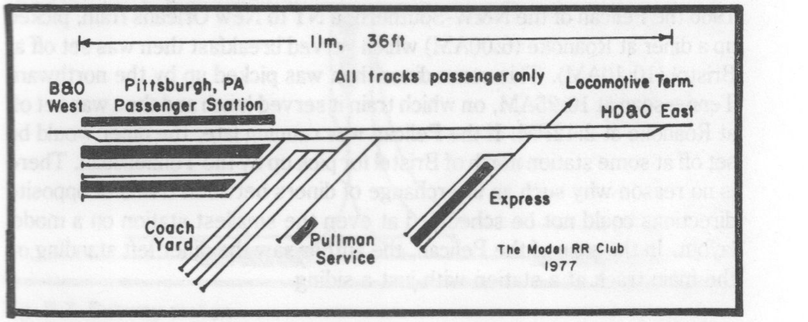


Fig. 9-5. Large HO passenger terminal.

Sleepers were often carried for only part of the run of a train, usually either to provide overnight sleeper service between two major cities or to provide through car service between various terminals. A rather extreme example of the latter was the 1905 Continental Limited of the West Short, B&M, and Wabash. As shown in Fig. 9-6, this train originated westward both from New York (ferry to Weehawken) and from Boston with cars for both Chicago and St. Louis. There was even a parlor car (Sundays only) NY to Albany.

Of particular interest to modelers is that three of the switching points of this train were at stations small enough to be realistic on all but the smallest of layouts. The operation at one of these stations, Kingston, was unusual. To provide local service on this train from points north of New York, a Pullman left early on a local train reaching Kingston in time to be added to the Limited which had made only one intermediate stop. Ravena, where the parlor car was set off, and Rotterdam Junction, where the NY and Boston sections combined, also were small stations.

If the demand justified, sleepers were carried to intermediate points far more than an overnight journey apart. For example, in 1964 the Pelican left NY at 7:00PM on the PRR for New Orleans with two sleepers, one for Bristol (10:10AM), the other for Chattanooga (6:00PM). Only coaches were carried beyond Chattanooga.

Head-end cars were quite subject to being set off or picked up at intermediate points, particularly by mail and express trains and by secondary passenger trains, but seldom by banner trains. It would have been a real emergency which would have caused the 20th Century Limited in its prime to handle such cars for intermediate set off or pick up.

By 1977 most, if not all, diners were carried by a train from terminal to terminal. This was not always true, particularly for secondary trains. The Continental limited, as shown in Fig. 9-6, set off its diner after the supper hour then picked up another for breakfast. The eastward Jeffersonian and some other PRR trains picked up their diners for breakfast at Altoona. In

1966 the Pelican of the N&W-Southern, a NY to New Orleans train, picked up a diner at Roanoke (6:00AM) which served breakfast then was set off at Bristol (10:10AM). This same diner then was picked up by the northward Tennessean at 10:25AM, on which train it served lunch and then was set off at Roanoke at 2:12PM. If the Pelican was running late, the diner would be set off at some station north of Bristol for pick up by the Tennessean. There is no reason why such an interchange of diners between trains of opposite directions could not be scheduled at even the smallest station on a model layout. In the case of the Pelican, the author saw the diner left standing on the main track at a station with just a siding.

Stub Intermediate Stations

Typically on-route stops are made at through (also called side) stations where the train can make a station stop and then continue on its route without reversing. Nevertheless, there were many stub stations which served primarily as way stations, particularly at large cities. This is fortunate, as a stub station is easier to fit onto benchwork than a through station. It can be built on a narrow peninsula or into a corner.

In most cases a through train backed into a stub station, as shown in Fig. 9-7. At Columbus, OH, the C&O trains from Detroit backed into the Union Station. That station was actually a through station and used as such by all other railroads except for trains terminating. At Jacksonville, FL, the Seaboard trains backed in and pulled out, but the Atlantic Coast Line trains pulled in as they were turned over to the Florida East Coast.

There were examples of through trains pulling into a stub station then backing out, a case in point was the Super Continental of the Canadian National at Ottawa.

Rush-hour commuter trains typically operated intact terminal to terminal on their runs. MU commuter trains sometimes combined for parts of their runs. On the DL&W it was common to assign the last two or four cars of a train leaving Hoboken to the Gladstone Branch with the forward cars for Dover on the Main Line. The train divided at Summit. At least one westward rush-hour train also divided at Summit with the first cars going on as an express and the last cars proceeding as a local beyond Summit.

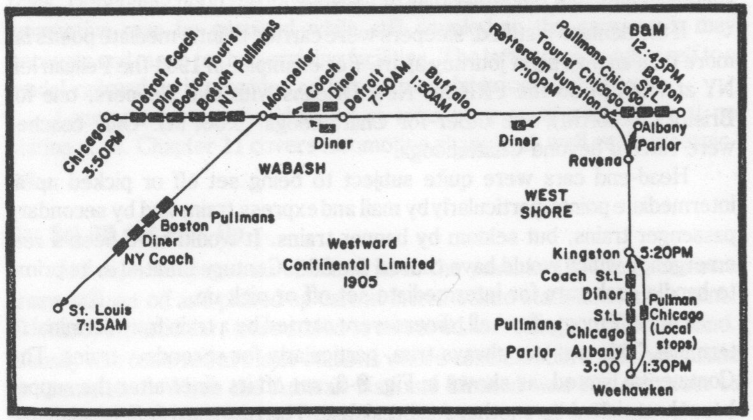


Fig. 9-6. Examples of car set offs and pick ups.

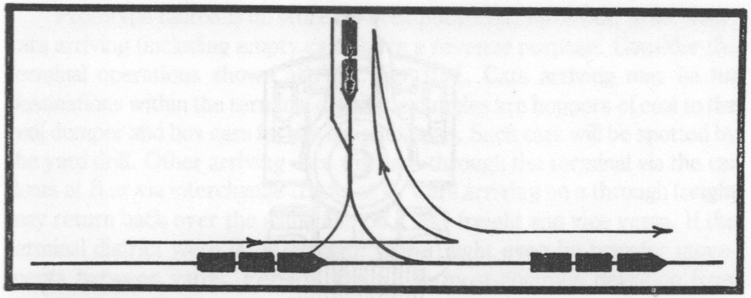


Fig. 9-7. Subway station.

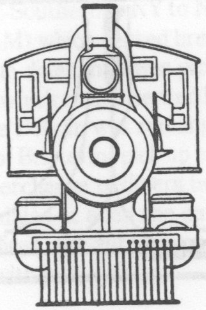
A very-active engine-change facility can be justified if commuter service is modeled. At South Amboy, NJ, all the commuter trains originating from Pennsylvania Station, NY and bound for the New York and Long Branch arrived behind a motor. This motor was uncoupled and moved to a small yard and a Diesel from the ready track coupled on.

COMMUTER SERVICE

For the modeler who likes to run many passenger trains with brief station stops, commuter service is ideal. Busy commuter lines such as the Long Island RR had trains operating on the closest possible headway at the height of the rush hour. Although commuter service implies bringing people to work in the morning and taking them home at night, many lines offering commuter service provided day-long service in both directions, at one time perhaps all lines offering commuter service did so. For that reason, commuter service is also called suburban service.

Fast turnaround is the name of the game. Some railroads such as the IC and the DL&W electrified their commuter lines to gain the advantage of multiple-unit trains even through they did not use the electrification for freight or long-distance passenger trains. The B&A and CNJ (among others) had double-ended steam locomotives to eliminate the delays caused by turning the engines. Budd RDC cars and push-pull operation also were used to speed turnaround.

In most cases, commuter cars offered in interesting contrast to the cars on long-distance passenger trains although this was not always true. In 1977, some of the ex-CNJ commuter trains were using cars which once operated on the Empire Builder of the GN. The usual commuter car, however, was a high-capacity coach, on some lines double-decked. Commuter trains also once handled newpapers, express, and mail. For example, the post offices along the electrified Gladstone Branch of the DL&W received their mail from postal combines in the MU commuter trains.



Chapter 10
Freight Operations

Freight is the king-pin of prototype operation on all but a very few railroads; on the model it is freight operation which generates the greatest interest. Many model railroaders feel the chief contribution passenger trains serve is to create problems for the freight trains in clearing the time of passenger trains.

Unlike passenger trains which, typically, have the same equipment run after run, prototype freight trains (with the exception of unit trains) never have the same consist twice. Indeed, freight operation can be thought of as a great many cars moving from one point to another. When a group of these cars going in the same general direction are put together to form a train it is in the interests of economy, not to provide the basic service directly.

As far as interest in operation is concerned, the importance of including car movements to a prespecified destination cannot be overstated. This is not to say that every freight car handled on a model railroad must, or even can, have a specific starting point and a specific destination. If long trains are to be run, the duration of an operating session would not permit such trains to be made up on a car-by-car basis and to have each such car delivered to a separate destination. Long trains can be operated realistically, either as complete trains received and delivered via interchanges, or as large blocks so received and delivered.

The main types of prototype freight operations are shown in Fig. 10-1. Most model railroads are too small to attempt to duplicate them all; indeed many layouts must be restricted to just one or two. Nevertheless, it is important that a modeler understand the entire freight-handling system of the prototype so that the part which can be modeled is a portion of a total system and not just a game of shuttling cars.

Prototype railroads do store cars temporarily in yards but, in the main, cars arriving (including empty cars) have a revenue purpose. Consider the terminal operations shown at A in Fig. 10-1. Cars arriving may be for destinations within the terminal district; examples are hoppers of coal to the coal dumper and box cars for the freight house. Such cars will be spotted by the yard drill. Other arriving cars will pass through the terminal via the car floats at B or via interchange tracks at C. Cars arriving on a through freight may return back over the same line on a way freight and vice versa. If the terminal district were large enough, there might even be transfer movements between yards. Perhaps the single most-common deviation from prototype terminal practice on model railroads is that cars received at a model terminal are often considered to have ended their run and placed on any convenient track.

Originating from the terminals are through freights as at D in Fig. 10-1. Such through freights may run intact to a distant terminal but, more likely they will carry blocks of cars to be set off at stations or yards on their run. Through freight do little, if any, local switching along the line. This latter work is handled by the way freights as at E. Way freights are known by other names such as local freights, peddlers, and road drills. Way freights might originate from a terminal, work along the line, then return to the same

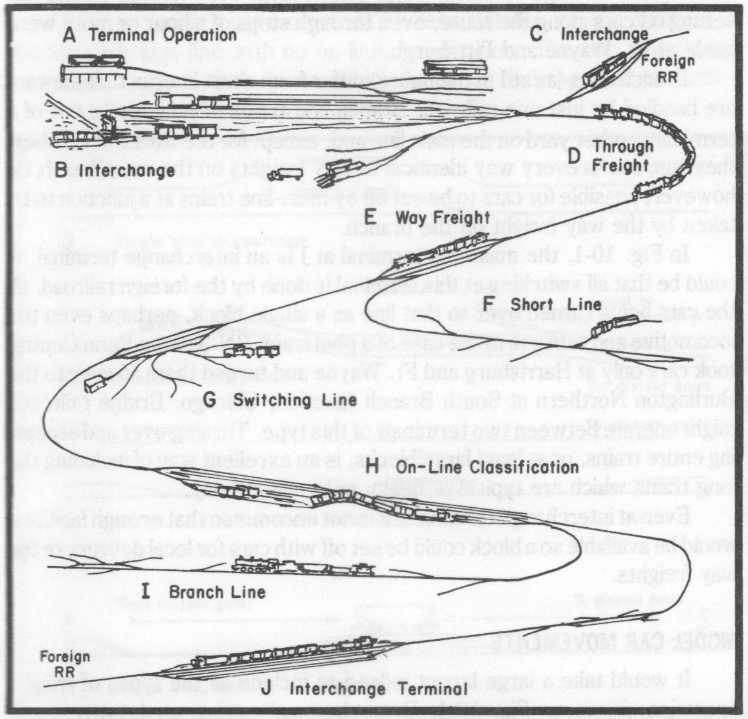


Fig. 10-1. Freight operation.

terminal. Such freights are often called *turns* or *turners*. Way freights might also work the line from one yard to another.

Way freights, even through freights, may set out cars for (and pick up cars from) a connecting short line as at F. From a modeler's point of view, the significant difference between a short line and a Class 1 railroad is its less-formal style of operation. Short lines typically do not work the tracks at the interchange point with their connecting railroad. In contrast a switching line, as at G, may handle all the switching at a given station except for the setting out or picking up of cars by the main railroad. Again from a modeler's point of view, the main distinction between a short line and a switching line is that a short line typically has a recognizable main line, but a switching line is often many destination tracks radiating from the interchange.

Major prototype railroads seldom do all their classification work at terminals. Very often there are on-line classification yards as at H in Fig. 10-1. Such yards usually act as terminals for both way freight and through freights. The Conrail Buckeye yard in Columbus is an example of an on-line yard which terminates through freights. Other through freights may set off or pick up blocks as they pass through such on-line yards and still others may pass through with perhaps only a locomotive or crew change. An example of the latter (1975) was Penn Central CG-2 which took cars classified at Blue Island yard, Chicago to Enola Yard, Harrisburg, PA—neither taking nor setting off cars along the route, even through stops of a hour or more were made at Ft. Wayne and Pittsburgh.

Branch lines (as at I in the figure) differ from short lines in that the cars are handled by just one railroad. Branch line trains often operate out of a terminal or other yard on the main line and, except for the tracks over which they run, are in every way identical to way freights on the main line. It is, however, possible for cars to be set off by main-line trains at a junction to be taken by the way freight on the branch.

In Fig. 10-1, the main-line terminal at J is an interchange terminal. It could be that all switching at this terminal is done by the foreign railroad, all the cars being turned over to that line as a single block, perhaps even the locomotive and caboose in the case of a pool train. BN-3 of the Penn Central took cars only at Harrisburg and Ft. Wayne and turned them all over to the Burlington Northern at South Branch Junction, Chicago. Bridge railroads might operate between two terminals of this type. Turning over and accepting entire trains, or at least large blocks, is an excellent way of including the long trains which are typical of heavy railroading today.

Even at interchange terminals, it is not uncommon that enough facilities would be available so a block could be set off with cars for local delivery or for way freights.

MODEL CAR MOVEMENTS

It would take a large layout indeed to include all the types of freight operation shown on Fig. 10-1. Even the smallest layout, however, can include at least two types. But, on small layouts, it is virtually essential that cars come from and depart to points not on the layout. Four different possibilities are illustrated in Fig. 10-2.

At A is a method suitable for single-station layouts, such as the one shown in Fig. 2-1. Cars are brought to the station by a way freight which then, in accordance with the waybill system in use, spots any cars from the train with destinations at the station and picks up any other cars which are to be moved in the direction of the train. Each train through is assumed to be an entirely new train carrying cars from remote points. Through trains are simulated by trains not stopping as they pass through the station.

At B in Fig. 10-2 is shown a branch or short line extending from a junction with the main line. All cars to and from this line are taken or set off on the interchange track at the junction. If the main line actually exists (even on a small layout it could be a hidden loop), a main line train could actually remove the cars from the branch returning them later as new cars to the branch. Even if the main line did not exist as a working line, cars could still be set off by the branch freight on the interchange track, with the waybill system providing a new destination on the branch after a waiting period on the interchange track. In comparison with the arrangement shown at A in Fig. 10-2, this system has the advantage, as far as branch or short line operation is concerned, that each car makes a complete move. All imaginary movements are beyond the interchange track.

At C is another car-movement system suitable for the smallest of layouts, a bridge line with no on-line classification. The two interchange terminals could, in fact, be reversing loops or tied together to form a

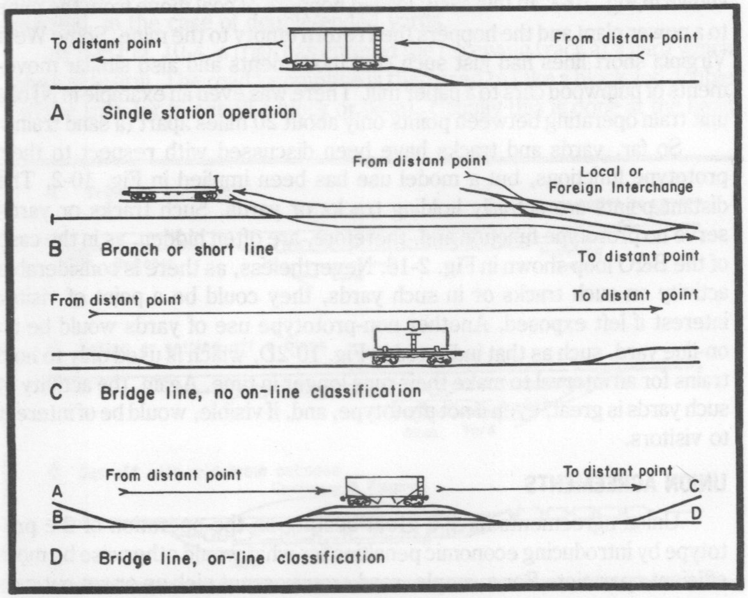


Fig. 10-2. Car movements to imaginary points.

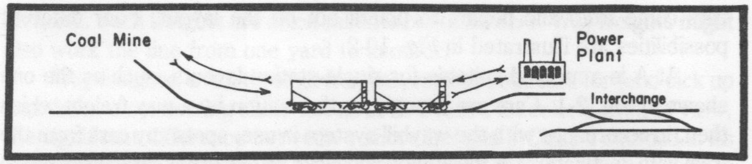


Fig. 10-3. Captive cars.

continuous loop. Through freights would move from terminal to terminal. If lineside industries are installed, way freights could deliver and pick up at such destinations, the way freights taking from or delivering the cars to one (perhaps both) of the terminals.

The bridge-line concept become more interesting if an on-line classification yard can be added, as at D in Fig. 10-2. It does not matter if the foreign roads A and B as well as C and D are tied together as reversing loops or as continuous loops. Trains reaching any interchange point presumably leave the railroad and return as though they were new trains. Trains arriving from any foreign railroad would have their cars classified for the other three foreign railroads. Departing trains would take the cars for their assigned foreign railroad. Way freights probably would operate out of the on-line yard.

In Fig. 10-2, all cars moved either came from or were being sent to imaginary points. For the smallest layouts this is probably the best type of car movements. Nevertheless, it does not take a large layout to justify complementary destinations, even captive car movements such as those shown in Fig. 10-3. In this case, loaded hoppers of coal move from the mine to a power plant and the hoppers then return empty to the mine. Some West Virginia short lines had just such coal movements and also similar movements of pulpwood cars to a paper mill. There was even an example in NJ of a unit train operating between points only about 20 miles apart (a sand train).

So far, yards and tracks have been discussed with respect to their prototype functions, but a model use has been implied in Fig. 10-2. The distant points are actually holding tracks or yards. Such tracks or yards serve no prototype function and, therefore, are often hidden, as in the case of the B&O loop shown in Fig. 2-16. Nevertheless, as there is considerable activity on such tracks or in such yards, they could be a point of visitor interest if left exposed. Another non-prototype use of yards would be an on-line yard, such as that indicated in Fig. 10-2D, which is used only to hold trains for an interval to make their runs longer in time. Again, the activity of such yards is great, even if not prototype, and, if visible, would be of interest to visitors.

UNION AGREEMENTS

Union agreements have a great bearing on the operation of the prototype by introducing economic penalties for what would otherwise be more efficient operation. For example, road crews cannot pick up or set out cars within switching limits without payment of a penalty. Thus, a hot car which could have been conveniently set out by the road crew upon arrival at a yard will, instead, await the arrival of a yard drill. Occasionally dedicated railroaders will ignore such artificial restrictions and take the obvious best course of action, but they are the exceptions.

Model operation is not confined by union agreements. But, to duplicate prototype operation as it is rather than how it could be, it is necessary to operate as though union agreements governed. Therefore the procedures, both model and prototype, described in this Handbook, include the effects of union agreements when applicable.

RECEIVING AND CLASSIFICATION

A train arriving at a yard must be received. Large yards, such as the one shown in Fig. 3-12, customarily are designed with specific receiving tracks. Nevertheless, any suitable track will be used for the purpose if, in the opinion of the yardmaster, it is more appropriate or if none of the usual receiving tracks are available. At small yards, when no other train is expected, the main track may be used to receive a train. Using the main track on a model railroad for this purpose is normally impractical due to the density of traffic.

Receiving

Figure 10-4A illustrates receiving a train at a yard where all cars will be classified. The road locomotive pulls the train onto a receiving track, uncouples and goes to the locomotive servicing track. A switching locomotive then begins to work on the cars, perhaps two switching locomotives, one at each end, in the case of double-ended yards.

At B in Fig. 10-4, a train has entered the receiving track at a yard which has no yard drill. The road locomotive is then used to take a block and double it to the train (or to set off a block or both). Usually this is done at the head

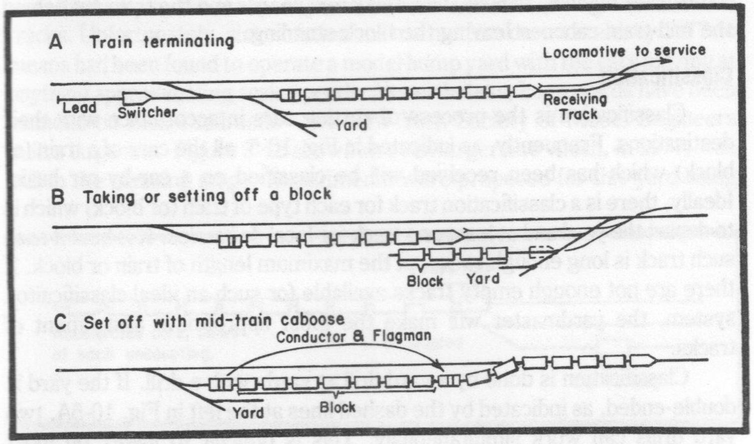


Fig. 10-4. Receiving a train.

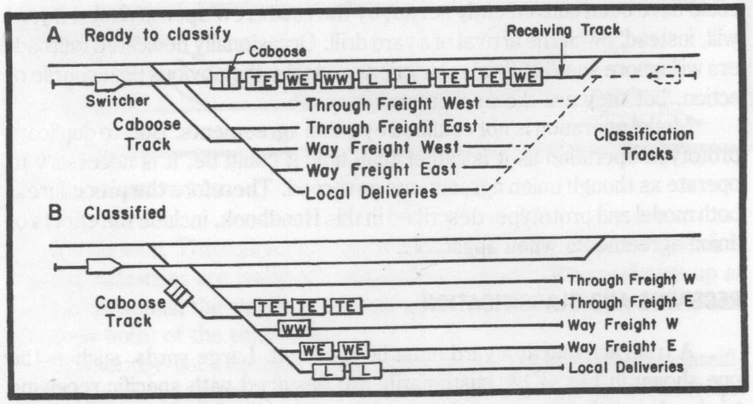


Fig. 10-5. Classification.

end of the train as shown. If the block being handled is at the rear, the entire train must be moved during the switching.

For moves of this type with long trains, the prototype is faced with the problem of getting the conductor and the flagman to the point of the switching. On the SOO at the small yard at Trout Lake, MI, the practice was for the train to continue up the main track until the caboose reached the point of the switching. The conductor and flagman got off and the train was backed until the head end was in position. After the switching was completed, the train proceeded, the conductor and flagman reboarding the caboose when it reached them.

At C is shown a method sometimes used by hot-shot freights for setting off a block. A mid-train caboose is coupled into the train just ahead of the block to be set off. When the block is pulled into the receiving track, the conductor and flagman are transferred to the mid-train caboose, usually by an off-track highway vehicle, or a new crew boards and the train cut behind the mid-train caboose leaving the block standing.

Classification

Classification is the process of sorting cars in accordance with their destinations. Frequently, as indicated in Fig. 10-5, all the cars of a train (or block) which has been received will be classified on a car-by-car basis. Ideally, there is a classification track for each type of train (or block) which is to depart the yard and at least one track for local deliveries. It is best if each such track is long enough to accept the maximum length of train or block. If there are not enough empty tracks available for such an ideal classificaiton system, the yardmaster will make the most appropriate assignment of tracks.

Classification is done by a yard drill at yards with a drill. If the yard is double-ended, as indicated by the dashed lines at the left in Fig. 10-5A, two yard drills can work simultaneously. This is difficult to justify on most model-size yards.

In the days of the wooden caboose used as living quarters by the train crew, the switcher would set the caboose over, perhaps directly onto the caboose track, before handling the cars. With modern steel cabooses, the switcher might couple to it and do all the work for classifying the car before placing the caboose on the caboose track. Even with steel cabooses, on the SOO at its Saulte St. Marie yard, a switcher would remove the caboose immediately from an incoming train, kick the caboose down an empty track on which it rolled completely past its train until braked to a stop at the yard office, the conductor and flagman then getting off.

In Fig. 10-5B, the classified cars are shown as grouped just past the fouling points on the ladder. This is typical model railroad practice. The switcher shoves the cars to this point, the cars for that track uncoupled, the locomotive then backing away with the remaining cars. On the prototype, typically, the cars are kicked to roll free onto the classification tracks as indicated in Fig. 10-6. The switcher accelerates the cars and the front car (or cut of cars) is uncoupled. The locomotive then slows, allowing the uncoupled cars to roll free. The locomotive then accelerates again and a second car or cut is uncoupled. This action continues until all cars have been kicked into their proper tracks. Unfortunately, momentum and friction do not scale, so this type of operation is not practical on a model.

If cars are mixed in the train or block being classified, the switcher probably would classify all of the cars. Should there be a block destined to a particular track which can be reached conveniently, the switcher might take that block directly to the destination track. Figure 10-7 shows a cut of cars destined for interchange with a foreign railroad being placed directly on the interchange track, rather than first being placed on a classification track.

Hump Yards

Sizable classification yards on the prototype tend to be hump yards. In such yards a down-grade, called a hump, is used to accelerate cars pushed over the hump by the hump engine. The cars then roll onto the classification tracks. Unfortunately, since friction and momentum do not scale, by 1977 no means had been found to operate a model hump yard with the cars moving at anything approximating scale speeds. Nevertheless, hump yards have been included on model railroads—the New York Society of Model Engineers built a large one. Figure 3-12 shows an even larger one which, in 1977, was still in the planning stage. Experiments were proposed for this yard using

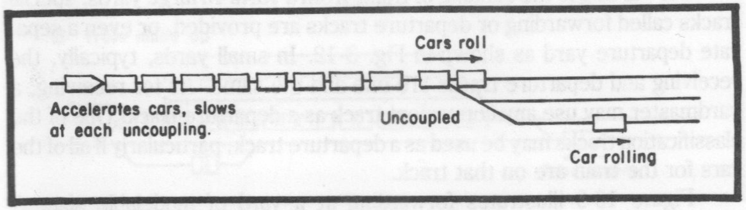


Fig. 10-6. Prototype classification by kicking cars.

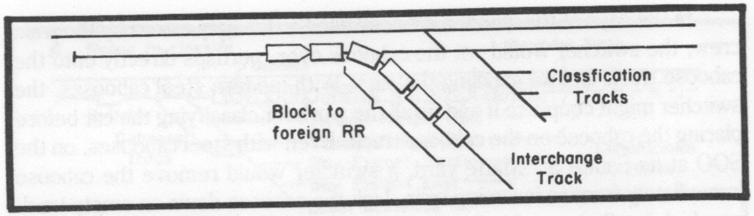


Fig. 10-7. Direct placement of cars.

vibrating conveyor techniques in the hope of achieving prototype-like speeds down the hump and onto the classification tracks.

The ideal arrangement of a hump yard is to have the receiving yard lead directly to the hump, as shown in Fig. 10-8. Then, as soon as the road locomotive clears, the hump engine can start shoving the cars over the hump. The caboose may be set over first, or it may go over the hump and roll to the caboose track.

Some cars, automobile rack cars are examples, should not be humped. The usual arrangement is to provide flat tracks around the hump, as indicated in Fig. 10-8. Cars placed on these flat tracks are added to the proper classification tracks by the trimmer engine. The trimmer engine also corrects errors of classification. The hump engine often assists in the correction work by going over the hump.

In the past, there were two additional (but rare) types of classification yards on the prototype: poling yards and gravity yards. A poling yard is similar in operation to the flat yard shown in Fig. 10-6, except that the cars or cuts were accelerated by a locomotive operating over a track parallel to the lead using a strut called a pole. This pole was either pushed directly by the locomotive, or was mounted on a special poling car built for the purpose. A gravity yard had all the tracks on a grade so cars could move merely by releasing the brakes. These two types of classification yards have not found favor on model railroads.

To facilitate classification, large prototype yards may have two or more classification yards, one for each direction from which trains arrive. Model yards, even that shown in Fig. 3-12, are too small to be divided effectively in that manner.

FORWARDING

Forwarding is the sending of trains from a yard. In large yards, special tracks called forwarding or departure tracks are provided, or even a separate departure yard as shown in Fig. 3-12. In small yards, typically, the receiving and departure tracks are one and the same. As for receiving, a yardmaster may use any convenient track as a departure track. One of the classification tracks may be used as a departure track, particularly if all of the cars for the train are on that track.

Figure 10-9 illustrates forwarding at a yard of modelable size. A through freight for Reading is to be prepared with a block for Auburn and a block for Reading. At A in the figure, the two blocks have already been classified. The switcher couples to the Reading block and sets it over onto the departure track. The switcher then doubles the Auburn block to the Reading block, runs around the cars and, at B, is adding the caboose as the road engine comes up. The order of blocks in the train is that which facilitates the set offs. Usually the blocks are in order of set offs. In this case the Auburn block, the first to be set off, is first in the train.

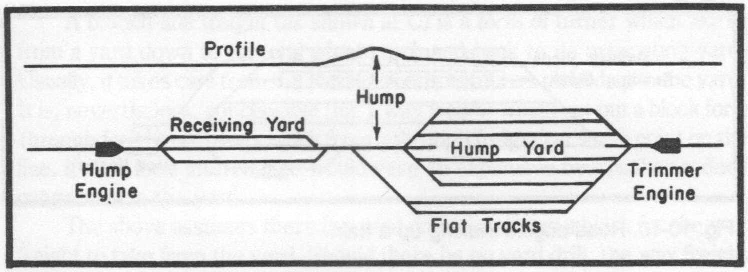


Fig. 10-8. Hump yard.

Customarily the switcher will add the caboose to the train as indicated in Fig. 10-9. Union agreements do, however, permit the road crew to double the train to a caboose.

In Fig. 10-10, the Auburn and Reading blocks essentially fill two tracks of the yard. These could be any two tracks, including classification tracks. In such a case, union agreements permit the road crew to double the two blocks together, as well as to double the train to the caboose.

Blocks for way freights, as classified, are not likely to be in the order which facilitates set offs. When feasible, the yard drill will arrange the cars in local order (also called station order), that is the order which makes it easy for the way freight when switching on the line. This work is done on any

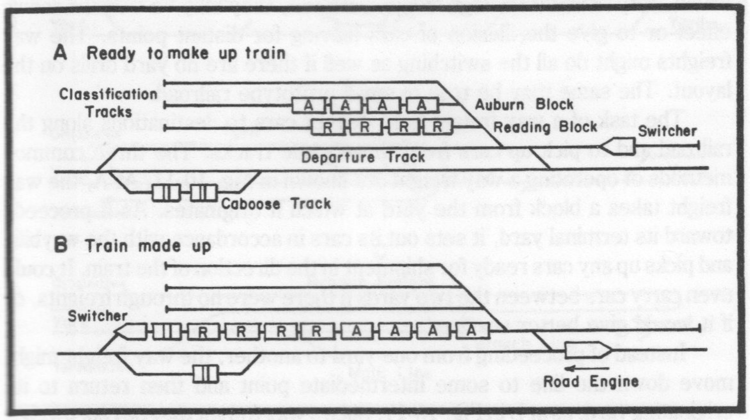


Fig. 10-9. Forwarding a train.

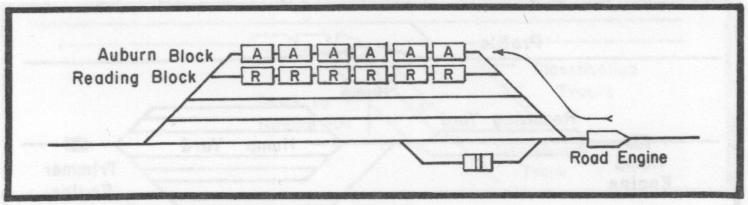


Fig. 10-10. Road engine making up a train.

available tracks. Large yards may provide special short tracks for the purpose, see Fig. 3-12.

If the cars for the way freight were not placed in local order by the yard drill, the way freight crew will do this work. Should tracks at the first way station be adequate for this type of switching, the way freight crew may chose to do the local order work there. Otherwise they will do it at the yard.

The above is based on prototype operation and applies directly to point-to-point operation. On a loop or out-and-back railroad, the yardmaster could be left with the decision of which direction the car is to be moved. It is easier to switch trailing-point spurs than facing-point tracks. The yardmaster then can tailor the trains to fit the skills of the train crew. This could even be done on a point-to-point layout by placing cars with difficult moves in the trains to be operated by the more proficient crews. Of course, this type of easy or difficult moves could have been taken care of by the waybill system, particularly if preset waybills are used.

WAY FREIGHT

Way freights (also called local freights or road drills, sometimes simply drills) may be regarded by the prototype as necessary evils, as they do not produce the revenue of a through freight. However, on a model, they are the mainstay of operating interest. On small layouts, way freights may be the whole story. Even if through freights are run, they may be only for scenic effect or to give the illusion of cars leaving for distant points. The way freights might do all the switching as well if there are no yard drills on the layout. The same may be true of small prototype railroad.

The task of a way freight is to deliver cars to destinations along the railroad and to pick up cars from those same tracks. The three common methods of operating a way freight are shown in Fig. 10-11. At A, the way freight takes a block from the yard at which it originates. As it proceeds toward its terminal yard, it sets out its cars in accordance with the waybills and picks up any cars ready for shipment in the direction of the train. It could even carry cars between the two yards if there were no through freights, or if it would give better service.

Instead of proceeding from one yard to another, the way freight might move down the line to some intermediate point and then return to its originating yard, as at B in Fig. 10-11. Such a way freight may be called a *turn* or a *turner*.

A branch-line freight (as shown at C) is a form of turner which works from a yard down to the end of a branch and back to its originating yard. Usually, it takes cars from the yard and returns all cars picked up to the yard. It is, nevertheless, conceivable that a way freight would set out a block for a through freight (or take a block from a through freight) at some point on the line, if such local interchange would save an expensive backhaul or reduce congestion in the yard.

The above assumes there is a yard drill to make up a block for the way freight to take from the yard. Should there be no yard drill, the way freight crew would make up its own train.

From a modeler's viewpoint, there are two main aspects to way-freight operation. The first is how the way freight, be it an extra or a regular train, works its way along the line in the presence of other trains. This part of way-freight operation is covered in Chapters 4 through 6. The second is the actual drilling of the side tracks to carry out the instructions of the waybills. Waybills are covered in Chapter 7; here it is assumed that the destination of each car is known.

In Fig. 10-12, a four-car way freight has arrived at a small station. Three cars of the train are to be set off at this station and the car on the house track is to be returned to the yard. The waybill destinations of these cars are indicated on the cars in this figure.

In the days of wooden cabooses used as living quarters for the crew, it was common practice to avoid, as far as possible, moving the caboose around during drilling. So, at B in Fig. 10-12, the caboose has been left on the main track out of the way of the switching moves. Today, with steel cabooses, a crew would not hesitate to switch with the caboose between the engine and the cars if that were more convenient. Nevertheless, on track

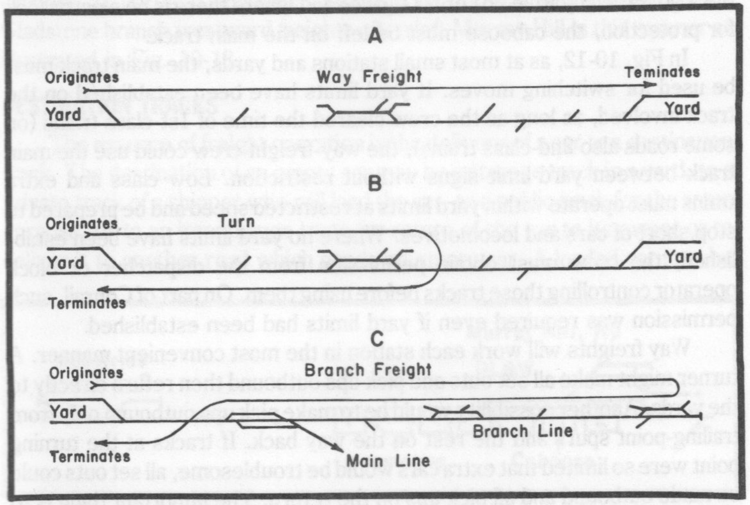


Fig. 10-11. Way freights.

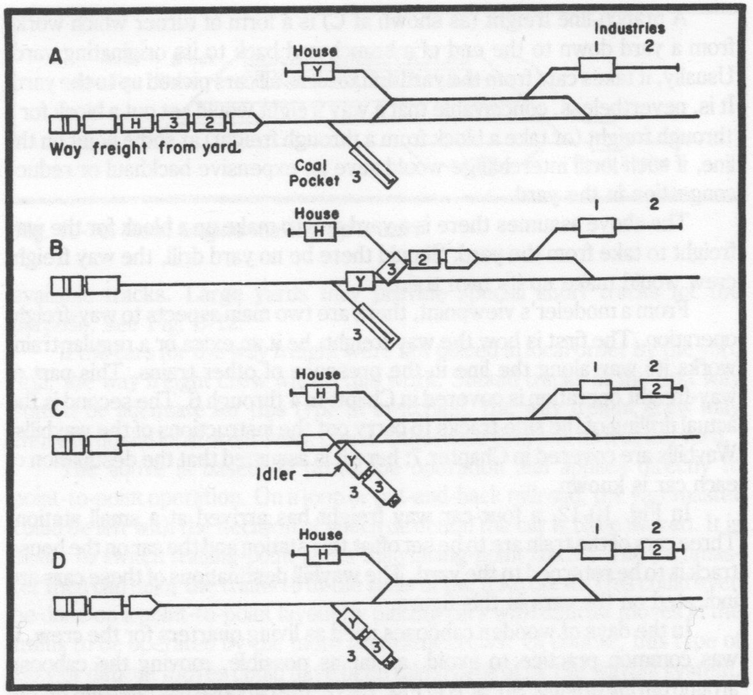


Fig. 10-12. Way freight switching.

equipped with signals, the caboose might still be left standing on the main track to hold the signals—thereby protecting the switching movements. On track governed by Rule 261 or CTC rules and where there is no electric lock for protection, the caboose must be left on the main track.

In Fig. 10-12, as at most small stations and yards, the main track must be used for switching moves. If yard limits have been established on the track involved, as long as the crew cleared the time of 1st-class trains (on some roads also 2nd-class trains), the way-freight crew could use the main track between yard-limit signs without restriction. Low class and extra trains must operate within yard limits at restricted speed and be prepared to stop short of cars and locomotives. Where no yard limits have been established, the crew must obtain permission from the dispatcher or block operator controlling those tracks before using them. On part of Conrail, such permission was required even if yard limits had been established.

Way freights will work each station in the most convenient manner. A turner might make all set outs and pick ups outbound then return directly to the yards. Another possibility would be to make pick ups outbound only from trailing-point spurs and the rest on the way back. If tracks at the turning point were so limited that extra cars would be troublesome, all set outs could be made outbound and all pick ups on the return. The important thing is to have a sensible approach. This means identifying all cars to be set off or picked up before starting to drill. A common error made by beginning operators is to identify cars one at a time, switch that car, then make the moves for the second and so on, or to make all the set offs first then consider the pick ups. It is not necessary to work out the absolute minimum number of moves. That might take longer than an extra move or two.

In Fig. 10-12, the crew has decided to set off the car for the house track first, picking up the empty there to use as an idler car when spotting the hopper on the coal pocket. At B they have set over the empty from the house track, spotted the car for the house track, recoupled to the empty and are preparing to run the engine around the cars. This will leave the car for industry 2 at the head of the cut.

At C, the crew has set over the car standing at industry 1, spotted the car for industry 2, and replaced the car for industry 1. It should be a hard-and-fast rule for model opeation that cars standing at a destination track without an order for move be considered in the process of being loaded or unloaded. If they are moved during switching, they must be replaced.

After finishing with the industrial spur, the crew has moved to the coal pocket and, using the empty car as an idler (also called reacher), has spotted the hopper on the coal pocket. Using an idler keeps the locomotive off the coal-pocket trestle.

At D, the locomotive has returned to the rest of the train and is ready to proceed. The empty car for the yard has been left on the coal-pocket spur so it will be a trailing-switch move when picked up by a freight going toward the yard.

As a way freight moves down the line, its crew will reorder the cars at any convenient siding or yard to facilitate switching. If set outs are to be made at points remote from sidings, the cars for facing-point spurs might be placed ahead of the locomotive and cars for trailing-point sputs behind the caboose at the last runaround available before the spurs. The DL&W Gladstone branch westward freights often left Murray Hill in this manner as illustrated in Fig. 10-13.

DESTINATION TRACKS

The essence of freight operation is the delivery of a car to a destination track. The destination of an empty car may be a storage track in a yard, to a private track of a shipper who will load the car, to a public track for the same purpose, or to an interchange track for return of the car to its owner or to deliver it to another road which needs an empty car. A loaded car may be

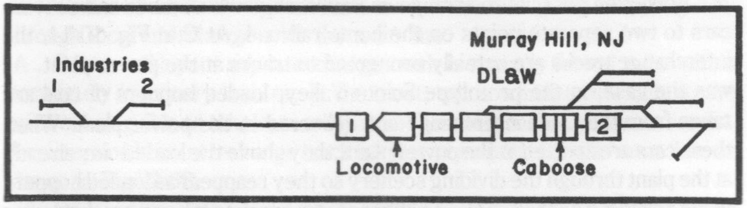


Fig. 10-13. Train arranged for convenient set outs.

destined to the private track of an on-line consignee for unloading, to a public track for unloading, or to an interchange track for delivery off-line. Obviously, each destination track is the originating track for the next move of any car delivered to that track.

Interchange Tracks

Interchange tracks serve to pass cars from one railroad to another (foreign interchange) or between two trains of the same railroad (local interchange). In the latter case, the tracks may be called *set-off* or *set-out tracks*. From a model point of view, the great advantage of an interchange track as a destination is that any number of any type of car can be sent to or received from such tracks. It is, however, unlikely that empty home road cars would have foreign interchange as a destination. Typically, empty cars move toward their home lines.

An interchange track is a destination only as far as the line which is delivering those cars to interchange is concerned. The cars themselves have a destination beyond the interchange. On a model destinations beyond the interchange are often imaginary. In such cases, it is sufficient that the waybill system merely specify the interchange as a destination. An example of such a waybill system is shown in Fig. 7-25.

Interchange to a foreign railroad can be included on layouts in several ways, as shown in Fig. 10-14. The simplest is at A. In appearance, this spur should seem to come from a remote point rather than being dead-ended. Figures 2-10 and 7-24 show cases of such interchanges as actually included on relatively small layouts. Cars delivered to an interchange of this type should remain there long enough to give the impression that they really are leaving the railroad before being given a new destination. This is a problem for the waybill system.

It is nicer if the cars delivered to an interchange are taken away from that interchange by the foreign railroad. It does not take much room to build a foreign railroad capable of taking the cars from interchange, hiding them for a while, and then returning them. In Fig. 10-14 B, the foreign RR is shown as a reversing loop, but it could as be an oval or even a spur. Figure 2-16 shows a larger example of a reversing-loop foreign railroad. When cars can be taken by the foreign railroad, the waybill system does not have to hold the cars. That comes automatically. It remains necessary, however, for the waybill system to assign new destinations to the cars when they return.

It is even possible to arrange an interchange which takes and delivers cars to two separate points on the home railroad. At C in Fig. 10-14, the interchange tracks are actually connected to tracks at the power plant. As was the case on the prototype Scioto Valley, loaded hoppers of coal are taken from the C&O interchange and delivered to the power plant. When these cars are spotted at the power plant, they shove the loaded cars already at the plant through the dividing scenery so they reappear as loaded hoppers being delivered by the C&O. In a like manner, empties taken from the power plant delivered to the C&O push the empties already at the interchange through to the power plant. This same scheme can be used for complementary destination on the line. The interchange of Fig. 10-14 could be replaced by a coal mine, so loaded cars of coal will be taken from the mine to the power plant, and empties returned to the mine.

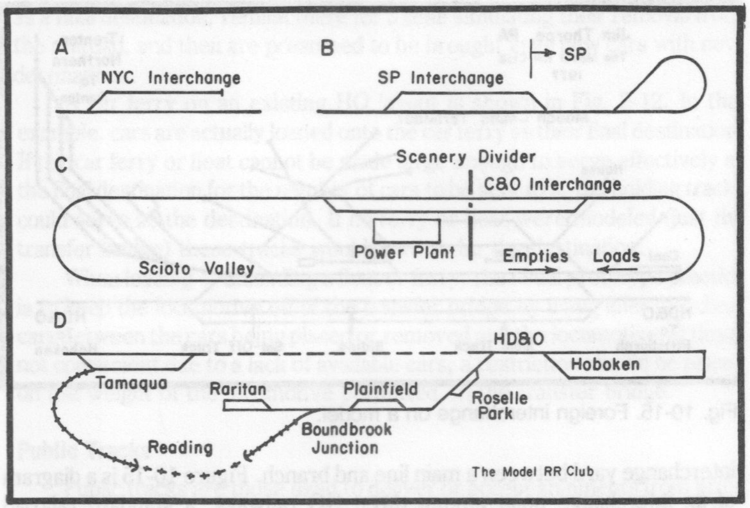


Fig. 10-14. Interchanges with foreign railroads.

In the above case, the foreign railroad did not, in fact, operate. Nevertheless, it could as shown at D, an example taken from the plans of The Model RR Club. Reading trains will take blocks for Philadelphia and south from the Hoboken yard, run over the Raritan branch of the HD&O to Boundbrook Junction, where they reach Reading tracks and are presumed gone. These trains, via a tunnel, will reappear at Tamaqua as trains from Buffalo whose cars will be turned over to the HD&O at that yard. The returning Reading trains will, of course, take blocks for Buffalo at Tamaqua and deliver them as cars from the south to Hoboken. This arrangement not only provides a major source of interchange traffic at two yards on the HD&O, but also adds traffic to help justify a multi-track branch.

The interchanges shown in Fig. 10-14 are designated as foreign interchanges in that figure. With the exception of the interchange at A, they could just as well be local interchanges. For example, at C the Scioto Valley could be considered a branch of the C&O, the branch taking and receiving cars through local interchange with the main line.

On a small layout any interchange track is virtually forced to be with a completely imaginary line, or, at the most, a line which exists only to the point of being able to take cars away from the interchange for a later return. An exception is an interchange track between two points on the same line, as shown in Fig. 2-6B.

On medium and large layouts, interchange can actually take place between two working lines. Figure 2-14 shows a home layout with a local

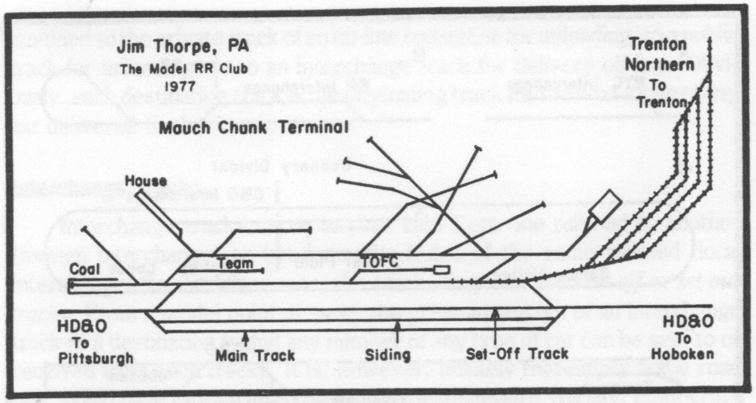


Fig. 10-15. Foreign interchange on a model.

interchange yard between a main line and branch. Figure 10-15 is a diagram of an interchange point among three HO railways, a standard railroad (HD&O), an interurban (Trenton Northern), and a switching line (Mauch Chunk Terminal). These three lines are operated completely independently of each other with separate crews. The tracks were designed so that interchange between any two of the lines was possible even if the third was not in operation.

Even with the restriction that the motors of the TN cannot operate beyond the limits of their overhead wire, different methods exist to operate this interchange point. One method is to assume that the MCT handles all switching at Jim Thorpe. The MCT then would pull the blocks delivered by the TN for the HD&O, add any cars from the MCT, the place the block on the set off track. An arriving HD&O freight could take the block for its direction and set off the cars for the MCT and the TN using its own crew and locomotive or this work could be done by the MCT crew and locomotive.

Another mode of operation would be for the HD&O crew and locomotive to set off a block for the MCT on the set out track and the block for the TN in the interchange yard with the TN. To permit this latter option, the tracks leading to the TN interchange yard from the HD&O end are built to HD&O standards rather than to the more relaxed standards permitted for switching lines and interurbans at the club.

Interchange can be by water as well as by land. In New York Harbor at one time there was a heavy interchange via car floats among the various lines diverging. Some of this traffic still remained in 1977. For open water, such as on the Great Lakes, sizable ships were used for car ferries.

Figure 10-16 shows the essentials of a car-float interchange. Usually, holding tracks are provided for cars destined to or received from the floats. A flexible bridge, called a transfer bridge, float bridge, or apron, connects the tracks on land to those on the float. In at least one case, the HO narrow-gage line of Dick Paterson, the car ferry actually moved between two transfer bridges. Usually, on a model, cars are delivered to the car float as a final destination, remain there for a time simulating their removal from the railroad, and then are presumed to be brought in as new cars with new destinations.

A car ferry on an existing HO layout is shown in Fig. 2-12. In that example, cars are actually loaded onto the car ferry as their final destination. If the car ferry or float cannot be made large enough to serve effectively as the final destination for the number of cars to be sent to it, the holding tracks could serve as the destination. If no ferry or float were modeled (just the transfer bridge) these tracks would have to be the destination.

When loading or unloading a float or ferry, the usual prototype practice is to keep the locomotive off of the transfer bridge by using idler (reacher) cars between the cars being placed or removed and the locomotive. If this is not convenient due to a lack of available cars, a restriction should be placed on the weight of the locomotive permitted on the transfer bridge.

Public Tracks

Public tracks are those used to deliver or accept shipments from firms or individuals not having private tracks. Some of the more common public tracks of the past and present are shown in Fig. 10-17. The letters of the paragraphs below refer to the same letters in that figure.

A. House Tracks

House tracks serve the freight house and were used primarily for LCL (Less-Than-Carload) shipments. Box cars were, by far, the most common car for such shipments, but any type of car suitable for the shipment might be employed. At small stations, the freight shipments often were handled from the freight room of a combination station (freight and passenger station). The car might be spotted on the house track just long enough for the freight agent and train crew to load or unload the shipment at his station. At larger stations, a separate freight house was the rule and at the largest stations there might be separate inbound and outbound sheds. The three tracks between platforms or sheds (as shown on the right) was typical of large freight houses. Access to the cars on the center track was through cars on the outer tracks. Therefore, when spotting cars, they have to be placed door-to-door.

B. Team Tracks

Team tracks are so located that a car can be loaded or unloaded directly from or to a team and wagon or truck. Any type of car with or for a shipment

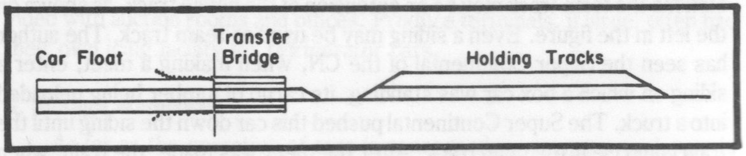


Fig. 10-16. Interchange via car float.

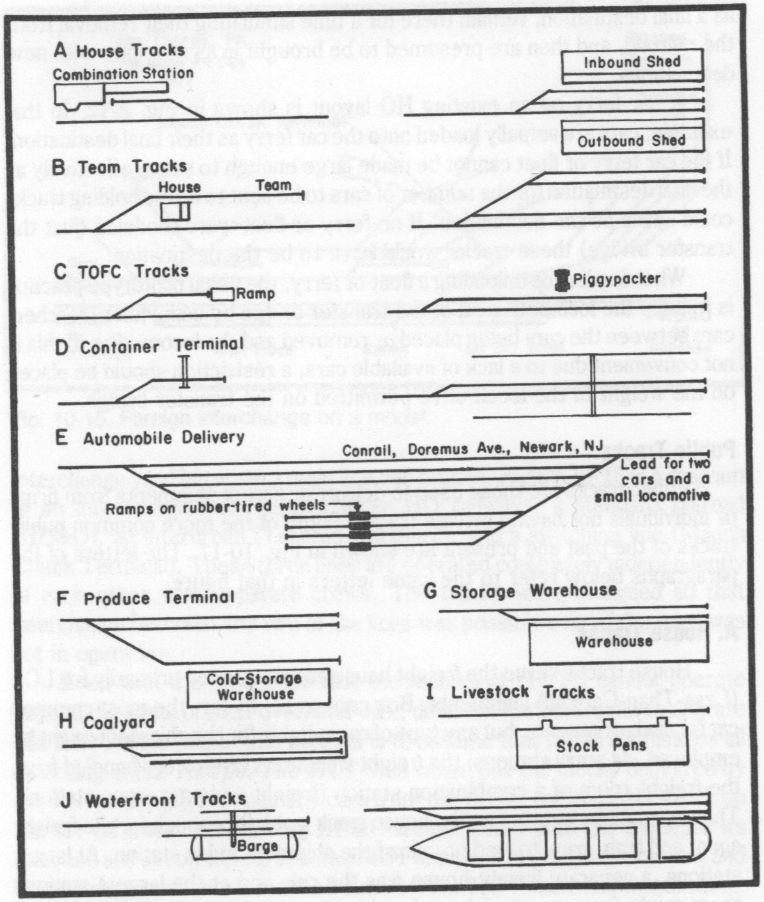


Fig. 10-17. Public tracks.

which can be handled manually or with portable equipment can be sent to a team track. Bulk cargoes, such as coal, when sent to a team track, tend to be sent in a gondola rather than a hopper car as it is easier to dig material from a gondola than from a hopper. Team tracks are also used to deliver bulk oil from a tank car directly to a tank truck. Some team tracks were equipped with a crane for heavy loads. When team tracks were equipped for handling bulk cargos (oil, grain, etc.) they were often called a *bulk terminal*. At small stations the team track may be an extension of the house track, as shown on the left in the figure. Even a siding may be used as team track. The author has seen the Super Continental of the CN, when making a meet, enter a siding on which a box car was standing, its cargo of lumber being unloaded into a truck. The Super Continental pushed this car down the siding until the train could clear the main track. After the meet was made, the train, when backing out, respotted the box car at its unloading point.

At large stations, several team tracks normally were formed into a team yard. The Bronx terminal of the CNJ consisted of nothing but team tracks and a house track around an oval freight house, railroad access being solely by car float.

C. TOFC Tracks

Trailer-On-Flat Car, (also called piggyback,) tracks are used to load and unload highway trailers on flat cars. At small stations, a short spur one or two car-lengths long equipped with an end ramp will do. Such a track on the Sanda Fe at Barstow used as a ramp an old TOFC car with one truck removed. For tracks with an end ramp, loaded cars must be spotted so that the fifth-wheel of each trailer, faces the ramp. Loading via an end ramp is sometimes called *circus loading*. The older TOFC tracks, even at large terminals, used end ramps but, by 1977, it was more common to handle the trailers by large off-track equipment such as lift trucks, known as Piggy Packers or by special cranes. Model railroads would find it difficult to justify the ground area needed to simulate this type of unloading.

D. Container Track

In the thirties a number of railroads and interurban lines offered container service for both LCL and bulk cargoes. In 1977 such service still existed, particularly for large containers designed for export service by ship. Container tracks were equipped with a crane for lifting the containers between the cars and trucks. At a small station, a fixed crane might be provided on the team track for the purpose. At large terminals, moving gantry or traveling cranes might be provided. Container service is sometimes called COFC (Container-On-Flat-Car).

E. Automobile Delivery

Autorack cars (bilevel and trilevel) load and unload the automobiles over the car ends. The railroads prefer to drive the automobiles forward and through not more than two cars. At the Doremus Avenue yard shown, a small switcher permanently stationed at the yard moves the cars to the unloading ramp in pairs. The cars are turned before they reach this yard so that the automobiles face the ramps.

F. Produce Terminal

Produce terminals were found at large cities. They consisted of team tracks for the direct unloading of refrigerator cars into wagons or trucks, and of special produce cars such as watermelon cars. Often there was a large cold-storage warehouse at the terminal. This warehouse usually was provided with auction rooms and offices. Produce terminals, if large, often had their own icing facility for refrigerator cars.

G. Storage Warehouse

As far as the operation of cars is concerned, a storage warehouse is identical to a freight house. The difference was that a warehouse was built to provide short term and long term storage, where a freight house was designed to facilitate immediate delivery. Warehouses usually were multi-story to provide more floor space.

H. Coalyard

When coal was a commonly-used fuel, railroads often provided tracks suitable for delivering coal from hopper cars directly into wagons or trucks, as well as for temporary storage of coal. At cities, coal yards could be extensive. At small towns, any convenient trestle might be used.

I. Livestock Tracks

Livestock can be shipped and received on team tracks but, where such shipments are frequent, stock pens and suitable ramps were often provided.

J. Waterfront Tracks

Tracks equipped with cranes for transfer of cargos between ships or barges and cars were once common at waterfront terminals—and some still exist. Bulk cargoes such as coal or ore normally are handled by special facilities such as car dumpers. When large ships were to be unloaded or loaded, a holding yard usually was nearby so sufficient cars could be assembled to handle the ship quickly.

Private Tracks

Industries, mines, quarries, and merchantile establishments often have private tracks for receiving and dispatching shipments. On a model, these tracks tend to be short one or two car spurs, serving just one firm as indicated at A in Fig. 10-18. Such spurs are easy to switch, but that is not necessarily desirable. Placing two or more firms on the same spur, as at B in the figure, creates switching interest when it is necessary to reach a firm beyond one with a car being loaded or unloaded. Although not an operating point, attention is called to the use of mirrors in Fig. 10-18B to open up visually what would otherwise be a rather restricted area behind the curving main tracks.

Many of the private tracks tend to be limited in the types of cars which can be delivered. Some industries, however, do serve as a logical destination of various types of cars and loads. The example shown in Fig. 10-18C is a tie-treating plant. Flat cars and gondola cars with raw wood are brought to the material yard tracks and similar cars are used to take the creosoted finished product. Hoppers of coal are delivered to the power plant as well as chemical tank cars of creosote. Gondolas are used to remove the ash and box cars can bring in machinery.

CAR SERVICE TRACKS

Certain types of cars or shipments require services en route. If the servicing facilities are installed on a layout, they can be included in the movements of the cars to add extra interest. The waybill system could direct cars to such facilities, but it might be equally good and certainly simpler if the operating rules made such moves automatic.

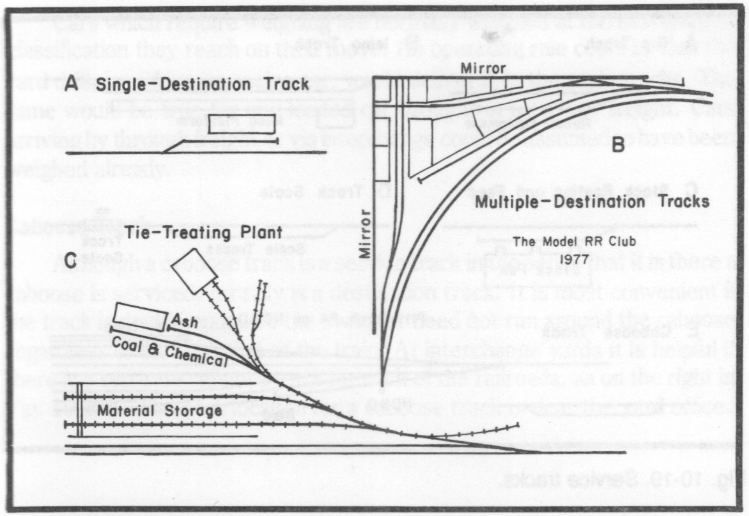


Fig. 10-18. Private tracks.

Rip Track

A rip track, also called bad-order, repair, or cripple track, is one on which light repairs of cars are made. Rip tracks are often found at terminals and adjacent to classification yards. On a model, such tracks could be used effectively as a destination for any cars discovered to be in need of repairs during an operating session, provided that such cars could be either pushed or pulled. Methods of directing cars to rip tracks are discussed in Chapter 7.

Rip tracks can be simple spurs so located that there is working space on both sides, as in Fig. 10-19A, the tools and supplies being brought to the track when needed. They also can be tracks with permanent repair equipment including one or more wheel pits.

For more extensive repairs or maintenance than can be handled on a rip track, cars are sent to the shops. If the waybill system is capable of providing the information, cars due for scheduled periodic inspection could be destined for the shop tracks when that inspection is due.

Icing Track

Before the days of mechanical refrigerator cars, an ice house with an icing platform at car-roof level was a common sight at yards and terminals. By 1977 most, if not all, had been abandoned. The ice-bunker refrigerator cars still in service were iced by off-track equipment as they stood in the trains. But models do not necessarily follow the latest practices. One could assume that even the mechanical refrigerator cars are serviced at the icing track.

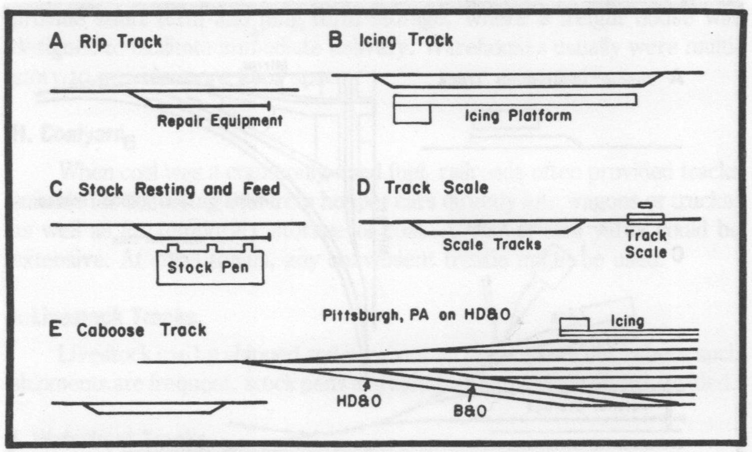


Fig. 10-19. Service tracks.

As indicated at B in Fig. 10-19, icing tracks were usually double-ended. This is convenient on a model if a rule is adopted that all loaded refrigerator cars passing through the yard must make a stop at the icing track. Even loaded refrigerator cars being delivered locally could be required to stop for icing to assure they had sufficient ice for the hours they might stand before unloading.

Stock Resting and Feeding Pens

Law requires that certain livestock be taken from the cars and rested after a specified time in the cars. Years ago, stock resting pens were frequently found at yards handling livestock trains. The higher speeds of modern trains have greatly reduced the need for such facilities. But, as in the case of icing tracks, they can still be included on a model as shown at C in Fig. 10-19. All loaded stock cars passing through the yard could be required to make a stop at the resting pens.

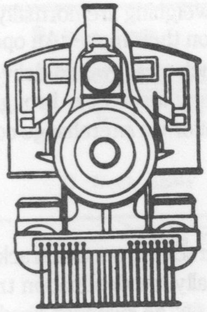
Scale Track

Most carload shipments are billed by weight. Among the exceptions are livestock shipments billed per head and automobile shipments. Those shipments billed by weight require that the loaded car be weighed on a track scale. The usual locations of such scales are at or near classification yards. The scales may be on the lead to the hump, the cars being weighed as they pass over the scales. When track scales are to one side of the yard they often are provided with holding tracks, called scale tracks, as shown in Fig. 10-19D. The track over the scales may be gantlet (often spelled gauntlet) with one set of rails supported by the scales (weigh rails) and the other supported independently (dead rails).

Cars which require weighing are normally weighed at the first point of classification they reach on their move. An operating rule could be that the yard drill, in picking up such a car, would deliver it to the scale tracks. The same would be true for any loaded car brought in by a way freight. Cars arriving by through freight or via interchange could be assumed to have been weighed already.

Caboose Track

Although a caboose track is a service track in the sense that it is there a caboose is serviced, it really is a destination track. It is most convenient if the track is double ended so the switcher need not run around the caboose regardless of the direction of the train. At interchange yards it is helpful if there is a separate caboose track for each of the railroads, as on the right in Fig. 10-19E. The best location for a caboose track is near the yard office.



Chapter 11

Locomotive Service

Locomotives and electrically-operated multiple-unit trains cannot be run and run without servicing, although that often seems the practice on many a layout. Not only are locomotives serviced at terminals and sometimes during runs, but also they may be changed. The latter was particularly true in the days of steam. Although on a model, locomotives are not actually serviced during an operating session (except on an emergency basis), the movements required for locomotive service on the prototype should be duplicated if the layout so permits. Obviously, small layouts may not have the room for engine facilities. Indeed, a small layout having a single-station concept in which the prototype station modeled did not have locomotive facilities would not include locomotive servicing in its operation.

Only those servicing activities which involve the movement or spotting of locomotives and trains are covered. In the days of steam, some minor servicing of the locomotives was carried out by the engine crew at station stops. The fireman's oil can was a symbol of such servicing, but such activity is not modelable.

STEAM LOCOMOTIVE SERVICING

Steam locomotives used prodigious amounts of water and usually took water several times for each load of fuel. In 1977, this could still be seen on the D&RGW run from Durango to Silverton. One load of coal was sufficient for the round trip, but water was taken twice up grade. On a model therefore, not only should the locomotive move to the water column or tank at engine terminals, but a water stop can be justified at the smallest of stations or even out on the line where no station exists. John Allen required water stops to be made on a long up grade by trains exceeding a specified tonnage.

Water

Figure 11-1 shows three methods of supplying water to the tanks for locomotives. On the left is the most picturesque, a tank with a water spout. In the middle is a water column (also called water crane or standpipe). The action of moving locomotives so that the tank filling hole (also called manhole) is under the spout can and should be duplicated on a model.

On the right in Fig. 11-1 is a track tank (also called track pan). Locomotives could take water from such tanks while traveling at speeds of about 50kmh (30mph). A scoop on the tender was used for the purpose. Since track tanks required at least 0.8km (0.5mile) of level, tangent track, it would be difficult to include one realistically on a model.

Not shown in Fig. 11-1 was the simple expedient of filling the tank with buckets hand-lifted from a reservoir of stream. This practice was the reputed origin of the term "jerk water".

Fuel

Coal or oil for fuel was most-commonly taken only at engine terminals although a few lines, notably in the West, had coaling towers over the main tracks to fuel long-distance trains. Coal was normally delivered to the bunker on the locomotive or tender from some sort of elevated structure, such as the one shown in Fig. 11-2. A crane with a clamshell also was used on occasion, as well as various hand-shoveled facilities. Oil fueling facilities were simpler, usually just one or more hoses for Diesels. Oil columns, similar in appearance to the water column of Fig. 11-1, but with a smaller

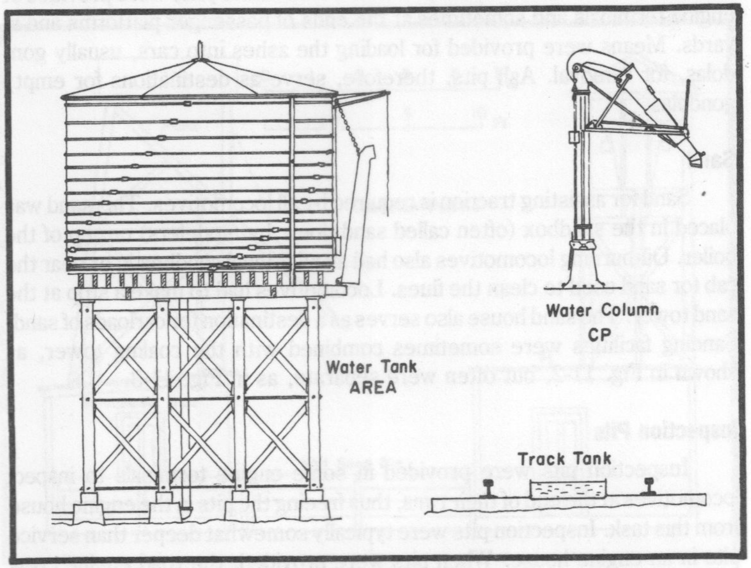


Fig. 11-1. Steam locomotive water facilities.

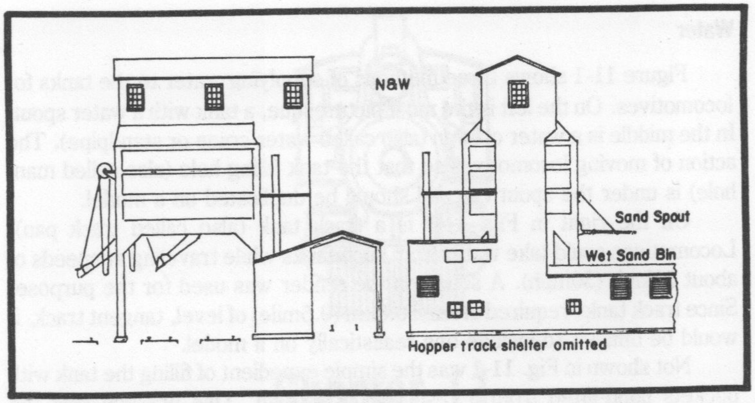


Fig. 11-2. Coaling station.

delivery spout, were often provided for supplying fuel oil to tenders. Wood-burning locomotives needed fuel more often than either coal or oil-burning locomotives. Wood racks were placed at various points along the line, the wood being loaded by hand.

Fueling facilities not only provide a reason for locomotive movements, but also serve as a destination for cars bringing in the fuel.

Ash

Coal and wood-burning locomotives had to dump their ashes, and sometimes the entire fire. Ash pits (also called cinder pits) were provided at engine terminals and sometimes at the ends of passenger platforms and in yards. Means were provided for loading the ashes into cars, usually gondolas, for removal. Ash pits, therefore, serve as destinations for empty gondolas.

Sand

Sand for assisting traction is required by all locomotives. This sand was placed in the sandbox (often called sand dome by modelers) on top of the boiler. Oil-burning locomotives also had an additional sandbox in or near the cab for sand used to clean the flues. Locomotives had to make a stop at the sand tower. The sand house also serves as a destination for carloads of sand. Sanding facilities were sometimes combined with the coaling tower, as shown in Fig. 11-2, but often were separate, as in Fig. 11-3.

Inspection Pits

Inspection pits were provided in some engine terminals to inspect locomotives at the end of their runs, thus freeing the pits in the engine house from this task. Inspection pits were typically somewhat deeper than service pits in an engine house. When pits were provided, the road engine crew often brought their engine to the pit, turning it over to a hostler at that point.

Engine House

Engine houses were primarily used for light repairs of locomotives and, if necessary, for inspection. Typically, locomotives were not stored in engine houses except on small railroads where the stalls could accommodate all locomotives simultaneously.

Turning Facility

Most road steam locomotives were designed to operate at high speeds only in one direction. Therefore, turning facilities were provided at most terminals and at many points on the line where helpers were cut off. In most cases, these turning facilities were turntables,but wyes and loops were also used. In 1977, a wye at Cumbres pass was still being used on the ex-D&RW narrow-gage line to turn the helper for its return to Chama, NM.

Engine Terminal

The servicing facilities for steam locomotives were usually grouped into an engine terminal. Figure 11-4 is a large HO example. The order of facilities varied from terminal to terminal. If an inspection pit were provided, it was usually placed on a receiving track and was the first stop of the locomotive as it entered the terminal. On a model this would be an excellent point at which to turn over control from a road cab to a hostler cab. A coal-burning locomotive then typically moved to the ash pit and dumped its ashes, also its fire if done with its work. If coal were taken on arriving, the coaling station, ash pit, and sand tower might be arranged so that all three activities could be accomplished without moving the locomotive, but often

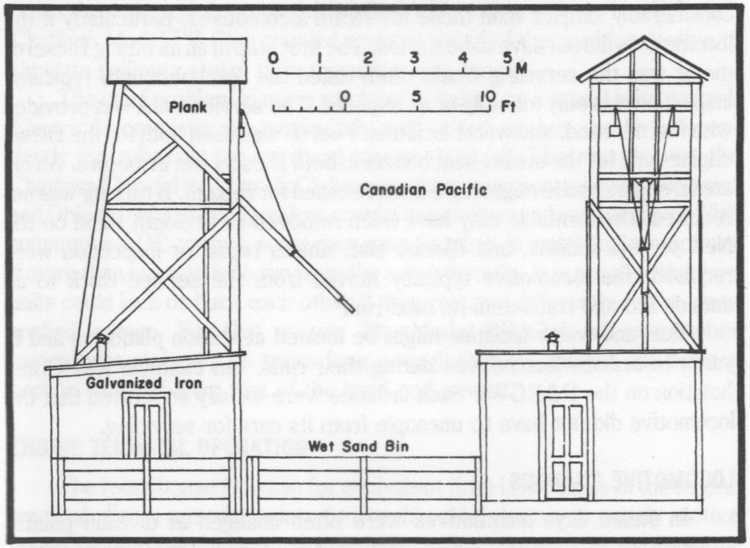


Fig. 11-3. Sand tower.

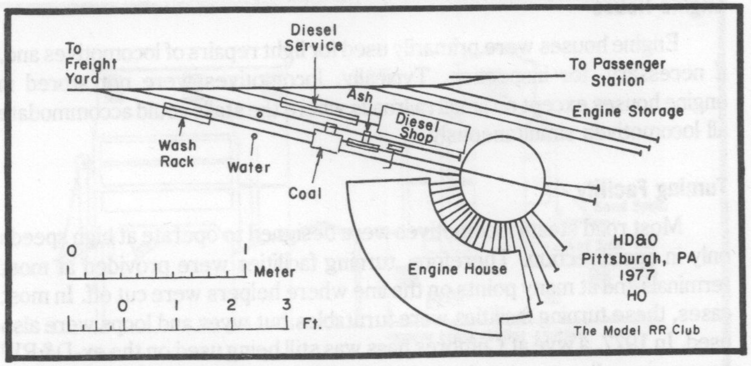


Fig. 11-4. Large model engine terminal.

these facilities were separated. At some terminals coal and sand were taken as the locomotive was readied for an assigment. If no outside inspection pit were provided, an arriving locomotive, after dumping its fires, would move to a stall with a pit for inspection, back out onto the turntable, and move to an outside storage track (latent heat in the boiler generating the steam necessary for these moves).

There were so many variations of the way a locomotive was serviced, that almost any routine could be considered realistic, as long as the basic functions of service were simulated.

DIESEL AND ELECTRIC LOCOMOTIVE SERVICE

Servicing facilities for Diesel and electric locomotives (motors) were considerably simpler than those for steam locomotives, particularly if the locomotives did not have to be turned. The first stop of an incoming Diesel or motor was the servicing track, often called the "pit" although, typically, inspection was only monthly or as required. The service track was provided with fuel oil, sand, and water facilities. Fuel oil was used both for the Diesel engines and for the steam-heat boilers in both Diesels and in motors. An old steam engine house might have been retained for repairs. If turning was not required, the turntable may have been removed as at South Bend on the New Jersey, Indiana, and Illinois. But, unless repair or inspection were required, the locomotive typically moved from the service track to an outside storage track until its next run.

Fuel and water facilities might be located at station platforms and in yards to service locomotives during their runs, (an example was Grand Junction on the D&RGW). Such facilities were usually so located that the locomotive did not have to uncouple from its cars for servicing.

LOCOMOTIVE CHANGES

In steam days locomotives were often changed at division points, although the latest steam locomotives tended to make longer runs. Often, the new locomotive was of the same type as the old, a case in point was the Ohio State Limited at Cleveland. This train did not enter the Union Station to make a station stop, rather it moved down the lakefront track, stopped and exchanged a Big 4 Hudson for an NYC Hudson or vice versa. A viable model concept can include a station at which all trains change locomotives.

When the characteristics of the line changed, a change of locomotive might also be made; for example, a Mountain for a Pacific to assault the heavy grades further on the route. This was even done with Diesels. The Great Northern pulled its Empire Builder up the long grade to the Cascade Tunnel with high drawbar-pull GE units, then changed to EMD units for the flatter and faster running to the east. This type of change can be included on a layout which has only a small station provided there is room for the necessary tracks.

Rather than changing locomotives, helpers can be added or removed. With Diesels this is as simple as converting from a three-unit engine to a five-unit one. Diesels can also be added as pushers or as mid-train helpers. In steam days, adding a helper was even more common. The heavier NYC passenger trains were boosted westward out of the Albany station by a steam switcher. The C&O added Mikado in front of a Texas for the long grade northward from Columbus, OH.

Changing from steam or Diesel to electric can add another phase of operation to a model railroad. On Conrail in 1977, electrics and Diesels were exchanged at Harrisburg, South Amboy, and at Harmon, and also on interchange with other railroads at Washington. The Milwaukee once changed from steam to electric for two portions of its coast-to-coast line, but at the end of its electrified days was merely adding a motor which ran multiple-unit with the Diesels already on the train. Electrics were used to assist steam trains through tunnels, as on the B&O, GTW, and the B&M. The HO-scale Chatham Model PR Club coupled a motor ahead of the road locomotive to simulate pulling a steam train through a long tunnel.

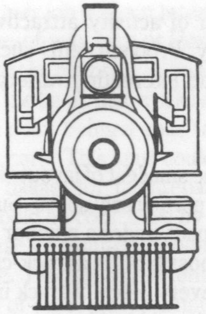
The chief problem in using any form of helper on a model is its control. Electric locomotives are particularly well suited as they can be independently controlled via the overhead wire or third rail. That was the way the Chatham Club did it. Allan McClellan uses frequency control on his Virginian and Ohio to maintain independent control over helper and road engines. With conventional DC control, some care must be taken in matching locomotives if more than one unit is to run from the same throttle. It is possible that two units could lock or buck each other if they respond differently to the same applied voltage. For that reason, The Model RR Club will use pusher locomotives and only on trains long enough that the pusher will be in a section different from that of the head-end power.

ENGINE TERMINAL OPERATION

The roundhouse foreman (or equivalent title) is in charge of the engine terminal. From a model point of view, his chief duty is to supply motive power as required for trains and switching. Even when it is customary to have specific assignments for locomotives, it may be necessary to make substitutions due to unavailability of locomotives or changing traffic needs. This job must be performed by some operator. On a model, it usually is combined with the job of hostler, the employee who moves light engines in the engine terminal and may take or bring locomotives to or from yards or stations.

Since there is far more movement into and out of engine terminals on model railroads in proportion to the number of trains run than on the prototype, it does not take a large layout to justify the position of roundhouse foreman-hostler. This is particularly true if the movements required for servicing steam locomotives are duplicated. At small yards or when manpower is limited, the yard drill or the yardmaster job can be combined with that of the engine terminal crew.

Model turntables typically are strong enough so that a locomotive can be placed anywhere on the table and it will turn correctly. Most prototype tables are of the cantilever type, which require the weight of the locomotive and tender to be balanced approximately over the center pivot. Therefore, for realism, model locomotives should be stopped on the turntable so that the locomotive and tender seem to balance at the pivot.



Chapter 12

Maintenance-of-Way

Maintenance and construction of a model railroad does not take place during an operating session. Further, trains are not used for such activities on a model. True, a wrecker could be dispatched to the scene of a derailment but, unfortunately, derailments are usually too frequent and the operating sessions too short to wait for a wrecker before clearing the line. The only known-to-be-useful maintenance-of-way train which can add real interest to an operating session is a track-cleaning train. Even a snow-plow extra which could scurry around the layout is seldom if ever applicable due to the season modeled. A track car, however, can add some interesting features of operation, particularly for the dispatcher is issuing orders to protect that car.

Although maintenance-of-way trains performing work (and thus requiring orders as a work extra) have not found favor on model railroads, such equipment does make for interesting trains. If maintenance-of-way equipment is moved in trains consisting only of such cars without performing work, those trains operationally are just more extra trains. A *work extra* must be created by train order to move freely in either direction between the two points specified in the order.

It has often been proposed, particularly by those without operating experience on a large layout, that some sort of trouble program be prepared and injected at random times. This could take the form of a deck of cards which were turned over according to a schedule. One card, for example, might specify that a washout had occured at a particular point on the line. The rules then would require that repair equipment be dispatched to that point and the repair work simulated before regular operation could resume over that track. Unfortunately, troubles aplenty are self-generating. As mentioned before for derailments, operating sessions just are not long enough to make this form of activity attractive on large layouts. Small layouts are a different story. Problem cards such as, "Heavy snow, double the usual power", could add interesting variety to the operation.

TRACK-CLEANING TRAIN

A problem on all but the smallest of layouts is that some of the tracks do not get run over regularly, particularly spurs. Such tracks tend to get dirty. John Allen placed cleaning pads under a number of cars to assist, but this is not a complete answer. A possibility is a track-cleaning train, which has the assignment of going over every piece of track in a given area. Such a train would set over any cars it found blocking any track and then replace those cars after that track was cleaned. This would be a very interesting train to operate on a railroad run by timetable and train orders. Chapter 5 describes the orders used to operate a track-cleaning train as a work extra.

TRACK CARS

Track cars, by 1977, often were highway vehicles with retractable guide wheels to hold the rubber-tired wheels on the rails. However, track cars may take many forms, the important thing being that they cannot be depended upon to operate track circuits. Since they may be operating on main tracks, it is necessary to protect the track cars against trains. In CTC territory, the dispatcher simply holds all trains from the track upon which the track car is operating by setting the appropriate signals to stop until the track car reports itself in the clear. In automatic block territory, or where there are no signals, the track car may be protected by orders. In Fig. 12-1, an order not to pass Murray Hill has been delivered to No. 62. This train must contact the dispatcher when it reaches Murray Hill. When the track car reports itself in the clear, the dispatcher can let No. 62 go. If there were a block operator at Murray Hill, the dispatcher could use a hold order instead of a do not pass order.

On a model, any powered track car will operate the signals just as if it were a locomotive. Nevertheless, if duplicating prototype operation is the objective, it could be treated just as it would be on the prototype. Running a track car on an inspection trip would be a good way of adding extra activity when operation is going well.

MAINTENANCE-OF-WAY EQUIPMENT

Some maintenance-of-way equipment can operate among the revenue trains. A rail grinder on a street-car line is a good example. Such cars can move down the line doing their job without interrupting the regular service. Many forms of maintenance-of-way cars or loads can be moved in revenue freight trains or in extras for the purpose. A bunk car, for example, could be set out at a small station on the basis that work is to be done there. Such cars can add variety—a case in point being a spur to a stock-loading pen which usually receives only stock cars. This spur could be used to hold flat cars of ties or side-dump cars of ballast for maintenance work in the area. The movements of such cars would be controlled by the waybill system in use.

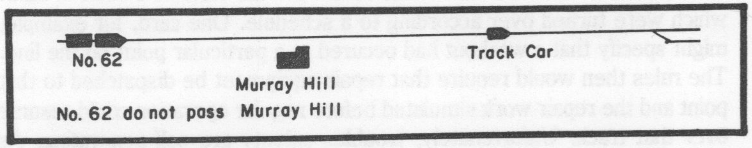


Fig. 12-1. Order protecting track car.

Another operational use of maintenance-of-way equipment is to mark tracks taken out of service. Placing equipment which can logically remain stationary for long periods of time, (for example a tamper,) will serve as a memory aid that the track cannot be used and give a spectator a visual reason why the track is out of service, even though the real reason is a short circuit under the benchwork.

Even when not out on the line and presumably working, maintenance-of-way equipment makes an interesting addition to the scene. Equipment with engines, particularly wreck cranes, are usually held near the engine terminal.

Chapter 13
Auxiliary Railways

As the term is used in this Handbook, an auxiliary railway is one operated separately from the main railroad on the layout. Those model railways which existed for scenery purposes only (such as the narrow-gage mine railway, which ran from a pit to a coal breaker at the Central Jersey Model RR Association) in no way affected the operation of the main railroad and so are not considered here. Narrow-gage auxiliary railways, however, can be added so that they enhance the operating interest of the layout. Although some prototype lines, the East Broad Top was one, replaced standard-gage trucks by narrow-gage trucks so carload freight could be interchanged, this is not practical on a model. So, from an operational point of view, the most interesting auxiliary railways are those of the same gage as the main line. Among the possibilities are short lines, switching lines, interurban and street-car lines, and even small portions of a connecting railroad. Freight cars, and even passenger cars, then can be interchanged between the main railroad and the auxiliary railway.

Actually modeled, the auxiliary railways mentioned in this Chapter are usually secondary lines connecting with standard railroads. Nevertheless, any of the types of lines could be the main railroad on a given layout. For example, the main railroad could be an interurban line with the connecting standard railroad serving as the auxiliary railway. Figure 10-14C gives such an example based on a prototype interurban line, the Scioto Valley.

NARROW GAGE

A great advantage of narrow gage for a model is that curves can be sharp and grades steep without doing violence to realism. Therefore, a narrow-gage connecting line can be added to an existing standard-gage layout using space inaccessable to standard-gage tracks.

As auxiliary railways, there are three main possibilities for narrow-gage lines. One is as a connecting line. On the prototype this was particularly effective for bulk materials such as coal which had to be cleaned and graded at some point in the shipment. A narrow-gage line was well suited for bringing mine-run coal from the mines to a coal breaker, standard-gage cars being loaded from the breaker. The aforementioned East Broad Top was a coal line of this type, although they did handle other types of traffic.

There is more interrelationship between the narrow-gage line and the standard if they share some common trackage and facilities at the junction. Figure 13-1 shows a model example of an interchange terminal between the HO and HON3 lines of Charles Small. The narrow-gage line approached from the left, the standard from the right. Dual-gage track permitted joint use of the passenger station and freight house and a transfer platform was provided for interchanging cargo between narrow-gage and standard-gage cars.

A second possibility is for the narrow-gage line and the standard-gage railroad to share a considerable length of route using dual-gage track. The D&RGW had many miles of such operation at one time and in 1968 the line from Merida to Progresso in the Yucatan was dual-gage its entire length, with narrow-gage trains performing some of the freight work and standard gage trains for both freight and passenger service. In such a case, the auxiliary railway and the main railroad would have to work under a common dispatcher, timetable, the book of rules for the shared trackage.

The third possibility is an industrial line with shared tracks and facilities; an example is the tie-treating plant shown in Fig. 10-18C. A larger prototype example of such a tie-treating plant existed at Port Reading on the CNJ.

If a narrow-gage line is included as an auxiliary railway, do not neglect the concept. Judging from layouts actually built, there is a strong tendency to model old-time western narrow gage in combination with a modern standard-gage line of another region. There were narrow-gage lines in all parts of the United States, in Mexico, and in Canada. Select a believable prototype, but above all—model it to exist in the same time frame as the standard-gage line.

TRACTION

Traction such as interurban and street car has the same advantage as narrow gage: curves can be sharp and grades steep without violating

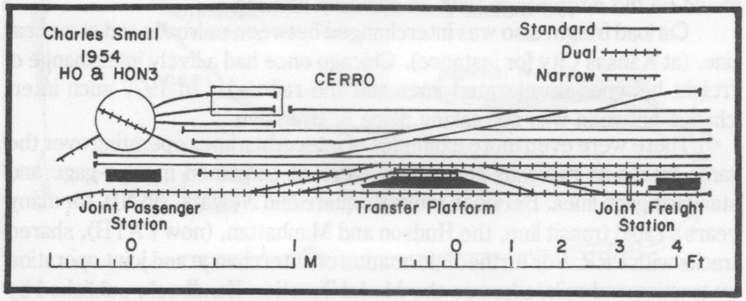


Fig. 13-1. Dual-gage terminal.

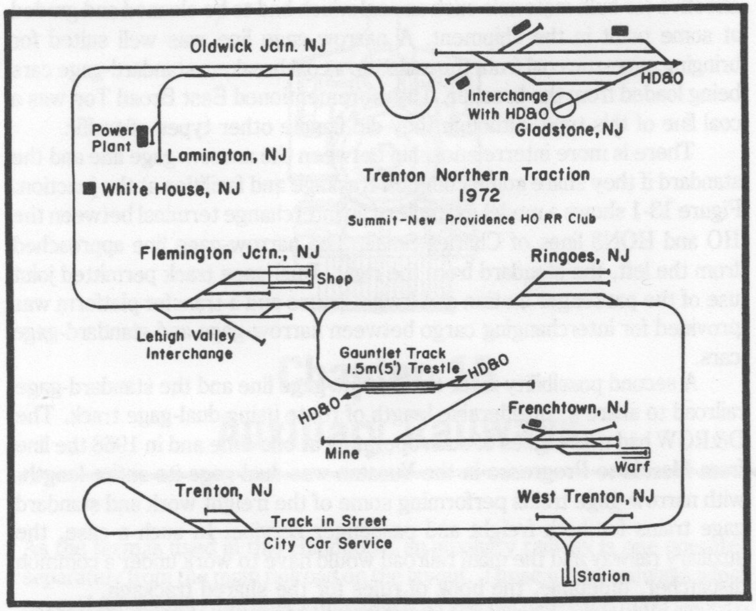


Fig. 13-2. Interurban as an auxiliary railway.

prototype. But traction can be standard gage and thus interchange of cars is possible. Interurban lines often exchanged much freight with one or more connecting railroads. The Trenton Northern, a large model example, is shown in Fig. 2-16. Its primary business is carrying coal from an interchange with the main railroad (the Hudson, Delaware and Ohio) from an interchange yard at Jim Thorpe, PA. to a power plant at Ringoes, NJ. This interchange yard is shown in Fig. 10-15. Figure 13-2 shows the Trenton Northern in its first embodiment. It served as an important source and destination for additional car movements down the Gladestone branch of the HD&O. Although the TN had over 100m (300′) of track, it was an auxiliary railroad, as the HD&O was much larger. But, the TN shown was an example of a traction line large enough to be the main railroad. The Gladstone terminal could be the interchange with an auxiliary railroad.

Carload freight also was interchanged between railroads and street car line, (at Kansas City for instance). Chicago once had a lively interchange of freight between its elevated lines and the railroads. In 1977 such interchange between was still taking place in Brooklyn.

There were even more examples of interurban lines operating over the same tracks as railroads than there were of combined narrow-gage and standard-gage lines. Between Journal Square and Newark, (in NJ), for many years a rapid transit line, the Hudson and Manhattan, (now PATH), shared tracks with PRR. For further information on interchange and joint operation by traction and railroads, see the Model Traction Handbook, published by Vane Jones, 6710 Hamptom Dr., East, Indianapolis, IN 46226.

Electric-powered industrial lines of all types once existed in great numbers, particularly to service power plants. These could be third rail, underrunning in the case of Commonwealth Edison, Chicago, but more often, overhead wire as in Toledo.

SHORT LINES

Typically, short lines operate from an interchange with a standard railroad and serve industries stretched out along a recognizable main line. Some even have more than one interchange, the Rahway Valley had three, (with the DL&W, the LV and the CNJ). Perhaps there were exceptions, but short lines do not serve as bridge railroads between their interchanges, although they might accept an empty car from one interchange for on-line delivery and turn that car over loaded through another interchange. A model example of a short line, the Rahway River (based on the Rahway Valley) is shown in Fig. 13-3. It has two interchange points. One is with the main railroad, the HD&O, at Summit, NJ. This interchange is a model of the actual interchange at that station between the RV and the DL&W. The second, a purely conceptual interchange, is with the Trenton Northern at Allentown to give a direct interchange between these two auxiliary railways. To avoid crowding the scenery with too much trackage, this short line is gauntleted with the HD&O for approximately 6m (23′) on the way to the Allentown interchange. Use of a gauntlet rather than two switches to a single track prevents any possibility of an operator deciding to switch his train to the other railroad.

A model short line could, of course, be operated as a branch of the main railroad. There are, however, two advantages of operating it as a short line. One is the resulting interchange between the two railroads; the other is the informal operation on a short line in contrast to the more rigid control on the standard railroad.

Although most short lines were freight only, passenger service was not unknown. In 1977 several short lines were operating steam passenger trains

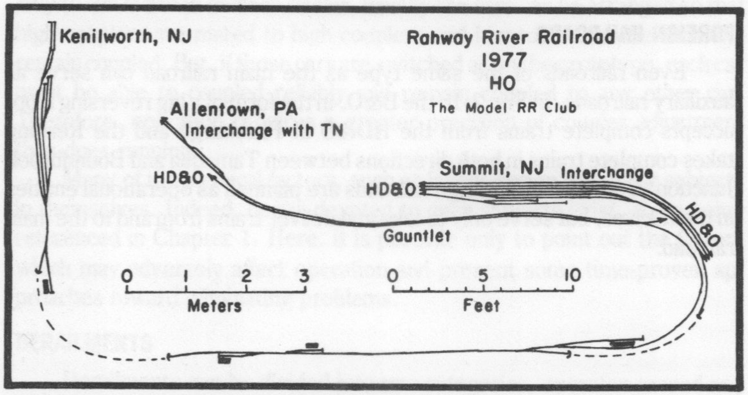


Fig. 13-3. Short line as an auxiliary railway.

as tourist attractions—a good opportunity to include some steam on a model set strictly in the present. At one time the Rahway Valley is reported to have run through passenger service to the Jersey shore in connection with the CNJ.

SWITCHING LINES

Very similar to short lines are switching lines serving the industries near an interchange point with the standard railroad. An HO example of a switching line, the Mauch Chunk Terminal, is shown in Fig. 10-15. How this line fits into the overall railroad can be seen in Fig. 2-16. Again, the industrial tracks of a switching line could be served by assuming them to be side tracks of the standard railroad. But, operating the switching line as a separate railway provides the justification for interchange and for a different style of operation.

TERMINAL RAILROADS

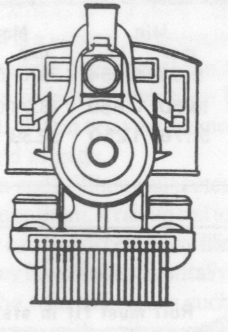
Terminal railroads may be switching lines serving the industries near the terminal of the standard railroad, but some operated the passenger terminal, particularly those which served several railroads as at Washington, St. Louis, and Jacksonville, FL. No model example of a terminal railroad operating as an auxiliary railroad in conjunction with main railroad was known at the time of writing. They would add the interest of coordinating the operations of two separate lines at the terminal in contrast to the main railroad handling all terminal activities.

INDUSTRIAL RAILWAYS

An industrial line is really a switching line owned by the industry or industries served by the line. It may be contained strictly within a plant, quarry or mine for moving cars within that establishment. Typically, the main railroad delivers cars to and takes cars from an interchange track on the grounds of the industry.

FOREIGN RAILROADS

Even railroads of the same type as the main railroad can serve as auxiliary railroads. In Fig. 2-16 the B&O, in the form of a big reversing loop, accepts complete trains from the HD&O at Pittsburgh and the Reading takes complete trains in both directions between Tamaqua and Boundbrook Junction. Both of these foreign railroads are planned as operational entities in themselves, but serve only to take and deliver trains from and to the main railroad.



Chapter 14

Physical Factors

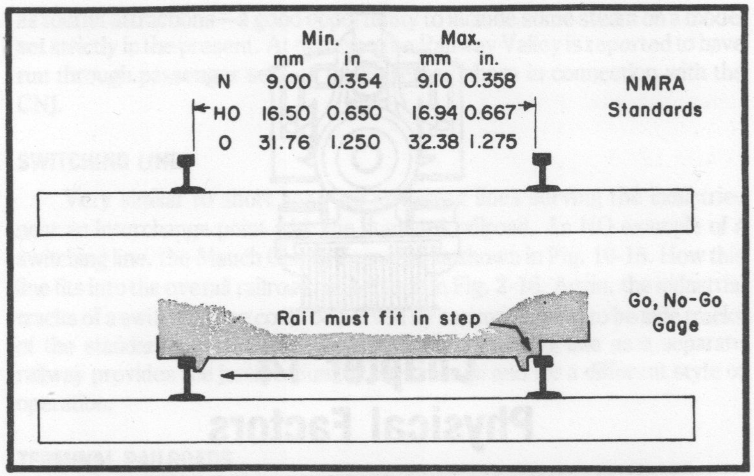
The preceding Chapters cover prototype operation and the means for duplicating such operation on a model railroad. What can be done and how interesting it is depends, to a large extent, on physical factors such as the design of the layout and the quality of track construction. Some of these factors are discussed in Chapters describing their specific inpacts. Nevertheless, physical factors are important enough to justify a hard look at them as a separate subject. This is of particular importance if the layout is still in its design or construction phase. But, even if the layout is completed, an examination on a point-by-point basis might disclose modifications which would improve operation and could be made relatively easily.

The physical factors which determine reliability affect both operation and also the mere running of trains. Nevertheless, it is the attempt to operate in the prototype manner which brings lack of reliability to the fore. Of particular importance is the adjustment of couplers. If the objective is only to run trains in endless circles, usually the cars can be arranged so that high couplers are mated to high couplers and low to low so the train will remain coupled. But, if those cars are switched as on the prototype, each car must be able to coupled reliably and remain coupled to any other car. Therefore, operation requires a greater precision of coupler adjustment than does running.

Many of the physical factors, such as layout design, are major subjects in themselves. Indeed, books devoted to such subjects exist, some being referenced in Chapter 1. Here, it is possible only to point out the factors which may adversely affect operation and present some time-proven approaches toward eliminating problems.

DERAILMENTS

Derailments can be divided into two categories, operator-caused and physical-factor caused. Throwing a switch under a moving train is represen-



	Min. mm	Min. in	Max. mm	Max. in.
N	9.00	0.354	9.10	0.358
HO	16.50	0.650	16.94	0.667
O	31.76	1.250	32.38	1.275

Fig. 14-1. Track gage.

tative of the first category. Such derailments are reduced and (hopefully,) eliminated as operating skills increase. It is the second category of derailments—the ones over which the operators have no control, which can become frustrating to operation if frequent. The larger the layout, the more vital it becomes that derailments due to physical factors be reduced to a minimum.

Derailments can generally be attributed to track defects, switch defects, car defects, or layout design defects. Sometimes two or more of these three must be present simultaneously to cause a derailment. This applies particularly to layout design defects which cause derailments of longer cars or of cars whose couplers are not well adjusted.

Track

The most common track defect is being out of gage. Figure 14-1 shows the NMRA Standards for the maximum and minimum gages for N, HO, and O standard-gage track. It cannot be stressed too strongly that all track should be checked for conformance to standard maximums and minimums which have been adopted for a particular layout. To avoid all guesswork, a go, no-go gage should be used for this checking, such as the one shown at the bottom of Fig. 14-1. Such gages (which can check other dimensions as well,) have been available from the NMRA for both O and HO standard-gage track.

Whenever track is found out of gage, either initially or later at the site of derailment, it must be brought into gage. With some forms of commercial track this might mean driving the rail over against plastic fasteners, perhaps even shearing those plastic fasteners off. When it is necessary to regage rails, defects in roadbed constructions will become known. Soft materials such as cork will not give firm support to spikes and humidity-sensitive materials such as Homasote can lead to repeated regaging of the same track. If track laid on such materials is a source of continued problems, consideration should be given to a complete overhaul of the track and its supporting structure. In 1952, the Summit-New Providence HO RR Club laid about 100m (300′) on cork roadbed. Within ten years almost all had to be replaced as the track could not be held in gage.

Rail joints are a problem spot. When rail joiners are used and the ties are not properly recessed under them, a raised rail joint is created, as shown at A in Fig. 14-2. This usually can be corrected by filing the top surface of the rail heads. The rails-heads may be offset horizontally, as at B. Even if the rail bases are in line, a twist in the rails can create such an offset in the heads. Driving one or both rails over with spikes usually can correct such a problem. Vertical steps in the rail head can result from several causes. At C in Fig. 14-2, a slight difference in rail height is indicated. Again, filing is a solution.

Particularly when prefabricated sectional track is used, the rails might form an angle at the joint, as shown at D. There is no solution other than moving the track so as to form a smooth curve. Similarly, a vertical angle might be formed at a joint, as at E in Fig. 14-2. On concave vertical curves it may be possible to insert a tapered filler under the ties to change this angle into a smooth curve, but on convex curves some sort of correction probably will have to be taken on the supporting structure under the track. If the vertical curve problem is severe, consideration should be given to replacing the supporting structure with one which will provide a gentle vertical curve.

Except on track approaching the minimum radius, smooth changes in radius or smooth waves in tangent track usually do not cause derailments. But, when derailments occur on short-radius curves, particularly if such derailments involve only specific cars or locomotives, look for deviations such as that shown in Fig. 14-3 where the track has portions where the

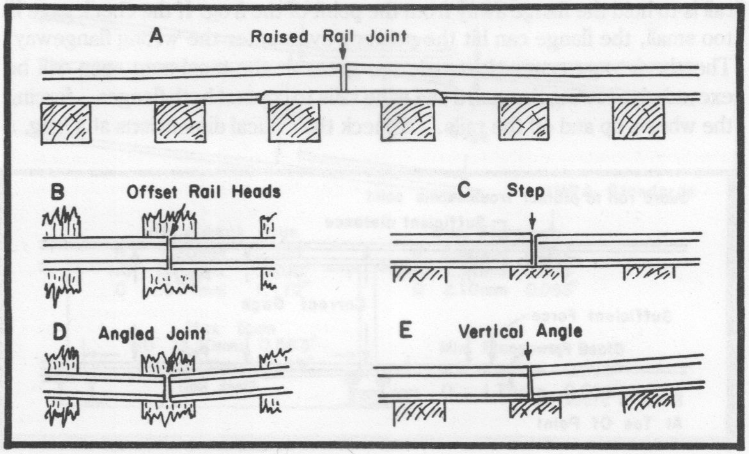


Fig. 14-2. Problems at rail joints.

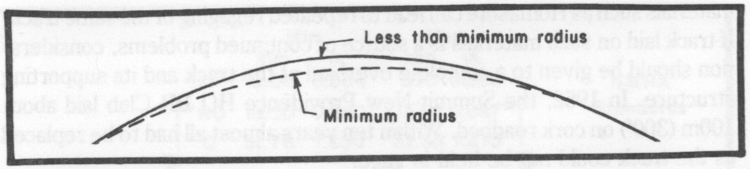


Fig. 14-3. Radius problem.

radius is below the minimum established for the layout. If such a condition is discovered to be the cause of derailments, one of the following actions should be taken: the track relocated to conform to layout standards; the equipment which derails modified so that it can negotiate the curve; or the cars and types of locomotives that are to be operated around the curve restricted. Restrictions of this nature appear as special instructions in the timetable. An example taken from a 1974 Penn Central timetable is, "Cars 89′6″ or more in length when coupled to cars less than 50′ in length including caboose cars prohibited at the following location:".

The points of switches are usually the greatest single source of derailments. It is vital that the toe of the point fit snugly against the stock rail, as shown in Fig. 14-4. The point must be pressed against the stock rail with sufficient force that the impact of a flange cannot open the point. For HO, 30 grams (about 1 oz.) of force appears to be adequate—although The Model RR Club specifies 100 grams to make sure. The gage should be checked all along the points for both settings.

If a point proves to be particularly troublesome, a guard rail to hold the flange away from the point in question should help. Such a guard rail is shown in Fig. 14-4 and should meet the check gage requirements of Fig. 14-5.

At frogs, the most-common cause of derailments is improper gage of the running rails or improper check gage of the guard rail. See Fig. 14-5 for the NMRA Standard dimensions applying to frogs. The purpose of the guard rail is to hold the flange away from the point of the frog. If the check gage is too small, the flange can hit the point or even enter the wrong flangeway. The check gage cannot be made too great or the maximum span will be exceeded, allowing the guard and wing rails to contact both flanges—forcing the wheels up and off the rails. To check the critical dimensions at a frog, a go, no-go gage (such as were available form the NMRA for HO and O) should be used. The NMRA gages can also check for minimum flangeway depth. It is important that the flanges not ride the bottom of the flangeway.

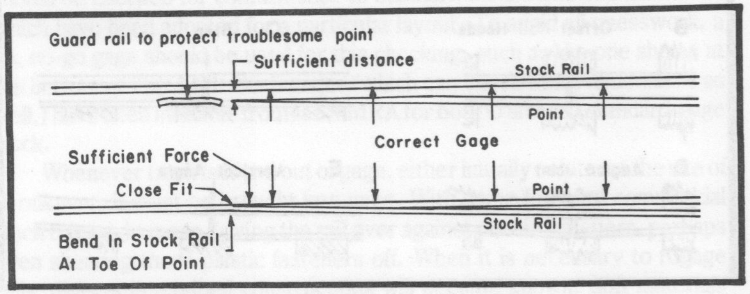


Fig. 14-4. Checking switch points.

In 1977, frogs in N scale presented a problem due to the different widths of the flanges and wheel treads available from the various manufacturers. Flangeways at frogs wide enough to accept the widest flanges would permit the narrower closer-to-scale wheels to drop into the flangeways instead of riding on the wing rails. The solution is to adopt personal or club standards for the wheels and track. The long-range solution is for the NMRA to adopt complete Standards and for N gagers to support those Standards by purchasing only products conforming to NMRA Standards.

A fault which has been common with commercial prefabricated turnouts is a frog which is significantly higher than the stock rails. If the ties are of plastic, it may be possible to heat the frog and press it down into the ties until the frog is at the same height as the other rails. This method may not be advisable if the frog is of the insulated type.

The critical dimensions shown in Fig. 14-5 apply to all frogs, those of crossings and slip switches, as well as those of turnouts.

If derailments occur at switches or frogs, it is good practice to check all parts of the entire turnout, crossing, or special switch. Any discrepancies found should be corrected. The temptation to feel that some dimension is not far enough out to warrant fixing is a strong one—avoid it!

Wheels

It obviously does no good to build and maintain track to precise standards if the wheels do not conform to complementary standards. The critical

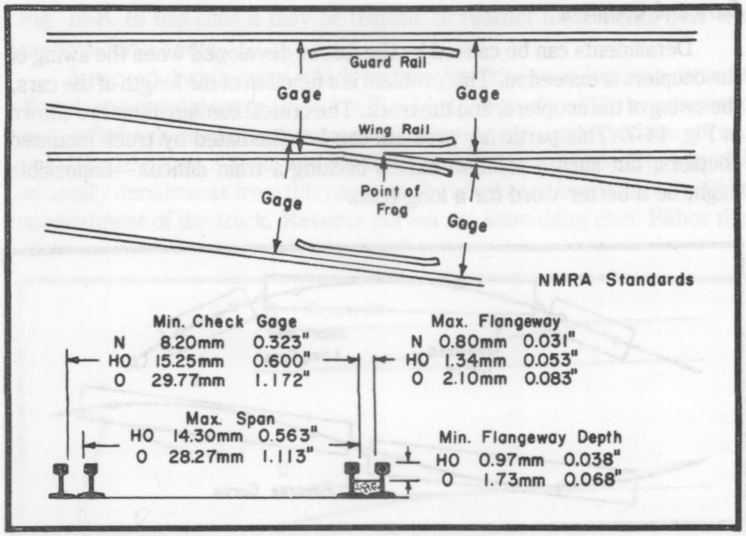


Fig. 14-5. Checking frogs.

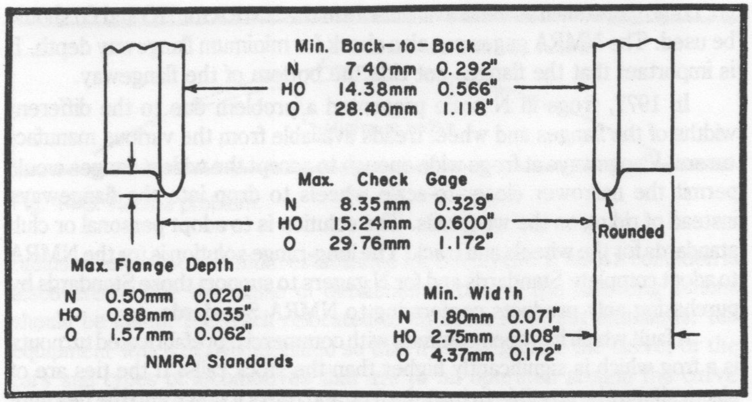


Fig. 14-6. Checking wheels.

dimensions for wheels are shown in Fig. 14-6 along with the NMRA Standards for those dimensions in N, HO, and O standard gage. Again, a go, no-go gage should be used to check wheel dimensions. The HO and O NMRA gages mentioned before also check wheels.

In particular, check for too-great a depth of flange as well as flanges with a sharp or rough edge. Sharp or rough flanges tend to bite into any irregularities of the rail and into the toe of a switch point, causing the wheel to climb up and over the rail.

Another source of derailments is dirt on the wheels. A regular inspection should be scheduled for all wheels.

Cars and Couplers

Derailments can be caused by the forces developed when the swing of the couplers is exceeded. This problem is a function of the length of the cars, the swing of the couplers, and the track. The critical combinations are shown in Fig. 14-7. This particular problem can be eliminated by truck-mounted couplers, but such a solution makes backing a train difficult—impossible might be a better word for a long train.

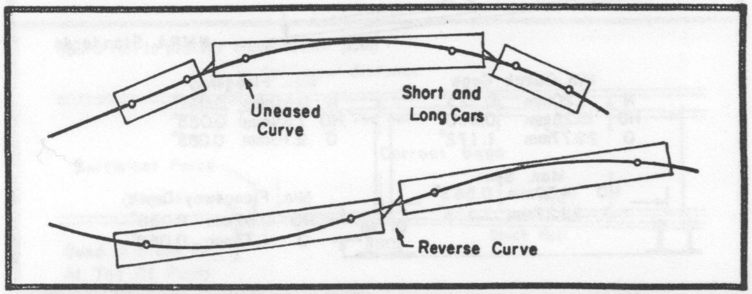


Fig. 14-7. Problems of coupler swing.

Other car-related causes of derailments are trucks which cannot pivot far enough, or are too-stiffly mounted to the car, so that all wheels do not make firm contact with the rails.

Car weight variations also can lead to derailments if the lightweight cars are near the locomotive. The NMRA Recommended Practice for HO car weight was 1 oz. plus 0.5 oz for each inch of car length. This is roughly 30 grams plus 6 grams per centimeter of length.

Because of the problems which can be introduced by untested cars and locomotives, no unproven equipment should be introduced just prior to or during an operating session.

Layout Design

Layout design can contribute mightily to derailments. The most common design fault is a reverse curve. The absolute worst such curve is one with no intervening tangent, as at A in Fig. 14-8. Derailments are all but guaranteed. Even if there is a short tangent between the curves, the swing of couplers may be exceeded at this point, as indicated at the bottom of Fig. 14-7. There should be at least one car-length of tangent between the curves so the cars can straighten out before being forced in the opposite direction.

Reverse curves sometimes overlooked are those at turnouts. At B in Fig. 14-8 is the reverse curve of a crossover. To get the longest possible tangent, the frogs should be straight (prototype practice). There have been commercial model turnouts with curved frogs. These are not suitable for crossovers. To obtain sufficient length of tangent, a No. 6 turnout is about the sharpest which can be used reliably for crossovers in railroad service without restricting the length of cars which can be operated over it.

Two turnouts point-to-point also form a reverse curve, as shown at C in Fig. 14-8. In this case it may be feasible to restrict movements over the reverse-curve route.

A second design error which causes derailments is joining a tangent directly to a circular curve, as at A in Fig. 14-9. There should be an easement (also called a spiral or transition curve) between the tangent and the curve, as at B in the figure. Almost any smooth transition is good enough on a model so usually derailments from this cause can be eliminated by a relatively slight readjustment of the track. Reverse curves are something else. Either the

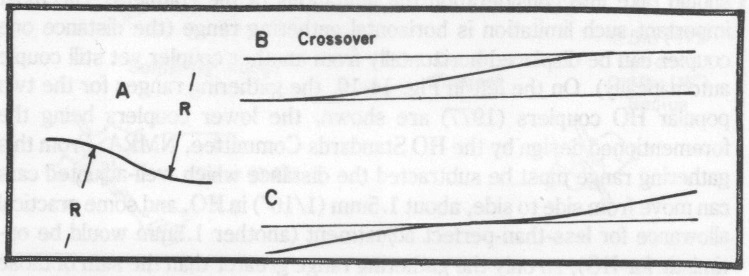


Fig. 14-8. Reverse curves.

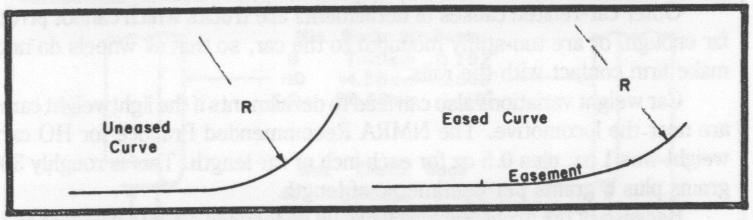


Fig. 14-9. Connection of curve to tangent.

equipment to be operated must be restricted or the track has to be relocated.

COUPLERS

The prototype AAR coupler is termed *automatic* because if it is properly aligned and at least one knuckle open, it will close and lock when the cars are pushed together. If both knuckles are closed or the couplers are not well-enough aligned to mate, manual assistance is required. Occasionally, as when a car is on a sharp curve, it is impractical to align the couplers and the car must be pulled off of the curve by a chain.

On the model, the term *automatic coupler* has a different sense—it means a coupler always ready to couple and one which generally does not have to be aligned manually. A coupler following the prototype design is usually called a *working knuckle coupler*. It is not necessary to have an automatic coupler to duplicate prototype operation on a model but, in 1977, all known operating model railroads in gages small than O used one sort or another of automatic coupler. Certainly, automatic couplers make switching much more simple and more pleasurable.

Unfortunately, there is a gaping hole in the otherwise complete set of interchange standards developed by the NMRA: there is no standard automatic coupler in any scale. This field has not been entirely neglected by the NMRA, for in 1954 the HO Standards Committee the NMRA, Russell L. Houghton Chairman, did introduce a design of coupler which became widely followed and took HO out of the jungle of couplers which existed at that time.

Without an NMRA Standard, each modeler must adopt an individual standard for a particular layout. Whichever the choice, the layout design should take into consideration the limitations of the couplers. The most important such limitation is horizontal gathering range (the distance one coupler can be displaced horizontally from another coupler yet still couple automatically). On the left in Fig. 14-10, the gathering ranges for the two popular HO couplers (1977) are shown, the lower couplers being the forementioned design by the HO Standards Committee, NMRA. From this gathering range must be subtracted the distance which well-adjusted cars can move from side to side, about 1.5mm (1/16″) in HO, and some practical allowance for less-than-perfect adjustment (another 1.5mm would be optimistic for HO), so only the gathering range greater than the sum of those allowances is available to take care of misalignments due to curves. That considerable gathering range is needed and is shown on the right in Fig. 13-10, where the two types of couplers shown in Fig. 14-10 are attempting to mate with one car on a 0.46m (18″) radius and the other on a tangent. This drawing makes no allowance for side movement of the cars and assumes perfect adjustment.

The gathering range of the coupler selected has its greatest impact upon design for the tracks on which coupling will normally take place. One of the design rules adopted for its new layout by The Model RR Club was that every such track would be straight and without vertical curves.

Whatever the capabilities of the coupler adopted, those capabilities can be realized only if the couplers are properly installed and kept in adjustment. Since couplers are in an exposed position, small, and subjected to strong impacts, couplers are a major problem as far as operating difficulties are concerned. It is important that they be checked regularly, not just when there is a false uncoupling or a failure to couple. To check the height and centering of couplers, some modelers mount a coupler on a block as a standard and judge and couplers on the cars against that standard coupler. This type of gage-by-eye-checking introduces many possibilities of judgment. A go, no-go gage such as the one shown in Fig. 3-15 is much more satisfactory. Such gages must be made for the type of coupler in use.

CAR INSPECTION

Although inspection of cars really is maintenance, this task is closely associated with operation. Therefore, in all known cases, car inspection is considered part of the operation system on model railraods. Car inspection is another of those matters which becomes more of a problem as the layout become larger. On the smallest layouts it may be quite satisfactory to ignore inspection completely, making corrections only when the car experiences difficulty or some problem is observed on the car. On large layouts this is not enough. If there are a hundred or more cars in service, there is a high probability that at least one needs maintenance if the cars are not checked regularly and brought up to standards before they cause trouble in operation.

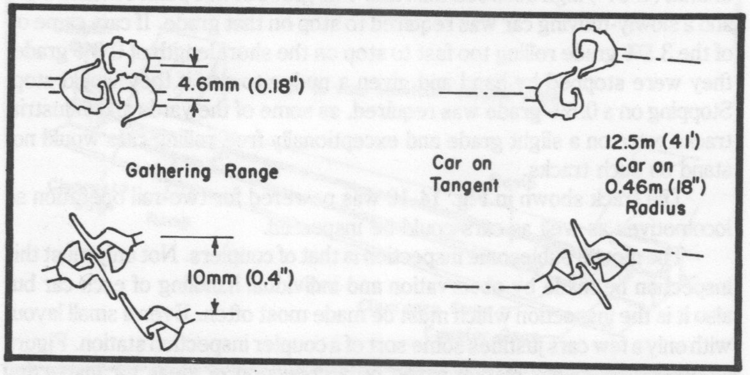


Fig. 14-10. Horizontal gathering range.

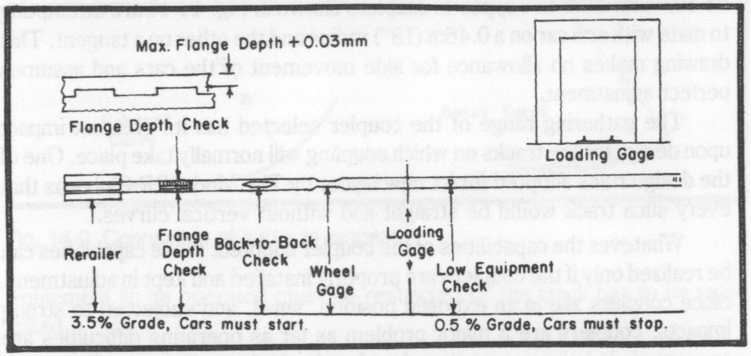


Fig. 14-11. Wheel and loading-gage check station.

It is possible to inspect a few cars with hand-held gages, but it is much faster to use track-mounted gages. The time it takes to construct a suitable car-inspection station will be repaid many times over.

Several checks of critical requirements can be made while the car rolls along a test track. Figure 14-11 shows part of the car inspection station as once used at the Summit-New Providence HO RR Club. To assure reasonable rolling capability of the car, it was placed at the top of a 3.5% grade. A rerailer was installed there for convenience, as indicated in the figure. The car was required to start rolling on that grade. As it rolled down the grade, the wheels passed over a series of brass bars, the flange depth gage. Flanges 0.03mm (0.001″) deeper than the NMRA maximum would strike the bars and made a clearly audible sound. Really deep flanges would be stopped. Next, the wheels passed a spreader 14.38mm (0.566″) wide which was mounted between the rails. Wheels with a back-to-back narrower than NMRA Standards would either be stopped or lifted. After that point, the rails were brought in to a gage of 16.1mm (0.634″). Wheels with a gage greater than NMRA Standards would stopped or lifted. Then, the car rolled through the club's standard loading gage and over a low-equipment gage 0.4mm (1/64″) high between the rails. The grade at this point became 0.5% and a slowly-moving car was required to stop on that grade. If cars came off of the 3.5% grade rolling too fast to stop on the short length of 0.5% grade, they were stopped by hand and given a nudge to see if they would stop. Stopping on a 0.5% grade was required, as some of the yards and industrial tracks were on a slight grade and exceptionally free-rolling cars would not stand on such tracks.

The track shown in Fig. 14-10 was powered for two-rail operation so locomotives as well as cars could be inspected.

The most troublesome inspection is that of couplers. Not only must this inspection be made by observation and individual handling of each car but also it is the inspection which must be made most often. Even a small layout with only a few cars justifies some sort of a coupler inspection station. Figure 14-12 shows such a station based on a collection of ideas for inspecting couplers which must be checked for horizontal as well as vertical position.

To make the horizontal check more accurate, the rails should be laid at the maximum gage of the wheels rather than the minimum track gage. This eliminates much of the side play which normally exists between the flanges and the rails. A smooth surface level with the rail heads provided with flangeways is indicated to facilitate placing the cars on the track.

For a layout with only a few cars, it might be satisfactory to have a coupler gage at only one end of the track with the car being turned to check both ends. It does not take many cars to justify coupler gages at both ends of the test station, as shown in Fig. 14-12. The coupler gage itself is arranged so that the coupler knuckle enters the vertical gage first, then the coupler head enters the horizontal gage. Mirrors are suggested as a means of observing the vertical gage from a comfortable position. Otherwise, the observer would have to change position to view the two gages. Ramps to check the uncoupling action and a clearance gage should be provided at both ends. If the uncoupling pin or other device had both a maximum and a minimum specification on its height over the railhead, a step clearance gage should be provided, the pin being required to clear the lower step but strike the upper step. These steps could be placed so that a pin hitting the lower step would prevent the coupler from entering the coupler gage and hitting the upper step would stop the car short of the end of the gage. In this way, both the height of the uncoupling pin and coupler position would be checked by observing at only one point.

Checking car weight is not a problem on a small layout. Such a check needs to be done only the first time the car is placed on the layout, so any convenient scale will do. But, on layouts with many cars (and club layouts of any size) it is worth while to provide a permanent car-weight station, as indicated in Fig. 14-13. It is most convenient if the maximum and minimum acceptable weights can be read directly from a chart on the scale. In Fig. 14-13, the chart indicates that the minimum weight acceptable for the car shown is 120 grams and the maximum is 130 grams. The scale dial indicates 125 grams, so the car is acceptable.

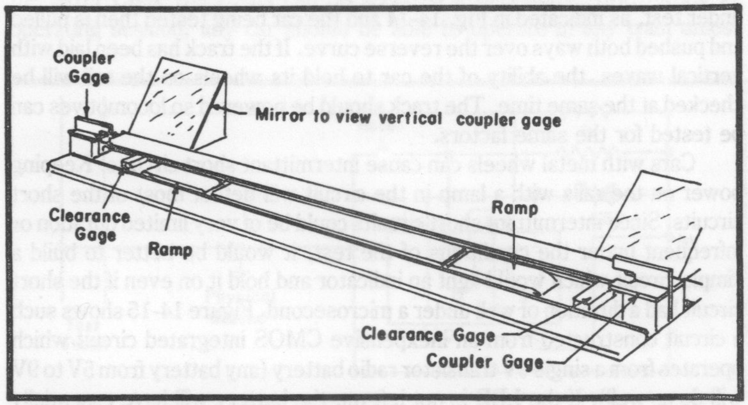


Fig. 14-12. Coupler inspection station.

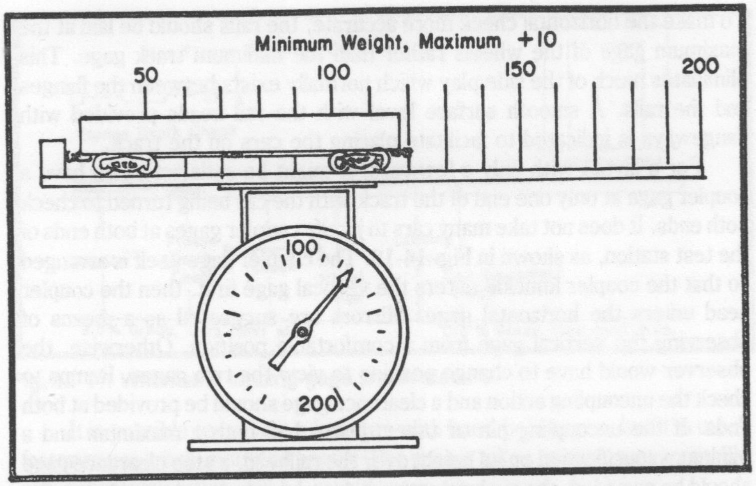


Fig. 14-13. Car weight check station.

Seldom do car inspection stations provide a means of checking the coupler swings or the ability of the car to hold the rails. This type of inspection is most needed if there are tracks of different standards. Two examples would be for interchange cars between an interurban line and a railroad and when industrial spurs have a shorter minimum radius than main tracks. It would be nice to have identified (in some easily-recognized way) the cars which must be restricted from such service or tracks.

An inspection station which has been used for this type of testing consisted of reverse curves approximately 10% more severe than those on the layout. Such a station is illustrated in Fig. 14-14. Since coupler-swing requirements are most severe when cars of unequal length are coupled, test cars 10% longer and 10% shorter than any actually to be operated should be made from blocks of wood. The appropriate cars are coupled to the car under test, as indicated in Fig. 14-14 and the car being tested then is pulled and pushed both ways over the reverse curve. If the track has been laid with vertical waves, the ability of the car to hold its wheels on the rail will be checked at the same time. The track should be powered so locomotives can be tested for the same factors.

Cars with metal wheels can cause intermittant short circuits. Keeping power on the rails with a lamp in the circuit will detect most of the short circuits. Since intermittant short circuits could be of very limited duration or infrequent under the conditions of the test, it would be better to build a simple circuit which would light an indicator and hold it on even if the short circuit had a duration of well under a microsecond. Figure 14-15 shows such a circuit constructed from an inexpensive CMOS integrated circuit which operates from a single 9V transistor radio battery (any battery from 5V to 9V will do as well). If the LED is not left on, the battery will have essentially shelf life. Any short circuit will "set" the flip-flop and light the LED. It will remain on until the "reset" push button is operation. If in a low-humidity location, guard against static electricity by grounding cars and hands before placing the car on the test track.

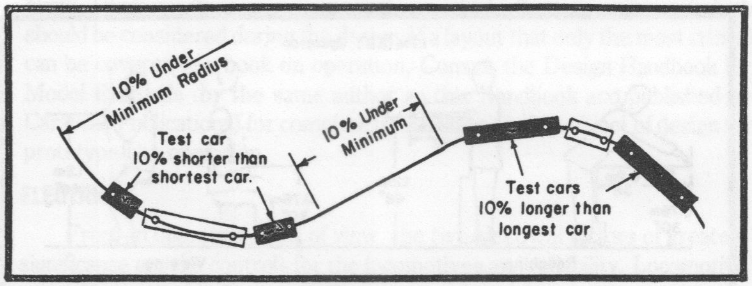


Fig. 14-14. Coupler swing test station.

If metal couplers are used, there is always a possibility of a short circuit through the couplers. To check for this, install trucks with metal wheels on the test cars, the uninsulated wheels of both trucks being on the same rail and both trucks connected to both couplers. Make one set of test passes over the track, then reverse the test cars to check for a short circuit to the other rail.

LAYOUT DESIGN

In the Design Handbook for Model Railroads, layout design is divided into two phases, preliminary design and detailed design. Preliminary design is the phase which tests various benchwork and layout possibilities for the space available against the concept. From an operating point of view, it is very important that the requirements for suitable yards, etc., be considered when examining the possible layouts. It should be remembered, when setting design rules, that operation in the prototype manner places greater stress on trouble-free operation than does the mere running of trains for, in the latter case, the trains can be adjusted if necessary. But, during an operating session, any car should be able to operate in any train unless

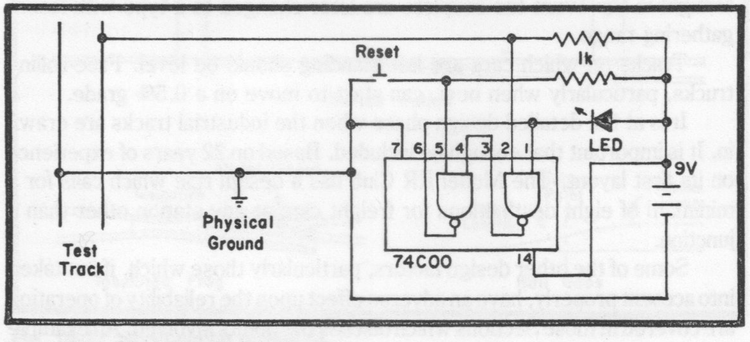


Fig. 14-15. Short circuit detector.

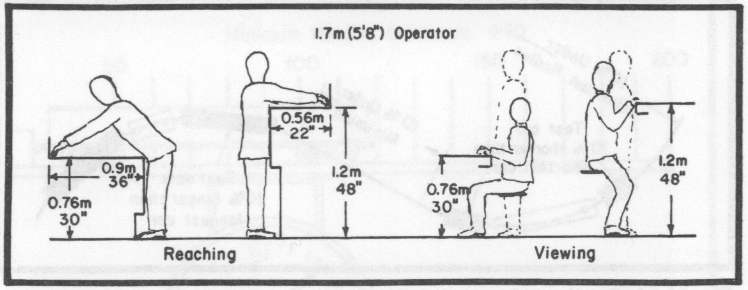


Fig. 14-16. Benchwork heights.

restricted by the operating rules. Therefore, the design rules for minimum radii, minimum turnout numbers, and maximum grades should not be stretched to the limit.

Convenient access to all tracks is important for all layouts, but is vital on one duplicating prototype operation. Every track should be within easy reach of an access aisle. Access is a function of benchwork depth and benchwork height. As shown on the left in Fig. 14-16, an operator 1.7m (5′8″) tall can easily reach a track 0.9m (36″) away on benchwork 0.76m (30″) high, but only 0.56m (22″) on benchwork 1.2m (48″) high.

Another significant difference between low and high benchwork, as far as operation is concerned, is the ability to obtain a better view. As shown on the right in Fig. 14-16, an operator seated at a low-benchwork layout need only stand up to get a significantly better view. An operator seated at a high-benchwork layout obtains only a small improvement by standing. That operators desire the better view is demonstrated by, when operating on low-benchwork layouts, operators will almost always stand to handle switching operations in their area.

When it comes to the detailed phase of layout design, special consideration should be given to points where coupling normally will take place. Even if the couplers presently in use have sufficient gathering range to couple reliably on curves, consideration should be given to making such tracks straight in the event the couplers are later changed to a type with lesser gathering range.

Tracks on which cars are left standing should be level. Free-rolling trucks, particularly when new, can start to move on a 0.5% grade.

It is at the detailed design phase when the industrial tracks are drawn in. It is important that enough be included. Based on 22 years of experience on its first layout, The Model RR Club has a design rule which calls for a minimum of eight destinations for freight cars at any station other than a junction.

Some of the other design factors, particularly those which, if not taken into account properly, have an adverse effect upon the reliability of operation are covered in those Sections which discuss the points involved. An example is the impact of layout design upon derailments which was discussed previously. There are, however, so many things which affect operation and which should be considered during the design of a layout that only the most critical can be covered in a book on operation. Consult the Design Handbook for Model Railroads (by the same author as this Handbook and published by Carstens Publications) for complete information on the subject of design for prototype-like operation.

ELECTRICAL

From an operating point of view, the two electrical factors of greatest significance are the controls for the locomotives and reliability. Locomotive control is covered in Chapter 3. The subject of reliability is too vast to cover in a Handbook of operation other than to state that electrical difficulties, if frequent, will frustrate operation. Consult the electrical reference cited in Chapter 1 for details on the installation of reliable wiring.

There are, nevertheless, electrical problem which are associated with operation. These are the short and open circuits which occur as trains move.

Short Circuits

The three major causes of short circuits due to locomotive and car movements are shown in Fig. 14-17. At the top, the open point of a switch is connected electrically to the opposite stock rail; a common form of construction. Unless the point is opened wide enough so that it cannot be touched by a flange, a metal wheel can cause a short circuit as indicated. This may be an illusive problem to locate, as only certain flanges moving in a particular direction under specific circumstances may be so positioned as to cause such a short. Opening the point wider will cure the problem, but a better solution to change to the type of point which is connected electrically to the stock rail against which it bears. This not only eliminates a cause of short circuits, but reduces the distance the point must be opened and results in a much better appearance of the switch.

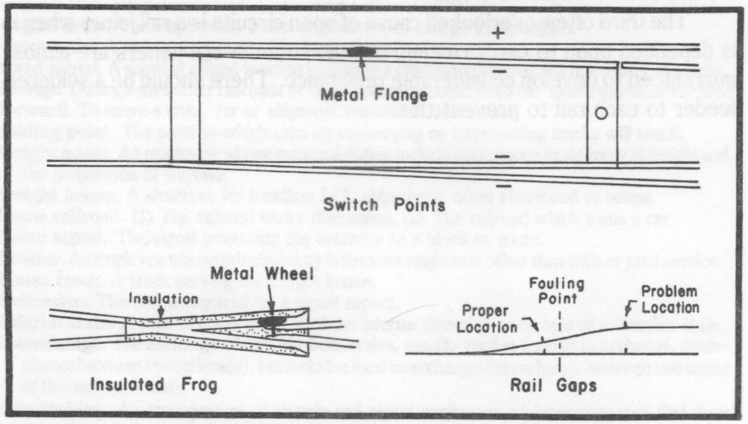


Fig. 14-17. Short-circuit problems.

Insulated frogs also can be a source of short circuits if a metal wheel wide enough to contact both rails simultaneously rolls over the frog, as shown at the bottom left in Fig. 14-16. Commercial frogs of this type have been manufactured in HO which depended upon the wheel taper to prevent such short circuits. Unfortunately, not all wheels are tapered. It is possible to remove the railhead where the short circuit occurs and fill in with epoxy. However, this makes the insulation longer and creates a greater opportunity for an open circuit. The best solution is to replace the frog with an all-rail (insulated) frog and make the necessary wiring changes.

At the bottom right of Fig. 14-16, rail gaps have been located outside of the fouling distance at a turnout. The ostensible reason for such a location is to prevent a locomotive from advancing to the fouling point when the switch is closed against it. The problem is that cars with metal wheels may be left standing on these gaps. The solution is to move the gaps within the fouling point as indicated. Cars then will not be left standing on the gaps.

Open Circuits

There are three causes of open circuits which are often overlooked by modelers. Two are shown in Fig. 14-16. If, at the top of the figure, the contact between the points and the stock rail is relied upon to carry power to the points, an open circuit is likely. Points are of the wrong shape and the wrong material to serve as reliable electrical contacts. As a minimum, good electrical contacts which throw with the points are required and also a soldered connection to the points. Even better is to connect the points electrically to the stock rail against which they bear. This solves both open and the short circuit problems.

The second cause of open circuits shown in the figure is the insulated frog. An insulated frog puts a significant dead spot in the track which materially increases the probability of stalling on the frog. Changing to an all-rail frog solves both the open circuit and the short circuit problem introduced by insulated frogs.

The third often-overlooked cause of open circuits is a rail joiner when it is depended upon to carry running power. In time, rail joiners are almost guaranteed to develop considerable resistance. There should be a soldered feeder to each rail to prevent this.

Appendix

Glossary of Important Operating Terms

This glossary contains only the most important of the terms used in the operation of prototype railroads and in the duplication of such operation a model. The definitions given are those pertaining to operation. Many of these terms also have other railroad-related definitions. When precise definitions exist, as in rule books, they are given. In such cases, model and slang variations are not included. Consult the index for more detailed information on the terms.

For a comprehensive listing of railroad terms with all of their railroad-related definitions including slang, model railroad terms, and model-railroad variations of prototype terms, consult the Railroad Dictionary, being prepared in 1978 for publication by Boynton and Associates.

approach. A signal indication instructing the engineman to proceed toward the next signal prepared to stop.

aspect. The appearance of a fixed signal.

block. (1) A length of track of defined limits, the use of which by engines and trains is controlled by signals. (2) Coupled cars with the same destination or so to couple cars.

block joint. An insulated rail joint for the purpose of isolating adjacent track circuits used to operate signal systems and interlockings.

block operator. See *Towerman.*

cab control. On a model, a system whereby each engine is controlled independently of other engines from a control unit called a cab.

class. The relative superiority of trains by type as specified by timetable schedule.

classify. To assemble cars according to destinations.

conductor. An employee in charge of a yard drill or train.

consist. The cars of a train.

consist report. A list of cars in a train, also called wheel report.

controlled point (CP). A location where signals or other functions of a traffic-control system are controlled remotely.

crossover. (1) Two switches so arranged that a train can transfer from one parallel track to the next, technically limited to between main tracks, secondary tracks, and sidings—but applied to any such arrangement between any parallel tracks by modelers. (2) To transfer a train or engine from one parallel track to another.

CTC. Centralized Traffic Control, a system for controlling trains by signals from a central point, also called TCS (Traffic Control System).

current of traffic. The movement of trains on a main track in one direction as specified by timetable. Not to be confused with direction of traffic, which may be established in either direction by an operator or automatically.

deadhead. Train or car being moved without performing revenue service.

direction of traffic. On two-way track, the direction of movement established by an operator or automatically.

dispatcher. See *Train Dispatcher*.

engine. One or more units coupled, operating under a single control, and in train or yard service.

engine crew. The employees, called enginemen, in charge of an engine.

extra train. A train not authorized by timetable schedule.

fixed signal. A signal at a fixed location indicating a condition affecting the movement of a train.

foreign. Distinguishes other railroads or cars of other railroads from the home railroad or its cars.

forward. To move a train, car or shipment toward its destination.

fouling point. The point at which cars on converging or intersecting tracks will touch.

freight agent. An employee whose principal duties include acceptance or delivery of freight and the preparation of waybills.

freight house. A structure for handling LCL shipments, often shortened to house.

home railroad. (1) The railroad under discussion. (2) The railroad which owns a car.

home signal. The signal governing the entrance to a block or route.

hostler. An employee whose principal duty is to move engines in other than train or yard service.

house track. A track serving the freight house.

indication. The action required by a signal aspect.

inferior train. A train of lower class or of the inferior direction as compared to another train.

interchange. The exchange of cars between trains, usually implies foreign interchange, (interchange between two railroads), but includes local interchange (interchange between two trains of the same railroad).

interlocking. An arrangement of signals and signal appliances so interconnected that their movements must succeed each other in proper sequence and for which interlocking rules are in effect.

LCL. Less than carload, shipments which are combined to make up a load for a car.

main track. A track running between stations and through yards on which trains are operated by timetable, train order, or signals.

meet. The action taken by two opposing trains on single track so both may continue in their original direction.

normal. The usual position of a switch, derail, movable-point frog, or lever. The opposite position is reversed.

order. See *Train Order.*

OS. To report a train.

pass. The action taken by a train overtaking another train to move ahead of the overtaken train.

passenger extra. A passenger train not authorized by timetable schedule.

receiving track. A track normally used to accept an arriving freight train.

regular train. A train authorized by timetable schedule.

reversed. The position opposite the normal position of a switch, derail, movable-point frog, or lever.

right. Authority conferred to a train by train order.

secondary track. A track running between stations and through yards on which trains may be operated without timetables, train orders, or signals.

section. (1) One of two or more trains operating under the same timetable authority. (2) An electrically-isolated, separately-controlled length of overhead wire or rail used to supply power to motors of locomotives or cars.

section break. Insulation separating one section from another for the purpose of permitting independent control of power in adjacent sections.

set off. To uncouple from a car and leave it standing, also called *set out,* although the latter is sometimes restricted to placing a car at its destination.

side track. Any track other than a main or secondary track, but usually not applied to sidings or yard tracks.

siding. A track auxiliary to a main or secondary track used for the meeting or passing of trains.

single track. A main or secondary track in which engines or trains move in either direction. Technically any track signaled for both directions is single track even if one of two parallel tracks or one of a multiple-track line, but the term is seldom used for such track although single-track rules apply.

spot. To place a car at its destination.

superior train. A train of higher class or of superior direction as compared to another train.

switch. (1) device for changing wheels from one rail to another. (2) To rearrange cars.

take. To add cars to a train.

TCS. See *CTC.*

team track. A public track for loading or unloading cars.

timetable. The document containing special orders, schedules, etc., for the government of employees.

tower. A structure, often elevated, from which switches or signals are controlled, usually by an interlocking machine, sometimes applied to the interlocking itself.

towerman. An employee charged with the operation or control of switches and signals, often by an interlocking machine; also called a block operator or signal operator.

traffic control system. See *CTC.*

train. One or more engines coupled, with or without cars, displaying markers.

train crew. The conductor, brakemen, and engine crew of a train unless the engine crew is listed separately.

train dispatcher. The employee responsible for the movement of trains, often shortened to dispatcher.

trainmaster. An employee in general charge of the operating personnel on duty.

train order. A directive governing the movement of trains issued by a train dispatcher or train director, often shortened to order.

two or more tracks. Main tracks on which a current of traffic has been set for each.

unit. The least number of wheels together with superstructure capable of independent movement.

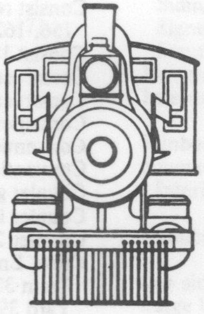
waybill. The document authorizing a shipment to be made; on a model anything which assigns a destination to a car.

work extra. A train, not authorized by timetable, which is permitted to move in either direction between the limits specified in the order which created the work extra.

yard. An assembly of tracks for the purpose of switching, servicing, storing, loading, or unloading cars.

yardmaster. The employees responsible for operations with yard limits and for the making up and breaking up of trains.

yard limits. Limits within which switching movements may be made without train order. Trains other than 1st class (2nd on some roads) must proceed within yard limits expecting to meet a switching movement.



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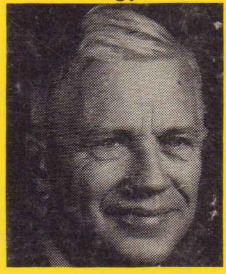

Paul Mallery is an engineer with Bell Telephone, and a dedicated model railroad buff. He is the author of several other books on the subject. His book is highly readable, thorough, and reliable—a must for all who operate model railroads.

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