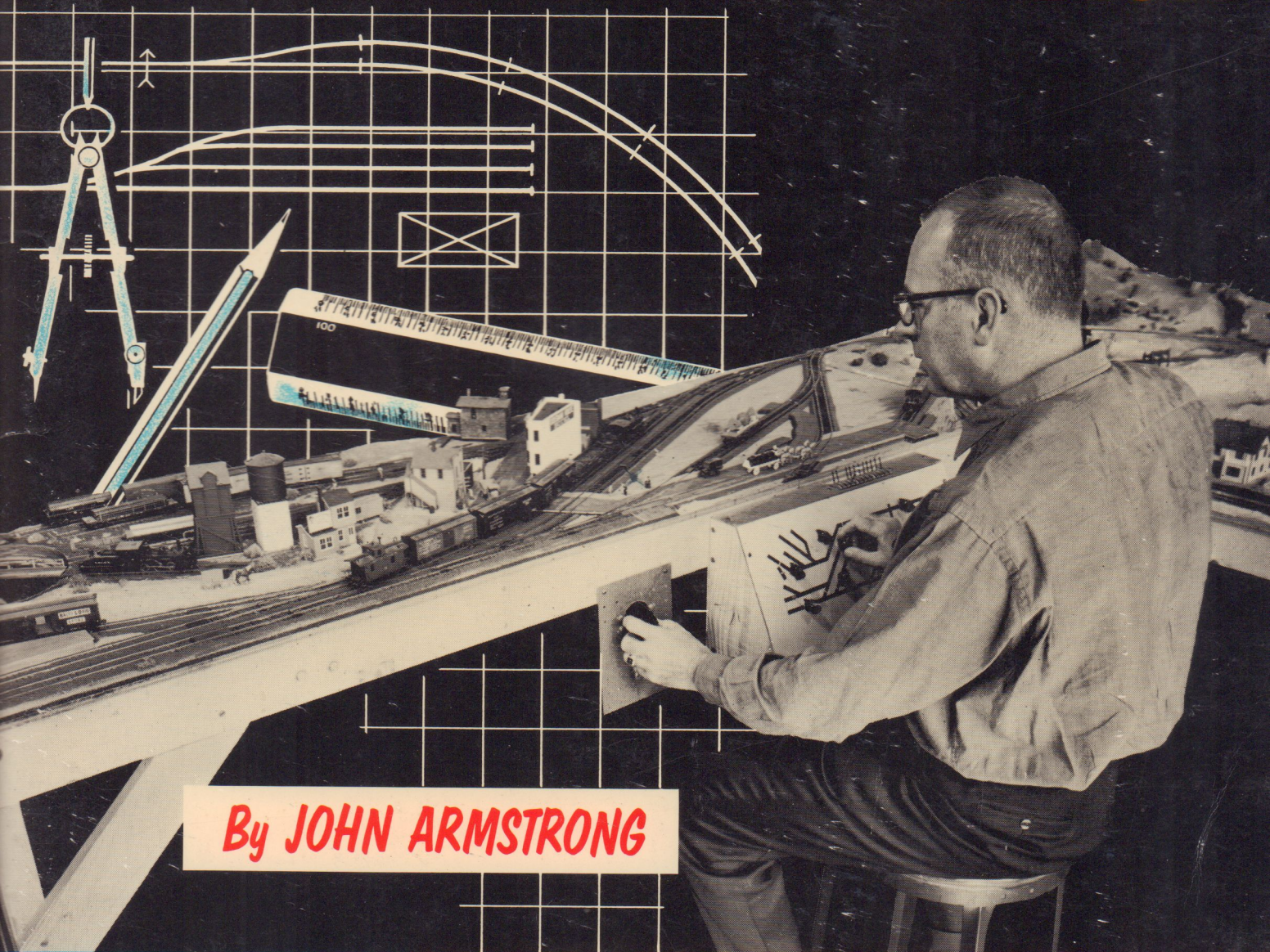


TRACK PLANNING

for REALISTIC OPERATION



By JOHN ARMSTRONG

**What the
prototype does**

**What the
modeler can do**

**How to make
it practical**

Track Planning for Realistic Operation

For the first time, this book brings together the techniques and information you need to design your model railroad for the best in *continuing* operating enjoyment. Author John Armstrong is considerate of your resources of time, space, and money, whether they are strictly limited or relatively boundless.

Prototype railroad practice in moving freight and passengers efficiently is discussed as interesting (and essential) background for selecting operations and track arrangements you will want to represent on your own line. In later chapters you translate these desires into practical curvature and grade standards for your gauge and into the various possible arrangements suitable for your space. The "by the squares" method developed by Armstrong makes it easy to find and put on paper the best possible mainline arrangement.

Handy tables and charts present the fundamental trackwork relationships which are the basis of easy and accurate track plan design; a step-by-step example shows how they fit into the evolution of a typical walk-in layout plan. Modifications to eight track plans show how applying the principles of full-size railroad operation can enhance the fun of running trains on even the smallest of pikes. Nine other diagrams illustrate classic layout schemes that have proved superior in a variety of common situations.

If you are planning an N scale railroad

This book was written before N scale gained the popularity it enjoys today. For that reason it is not included in many of the graphs and tables in Section 2 of this book. However, very workable N scale dimensions can be arrived at simply by dividing the HO dimensions by 2. Widths of some aisles should be doubled.

TRACK PLANNING for REALISTIC OPERATION

by John Armstrong

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John Armstrong

John Armstrong has been designing track plans for publication in *MODEL RAILROADER* magazine and in other books for the past dozen years—track plans aimed at cramming the most in railroadlike operation into whatever space may be available. His more radical innovations for crowding in the trackage ("reverted" loops, multi-level stackups, double-faced backdrops, and the like) were worked out at first on paper. To his intense relief, these ideas proved practical when he tested them on the O gauge layout (his fourth) which has been taking shape in his Silver Spring (Md.) basement over a similar period of time.

Although he is blessed with an exceptionally understanding wife, he is still somewhat unique in living in a house with two basements, each with its own stairway. The unbroken wall between them maintains peace in the family by impartially keeping the four children out of the railroad and keeping the tracks from invading the family area.

A Navy mechanical engineer by profession, he is not above including a flock of relays in his walkaround cab control system but he clings to outside third rail and battery lighting because of an abiding distrust of electronics (at least during hours of pleasure).

introduction

Model railroads are fun to build and fun to look at, but most of all, fun to operate. For real satisfaction you need the two big "R's"—realism and reliability: realism because it's the fascination and operating variety of the real railroad that you're trying to capture in miniature, and reliability because putting the train back on the track every few minutes is no pleasure (and anything but realistic).

Both realism and reliability depend on the skill and care with which you build, adjust and maintain your track and rolling stock. Improvements in kits, parts and materials available for model railroading have greatly eased and speeded the process of acquiring rugged, reliable and realistic trackage and equipment. The purpose of this book is to discuss those characteristics of the track plan itself which permit you to get the most in continuing operating pleasure out of the hobby in any given available space and within the limits of time and money that can be devoted to your pike.

No matter how well it's constructed and how excellent its rolling stock, the track plan that does not provide for interesting operation misses its mark—so let's look into the process (which can be fun in its own right) of laying out trackage for the greatest railroading satisfaction, from start to finish.

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Section 1: Prototype operation

A big part of the fascination of model railroading comes from the sheer variety of operations to be represented in miniature. You have mainline running of through and local freight and passenger trains, yard and industry switching, engine terminal maneuvering, helper service on steep grades, branch lines, consolidation and splitting of trains at junction points, commuter traffic, and so on — a repertory of movements so varied that there's no need to run out of new things to do on the well-designed layout. How much pleasure you can build into your pike is largely a question of just how efficiently you can arrange a given amount of track so as to accommodate, with satisfactory realism, the types of operation in which you are most interested.

The real railroads which serve as our prototype

don't, of course, run trains just for the fun of seeing the wheels go 'round. Their object is to move a variety of traffic as speedily and efficiently as possible. However, in the effort to make a little net profit, American railroads do have about the same problems in laying out their trackage as we modelers do. Construction and maintenance costs, to say nothing of taxes, compel the railroads to use a minimum of real estate and trackwork. So, apart from the fact that the best way to make a realistic model of anything is to understand how the real thing works, a good way to get ideas for a track plan is from study of the track elements and the arrangements railroads use to do their job. That's the way we will start looking into this business of designing layouts for the best in operation.

1

Getting goods and people aboard

All railroad operations rest basically on providing transportation for freight and passengers in trains of individual cars. The first essential is a place where cars can be loaded, and any complete model must reflect this to some degree. In the case of freight traffic, this is one of the things we can do most realistically. It isn't often possible to have running room for 60-car trains on a model pike, but most of the cars in prototype mainline consists originated at industry tracks where they were picked up one or a few at a time. We can readily duplicate this operation. Let's see what track arrangements are required for this grass-roots railroading.

Pickups and setouts

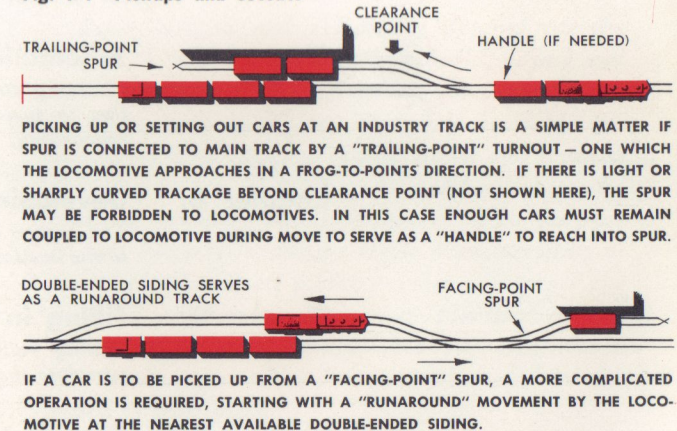
Picking up a car or two simply involves a turnout leading from the main line to the spur track and is a straightforward process if the spur faces the "right" way, as shown at the top of Fig. 1-1. Auxiliary provisions (a "runaround" track) are needed somewhere near any facing-point spurs. Sometimes a runaround is avoided by an interesting maneuver known as a *flying switch* (also known as a drop, Dutch drop, Chinese switch, and doubtless other names on various roads). This isn't really practical in the model unless you cheat a little — by using a flywheel-equipped car, or by having carefully tailored grades at the particular location — but it's worth considering as a novel point of interest. See Fig. 1-2.

In locating your spur track, the important thing in each case is to provide some reasonably easy (but not always too easy) way for getting at the right end of the car for switching it. Often, a good compromise is to have all the spurs in a given area, except one, face in the same direction. This means that most of the pickups and setouts can be accomplished quickly but that on occasion there must be a runaround movement. This provides variety and

greatly increases the interest of switching maneuvers.

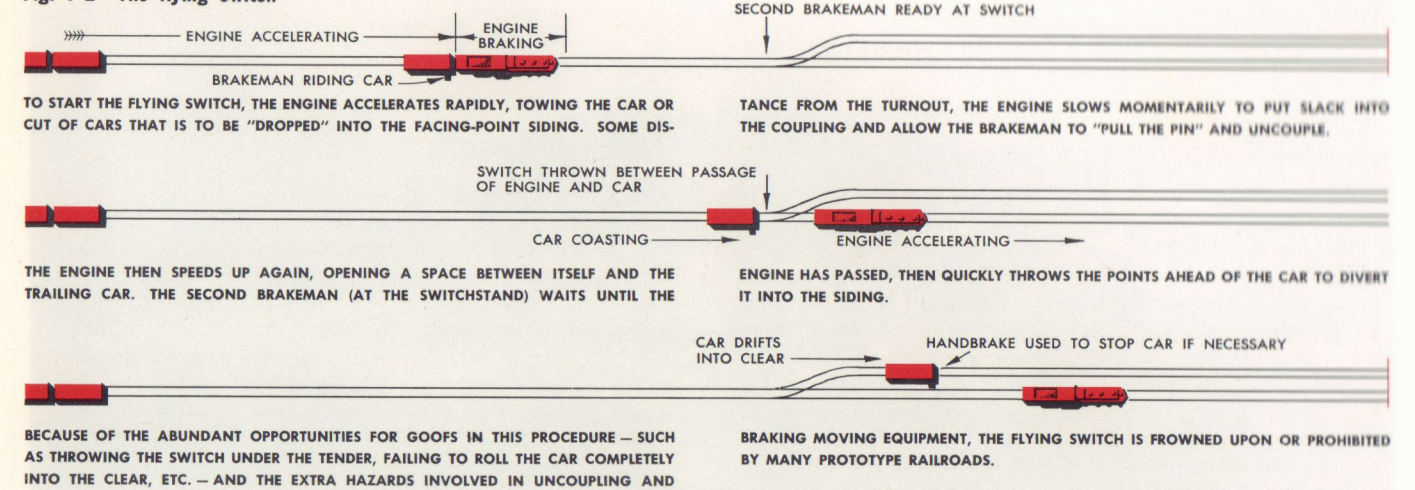
Freight cars are loaded and unloaded on three principal classes of tracks: industry, freight station, and team. Industry tracks are spurs located at the edge of or completely off the railroad's right of way. They serve industrial operations of all types — mines, refineries, factories, retail dealers in coal, lumber or feed, grain ele-

Fig. 1-1 Pickups and setouts



AFTER COUPLING TO THE REAR OF ITS TRAIN THE ENGINE SWITCHES THE SPUR IN NORMAL FASHION. A SECOND RUNAROUND MANEUVER GETS THE TRAIN BACK IN PROPER ORDER. (SOME RAILROADS OR CREWS WILL CUT OFF THE CABOOSE BEFORE MAKING THE RUNAROUND, THUS LEAVING IT OUT OF THE PULLING AND HAULING INVOLVED AND REDUCING THE RISK OF KNOCKING OVER THE STOVE. WEAK WOOD-FRAME CABOOSES MAY NOT WITHSTAND THE TORMENT OF CAR-PUSHING; CONDUCTOR MAY OBJECT TO JOSTLING.)

Fig. 1-2 The flying switch



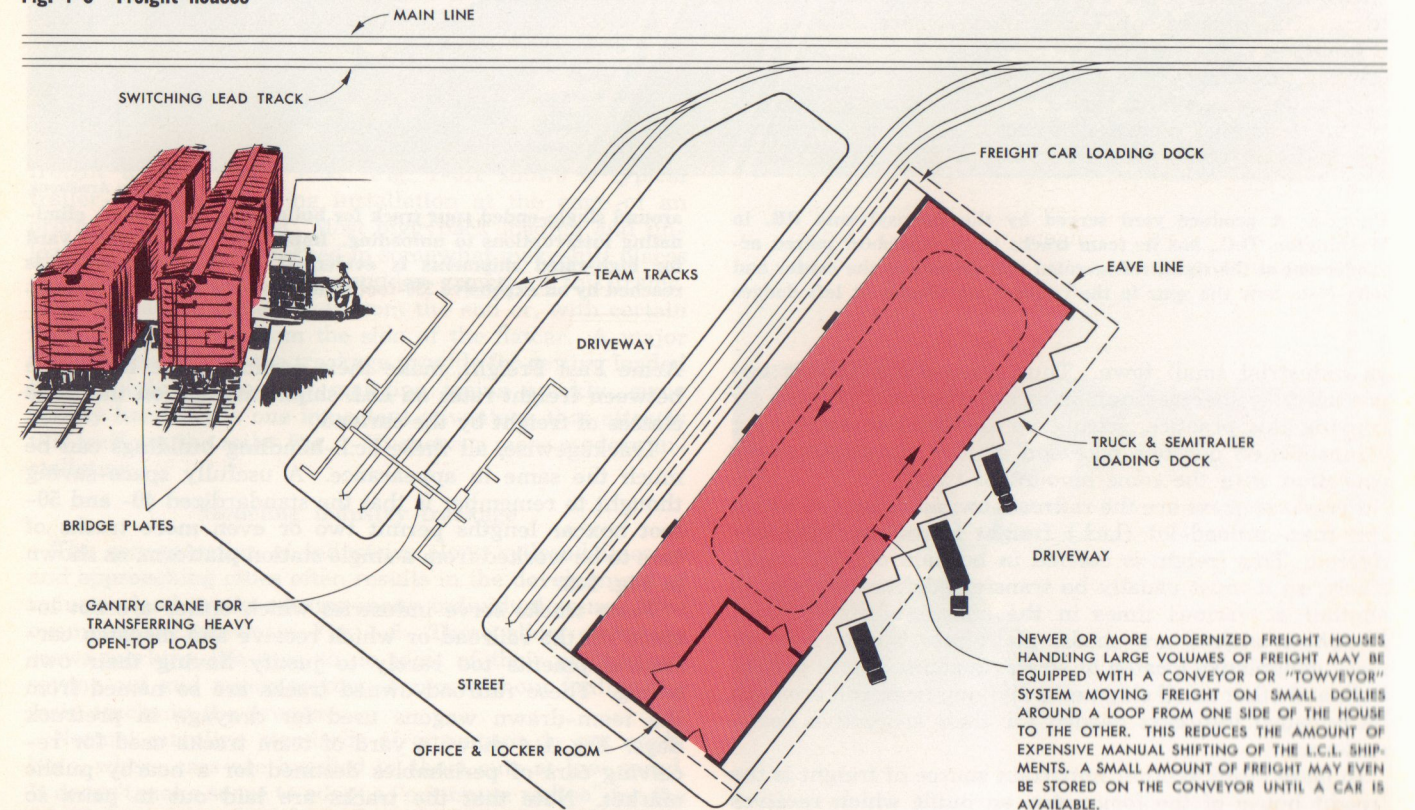
vators, and so on. These tracks are usually installed by railroad track gangs, but primarily at industry expense. Traffic to and from industry tracks is in carload lots, though a car may occasionally "break bulk" somewhere en route, with portions of its load being reloaded in a separate car to reach two different destinations.

The railroad will spot cars directly at the proper loading door in small installations; large industries, such as steel mills, which handle dozens or hundreds of cars a day, will usually have the cars moved about frequently because loading or unloading goes on constantly. These companies will usually have their own switching locomotives to avoid the switching charges which railroads otherwise must make in accordance with published tariffs.

An industry spur serving a big but isolated source of

minerals, lumber, or other heavy freight may be as long as 50 miles or so, dwarfing many shortline railroads. If privately owned, such a spur line is not necessarily registered as a common carrier. If it were, the owners would have the duty of handling freight for all comers. On the other hand, it's sometimes better business for such industries to operate a long spur or a network of trackage as a common carrier because a shortline railroad originating or terminating tonnage then gets a healthy cut of the rate charged for its part in handling the interline shipments. Remnants of otherwise defunct interurban lines may be found carrying coal to power plants as common carriers for a reason like this. Likewise, you'll find moderately short lines doing well as a bridge between two larger mainline routes or between a main line and

Fig. 1-3 Freight houses



THE ESSENTIAL FEATURE OF A FREIGHT HOUSE OR FREIGHT STATION IS A PLATFORM WITH PROVISIONS FOR PARKING FREIGHT CARS ON ONE SIDE, TRUCKS ON THE OTHER. PREFERABLY IT HAS SOME KIND OF ROOF. IN CONGESTED AREAS THERE MAY BE TWO OR THREE

PARALLEL, CLOSELY SPACED TRACKS ALONGSIDE SO THAT MORE THAN ONE ROW OF CARS CAN BE "WORKED" AT A TIME, VIA "BRIDGE PLATES" PLACED BETWEEN OPPOSITE DOORWAYS.

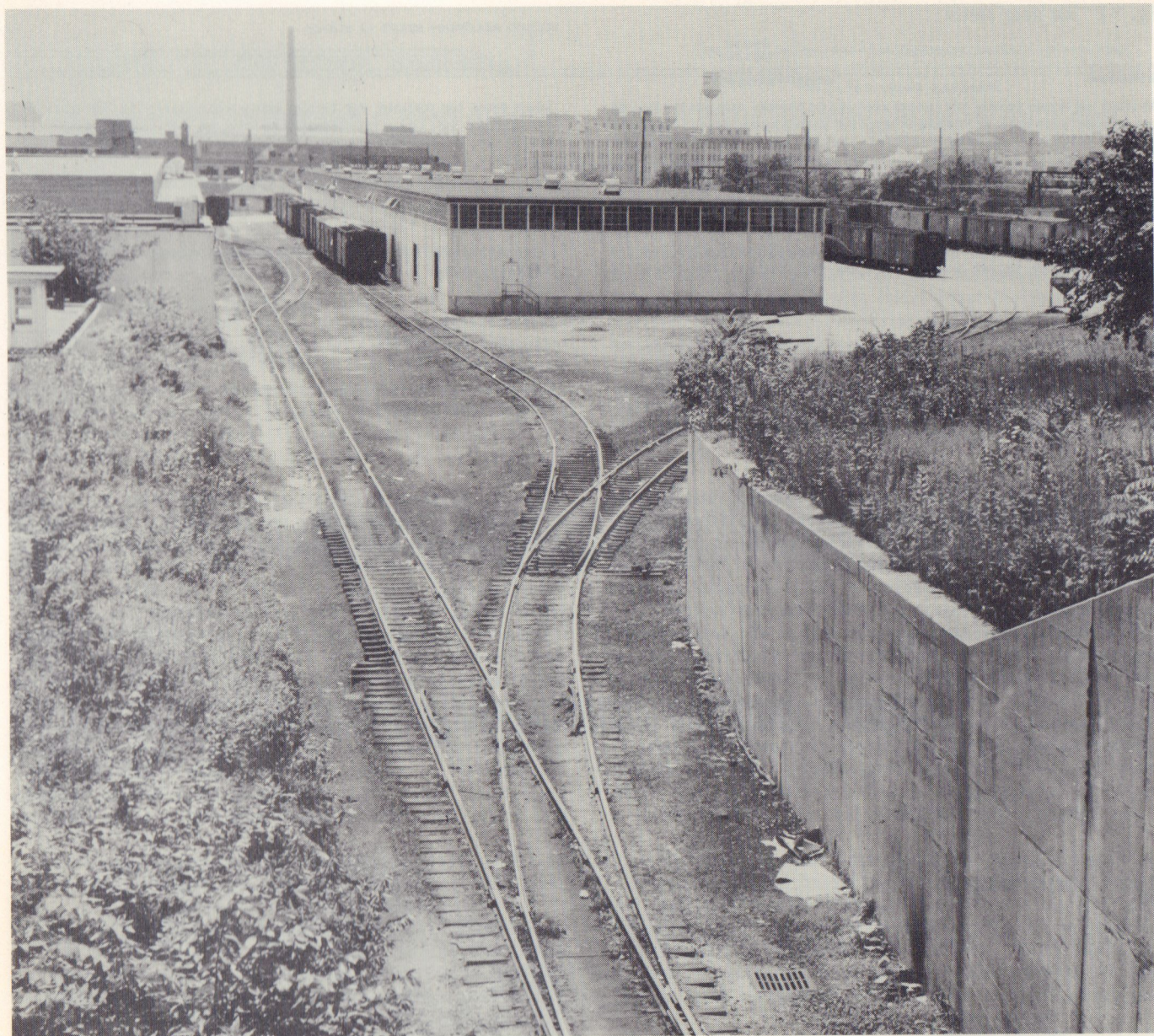


Fig. 1-4. A produce yard served by the Pennsylvania RR. in Washington, D.C., has its team tracks in the standard paired arrangement at the right, refrigerated warehouses at the center and left. Note how the spur to the farthest warehouse at left dodges

an industrial small town. Thus, we have a golden opportunity to increase our stature as railroad tycoons by copying this practice, setting up several interconnecting companies on our one pike and getting more interesting operation with the same amount of track.

Freight stations are the railroad-owned depots at which less-than-carload-lot (l.c.l.) freight is received and delivered. This freight is carried in boxcars almost exclusively, so it must usually be transferred from one car to another at various times in the course of its journey. *Freight transfers* are sheds, platforms, warehouses, or mere gangplanks located at strategic points where break-bulk and other small shipments arriving from one area can be reloaded into cars headed for their respective destinations.

In large cities another important source of freight is the freight house of the *forwarder*, an outfit which receives l.c.l. shipments from shippers and loads them into cars which are then handled by the railroads as carload shipments. These companies, such as Western Carloading and

around single-ended spur track for building in foreground, eliminating interruptions to unloading. Importance of this small yard for high-rated shipments is evidenced by the fact that it is reached by an expensive 350-foot tunnel serving no other trackage.

Acme Fast Freight, make their profits on the difference between freight rates on l.c.l. shipments and on the same classes of freight by the carload.

Trackagewise, all these l.c.l.-handling buildings can be much the same in appearance. A usefully space-saving thought to remember is that the standardized 40- and 50-foot boxcar lengths permit two or even more tracks of cars to be worked from a single station platform, as shown in Fig. 1-3.

Team tracks serve industries which either are not located on the railroad or which receive and dispatch carload shipments too rarely to justify having their own siding. These railroad-owned tracks are so named from the team-drawn wagons used for drayage in pretruck days. Fig. 1-4 shows a yard of team tracks used for receiving cars of perishables destined for a nearby public market. Note that the tracks are laid out in pairs so that one door of each car is accessible to trucks backing in from the wide driveways between tracks. A single spur alongside a road can serve the same purpose in prin-



Fig. 1-5A. A typical piggyback loading and unloading facility may consist of a single ramp by means of which semitrailers are backed onto a block of flatcars (loading) and driven off forward

(unloading). Every piggyback flatcar has a bridge plate at the left side of each end (as you stand looking off the end) so that they mate much like sections of model railroad track.

ciple, and is more suitable a way to provide team-track service in most model situations where the driveways would represent mostly lost space for our purposes.

Piggyback loading areas became a major source of freight traffic around 1960. Fig. 1-5A shows a typical trailer-on-flatcar loading installation at the edge of an ordinary railroad yard. Most piggyback loading and unloading is still accomplished in somewhat makeshift places such as this because of the sudden growth of this traffic. Loading can be done either from the end or, with certain special equipment, from the side of the flatcar. A major requirement is that the trackage provide for getting loaded flatcars into and out of mainline trains quickly, since speedy handling is one important advantage that attracts this traffic to the rails. Fig. 1-5B shows a more modern installation.

Modeling industry trackage

The concentration of industries along railroad lines in and approaching cities often results in the development of industry lead tracks serving many individual spurs. Two examples are shown in Fig. 1-6. These allow switching crews working the area to do most of their picking up, setting out and minor sorting of cars without fouling the main tracks in the process.

Normal mainline standards of curvature do not apply here, where cars are handled in short cuts at low speed. It doesn't make sense to adopt a "minimum radius" for the whole layout. A boxcar and a switcher can get around curves you wouldn't think of for the main line. You should take full advantage of this on your layout to crowd more



Fig. 1-5B. PRR's "TrucTrain" tracks have lighted walks between them to facilitate loading at night, when most loading is done.

fun into a small space. As Fig. 1-6 shows, even with tight curves some tricky trackwork may be needed to get a spur into a particular factory at an acceptable angle.

A good deal of trackage may be located inside buildings, giving you another chance to double up on the use of your space and have both extensive industrial buildings and ample car capacity. The lead track should join the main with a trailing-point turnout, if possible. Facing-point turnouts on main tracks are usually avoided, both for safety and to speed up switching. As a rule, industry trackage beyond the mainline switch is lightly and cheaply constructed and indifferently maintained. However, to reach a good source of revenue traffic, a spur will be put in the right location even if it means crossing a river on an expensive bridge, locating the entire track on a trestle, constructing a special curved turnout, crossing several other tracks, or other expensive feats of engineering and trackwork.

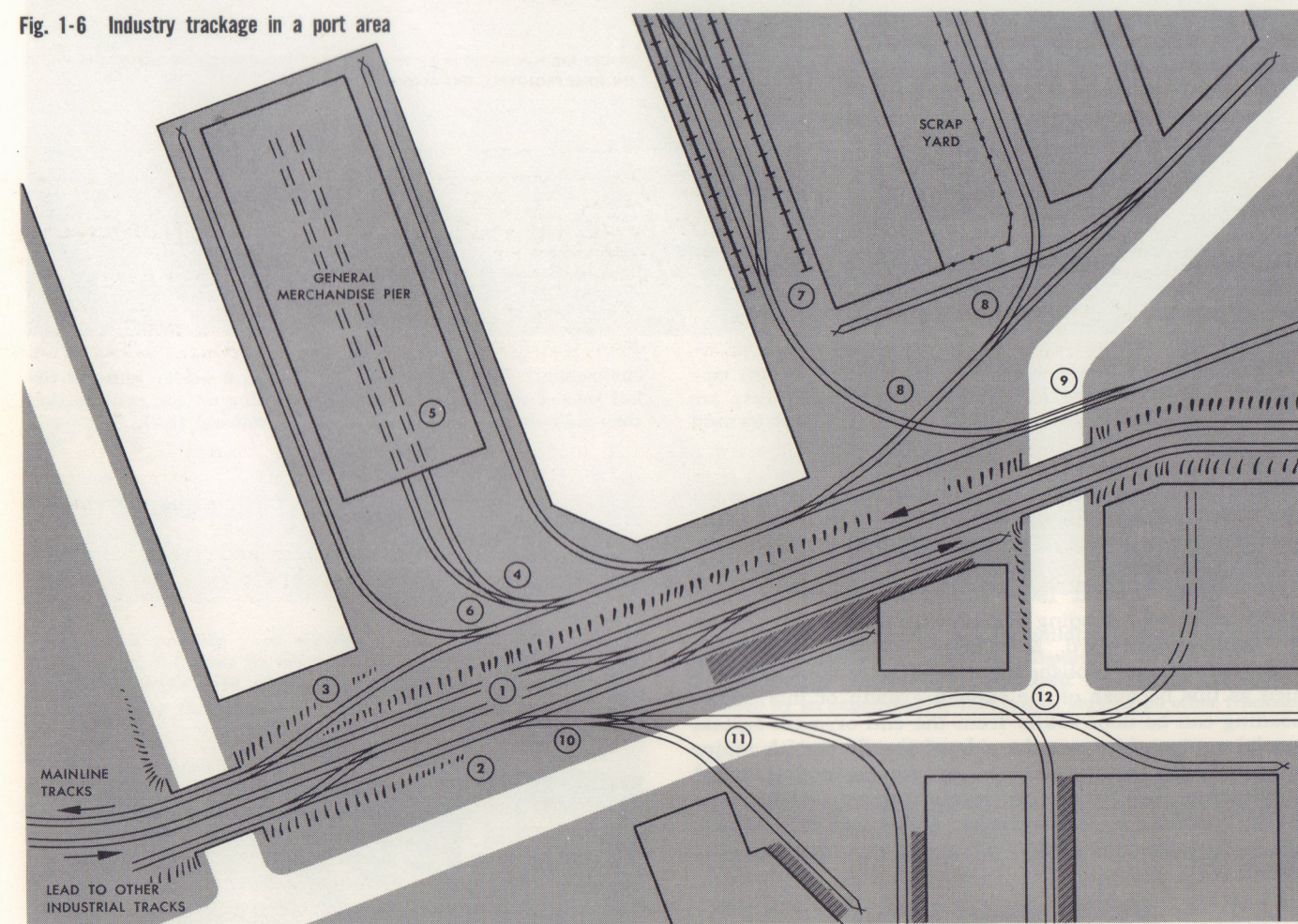
The trackage required to serve a medium-size industry generating 10 or 20 cars of freight a day, such as a mine

or quarry, is quite extensive—usually far too big to model in its entirety unless the whole model railroad is devoted to this one feature. As Fig. 1-7 illustrates, however, the essence of the larger-scale operation can be retained with fewer tracks by selectively pruning out the duplicated tracks. These are tracks that merely increase capacity. Even a single track can provide for the essential functions of empty car storage, loading, and loaded car storage, with a prototypical method for “intraplant switching” (Fig. 1-8) to make our minimum-size heavy industry self-sufficient.

Interchange tracks

It would take more industry trackage alone than the total footage of the average model railroad, main line and all, to generate a traffic of 100 cars a day. This level of business still would not go far toward providing enough trains to meet the needs of an evening's mainline operation, even with our typical bobtailed drags of 12 to 15 cars. Fortunately, any given section of prototype rail-

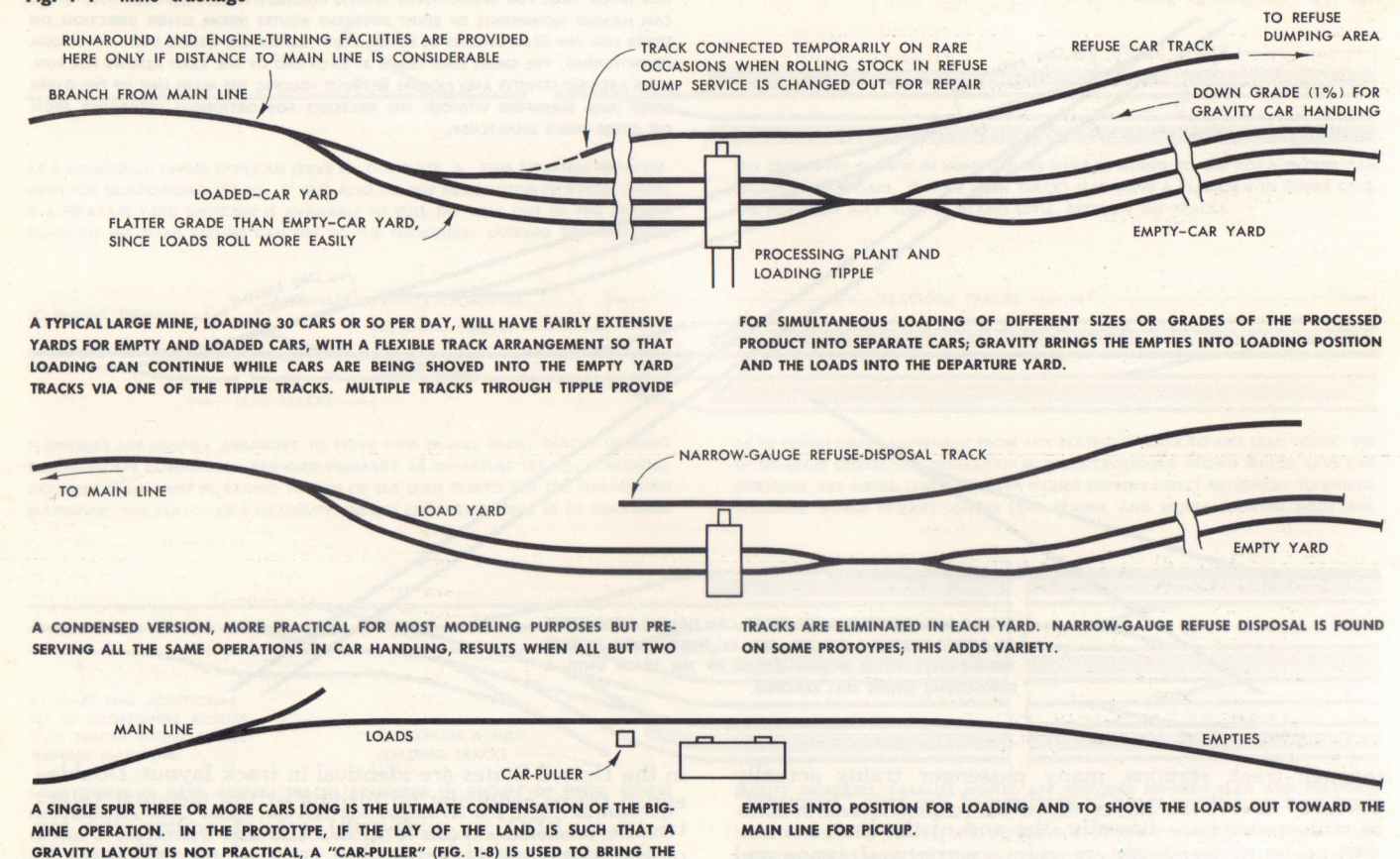
Fig. 1-6 Industry trackage in a port area



1. TRAILING-POINT CROSSOVER BETWEEN MAIN TRACKS LETS SWITCH CREW WORK BOTH SIDES OF THE MAIN LINE. TURNOUTS IN MAIN TRACKS ARE KEPT TO A MINIMUM.
2. SWITCHING LEAD TRACK PARALLEL TO MAIN LINE ALLOWS SETOUTS AND PICKUPS FROM MANY SIDINGS WITHOUT FOULING MAIN LINE; TWO TRAILING-POINT CROSSOVER CONNECTIONS WITH MAIN LINE FORM A RUNAROUND TRACK SO SPURS IN BOTH DIRECTIONS CAN BE HANDLED.
3. LEAD TRACKS CAN BE ON AN EXTREMELY STEEP GRADE, SINCE ONLY SHORT CUTS OF CARS NEED BE HAULED UP THEM.
4. EXTREMELY SHARP CURVATURE CAN BE USED TO GET TRACK INTO THE MOST USEFUL POSITION FOR LOADING AND UNLOADING FREIGHT, AS ON THIS PIERSIDE SPUR. IF NECESSARY, LONG CARS WILL BE PULLED AROUND THE CURVE WITH A CHAIN TO AVOID EXCESSIVE COUPLER SWING.
5. TRACKS INSIDE GENERAL-PURPOSE PIER SHED ARE USUALLY IN PAIRS, SIMILAR TO TEAM-TRACK ARRANGEMENTS IN THE OPEN.
6. CURVED TURNOUTS ARE USED WHEREVER NECESSARY.

7. DOUBLE TRACK ALONG THIS PIER, WITH CROSSOVERS, ALLOWS CARS BEING LOADED BY SHIP'S DERRICK TO REMAIN UNDISTURBED WHILE THOSE AT OTHER POSITIONS ARE BEING SPOTTED OR REMOVED. CRANE ON PIER CAN BE USED TO SHIFT CARS WHEN LOCOMOTIVE IS NOT AROUND. ITS PRINCIPAL DUTY IS TO ASSIST IN LOADING AND UNLOADING CARS.
8. SPURS FREQUENTLY CROSS EACH OTHER AS NECESSARY TO SERVE ADJACENT INDUSTRIES.
9. "GANTLET TURNOUT" IS OFTEN USED WHERE A NORMAL TURNOUT WOULD HAVE ITS POINTS WITHIN A STREET OR HIGHWAY.
10. LAP (THREE-WAY) SWITCHES ARE USED UNHESITATINGLY IF NEEDED TO GET TRACKS INTO LINE WITH LOADING PLATFORMS AT TWO DIFFERENT PLANTS.
11. TURNOUTS ON TRackage IN STREET ARE USUALLY OF THE SINGLE-POINT (STREETCAR) TYPE, WITH A SWITCHSTAND UNDER AN ACCESS PLATE IN THE ROADWAY.
12. IN EXTREMELY CLOSE QUARTERS, TRACK MAY HAVE TO HEAD TO THE LEFT TO GO TO THE RIGHT, EVEN USING MINIMUM POSSIBLE RADIUS.

Fig. 1-7 Mine trackage



road gets most of its traffic from connections, either from other divisions of the same company or from other railroads. For realism and convenience we will therefore tap these sources to provide most of our model freight traffic.

An interchange movement may run the gamut from a single car shoved into a connecting track by one line and picked up later by another to a through-service arrangement in which a 175-car train, complete with pooled motive power and crew, roars nonstop past a post marking the line between one road's trackage and the other's. Between these extremes there is ample opportunity to pick suitable arrangements which will not only justify your traffic level, but also furnish interesting operation. Fig. 1-9 shows some simple interchange yard layouts.

Passenger stations

Unlike freight, passengers are essentially self-loading. At many points, all that is necessary is to stop the train on the main line for a minute or so and to provide a platform from which passengers can clamber aboard. At major through stations, loading “head-end traffic”* (baggage, mail, and express) will take quite a while. Some trains may also terminate their runs here. Platform-equipped sidings off the mainline tracks then are necessary to keep the through lines from getting clogged.

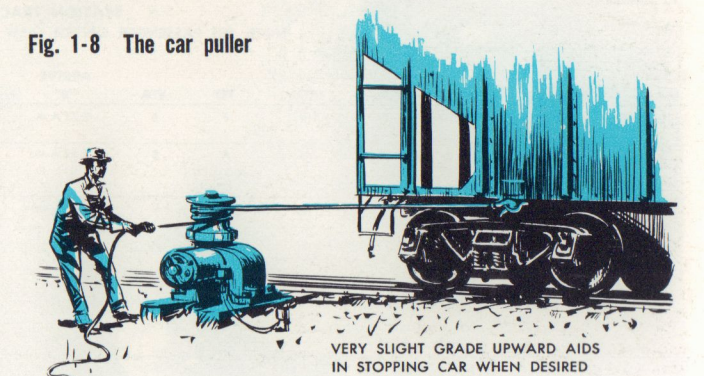
Passenger trains also receive “carloads” of passengers and head-end traffic by the interchange and pickup process during the course of their runs. A typical medium-size passenger station with trackage for such switching is shown in Fig. 1-10. As the notes on a day's consist-changes show, this is an extremely fruitful, though

*So called because of the customary location of baggage, mail, and express cars right behind the locomotive in the passenger train. Cars for this traffic are also referred to as “head-end equipment.” Where switching is made easier by locating such cars on the rear of the train and there is no observation car to be concerned about, they may be hauled behind the passenger-carrying part of the train.

often neglected, source of operating interest. Even with the rather simple trackage available at this point, only five trains a day each way and no single-ended cars to worry about turning, the switchers are very busy. Add such niceties as a baggage-smoker combine on Nos. 51 and 52 (to be turned at E and to run between there and F) and an occasional extra coach or sleeper movement, and the variety is endless.

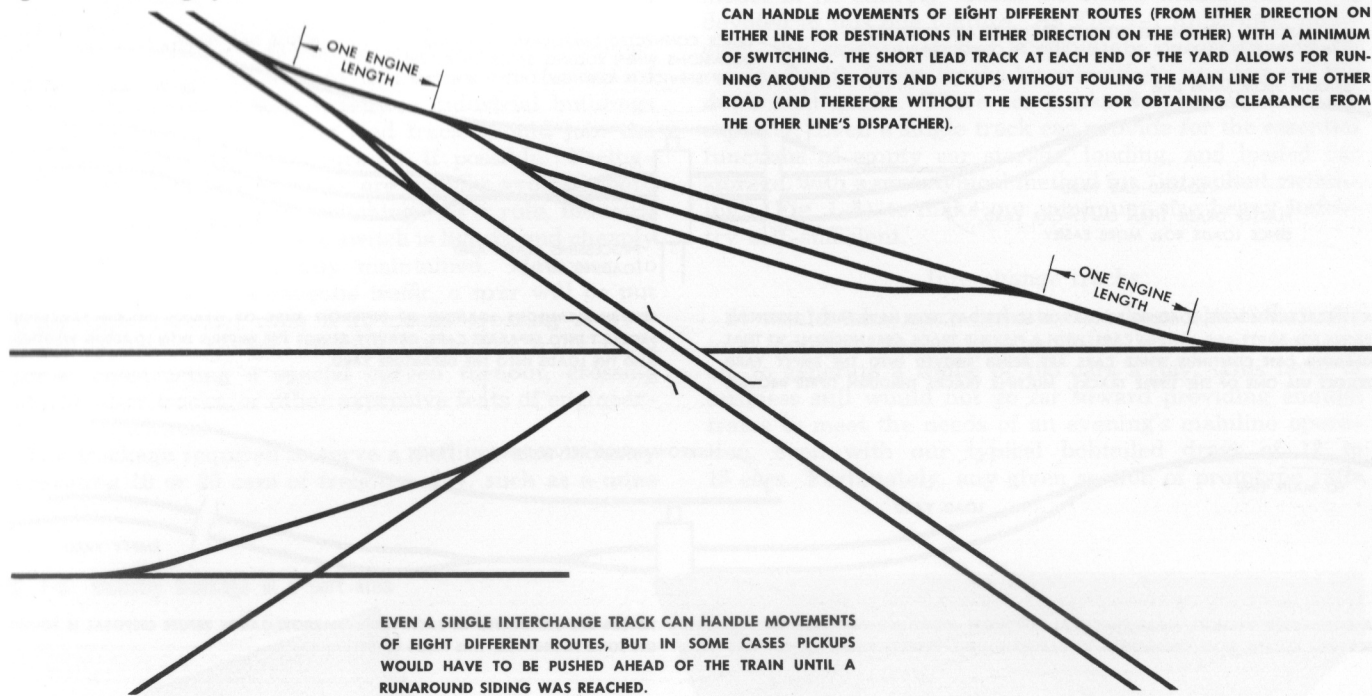
Stub terminals. Most passenger and much head-end traffic is carried in cars which shuttle back and forth on the same trains day after day. Freight cars, on the other hand, are generally drawn from a pool of similar equipment and sent to different loading points as required for individual shipments. Although modern theory prefers

Fig. 1-8 The car puller



AN ECONOMICAL WAY OF SPOTTING CARS FOR LOADING OR UNLOADING WITHOUT A LOCOMOTIVE IS TO USE A “CAR-PULLER,” A MOTOR-DRIVEN SPOOL USED LIKE A SHIP'S CAPSTAN TO PULL A CABLE HOOKED TO THE “ROPING STAPLE” FOUND NEAR EACH CORNER OF MOST HOPPER AND GONDOLA CARS. WITH THE CABLE WRAPPED AROUND THE CAPSTAN A FEW TURNS, PULLING THE FREE END TAUT DEVELOPS ENOUGH FRICTION FOR THE TURNING OF THE SPOOL TO PULL ONE OR MORE CARS AT A SLOW PACE. IF THE YARD MAN STOPS PULLING, THE ROPE WILL SLACKEN; THUS, THE CAR-PULLER CAN BE TURNING CONSTANTLY. CONTROL OF CAR IS ENTIRELY BY ROPE TENSION.

Fig. 1-9 Interchange yard

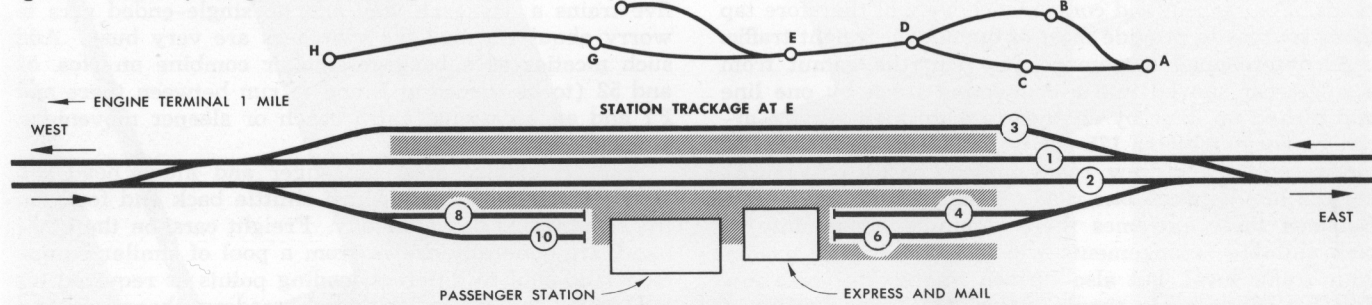


THIS SMALL YARD FOR INTERCHANGE TRAFFIC BETWEEN TWO RAILROADS THAT CROSS CAN HANDLE MOVEMENTS OF EIGHT DIFFERENT ROUTES (FROM EITHER DIRECTION ON EITHER LINE FOR DESTINATIONS IN EITHER DIRECTION ON THE OTHER) WITH A MINIMUM OF SWITCHING. THE SHORT LEAD TRACK AT EACH END OF THE YARD ALLOWS FOR RUNNING AROUND SETOUTS AND PICKUPS WITHOUT FOULING THE MAIN LINE OF THE OTHER ROAD (AND THEREFORE WITHOUT THE NECESSITY FOR OBTAINING CLEARANCE FROM THE OTHER LINE'S DISPATCHER).

through-track stations, many passenger trains actually start and end their runs in stations of the true "terminal" or stub-end type—literally, the end of the line. These stub terminals come in a variety of types and sizes. In fact, it is probably true that no two stub terminals

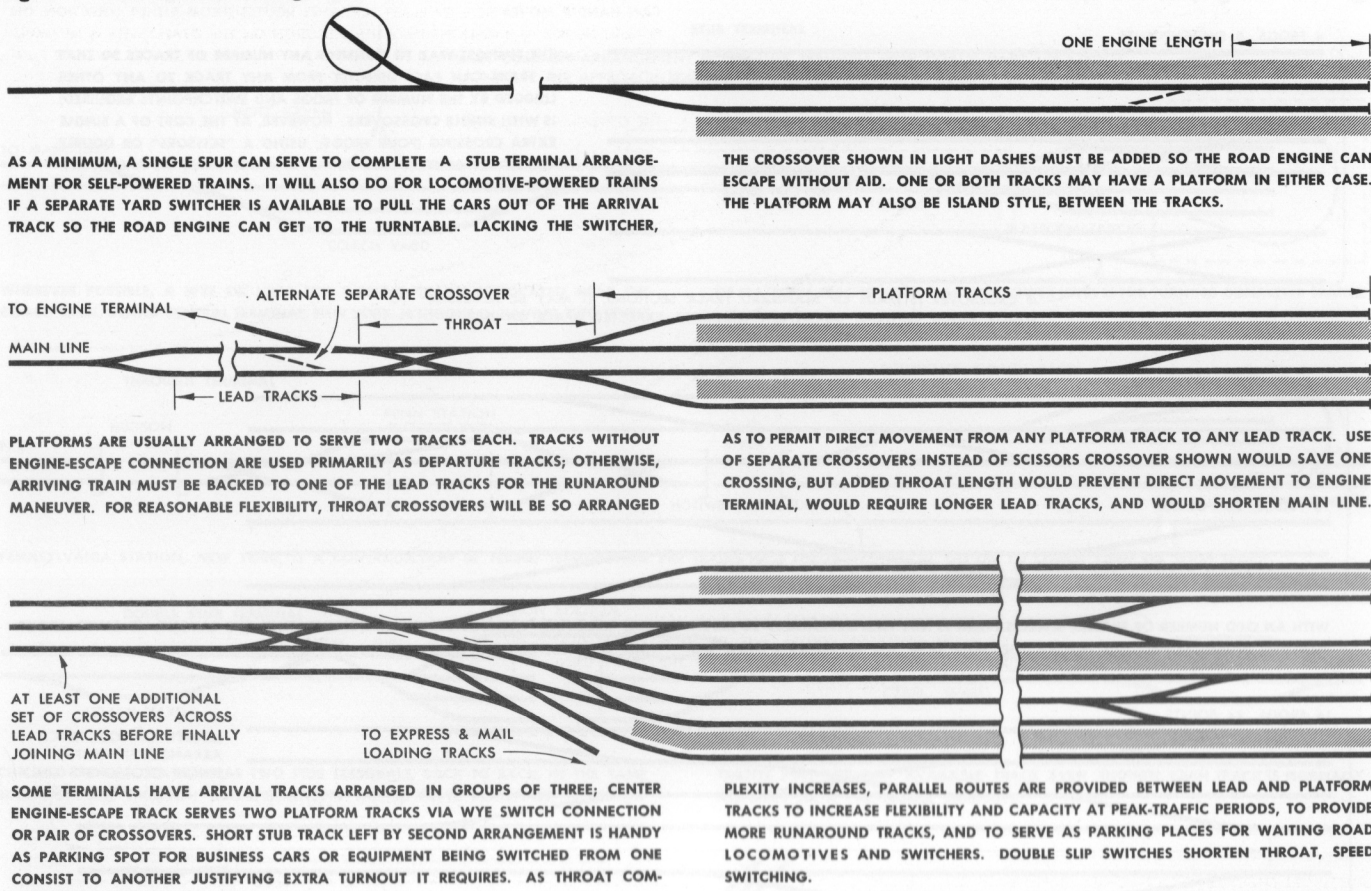
in the United States are identical in track layout. Double-ended trains requiring no turning at the terminal (electric m.u., RDC, or push-pull) are, of course, the joy of the stationmaster's life, but most of us will want to increase the operating opportunities per square foot of

Fig. 1-10 On-line passenger train switching



TRAIN NO.	DIRECTION	DESIGNATION	FROM	TO	VIA	ARRIVE "E"	LEAVE "E"	SWITCHING OPERATIONS AT "E"
						"E"	"E"	
41	WEST	"F" NIGHT EXP.	A	F	B	2:25 A.M.	2:40	ROAD ENGINE PICK UP EXPRESS AND STORAGE MAIL CARS FOR "F" FROM TRACK 8; SET OUT EXPRESS CAR FROM "A" ON 8.
26	EAST	NIGHT LIMITED	H	A	B	4:52 A.M.	5:15	ROAD ENGINE CUT OFF WHILE TRAIN REMAINS ON TRACK 2 AND HEAD-END TRAFFIC IS WORKED; RUN AROUND TRAIN VIA TRACK 1; PICK UP DINER FROM 3, SET ON REAR OF TRAIN. RETURN TO HEAD END VIA 1, SET OUT EXPRESS CAR FROM "H" ON TRACK 6.
27	WEST	"G" NIGHT EXP.	A	G	C	6:45 A.M.	6:59	ROAD ENGINE PICK UP DINER-LOUNGE FROM TRACK 3, PLACE IN TRAIN AHEAD OF COACHES & SLEEPER. (SLEEPER CONTINUES TO "G.")
102	EAST	LOCAL	E	A	B	—	7:30	ROAD ENGINE FROM TERMINAL VIA TRACK 2 PICKS UP EXPRESS CAR OFF NO. 26 FROM 6, R.P.O. FROM 4, AND MAKES UP TRAIN ON 3 BY PICKING UP COACH THERE.
52	EAST	DAY EXPRESS	F	E	—	9:38 A.M.	9:58	NO. 52 IN ON TRACK 2 WITH R.P.O., COACH, DINER-LOUNGE; SWITCHER PULLS DINER-LOUNGE, SETS OUT ON 8; PICKS UP PARLOR CAR FROM 10, SETS ON NO. 52'S THROUGH COACH ON 2, AND AWAITS ARRIVAL OF NO. 32 VIA CROSSOVER ONTO 1. SWITCHER PULLS REAR SLEEPERS OF NO. 32 THROUGH CROSSOVER TO 2, PICKS UP PARLOR AND COACH, AND SETS WHOLE CUT BACK ONTO NO. 32, WHICH LEAVES FOR "A" VIA EAST CROSSOVER.
32	EAST	DAY EXPRESS	G	A	C	9:44 A.M.	—	REVERSE OPERATIONS FROM THOSE CONSOLIDATING NOS. 52 AND 32; SWITCHER SETS PARLOR CAR ON 10 AFTER NO. 31 HAS CLEARED (RUNAROUND MOVE NECESSARY), ENGINE FROM NO. 52 MAY HAUL NO. 51.
31	WEST	DAY EXPRESS	A	G	C	2:46 P.M.	3:02	NO. 28 DROPS SLEEPER DEADHEADED FROM "G." SWITCHER PARKS THIS SLEEPER ON TRACK 8, READY FOR OCCUPANCY AT 10 P.M.
51	WEST	DAY EXPRESS	E	F	—	—	3:06	TERMINATES. SWITCHER PLACES DEADHEAD DINER-LOUNGE FROM "D" OFF NO. 28 ON TRACK 8, COACH ON 3, R.P.O. ON 6, HEAD-END ON 3.
28	EAST	EVENING EXP.	G	A	C	5:45 P.M.	5:48	ROAD ENGINE CUTS OFF. SWITCHER SETS HEAD-END CARS OFF NO. 101 ONTO NO. 25, RUNS AROUND VIA TRACK 2, SETS OUT DINER ON 2. AFTER DEPARTURE OF NO. 25, SETS DINER ON TRACK 8, TAKES DINER AND DINER-LOUNGE FROM 8, SETS OUT AT WEST END OF TRACK 3.
101	WEST	LOCAL	A	E	B	10:15 P.M.	—	SWITCHER SETS SLEEPER FROM 8 ON REAR; PICKS UP HEAD-END CAR FROM 4 AND SETS ON NO. 40.
25	WEST	NIGHT LIMITED	A	H	C	10:46 P.M.	11:05	—
40	EAST	NIGHT EXPRESS	F	A	C	11:40 P.M.	11:55	—

Fig. 1-11 Stub terminal trackage



PLATFORMS ARE USUALLY ARRANGED TO SERVE TWO TRACKS EACH. TRACKS WITHOUT ENGINE-ESCAPE CONNECTION ARE USED PRIMARILY AS DEPARTURE TRACKS; OTHERWISE, ARRIVING TRAIN MUST BE BACKED TO ONE OF THE LEAD TRACKS FOR THE RUNAROUND MANEUVER. FOR REASONABLE FLEXIBILITY, THROAT CROSSOVERS WILL BE SO ARRANGED

AS TO PERMIT DIRECT MOVEMENT FROM ANY PLATFORM TRACK TO ANY LEAD TRACK. USE OF SEPARATE CROSSOVERS INSTEAD OF SCISSORS CROSSOVER SHOWN WOULD SAVE ONE CROSSING, BUT ADDED THROAT LENGTH WOULD PREVENT DIRECT MOVEMENT TO ENGINE TERMINAL, WOULD REQUIRE LONGER LEAD TRACKS, AND WOULD SHORTEN MAIN LINE.

SOME TERMINALS HAVE ARRIVAL TRACKS ARRANGED IN GROUPS OF THREE; CENTER ENGINE-ESCAPE TRACK SERVES TWO PLATFORM TRACKS VIA WYE SWITCH CONNECTION OR PAIR OF CROSSOVERS. SHORT STUB TRACK LEFT BY SECOND ARRANGEMENT IS HANDY AS PARKING SPOT FOR BUSINESS CARS OR EQUIPMENT BEING SWITCHED FROM ONE CONSIST TO ANOTHER JUSTIFYING EXTRA TURNOUT IT REQUIRES. AS THROAT COM-

PLEXITY INCREASES, PARALLEL ROUTES ARE PROVIDED BETWEEN LEAD AND PLATFORM TRACKS TO INCREASE FLEXIBILITY AND CAPACITY AT PEAK-TRAFFIC PERIODS, TO PROVIDE MORE RUNAROUND TRACKS, AND TO SERVE AS PARKING PLACES FOR WAITING ROAD LOCOMOTIVES AND SWITCHERS. DOUBLE SLIP SWITCHES SHORTEN THROAT, SPEED SWITCHING.

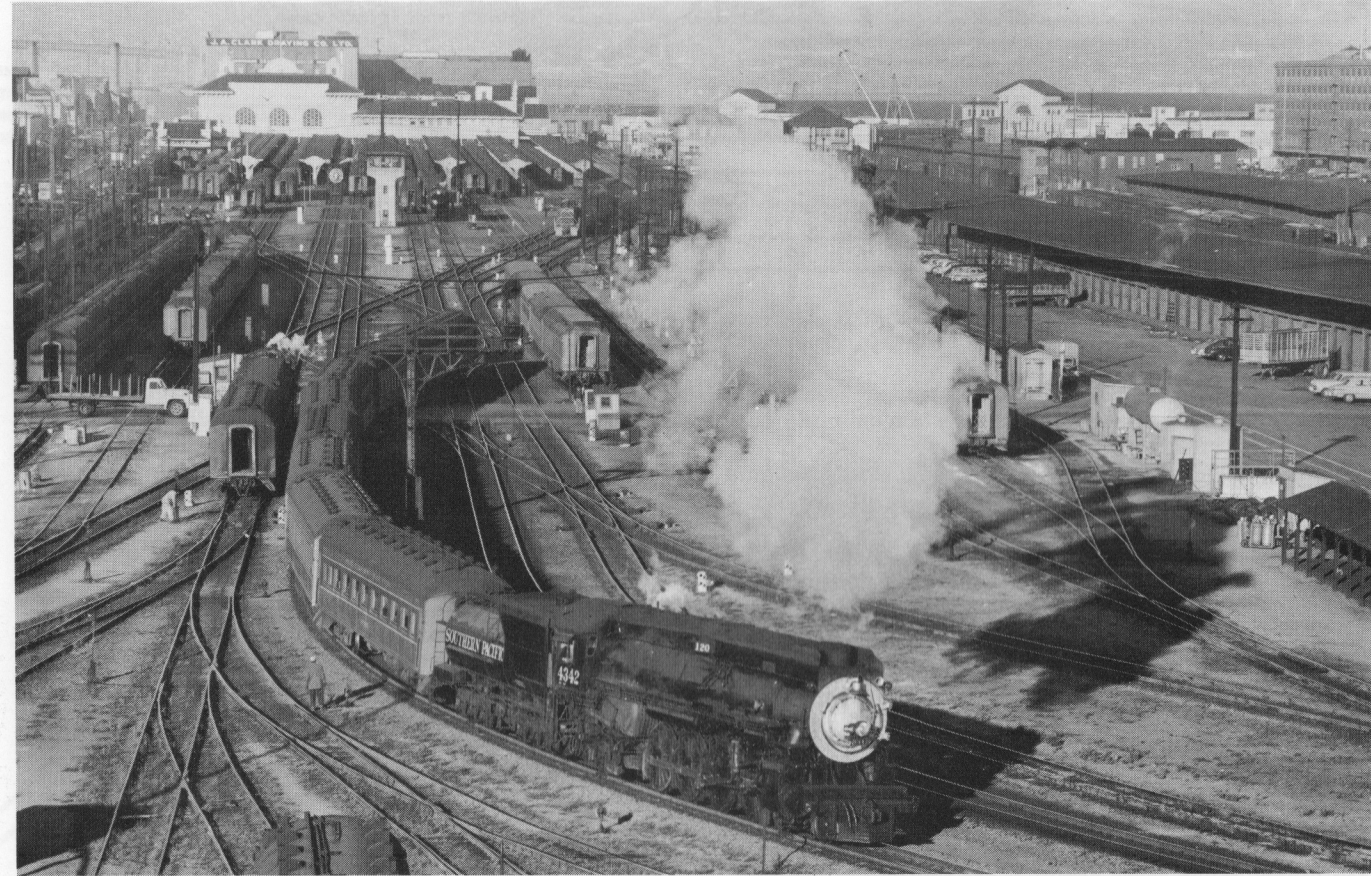
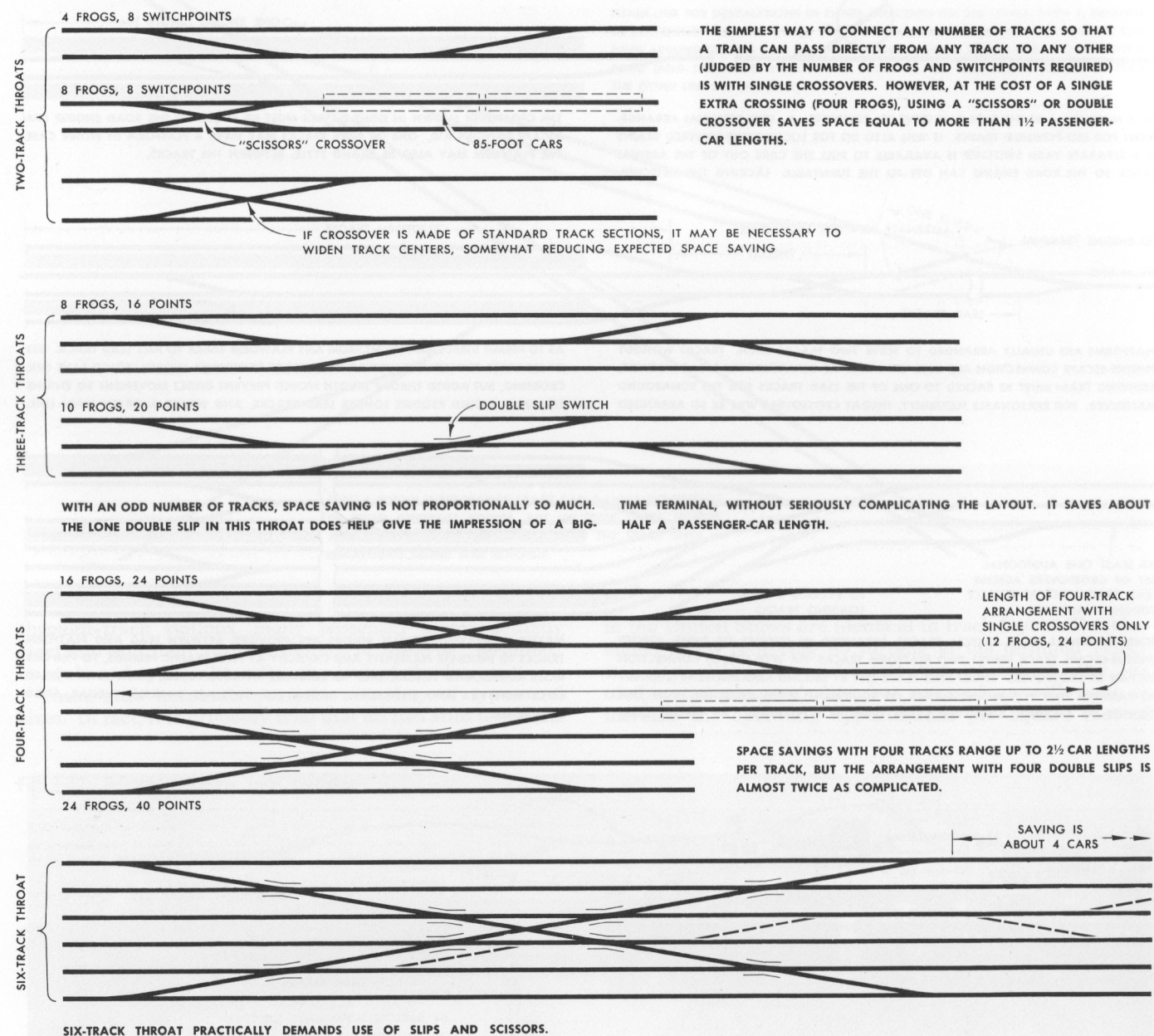


Fig. 1-12. Commuter trains leave Southern Pacific's stub terminal at 3rd and Townsend streets in San Francisco on 3-minute head-way during the evening rush hour. Note the parallel routes from

track to track provided by the crossovers and double slip switches. Operation is further complicated by the grade crossing of a street over no fewer than 14 tracks in the foreground!

Fig. 1-13 Saving space with special trackwork



layout by also handling locomotive-hauled trains and especially those trains that require a certain amount of car rearrangement for the return trip.

Fig. 1-11 shows four typical stub arrangements, ranging from the very simplest to moderately large terminals where the complex trackage at the throat of the station approaches big-city proportions. Many terminals are operated without the engine-escape provisions shown, but a runaround track is needed somewhere in the area. The ability to start servicing the locomotive while the train is still being unloaded is of principal importance where head-end traffic is the big end of the stick and where hours may be required to manhandle all the mail and express off the cars.

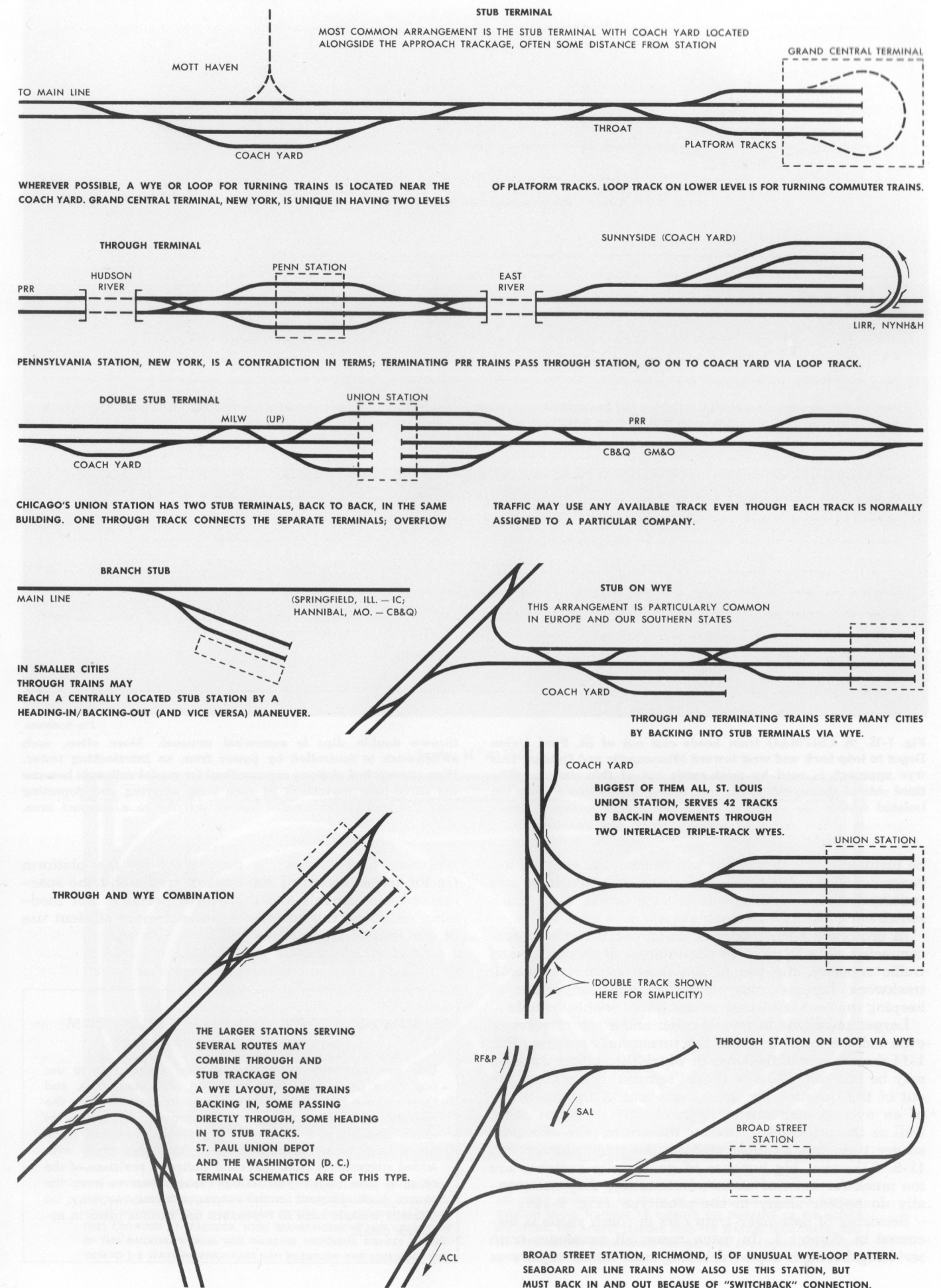
A few terminals have platforms on both sides of some or all of the station tracks, so that passengers and baggage trucks can move up and down the platforms on opposite sides of the train without interfering with each other. Much more common are the paired arrangements with one platform for two tracks, and as a space-conserving matter we will usually want to go along with this in the model.

In the larger terminals separate express and mail loading tracks, or even separate subterminals for head-end work, are commonly provided. These are arranged much like freight stations such as in Fig. 1-3, except that only one track of cars can be worked from one side of a platform. The spacing of baggage car doors is not standardized enough, and car lengths vary too much to permit crossing through one string of cars to reach another.

Throat trackage. While mainline trains can usually be scheduled so they don't get into each other's way at a terminal, commuter trains are another matter. Most large stations are blessed (or cursed, financially) with commuter traffic. This peaks up at rush hours. Therefore, it is common to provide not one but two or even more parallel routes from one track to any other track in the lead tracks extending from the station throat. This not only speeds movements during peak periods but also avoids a complete tie-up in case of a delay to one train while it is crossing over. Fig. 1-12 illustrates this beautifully.

Since land is at a premium in the downtown area where most large terminals are located, space-saving but expensive trackwork, particularly double slip switches, can

Fig. 1-14 Passenger terminal arrangements





Jim Scribbins.

Fig. 1-15. A CS&PM&O train heads east out of St. Paul Union Depot to loop back and west toward Minneapolis and Omaha. This wye approach is used by most roads out of this station. (The third side of the wye is to the left, out of the picture.) Note the isolated double slip switch at this point; extensive use of hand-

thrown double slips is somewhat unusual. More often, such switchwork is controlled by power from an interlocking tower. Wye-approached stations are excellent for model railroads because the three-time movement of each train arriving and departing over the lead tracks creates intense activity in a compact area.

be justified in the throat if it will shorten the over-all arrangement. What it takes in the way of extra frogs and switchpoints to save length is detailed in Fig. 1-13. Such switchwork also saves valuable space on a model pike.

In prototype terminals with six or more tracks, interconnected several times in the interest of flexibility and traffic capacity, the use of the more expensive special trackwork becomes proportionally more important in keeping the over-all length of the throat within bounds.

Larger prototype terminals often make use of wyes or even balloon loops to speed the turnaround process. Fig. 1-14 shows some of the ways in which the station trackage may be laid out. Most of these "terminal complexes" are out of the question for use as one end of the main line of an average-size model railroad, but they can serve well as the principal theme for the entire pike of a passenger train fan, as illustrated by the track plan of Fig. 11-9. Likewise, big bunches of double slip switches are too much for most of us but, fortunately, they occasionally do appear singly in the prototype (Fig. 1-15).

Servicing of passenger-train cars in coach yards is discussed in chapter 4. In many cases, all passenger-train servicing between trips (including such minor repairs as

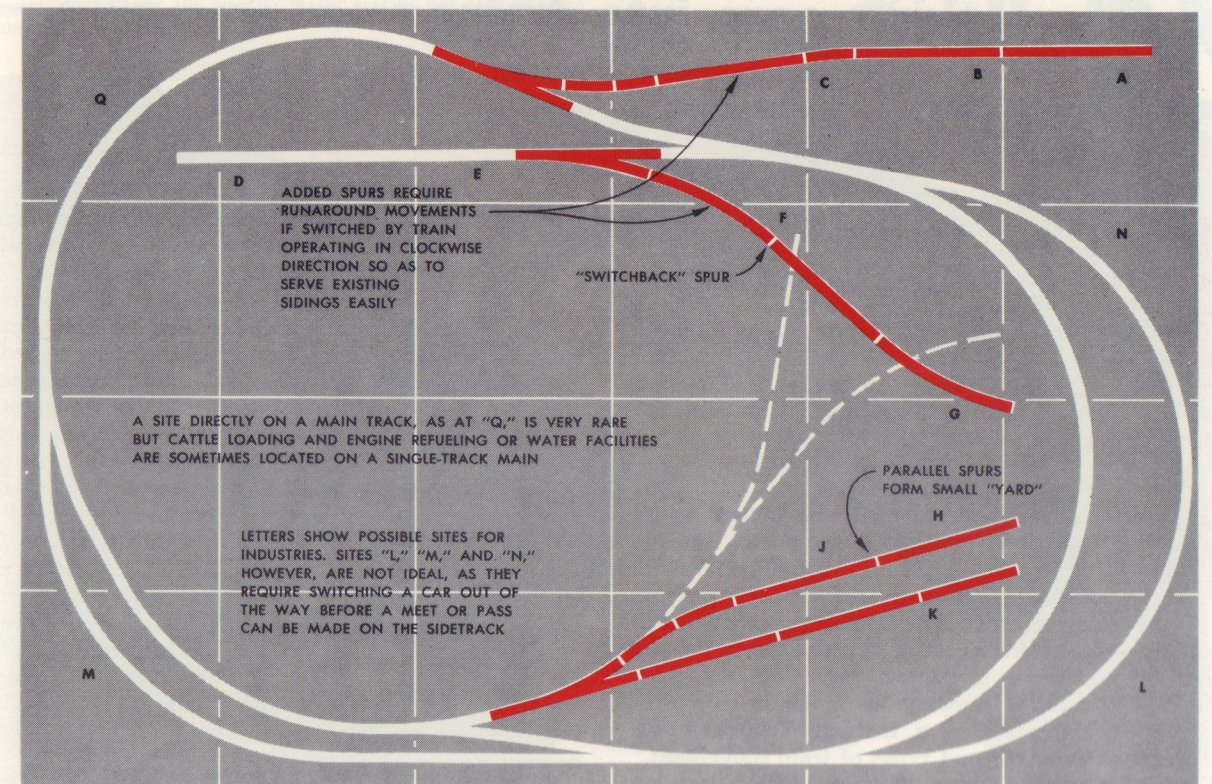
replacing brake shoes) is done right on the platform tracks in the station, if the level of traffic and the spacing of train arrivals and departures permits. For modeling purposes, this usually represents more efficient use of our limited space.

CUSTOMIZING LAYOUTS BUILT FROM PUBLISHED TRACK PLANS

One practical way to develop a good railroad is to use one from plans published in books and magazines, and then make a few alterations to suit your tastes. Often the operational possibilities can be improved. With this in mind, sketches of a number of previously published track plans have been reproduced throughout this book with added suggestions. Note that color indicates revisions of the original plan. Since you will probably want to have the source books in your model reference library anyway, no attempt is made here to reproduce the various plans in accurate detail.

CUSTOMIZED TRACK PLAN EXAMPLES

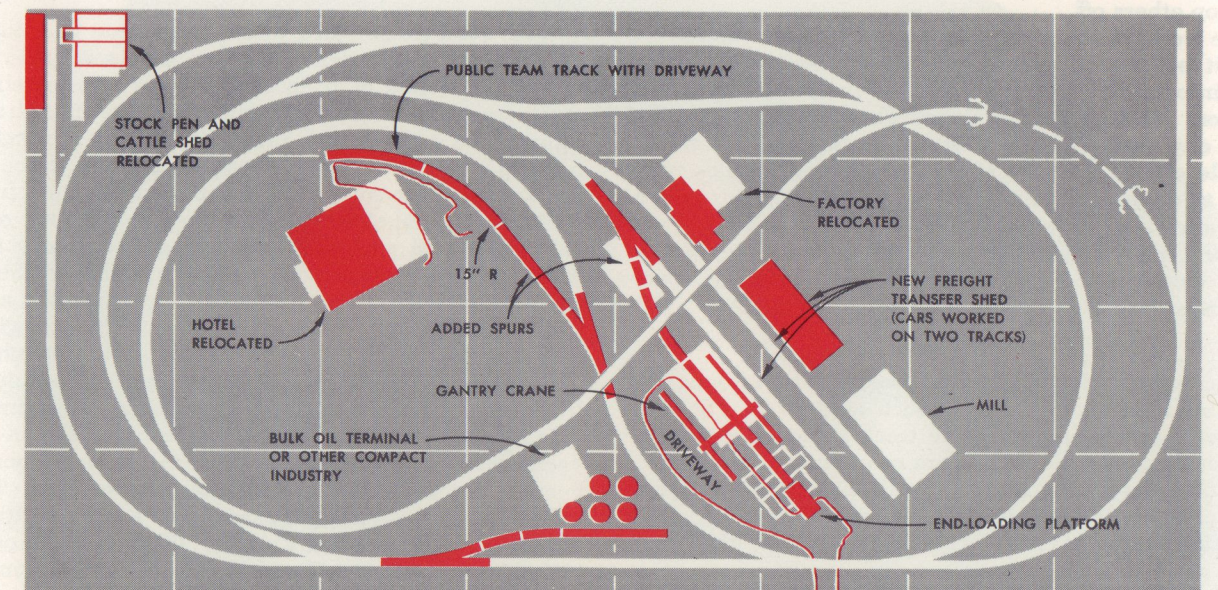
Scale: 1" = 1'-0"



THIS IS "RAILROAD A" FROM ATLAS BOOK "SIX RAILROADS" (4 x 6-FOOT FLAT OVAL WITH PASSING TRACKS IF BUILT IN HO). THE INDUSTRY SPURS IN THIS MINIMUM-SIZE TRACK PLAN ORIGINALLY FACED IN ONE DIRECTION SO THAT THEY COULD BE SWITCHED CONVENIENTLY BY THE LOCAL FREIGHT RUNNING CLOCKWISE. SINCE THERE ARE PLENTY OF RUNAROUND OPPORTUNITIES WITH THE TWO PASSING TRACKS, ADDITIONAL SPURS CAN BE ADDED TO ACCOMMODATE THE GROWING ROSTER OF FREIGHT CARS. TO PROVIDE MORE DIVERSITY IN OPERATION THEY MAY WELL FACE IN THE

OPPOSITE DIRECTION. SWITCHBACK SPURS DO A LOT TO LIVEN THINGS UP WITHOUT ADDING TURNOUTS TO THE MAIN LINE. TO GIVE THE LOCAL'S CREW MORE OF A SENSE OF COMPLETING A DAY'S WORK, CONVERTING TWO OF THE WINDING SPURS TO THE APPEARANCE OF A SMALL FREIGHT YARD LETS THE MEN HAVE A "HOME BASE" TO WHICH THEY CAN RETURN WITH THE CARS THEY HAVE PICKED UP ALONG THE LINE. INDUSTRIES CAN STILL BE LOCATED ALONG ONE OR BOTH TRACKS. SINCE SPACE IS AT A PREMIUM, THE TRACKS THEN DO DOUBLE DUTY.

Scale: 3/4" = 1'-0"



THIS IS "THE HO RAILROAD THAT GROWS" (4 x 8 FEET) FROM THE BOOK OF THE SAME NAME PUBLISHED BY KALMBACH PUBLISHING CO. IF YOUR RAILROAD "GROWS" INTO A MORE URBAN SETTING WITH ADDITIONAL INDUSTRIES CROWDED AT TRACKSIDE, SOME REARRANGEMENT AND EXPANSION OF THIS RAILROAD'S SPURS WILL INCREASE SWITCHING VARIETY. ATTENTION TO THE WAYS IN WHICH CARS CAN BE LOADED AND UNLOADED WILL

SUGGEST PLACEMENT OF FREIGHT STATION AND TEAM TRACK SO AS TO USE ALL AREAS ACCESSIBLE TO TRACK IN AS PLAUSIBLE WAYS AS POSSIBLE (THOUGH DOING NOTHING TO IMPROVE THE ELEGANCE OF THE HOTEL'S LOCATION). THE S-CURVE LEADING INTO THE STATION TEAM TRACK, AND ITS SHARP RADIUS (UNDESIRABLE FOR MAINLINE SITUATIONS) ARE ACCEPTABLE HERE WHERE ONLY SHORT CARS WILL BE SWITCHED AT LOW SPEED.

2

Making cars into trains

The railroad can move freight of all types from anywhere to anywhere at the lowest cost of any form of land transport. This is because carloads travel most of the way in long trains where only five men are required to move 100 or even 200 cars though the individual cars are en route from any shipper to any consignee. Assembling the single cars into trains for the long haul is the function of the railroad yard, but first the cars must be collected from the shippers.

Getting cars to the yard

The process of gathering cars from the points where they have been loaded or unloaded is somewhat like the flowing together of major and minor tributaries to form a river. Little trickles of cars come in via way freights on lightly traveled branches. The largest industries, such as cement or pipe makers, produce so much heavy freight that their traffic comes in almost trainload lots from each source. As Fig. 2-1 shows in some detail, in a fair-sized city the major yard of a trunkline railroad will receive cars by many different types of train movement.* Often these will involve separate beltline railroads, marine operations, trackage rights over other lines, and movements through more than one junction.

These local movements are slow and expensive, undesirable in the extreme as far as the railroads are concerned but excellent for modeling because they cover only short distances which we can represent quite realistically in our always-inadequate space. They are also numerous; a big-city yard which originates only 8 or 10 scheduled through freights a day may send out 20 or more transfer runs to other yards in the area to pick up its cars and drop others off.

Once we have the picked-up cars moved into their first yard, it becomes a matter of sorting them in the right order into trains of the proper class headed in the right direction. This process is called *classification*. At congested city yards like the PQR's 97th Street Yard in the example of Fig. 2-1, the railroad operating officials may prefer to do very little more than hook the cars received into trains, slap on engine and caboose, and send them down the main line as fast as possible to a more strategically located out-in-the-country yard which has room to get cars classified more economically.

Classification

Consideration of a freight yard located farther along the main line of a major railroad, such as at C in Fig. 2-3, will give a better picture of the track arrangements used for classification. Eastbound cars come into C as follows:

- Coal from the Mechanicsburg Branch mine-run train.
- Coal from the mainline mine-run train.
- Mixed freight from local industries and the local freight from B to C.
- Perishables (in season) and mixed freight from the Florial Branch.

*Some of these runs take place entirely within yard limits. These are not "trains" in the strict dispatching sense, but just long switching movements. Even then, in practice they may be closely scheduled for making connections with through trains.

- Perishables and mixed freight from the main line west, mostly from connections at A with western railroads.
- Piggyback train from main line west.
- Ore empties from main line west, mostly from B.

Out of this mess our yardmaster is to make trains for the most efficient movement, not just from his yard to the next one at D but for the best over-all performance of the entire east end of the railroad. He has been provided with a modern gravity-operated yard (hump yard) and therefore will be expected to handle as much as possible of the switching in this whole territory, since it is quicker and less expensive to sort out cars in such a yard than it is to flat-switch them.

Humpyard operation requires little explanation in principle: strings of cars from the receiving yard* are pushed up over the hump, uncoupled at the crest into cuts according to destination, and allowed to roll down to the proper classification tracks under control of car retarders (or, in earlier days, car riders working the hand brakes on the cars) until they form new trains headed in the same direction.

Our yardmaster has cars for the five major destinations along the main stem to H, for the port at N, for the branch line to J and K with its two connecting railroads P and Q, and for wayfreight points R to Z between stations C and D. He has empties for the Mechanicsburg Branch and local industries, and some home-road empties to be held for later disposition as needed. However, when we look at what his yard is supposed to accomplish, we find that he needs about 30 classifications instead of 12 or 15 into which he can pigeonhole his cars. Why?

Classes of freight train

Well, what he is trying to do, in addition to getting the cars headed in the right direction, is to send them there in the right class of train. Perishables and merchandise must travel in expedited trains because this traffic is competitive and because the ice in the reefers keeps on melting whether or not the cars are moving. Such trains are known variously on different roads as time freights, preference, symbol or manifest trains, hotshots, or red-balls. For coal and other bulk freight, a steady flow is more important than over-the-line speed, and the principal thing is to keep it moving as efficiently as possible. So, for many destinations the yardmaster will further classify cars as to speed, putting all the merchandise and perishable traffic for K, for example, onto a different track from the coal and empties headed for the same place.

In sorting a train of hotshot cars for destination H, the yardmaster at C will arrange them in the order most convenient for all eventual switching movements. This is called "blocking." For an example of a blocked train see CH-20 below the map in Fig. 2-3. This train will not only include fast traffic for H and D, but also for stations E, F, and G between these points. The yardmaster blocks the cars so that those that will be dropped off by the road en-

*The word "yard" has two shades of meaning. Basically, it refers to a single group of tracks; but where several small yards for receiving, classification, departure, etc., are grouped to work together, the whole is also known as a yard.

Fig. 2-1 Getting cars to the yard

IN A TYPICAL PORT CITY, CARS REACH THE PRINCIPAL FREIGHT YARD OF A MAJOR RAILROAD BY A VARIETY OF ROUTES AND METHODS. IN THIS EXAMPLE, THE 97TH STREET YARD IS THE TERMINUS FOR FREIGHT TRAINS OF THE PQR RR. (TRackage INDICATED THUS: ———). INTERCHANGE AND INDUSTRY TRAFFIC REACHES THIS YARD IN THE MANNER INDICATED IN THE TABLE.

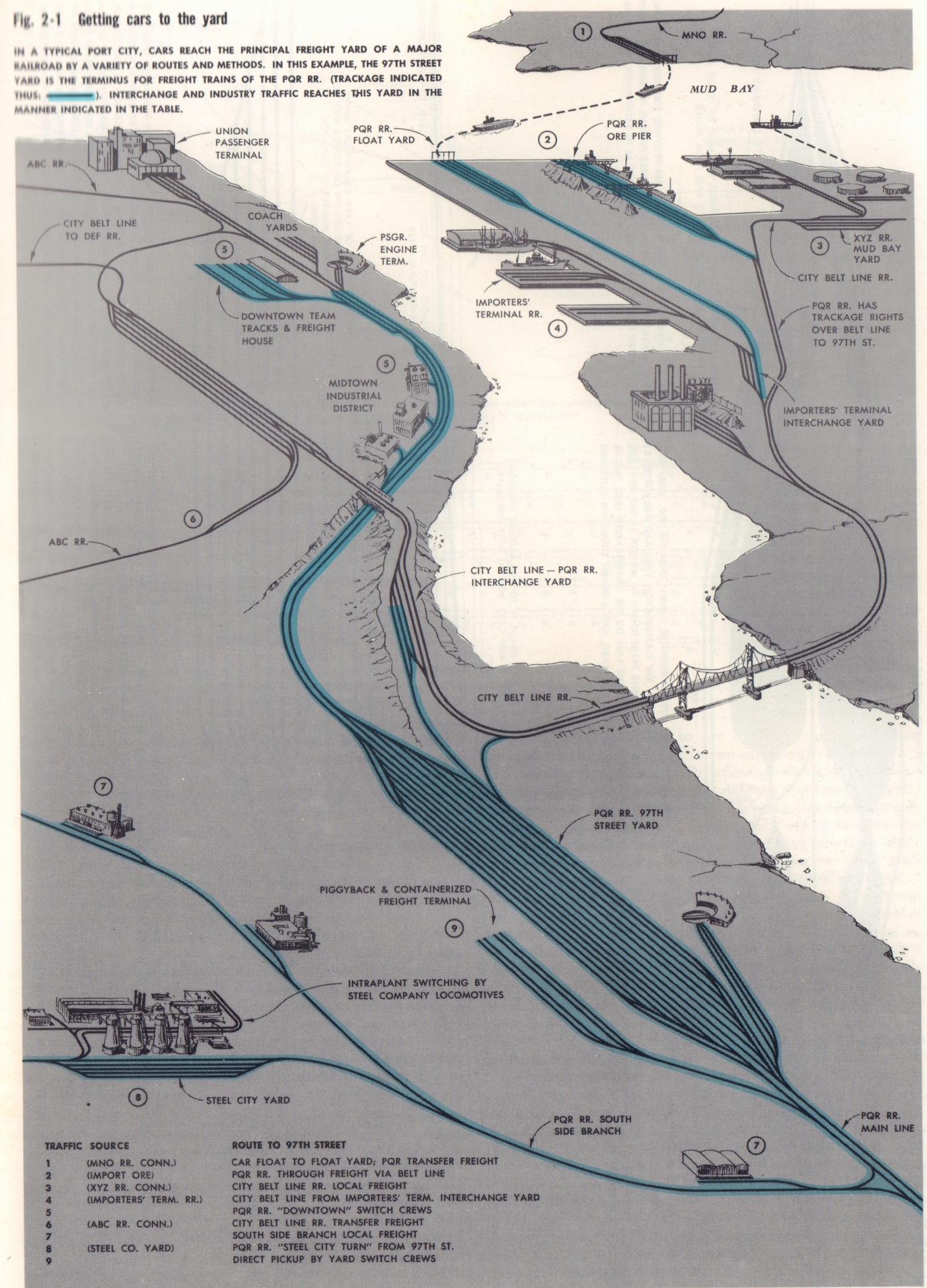
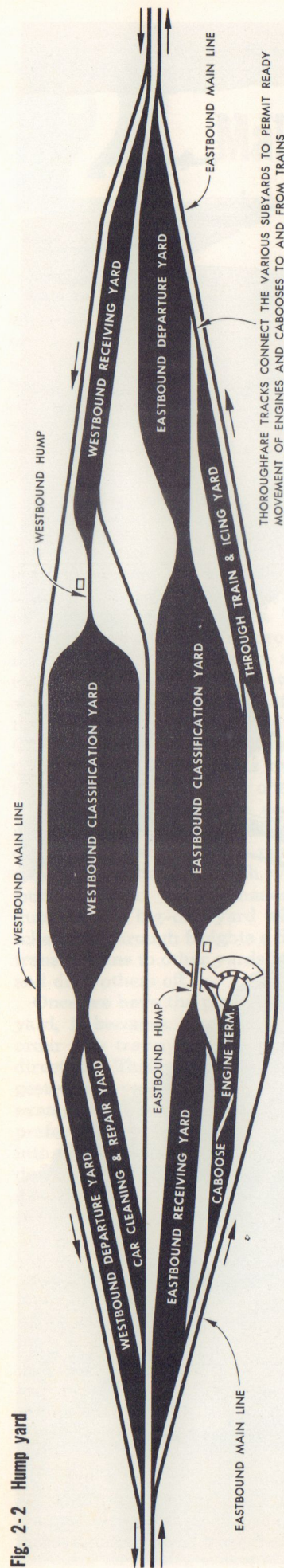


Fig. 2-2 Hump yard

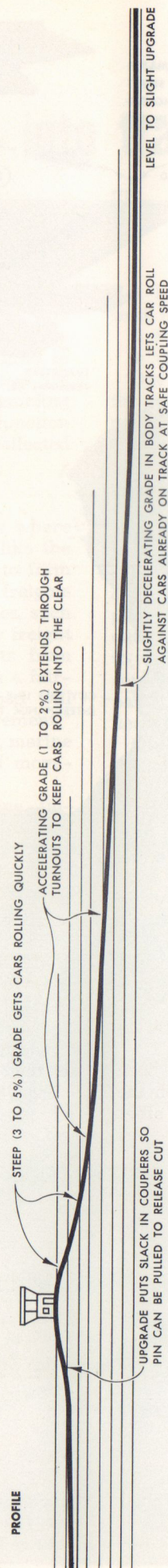


A TYPICAL MAJOR HUMP CLASSIFICATION YARD IS REALLY A COMPLEX OF MANY SEPARATE SUBYARDS TAILORED IN SIZE AND PLAN TO THE PARTICULAR JOB TO BE DONE AT THAT POINT ON THE RAILROAD. WHERE SPACE PERMITS, YARDS ARE SO ARRANGED THAT CARS PASS DIRECTLY THROUGH WITHOUT BACKTRACKING, AS IN THIS CASE. THE RECEIVING YARDS GET THE TRAIN OFF THE MAIN LINE, THEN THE

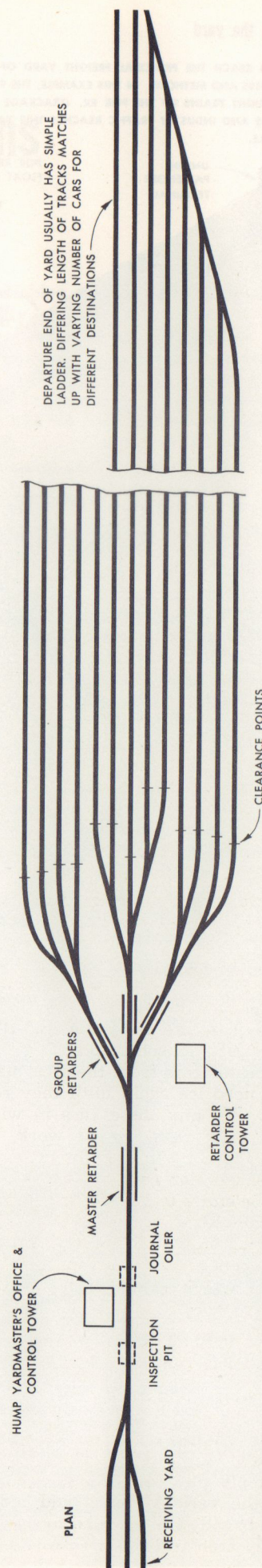
HUMPING ENGINE TAKES OVER TO PUSH THE CONSIST OVER THE TOP. CARS ROLL INTO THE NUMEROUS TRACKS OF THE CLASSIFICATION YARD AND ARE SORTED BY DESTINATION WITH ONLY A SINGLE TRAIN LENGTH OF MOTION BY THE SWITCHER. TRIMMER ENGINES CONSOLIDATE THE CARS ON THE CLASSIFICATION YARD TRACKS, HAUL THE CUTS TO THE DEPARTURE YARD, AND ASSEMBLE THEM INTO OUTGOING

CONSISTS. SPECIAL TRACKS AND SUBYARDS ARE PROVIDED FOR SERVICING TRAINS NOT BEING CLASSIFIED AT THIS POINT, ICING, STOCK FEEDING, WEIGHING, CLEANING FOR LOADING, HOLDING CARS AWAITING ORDERS AS TO DESTINATION, AND SO ON.

PROFILE



PLAN



THE MODERN GRAVITY OR HUMP CLASSIFICATION YARD USES ELECTROPNEUMATIC OR ELECTRIC RETARDERS TO CONTROL THE IMPACT OF CARS AS THEY ROLL INTO THE BODY TRACKS.

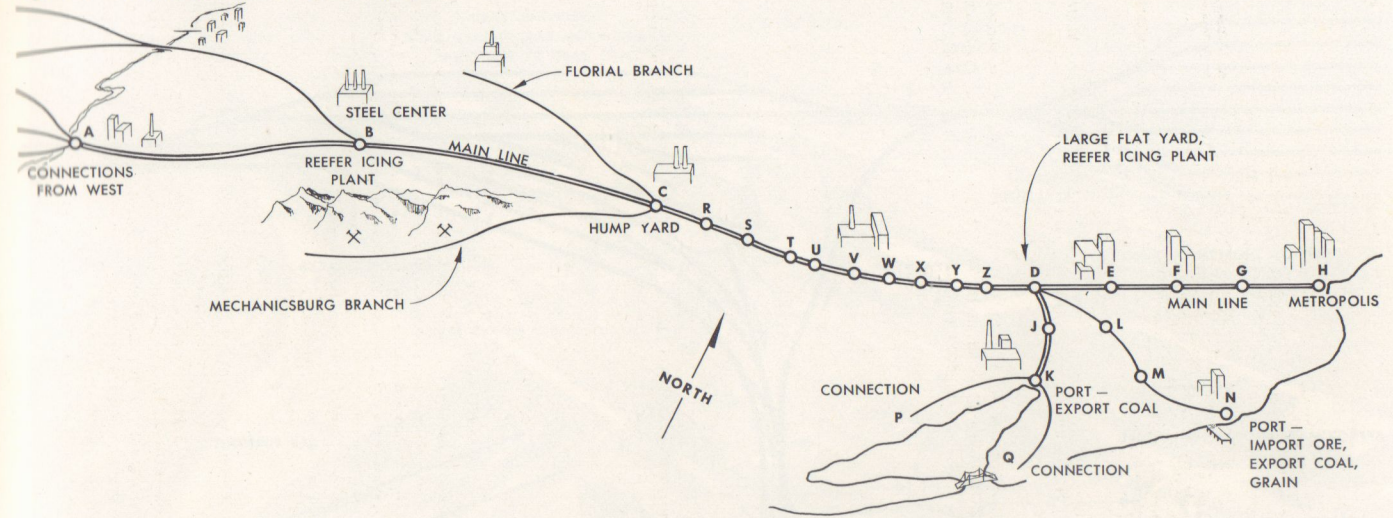
LAP TURNOUTS, COMPOUND AND SPLIT-LADDER ARRANGEMENTS, AND RELATIVELY SHARP CURVES ARE USED TO REDUCE THE DISTANCE FROM THE HUMP TO THE CLEARANCE POINTS AS MUCH AS POSSIBLE. THIS GETS THE CARS CLEAR OF THE SWITCHES RAPIDLY SO THAT OTHER CARS CAN FOLLOW CLOSE BEHIND, INCREASING THE CLASSIFICATION SPEED.

GRADES USED ARE CAREFULLY CALCULATED FOR THE PARTICULAR TRAFFIC BEING HANDLED, WEATHER CONDITIONS IN THE AREA, ETC. A YARD HUMPING ONLY

LOADED ORE CARS WILL HAVE VERY FLAT GRADES, WHILE A HUMP REQUIRED TO HANDLE MANY EMPRIES AND OPERATE IN SEVERE WINTER TEMPERATURES AGAINST A PREVAILING WIND WILL BE MUCH STEEPER THROUGHOUT.

BODY TRACKS ARE ARRANGED IN GROUPS OF FOUR TO SEVEN SO THAT ONE RETARDER CAN SERVE AS MANY TRACKS AS POSSIBLE. IF MANUAL CONTROL OF RETARDERS IS USED, OPERATOR'S TOWER WILL BE LOCATED OFF HUMP, NEAR THE GROUP RETARDERS. MOST MODERN INSTALLATIONS USE VARYING DEGREES OF AUTOMATIC CONTROL OF RETARDATION, RANGING UP TO COMPLETE ELECTRONIC COMPUTATION OF SPEED AT WHICH A CAR MUST LEAVE THE RETARDER TO GO THE EXACT DISTANCE TO THE LAST CAR ON THE TRACK FOR WHICH IT IS HEADED. THIS IS BASED ON RADAR

Fig. 2-3 Classification at a major hump yard



TYPICAL CONSISTS OF EASTBOUND TRAINS AFTER CLASSIFICATION AT C
LETTERS BELOW CARS INDICATE DESTINATION

TOFC-2 — PIGGYBACK SPECIAL

CH-20 — HOTSHOT FOR H

ADX-4 — PERISHABLE BLOCK FOR D

EXTRA — COAL DRAG FOR N

CK-6 — HOTSHOT FOR K

CD-104 — TIME FREIGHT FOR D

EXTRA — DRAG FOR D

4TH CL — LOCAL FREIGHT FOR V (ON TO D NEXT DAY)

CABOOSE BOXCAR ICE REEFER MECH. REEFER COV. HOPPER GONDOLA BULKHEAD FLAT TANK TOFC FLAT HOPPER ORE JENNY

gine at E, F, and G are in station order. The first cars to be dropped are placed behind the engine, and so on. Hopper cars for D are more likely to be pulled off by a switcher in yard D, so the hoppers are at the rear of the train. Thus the road engine will not have to be uncoupled to leave these cars.

Hotshot refrigerator cars are not yet included in train CH-20, although it might pick some up at D.

Most of the refrigerator cars from the west have been iced at B and won't need ice again until they reach the icing platforms at D. To mix these cars in with other kinds of cars at C would merely make work, for they would have to be separated again at D for icing. For this reason ice-cooled refrigerator cars are moved in large blocks. These might be entire trains of refrigerator cars as shown in Fig. 2-3, train ADX-4, or they might be blocks of refrigerators together in a long train of various cars. Even then, they are sooner or later arranged in an order convenient for future switching and dropping off. Note that mechanically refrigerated cars do not require these special considerations.

Trimming

If he has enough classification tracks, our yardmaster at C can do the work in one move by allocating each track to a single destination and class of traffic. The "trimmer" engine working down at the lower end of the classification yard would then simply pick up strings of cars in the proper order from the various tracks and move them to the departure yard ready for the road locomotives. In practice, there usually aren't enough tracks and so a certain amount of flat-switching may have to follow the origi-

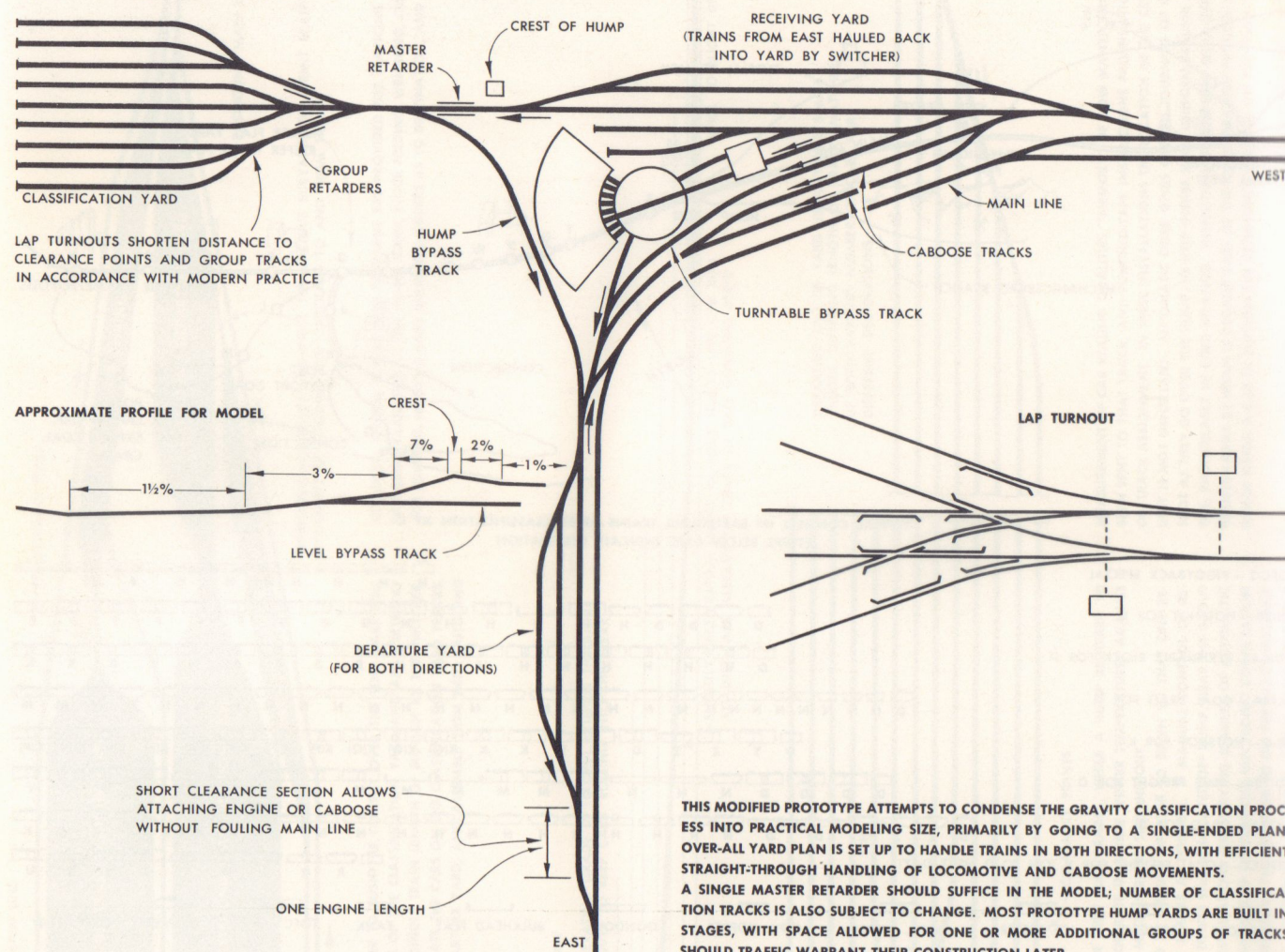
nal classifying in order to get each primarily classified group into the right order for an outgoing train.

The inspection made from below, as the cars approach the hump, may turn up some defects requiring immediate attention; these cars will be sent to the repair track, where a mobile crew will make every effort to have the priority cars back in running order by the time their forwarding train is scheduled. The trimmer will then set them back into their consist on an individual basis.

Piggyback train TOFC-2 moves through C without taking the hump. In fact, since C itself is not a source of destination of much high-speed traffic, this train makes no setouts nor pickups and it may even go through nonstop if arrangements for an extended operating district for its train crews can be worked out with the brotherhoods.

Other oddities in consist point out ways in which the classification process is varied to make best use of the railroad plant. What are those coal loads doing in the hotshot for H? Well, the idea is (contrary to some model railroading practice) to run as few trains as possible for the traffic, so the cars of coal were added to "fill to tonnage" on a day when the hotshot was running below the time-freight rating for the assigned motive power. Each class of locomotive has two tonnage ratings for a given engine district: a drag rating, which is the most the engine can haul without being likely to stall completely on the ruling (most severe) grade; and a time-freight rating, which is the load the locomotive can move over the line on a fast freight schedule. Superspeed runs, such as piggyback jobs, may have special, even lower, tonnage ratings in keeping with their 50 m.p.h. or better average speed requirements.

Fig. 2-4 Single-ended hump yard



THIS MODIFIED PROTOTYPE ATTEMPTS TO CONDENSE THE GRAVITY CLASSIFICATION PROCESS INTO PRACTICAL MODELING SIZE, PRIMARILY BY GOING TO A SINGLE-ENDED PLAN. OVER-ALL YARD PLAN IS SET UP TO HANDLE TRAINS IN BOTH DIRECTIONS, WITH EFFICIENT STRAIGHT-THROUGH HANDLING OF LOCOMOTIVE AND CABOOSE MOVEMENTS. A SINGLE MASTER RETARDER SHOULD SUFFICE IN THE MODEL; NUMBER OF CLASSIFICATION TRACKS IS ALSO SUBJECT TO CHANGE. MOST PROTOTYPE HUMP YARDS ARE BUILT IN STAGES, WITH SPACE ALLOWED FOR ONE OR MORE ADDITIONAL GROUPS OF TRACKS SHOULD TRAFFIC WARRANT THEIR CONSTRUCTION LATER.

Switching delays along the line and in cramped yards are even more damaging to over-all freight delivery schedules than slow running on the road. That accounts for the cars for Y and Z in train CK-6, the through freight for K, and for the extra caboose ahead of them in the consist. These cars will make better time to their destinations by being carried beyond to D and then coming back in the local freight than they would if they went there directly via the C-to-D local. The extra caboose in CK-6 allows it to move on quickly after setting out the cars for D points by simply detaching the rear portion of the train. The new crewmen for the D-K run climb into the extra crummy and off the train goes, with no waiting for a switcher to set out the D cars and bring forward another caboose.

Similarly, we find empty ore hoppers going eastbound in the same drag with a batch of loaded hoppers of coal. The explanation is that it is summer and the ore movement west from N is actually heavier than the eastbound coal tonnage. The extra empty hoppers needed at N could be brought from the coal dumper yard at K, but this is a more expensive movement (taking into account the congestion in the flat yard at D) than sending the cars directly from C to N.

Humpyard design

Fig. 2-2 illustrates in some detail the design features of a modern hump classification yard. A humpyard installation includes much more than just the trackage in the classification yard or "bowl" (so called because of its concave profile). As a minimum, there must be an ar-

rival yard, a bypass for traffic not going over the hump, and caboose and engine terminal tracks.

As we found in the case of our yardmaster at C, the most useful thing he can have is plenty of classification yard. When departure is made from the lower end of the classification yard, as in prototype practice, the whole yard becomes very long. This is true even though the track layout of the modern hump yard is such as to get as much width (and as many tracks) in as short a space as possible. It is also more common nowadays, in the interest of speedy car handling, to eliminate the departure yard as such and pick up outgoing trains right from the classification tracks.

Modeling hump yards

The great length of the hump yard as a complete installation is enough to make it somewhat impractical for most model layouts. Also, to be truthful, unless there are some artificial means for keeping the cars rolling but not too fast (a subterranean belt with magnets, maybe), no model hump yard can be really realistic in operation. The laws of physics are such that cars must move through the yard at far too high a scale speed if they are not to stall, no matter how good their bearings. Nevertheless, the idea of gravity classification is so interesting a point to include in a model railroad that we show, in Fig. 2-4, a humpyard plan modified from the prototype so as to be as practical as possible for the medium-size to large layout.

This is a single-ender, in which cars are pulled from the classification tracks back beside the hump on a by-



Fig. 2-5. Cars rolling down the hump of the Southern Ry.'s modern Ernest Norris Yard, Birmingham, Ala., pass a glassed-in inspection pit and an automatic journal oiler before crossing the overpass. The track arrangement takes advantage of the hump's elevation to provide uninterrupted access of both rail and automobile traffic from one side of the yard to the other. The first

boxcar has just left the master electropneumatic retarder at computer-controlled speed and is approaching a lap turnout which will direct it into one of three secondary lead tracks (lower right). Note repair yard to the left of the hump, bypass tracks to the right — tracks which also bring trains from other directions into the receiving yard to be shoved over the crest.

pass track generally parallel to the receiving yard. This somewhat questionable arrangement greatly reduces the over-all length by eliminating the second ladder track at the foot of the classification yard and doubling up receiving and departure tracks. This condensed yard also handles traffic in both directions. This feature is by no means unprototypical; many of the largest and most modern yards are so laid out, particularly in cities which are the hub of a network of main lines with trains moving in and out from all points of the compass. Approach tracks arranged somewhat like a gigantic highway cloverleaf bring cars from all directions into a single receiving yard to go over a common hump and leave the classification yard in whatever direction their waybills call for. Fig. 2-5 shows how the hump itself may be used as a convenient way to get thoroughfare tracks across the yard without interference from the almost constant slow procession of trains through the classification system.

The gravity classification principle is also found in a condensed form in yards serving rotary car dumpers at river, lake, or ocean ports. Fig. 2-6 illustrates two degrees of compression of a typical rail-water terminal into practical modeling size. Even in some respectably large prototype installations of this type, a single car retarder is enough for the four or five tracks in the empty-car yard.

Flat-switching yards

Most yards do their classification by flat switching. This

is actually the most economical way if most of the cars passing through do not need to be rearranged (as would be the case at D in our example of Fig. 2-2, where the thorough classification and blocking job done at C leaves little to be done at the next yard). Flat switching is an interesting process and not too slow if the trackage is efficiently arranged, either in prototype or in model. Fig. 2-7 discusses the reasons behind the layout of a medium-size flat yard typical of a thousand "division point" arrangements on main lines all over the country — yards where trains pass from one division of the main line of a railroad to the next, with crew, caboose, and motive power changes for all consists. Cars for points on the next division are set out for the local freight; cars brought in by the local from the preceding division are picked up. Most of the train, however, continues on its way relatively undisturbed.

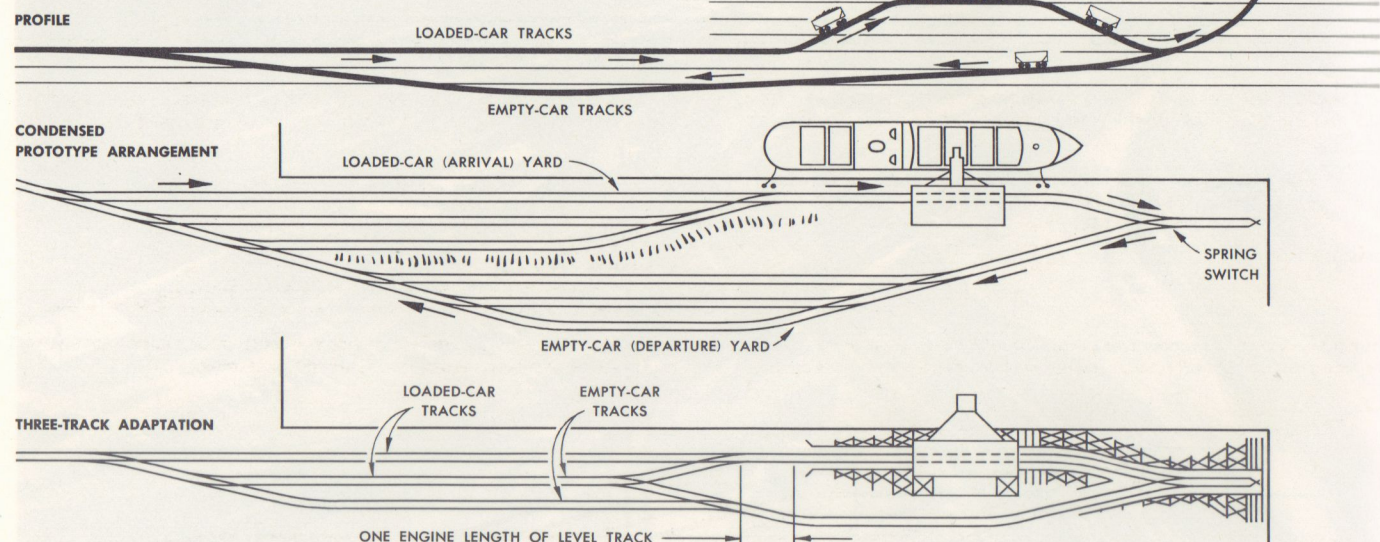
The basic types of flat classification yard arrangement are shown in Fig. 2-8, with some discussion of the reasons for selecting one or the other for modeling purposes. In most situations we will probably want to use the pyramid, because it does give at least one track of fair length. The key item is the switching lead clear of the main track.

Flat-switching techniques

Flat switching has more of an art to it than gravity switching, and the time it takes to accomplish a given rearrangement of consist is highly dependent on the skill

Fig. 2-6 Car-dumper yard

CARS ARE PUSHED FROM THE ARRIVAL YARD TRACKS TOWARD THE DUMPER, WHERE A CABLE-DRAWN "BARNEY" BETWEEN THE RAILS TAKES OVER AND SHOVS INDIVIDUAL CARS UP THE STEEP GRADE INTO THE DUMPER. THE DUMPER INVERTS THE CAR, TUMBLING THE COAL INTO SHIP OR BARGE.



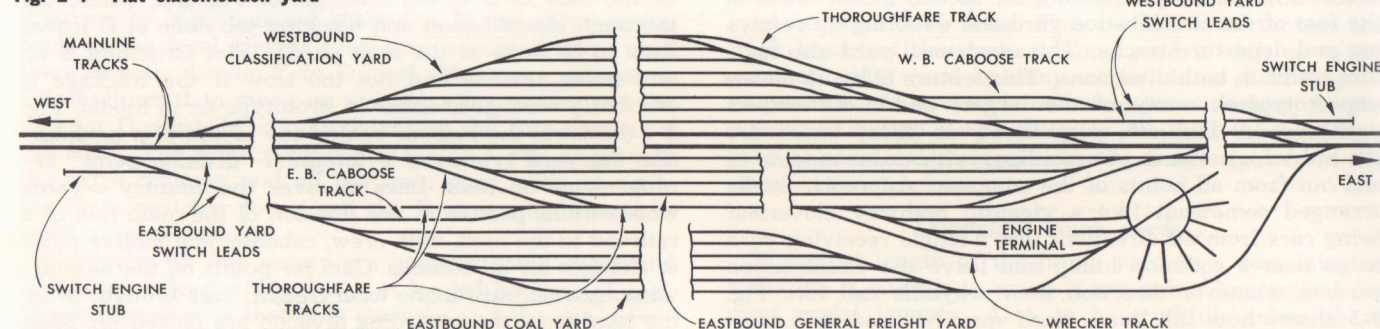
PROTOTYPE LOADED-CAR YARDS SUPPORTING MAJOR CAR-DUMPING OPERATIONS ARE VERY LARGE, STOCKPILING ENOUGH COAL FOR SEVERAL SHIPLOADS. IN THE MODEL, FEWER AND MUCH SHORTER TRACKS WILL SUFFICE. IN THE CONDENSED PROTOTYPE ARRANGEMENT SHOWN, THE SEPARATE ARRIVAL AND DEPARTURE YARDS ARE RETAINED BUT REDUCED TO THREE TRACKS EACH. IN THE THREE-TRACK ADAPTATION, THE CENTER TRACK IS MADE TO DO DOUBLE DUTY AS BOTH AN ARRIVAL AND A DEPARTURE TRACK. THIS PROVIDES, IN EFFECT, A TWO-TRACK LOADED-CAR YARD AND A TWO-TRACK EMPTY-CAR YARD WITH A TOTAL OF ONLY THREE TRACKS. BY LEAVING ONE ENGINE LENGTH BETWEEN THE LAST YARD SWITCH AND THE STEEP GRADE UP TO THE DUMPER, THE THIRD TRACK CAN BE USED AS AN ENGINE-ESCAPE

TRACK FOR THE ROAD LOCOMOTIVE OF THE INCOMING TRAIN. FOR FURTHER SIMPLIFICATION WITHOUT LOSING THE ESSENTIAL FLAVOR OF THE OPERATION A LOCOMOTIVE INSTEAD OF A BARNEY CAN BE USED TO PUSH CARS UP TO THE DUMPER IN THE MODEL. AT SOME LOCATIONS IN THE PROTOTYPE, A GENERALLY SIMILAR TRACK ARRANGEMENT IS USED TO GET HOPPER CARS TO A DUMPING TRESTLE WHERE THE COAL IS DISCHARGED THROUGH THE HOPPER DOORS IN NORMAL FASHION, WITH FOUR TO TEN CARS AT A TIME IN DUMPING POSITION. "SHAKEOUTS" (VIBRATING MACHINES LOWERED FROM AN OVERHEAD TRESTLE ONTO THE CAR SIDES) AGITATE THE CAR ON ITS TRUCK SPRINGS TO SPEED FLOW OF LADING THROUGH THE OPENED HOPPER DOORS.

of the crew and the judgment of the conductor, who must decide how much of a chunk of train to bite off at a time. If he takes the whole train and starts shoving it into the various tracks, his switcher will move more sluggishly and he will have to start off with a long backing movement to get the free end of the train out of the arrival track so that classification can commence. If he takes it in short cuts, he will have to keep going back for more cars.

As is the case in the hump yard, there is a lot more to the installation than the classification tracks themselves. Most vital to the efficiency of the yard is the arrangement of thoroughfare tracks—the extra trackage that lets road engines and cabooses be moved on and off their trains without continually interfering with mainline traffic or the switching required for the classification process itself. Fig. 2-9 shows two condensed model ver-

Fig. 2-7 Flat classification yard

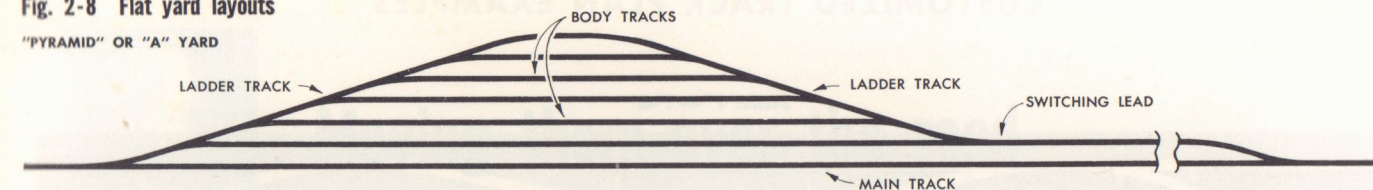


THIS TYPICAL MEDIUM-SIZE YARD IS LOCATED ASTRIDE A DOUBLE-TRACK MAIN LINE HANDLING A HEAVY EASTBOUND COAL TRAFFIC, ALONG WITH GENERAL FREIGHT TRAFFIC MORE OR LESS BALANCED IN EACH DIRECTION. AN ALTERNATE COMMON ARRANGEMENT WOULD LOCATE THE ENTIRE YARD BETWEEN THE TWO MAIN TRACKS, WHICH WOULD SWING OUT GRADUALLY TO CLEAR IT; SPACE PERMITTING, THIS IS A SOMEWHAT MORE EFFICIENT ARRANGEMENT SINCE YARD AND ENGINE MOVEMENTS ACROSS THE MAIN TRACKS ARE VIRTUALLY ELIMINATED. EASTBOUND COAL TRAFFIC, TRAVELING IN HEAVY TRAINS OF UNIFORM LENGTH, HAS ITS OWN "DIAMOND" YARD. EASTBOUND GENERAL FREIGHT IS CLASSIFIED IN A PARALLEL "PYRAMID" YARD WHICH ALSO SERVES LOCAL FREIGHTS OPERATING OUT OF THIS DIVISION POINT. A COMMON CABOOSE TRACK SERVES BOTH YARDS. THE WESTBOUND YARD IS OF "PYRAMID" PATTERN SINCE TRAIN LENGTHS VARY GREATLY, DEPENDING UPON THE NUMBER OF EMPTIES INCLUDED IN THE PARTICULAR CONSIST. TWO SWITCH LEADS ARE PROVIDED SO THAT TWO CREWS CAN WORK AT THE SAME TIME WITHOUT INTERFERING WITH EACH OTHER. THUS THE CLASSIFICATION CAPACITY OF THE ONE

WESTBOUND YARD IS ABOUT THE SAME AS THAT OF THE TWO EASTBOUND YARDS. NOTE THAT THOROUGHFARE TRACKS PARALLELING THE LADDER TRACKS ARE PROVIDED SO THAT SWITCHERS AND ROAD LOCOMOTIVES CAN MOVE ABOUT THE YARDS FREELY. ARRIVING FREIGHT TRAINS GENERALLY PULL IN ON A SWITCHING LEAD TRACK; THE SWITCH ENGINE STUB SERVES AS A "POCKET" FROM WHICH THE YARD ENGINE EMERGES TO BEGIN CLASSIFYING THE CONSIST. DEPARTING TRAINS ARE MADE UP ON THE BODY TRACKS OF THE CLASSIFICATION YARDS. SINCE CABOOSSES GENERALLY STAY ON THEIR OWN DIVISION, OCCASIONAL "TRAINS" OF THEM ARE HAULED FROM ONE CABOOSE TRACK TO THE OTHER (VIA THE THOROUGHFARE TRACKS AND THE TRAILING-POINT MAINLINE CROSSEVER) TO PUT THEM IN POSITION TO START THE RETURN TRIP. NOT SHOWN IN THIS YARD ARE SUCH SPECIAL SERVICING FACILITIES AS STOCK FEEDING AND RESTING TRACKS OR REFRIGERATOR CAR ICING TRACKS. WHERE THESE ARE REQUIRED, SPECIFIC SUBYARDS, LOCATED FOR QUICK RECEIPT AND DISPATCH OF THE SOLID TRAINS OR BLOCKS OF CARS CONCERNED, ARE PROVIDED.

Fig. 2-8 Flat yard layouts

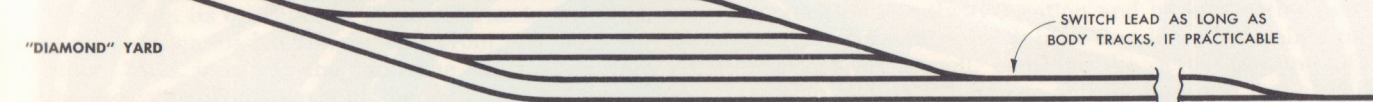
"PYRAMID" OR "A" YARD



THE PYRAMID YARD PROVIDES TRACKS OF CONSIDERABLY DIFFERING LENGTHS AND IS THUS MOST SUITABLE WHERE MIXED TRAFFIC INCLUDING SHORT LOCALS AND LONG

DRAWS IS TO BE HANDLED. SWITCHING LEAD, USED BY YARD ENGINE WHILE SORTING OR "CLASSIFYING" CARS, AVOIDS INTERFERENCE WITH MAINLINE TRAFFIC.

"DIAMOND" YARD



BODY TRACK LENGTH IN THE DIAMOND YARD IS UNIFORM, A DESIRABLE FEATURE WHERE ALL TRAINS ARE OF ABOUT THE SAME LENGTH. IN MODEL RAILROAD LAYOVER OR STOR-

AGE YARDS THIS ARRANGEMENT IS OFTEN BEST BECAUSE TRAIN CONSIST IS USUALLY REGULATED BY STATION-PLATFORM OR PASSING-TRACK LENGTHS.

BODY TRACKS DO NOT HAVE TO BE STRAIGHT; THIS PYRAMID-STYLE YARD IS BENT TO FIT IN A DIAMOND-SHAPED SPACE AND THUS LINES UP CONVENIENTLY ALONGSIDE A MAINLINE CURVE. THIS ARRANGEMENT, WITH THE LONGEST TRACK TO THE REAR, IS PAR-

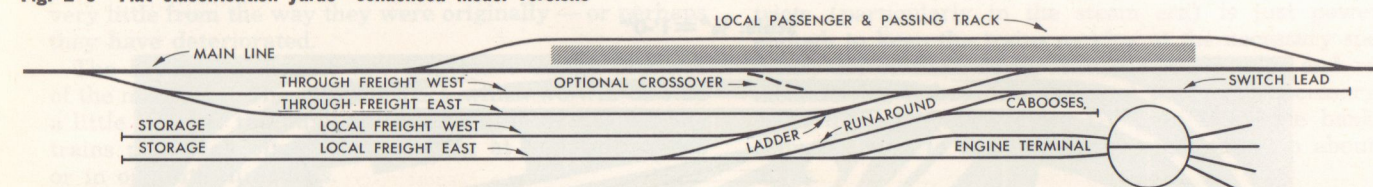
TICULARLY EASY TO OPERATE, SINCE ALL TURNOUTS AND COUPLING-UNCOUPLING POINTS ON THE BODY TRACKS ARE TOWARD THE FRONT AND READILY ACCESSIBLE.

sions of the classical division-point yard which compromise between having enough thoroughfare trackage so that movement in the yard is extremely free and easy, and allocating most of the space for car storage capacity. In actual operation of a yard like this, we make adjustments if the balance is not just right at a particular time. We do this by temporarily storing cars on a thoroughfare track or by running trains through what is basically a classification track.

Single- or double-ended?

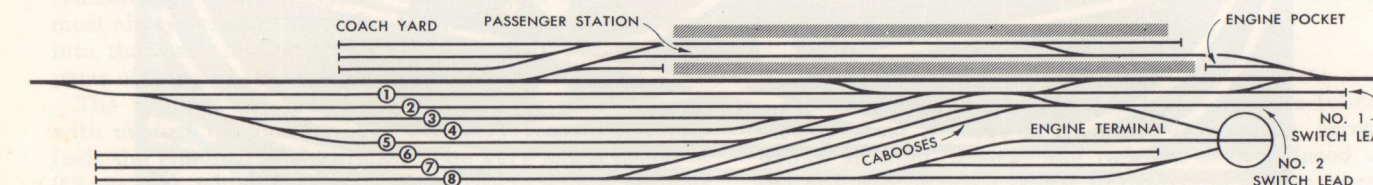
Most prototype flat yards handle traffic in both directions and are double-ended, a nice feature that lets a train on any track proceed in either direction without backing up. In the model, space considerations are more binding; also, the cost of turnouts in time or money looms somewhat alarmingly. The partially double-ended arrangements shown in Fig. 2-9 usually represent a good compromise.

Fig. 2-9 Flat classification yards—condensed model versions



A MINIMUM BUT ADEQUATE DIVISION-POINT YARD CAN BE WORKED OUT IN SIX TRACKS AND 14 TURNOUTS BY CONDENSING ESSENTIAL FUNCTIONS TO THEIR LOWEST LIMIT AND USING SOME TRACKS FOR MULTIPLE PURPOSES. THE FOUR BODY TRACKS IN THE YARD PROVIDE THE FOUR BASIC CLASSIFICATIONS INTO WHICH ALL ARRIVING CARS CAN BE SEGREGATED FOR FORWARDING. MAKING TWO OF THESE SINGLE-ENDED SAVES TURN-OUTS WITHOUT SERIOUSLY IMPAIRING OPERABILITY, INCREASES TOTAL CAPACITY, AND PROVIDES DEAD-END TRACKAGE FOR TEMPORARY STORAGE OF LESS-ACTIVE EQUIPMENT.

THE OPTIONAL CROSSEVER INDICATED CONSIDERABLY INCREASES FLEXIBILITY BY ALLOWING TRAINS TO ENTER THE SWITCH LEAD DIRECTLY WHEN THE THROUGH TRACKS IN THE YARD ARE OCCUPIED. LOCAL FREIGHTS, ASSEMBLED ON THE DEAD-END TRACKS, ARE PARKED TEMPORARILY ON THE MAIN LINE TO RECEIVE MOTIVE POWER AND CABOOSE, THE PASSING TRACK SERVING AS A THROUGH ROUTE FOR ANY TRAFFIC THAT MUST NOT BE BLOCKED.

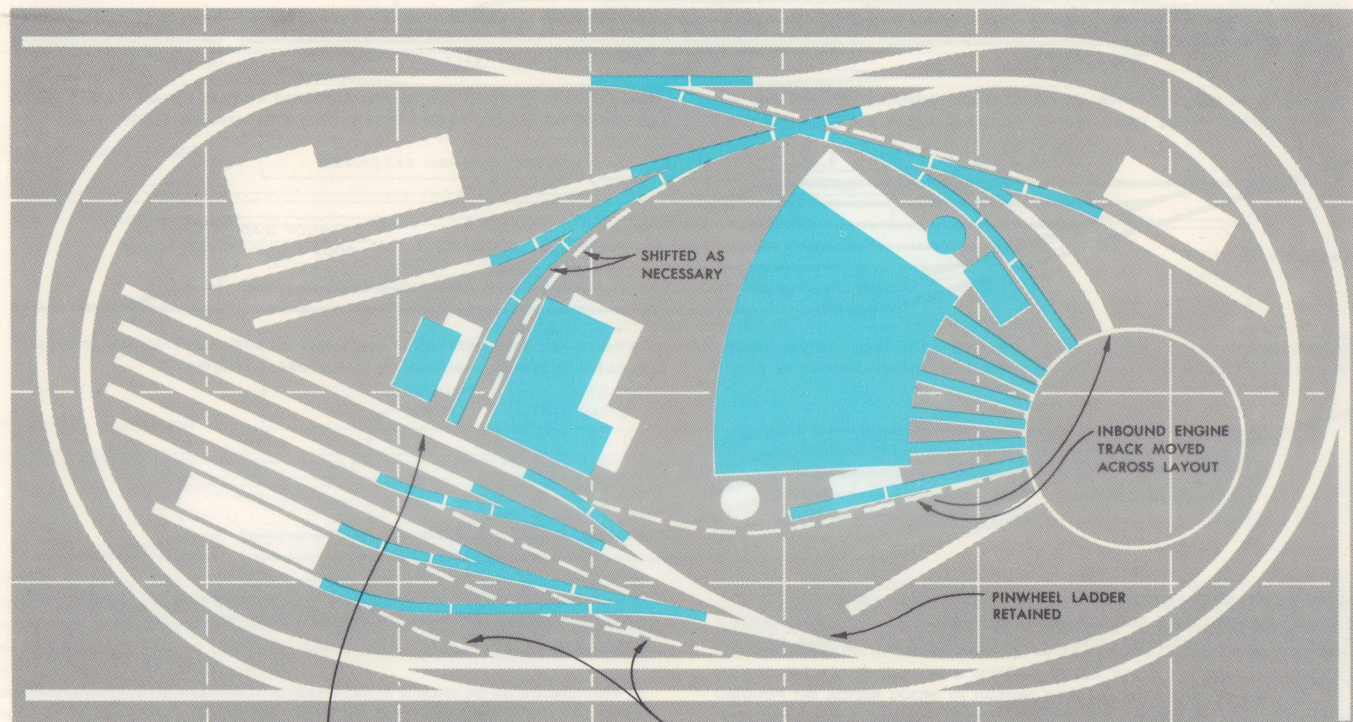


THIS CLUB-SIZE DIVISION-POINT YARD ALSO ACHIEVES INCREASED CLASSIFICATION CAPACITY BY DIVIDING THE WORK BETWEEN TWO CREWS WORKING ON SEPARATE SWITCH LEAD TRACKS AT THE SAME END OF THE YARD. PROVIDING THE SECOND LEAD TRACK AT THE OTHER END OF THE YARD WOULD ACCOMPLISH THE SAME RESULT, BUT WOULD MAKE THE YARD SO LONG THAT THE LENGTH OF "OUT-IN-THE-COUNTRY" MAIN LINE WOULD BE SERIOUSLY REDUCED. WHEN ONLY ONE CREW IS WORKING, NO. 1 LEAD SERVES ALL EIGHT TRACKS. NO. 2 LEAD SERVES TRACKS 5 THROUGH 8 AND ALSO PROVIDES AN ALTERNATE ROUTE TO THE TURN-ABLE. TRACK 5 IS LEFT CLEAR WHEN POSSIBLE TO SERVE AS A THOROUGHFARE TRACK

FOR ENGINES GOING TO AND COMING FROM THE FAR END OF THE YARD. SINGLE-ENDED TRACKS IN A YARD ARE RARE IN PROTOTYPE BUT DESIRABLE IN MODEL PRACTICE FOR REASONS GIVEN ABOVE. PRESENCE OF PASSENGER STATION IS COINCIDENTAL, SINCE PASSENGER FACILITIES MAY OR MAY NOT BE ADJACENT IN PROTOTYPE DIVISION-POINT COMMUNITIES AND MANY SUCH TOWNS ARE OF SUCH LIMITED POPULATION AS TO REQUIRE NO TRACKAGE FOR TERMINATING OR SERVICING PASSENGER TRAINS. IF THEY ARE TOGETHER, HOWEVER, THERE IS SOME INCREASED FLEXIBILITY AND CAPACITY FROM THEIR COMMON USE OF THE MAIN LINE AND NEARBY TRACKAGE TO RELIEVE TEMPORARY CONGESTION.

CUSTOMIZED TRACK PLAN EXAMPLES

Scale: 1" = 1'-0"



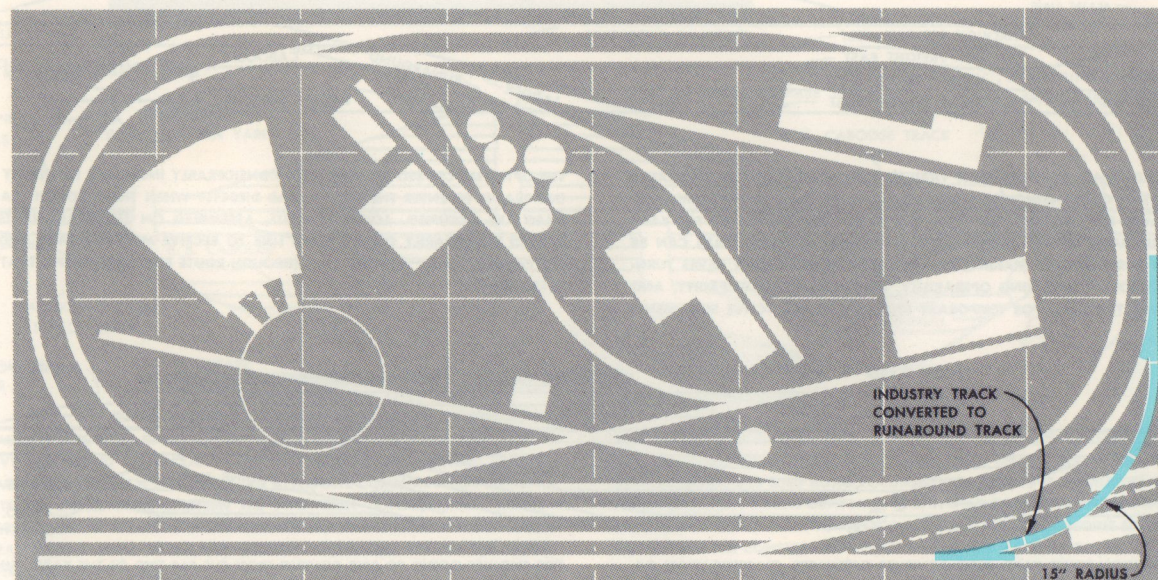
THIS TRACK NOW AVAILABLE FOR YARD STORAGE, SINCE IT DOES NOT HAVE TO BE KEPT CLEAR FOR ACCESS TO ENGINE TERMINAL

TURNOUTS MOVED OFF MAINLINE TRACK - BETTER PRACTICE IF SLIGHTLY REDUCED YARD CAPACITY IS UNIMPORTANT. IN THIS INSTANCE CAPACITY IS REGAINED AS NOTED AT LEFT

THE SOURCE IS LAYOUT 20 FROM THE BOOK "101 TRACK PLANS." IF IN HO SCALE, IT FITS A 4 x 8-FOOT SPACE. IT PROVIDES A DOUBLE-TRACK OVAL WITH LARGE YARD AND ENGINE TERMINAL. THE ORIGINAL TRACK PLAN MAKES EXCELLENT USE OF THE "PINWHEEL" LADDER (A NATURALLY CURVED ARRANGEMENT FORMED WHEN EACH TURNOUT SPRINGS FROM THE CURVED LEG OF ITS PREDECESSOR) TO FIT AN UNUSUALLY LARGE CLASSIFICATION YARD INSIDE A SMALL MAINLINE OVAL. THE MODIFICATIONS SHOWN

MAINTAIN THE SAME LARGE YARD CAPACITY WHILE FAVORING DOUBLE-TRACK OPERATION BY KEEPING TURNOUTS OFF THE MAIN TRACK. WITH ITS BIG ENGINEHOUSE FOR RELATIVELY LARGE LOCOMOTIVES, THIS ROAD WILL RUN MANY THROUGH FREIGHTS. A FURTHER MODIFICATION WOULD BE TO FLOP THE ENTIRE ARRANGEMENT END FOR END, THUS CONVERTING THE YARD LEAD TO A TRAILING-POINT CONNECTION FOR NORMAL RIGHT-HAND OPERATION AROUND THE MAINLINE OVAL.

Scale: 3/4" = 1'-0"



THIS IS TRACK PLAN 142 FROM "TRACK PLANS FOR SECTIONAL TRACK," A DOUBLE-TRACK OVAL WITH OUTSIDE YARD. LONGER YARD TRACKS RESULT WHEN THEY ARE LOCATED OUTSIDE THE MAIN LINE ON A SMALL LAYOUT. LOCATION OF THE CROSSOVERS BETWEEN MAIN TRACKS IN THIS PLAN ALLOWS USING ONE MAIN LINE AS A SWITCHING LEAD OR "DRILL TRACK" FOR THE ENGINE WORKING THE YARD WITHOUT SEVERELY IMPEDING

THROUGH TRAFFIC. CONVERTING ONE INDUSTRY TRACK TO A RUNAROUND TRACK ALLOWS SUCH MOVEMENTS (AS IN HANDLING CABOOSSES) TO BE MADE WITHOUT TEMPORARILY FOULING BOTH MAIN TRACKS. IT ALSO GREATLY FACILITATES GETTING THE YARD ENGINE IN POSITION TO START CLASSIFYING AN INCOMING TRAIN.

3

Moving them over the road

There is only one way in which a railroad can make money from its operations. This is to run trains of paying passengers or loaded freight cars from one place to another. Thus, in a way the main line and branch lines are the most important parts of the railroad, for they alone have the potential of producing income. Stations and yards would be useless without them.

The location of main and branch tracks depends on economics too. You can build a railroad from A to B at a low cost using sharp curves and probably steep grades to avoid heavy earthwork, and especially to avoid tunnels and bridges. Or you can spend a little more money and use tunnels and bridges to provide a faster-moving line with easier curves and lower grades. Today a third phase has arrived in which money is spent to get rid of tunnels by making deep cuts and to eliminate some bridges by making high fills. This is because earthmoving machinery is now so much better than it used to be that it is more economical to do new engineering than to continue repairing old bores and structures.

A cheaply built railroad is not desirable because the sharp curves slow the train and the steep grades not only slow trains but require more of them, each with its own crew, to move a given number of cars. Thus many a railroad, originally built in a poor location because funds were limited, had to use some of the profit, if there was any profit at all, to rebuild the line in a better location. Practically all of our main lines have been rebuilt in this way more than once. On the other hand, some railroads that produced a slim profit, if any, could not be improved. If these railroads remain in business, they differ very little from the way they were originally — or perhaps they have deteriorated.

The location is one of two important design features of the main line. The second aspect, which we will discuss a little later, is the auxiliary trackage needed to get the trains past each other when moving at different speeds or in opposite directions.

Locating the main line

If it were not for obstacles such as mountains, lakes, bays, rivers, and already-built-up areas (and the anti-railroad citizenry of the 1830's), the railroad route would run straight as an arrow from city to city, and we'd have a really impossible time trying to model the prototype realistically. Fortunately, for our purposes there are almost always enough obstacles to introduce curves aplenty into the main line, even in such relatively flat areas as parts of Iowa or Delaware.

The railroad is capable of moving enormous tonnage with modest horsepower. For this very reason, it really feels the effect of slight grades. The very slight grade of 0.3 per cent, which is only 16 feet of rise in a mile, doubles the pulling power needed compared to performance over level track. A 1 per cent grade more than triples the drag of the train.* It is no wonder, therefore, that hills and mountains are the most serious obstacles in determining

*On a model railroad the drag is doubled by grades ranging from 1.5 per cent to more than 3 per cent, depending on the care with which you select the trucks. — Ed.

where the line must go. To understand a little about the economics of railway location and be in a better position to come up with a track plan that lets us simulate main-line operation well, consider the actual routing of the Lehigh Valley RR. across and through the Appalachians, as discussed in Fig. 3-1.

Water-level grades

We find, first, that the engineers follow stream valleys wherever they can — even in such fairly level country as central New Jersey. The only exceptions are certain kinds of country where the highlands are generally on the same level and with their ridges running in the desired direction. This is rare, but you find it in parts of Wisconsin, New York, and western Pennsylvania. Through rugged territory the line is even more often confined to the most convenient river gorge as the only practical way to cut through ridges towering 1000 feet or more above the water. Following a gorge means miles of extra distance because of the bends in the watercourse, but curves add little resistance to the train and are accepted as by far the better alternative to the grades that would be needed for a straighter route. In the lower reaches of a major river the track tends to stay on one bank or the other for considerable distances, mainly because it would cost too much to shorten the line by building a bridge over the wide stream at every bend.

The line will follow a water grade as far into the mountains as it can, typically on a gradually steepening but still modest grade as the river's flow becomes more rapid. Motive power assigned to trains on these more-level districts (particularly in the steam era) is just powerful enough to keep the trains moving at the necessary speed. When the streams being followed are smaller and more meandering, it becomes practical and even necessary to cross them frequently; the LV goes from one bank of Cayuta Creek to the other bank eight times in about 10 miles.

Sometimes, as in the Lehigh's case in crossing from the Susquehanna to the Lake Ontario watershed at Alpine, it is possible to get through a divide without really departing from a water grade. At other times, as in going from the Atlantic to the Delaware watershed on the LV, a narrow ridge forms the boundary and in this case a single tunnel gets the line through on a moderate grade only because the ridge is narrow and is approached on both sides by creeks.

Mountain districts

More typically a main ridge is too wide to be tunneled through, and if there is no water-level route across it within striking distance the railroad is then faced with the problem of using power to overcome grades, regardless of the civil engineer's degree of success in developing a route that reaches the summit with as even a gradient as possible. There are three principal ways of getting heavy trains over mountain districts, all of them interesting from the modeling standpoint:

Engine changes. Some mountain districts are hundreds of miles long — as on the Santa Fe from La Junta,

Colo., to San Bernardino, Calif., and on the Northern Pacific from Livingston, Mont., to Seattle, Wash. In the East the mountains are lower and a typical mountain district is more likely 60 to 100 miles in length. The Lehigh-Coxton portion of the Lehigh Valley that we've been looking at is typical. So is the Baltimore & Ohio's particularly rugged line from Keyser to Grafton, W. Va.—the justly famous West End of the B&O's Cumberland Division.

The most troublesome of these districts are those with a saw-tooth profile, where not one but two or more ridges must be crossed by traffic in either direction. The seriousness of the problem is not entirely related to the ruling grade. The Erie's main line from Marion, Ohio, to Meadville, Pa., was a problem for decades because its many roller-coaster grades of 1 per cent were steep by contrast to the exceptionally level divisions on each side of this hilly stretch.

For trains which must make good time over extended hilly or mountainous districts, the only solution is to use heavy motive power and limit the tonnage per train over the whole territory. Thus, we find the prediesel west-bound Santa Fe trains exchanging 4-6-4's for enormous 4-8-4's at La Junta. The big engines were usually slated to run through the whole 1247 miles to Los Angeles. The Erie eased its situation in the mixed-power era by using four diesel units between Marion and Meadville instead of the single 2-8-4 that could roll the same hotshots so well east and west of these points. Today we find the B&O cutting in from one to three extra diesel units on passenger and mail trains to maintain a brisk schedule over the entire West End. Whatever era you favor, beefing up the power for the run over your own mountain district is a realistic and never-failing point of operating interest.

Doubling the hill. On the other hand, if the problem is a single, relatively short grade and the line is not crowded, the straightforward process is to cut the train in two and make two trips up the hill. The same power returns for the rear section on the second trip. The train halves are then rejoined at the summit siding. The Chicago & Illinois Midland, which hauled coal in no need of redball handling, regularly *tripled* its worst grade, year in and year out.

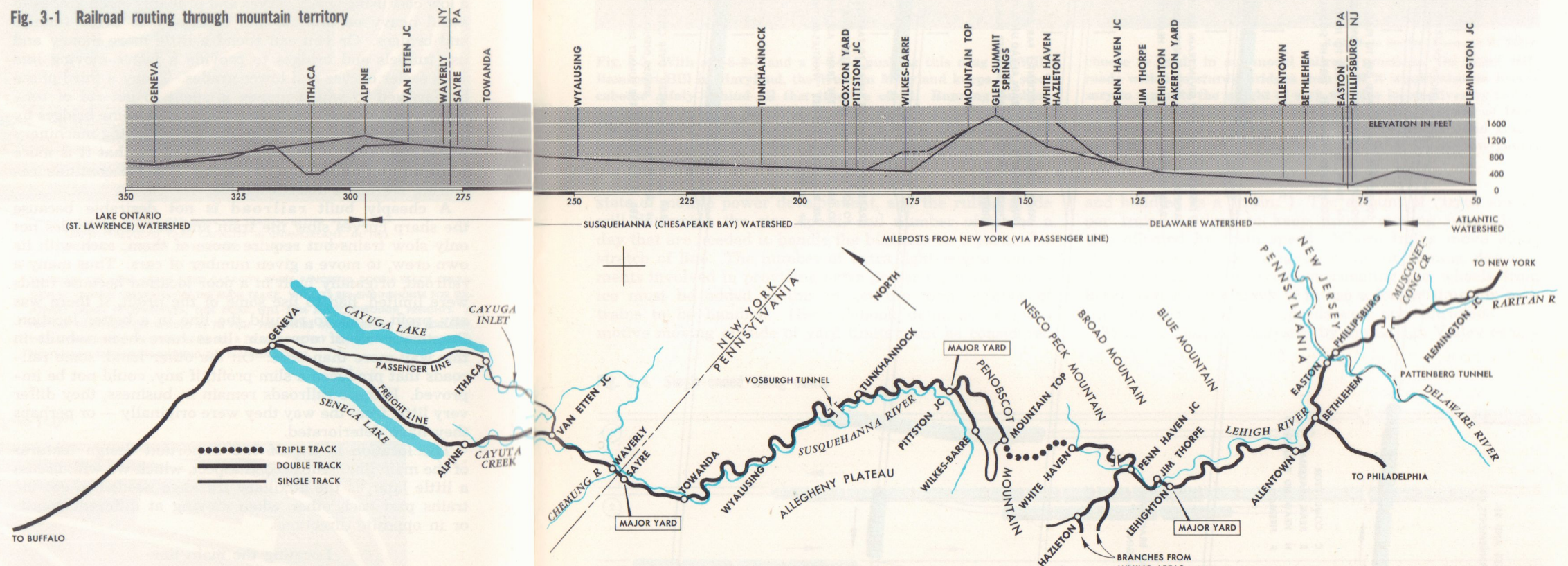
In a few cases where passenger trains serving mountain-resort branches ran heavy at times, the practice of doubling the hill was even used for first-class traffic on a routine basis. There are also those unplanned occasions when things go wrong and the assigned power just can't make it to the top. Doubling the hill is again the answer most likely to be used. This can happen on busy lines which could not tolerate doubling the hill as a standard practice. Incidentally, the procedure shown in Fig. 3-2 is most likely to be used in getting a train over the top in two pieces, even though it appears to involve extra engine and car mileage. With a five-man crew, it's the fastest way because each man can be where he's needed at all times with a minimum of time lost walking back and forth.

You might wonder why the train couldn't be headed into the sidetrack instead of backing into it. However, if you place each member of the five-man crew where required, you find that heading into the passing track with the first cut keeps leaving the men at the wrong places to do the next job, such as opening or closing switches, making cuts, or setting hand brakes. It also requires restarting the train on the grade unless the fireman can run far enough ahead of the engine to get the gate open in time. Of course, if the far side of the hill is steeper than the ascent being doubled, the back-in move would be impractical—which is the reason for the weasel statement at the top of the figure.

Helper service with a pusher. The most prevalent practice in conquering grades is to add extra power for only the distance from the bottom of the grade to the top, so let's take a look at some of the general rules for helper service. There are about as many exceptions as there are rules, so if you handle helpers in a different but logical way, you are still right.

Pusher assistance is the most common form of helper service. If you were to put all the power at the head end it might exceed the strength of the couplers. The operation also takes extra time because the train has to be stopped at the summit to let the helper uncouple and move aside. When the helper is a pusher, it merely slows to a stop at the summit and lets the train continue on the way. Only cabooses with steel underframes can be used on a helper division, as a wood-frame car could easily be crushed by the pushing. In some states and on some roads the caboose must be placed *behind* the pusher. This involves a good deal of extra switching at both the bottom and the top of the helper grade. See Fig. 3-3.

Fig. 3-1 Railroad routing through mountain territory



THE LEHIGH VALLEY'S MAIN LINE OVER THE APPALACHIAN MOUNTAINS IS A CLASSIC EXAMPLE OF THE USE OF WATERCOURSES TO PROVIDE AN ECONOMICALLY PRACTICABLE PATHWAY THROUGH RUGGED COUNTRY. DETAILS OF ITS TRACKAGE AND ALIGNMENT CAN SERVE AS AN EXCELLENT BASIS FOR DEVELOPING A REALISTIC AND OPERATIONALLY INTERESTING MAINLINE SCHEME FOR AN AVERAGE OR LARGER-SIZE MODEL RAILROAD.

THE ROUTE

LEAVING THE RELATIVELY FLAT BUT CONGESTED TERRITORY WEST OF NEW YORK CITY, THE LEHIGH FIRST FOLLOWS THE BROAD VALLEY OF THE RARITAN RIVER. A RIDGE ABOUT 500 FEET HIGH DIVIDING THIS VALLEY FROM THE DELAWARE WATERSHED IS PIERCED BY THE PATTENBERG TUNNEL, LONGEST ON THE RAILROAD. THERE IS NO OTHER WAY TO GET OVER THIS ISOLATED RIDGE ON AN EASY GRADE WITHOUT A CONSIDERABLE DETOUR OR EXTENSIVE EARTHWORK.

THE DELAWARE VALLEY, ALSO BROAD AT THIS POINT, IS CROSSED BETWEEN PHILLIPSBURG AND EASTON AT THE MOUTH OF THE LEHIGH RIVER. THE RIVER IS THEN FOLLOWED FOR 68 MILES. FOR THE FIRST 40 MILES THE RIVER IS WIDE AND THE GRADE IS ONLY 5 FEET PER MILE (0.1%), ALTHOUGH BLUE MOUNTAIN, 2000 FEET HIGH, IS CUT THROUGH AT LEHIGH GAP. THE RAILROAD REMAINS ON THE SOUTH BANK OF THE RIVER THROUGHOUT THIS STRETCH.

BEYOND LEIGHTON THE RIVER NARROWS AND FLOWS MORE SWIFTLY. FOR THE NEXT 25 MILES THE GRADE AVERAGES 24 FEET PER MILE (0.5%) AND THREE RIVER CROSSINGS AND A TUNNEL BYPASSING A PARTICULARLY SHARP OXBOW BEND ARE REQUIRED TO AVOID EXCESSIVELY SHARP CURVES. MUCH OF THE TRACK IS ON A LEDGE BLASTED INTO THE STEEP ROCK WALLS OF THE GORGE.

Helper service by double-heading. While double-heading involves extra moves and cannot be done when the total drawbar pull of the locomotives exceeds the strength of the couplers, there are times when it is preferred. A pusher behind the last car of a passenger train in daylight, as in the case of a limited ascending the short West Albany Hill on the New York Central on the otherwise gradeless "Water Level Route," is not serious. On the other hand, trains handling sleeping cars at night, or any passenger train on a long helper grade, would be mighty rough on passengers if a helper were used in the pusher manner. Somewhere in the middle of the train is a car that is sometimes being pulled, sometimes being pushed, and it may shuck back and forth quite vigorously unless it is equipped with Tightlock couplers and rubber draft gear.

Thus, with passenger trains, double-heading is generally preferred even though it takes more switching time and an extra stop. All the extra moving also makes it desirable for the action it creates when done on a model railroad.

Helper liabilities

After cutting off at the top of a hill, any kind of helper is simply a liability which the dispatcher must try to send back downhill as quickly as traffic permits, whereas a freshly coaled hog with a full tank of water at the foot of the grade is money in the bank. Layover and engine-service facilities for helpers are therefore almost always at the base of the mountain.

The speed limit for locomotives running light (without a train) is usually much higher in the forward direction than tender-first. Whether or not helpers are turned at the top and bottom of the helper district depends mostly on whether the time saved by running forward makes up for the time lost by turning them. In other words, it's pretty much a matter of the length of the grade. We model railroaders will naturally tend to elect to turn our helpers if we have the choice, just for the extra fun.

Auxiliary mainline trackage

The amount and type of traffic over the main line, the

AT WHITE HAVEN THE RIVER TURNS NORTHEAST AND THE TRACK CLIMBS THE REMAINING 500 FEET TO THE HIGHEST POINT WITH LITTLE BENEFIT FROM WATERCOURSES, ON A GRADE EXCEEDING 1%.

THE DESCENT FROM MOUNTAIN TOP TO THE VALLEY OF THE SUSQUEHANNA IS ALONG THE FACE OF PENOBSCOT MOUNTAIN ON GRADES IN THE 2% RANGE. FROM COXTON YARD, WEST OF PITSTON JC., THE MAIN LINE FOLLOWS THE SWEEPING BENDS OF THE SUSQUEHANNA FOR 90 MILES. ONLY AT VOSBURGH TUNNEL, WHERE ONE OXBOW IS BYPASSED, DOES IT LEAVE THE RIVER BANK. THE GRADE IS ESSENTIALLY LEVEL (3 FEET PER MILE) AND, DESPITE THE NUMEROUS CURVES, THIS IS ONE OF THE FASTEST SECTIONS OF TRACK ON THE RAILROAD. NEVERTHELESS, THE WATER-LEVEL GRADE CARRIES THE LINE HIGH ENOUGH TO CROSS OVER THE DIVIDE TO THE GREAT LAKES-ST. LAWRENCE WATERSHED ON A GRADE OF LESS THAN 0.5%. A LONG DESCENT ON THE SLOPE FAR ABOVE SENECA LAKE'S EAST SHORE BRINGS THE FREIGHT LINE INTO GENEVA. THE ROUTE FROM THERE TO BUFFALO IS CROSS-COUNTRY AND ESSENTIALLY LEVEL.

TRACKAGE AND OPERATION

TRACKAGE SHOWN REPRESENTS THAT IN USE IN THE WORLD WAR II ERA, BEFORE EXTENSIVE C.T.C. AND TERMINATION OF PASSENGER SERVICE. AS A ROUNDABOUT ROUTE (50 MILES LONGER THAN THE DL&W FROM NEW YORK TO BUFFALO AND FAR HILLIER THAN THE NEW YORK CENTRAL), LEHIGH VALLEY HAS ALWAYS RUN TRAINS FAST WHEREVER IT CAN. THE RESULTING USE OF HEAVY MOTIVE POWER ON SHORT CONSISTS ELIMINATED THE NEED FOR MUCH HELPER SERVICE ON THE MINOR GRADES BUT CALLED FOR DOUBLE TRACK THROUGHOUT, DESPITE MODERATE TOTAL TONNAGE PER MILE OF LINE. EXTENSIVE THIRD TRACK EAST OF MOUNTAIN TOP HELPED KEEP TRAFFIC FLUID AT A PLACE

WHERE TONNAGE TRAINS HAD TO MOVE SLOWLY.

TWO MAJOR PASSENGER SOURCES, ITHACA AND WILKES-BARRE, WERE SERVED BY ALTERNATE ROUTES, MOSTLY SINGLE-TRACK AND OTHERWISE USED ONLY FOR LOCAL FREIGHT BECAUSE OF THEIR GREATER LENGTH AND STEEP GRADES. HELPER SERVICE WAS REQUIRED IN BOTH DIRECTIONS OUT OF ITHACA AND FROM WILKES-BARRE TO MOUNTAIN TOP. NIGHT TRAINS AT UNATTRACTIVE HOURS BYPASSED THESE CITIES BY BEING ROUTED VIA THE FREIGHT LINES.

IN THE HEYDAY OF ANTHRACITE MINING, BY FAR THE MAJOR SOURCES OF ON-LINE TONNAGE WERE ON THE MAIN LINE AND BRANCHES BETWEEN LEIGHTON AND PITSTON. PACKERTON AND COXTON YARDS WERE THEREFORE STRATEGICALLY LOCATED NEAR THESE POINTS FOR HANDLING BOTH THROUGH TRAFFIC AND THAT ORIGINATING IN THE TERRITORY BETWEEN. COXTON ALSO SERVES AS BASE FOR HELPER OPERATIONS TO MOUNTAIN TOP. SAYRE, LOCATED WITHIN THE BASIC 100-MILE "DAY" FROM COXTON AND WILKES-BARRE, IS A DIVISION POINT AND ALSO LOCATION OF THE PRINCIPAL LOCOMOTIVE AND CAR SHOPS FOR THE RAILROAD. SAYRE IS ALSO BASE FOR EXTENSIVE INTERCHANGE AND TRACKAGE-RIGHTS OPERATIONS WITH OTHER RAILROADS PASSING THROUGH WAVERLY.

LEHIGH VALLEY TRACKAGE AND OPERATIONS BETWEEN PITSTON AND EASTON ARE MADE MORE COMPLICATED (AND INTERESTING) BY PRESENCE OF THE PARALLELING CENTRAL RAILROAD OF NEW JERSEY, WHICH SHARES THE NARROW LEHIGH RIVER GORGE ALL THE WAY AND WHICH CROSSES THE LEHIGH VALLEY SIX TIMES. EVEN MORE RUGGED RAILROADING IS CALLED FOR ON THE HAZLETON BRANCH LINES, MANY OF WHICH ARE DOUBLE-TRACK—BRANCH LINES WHICH TAP HARD-COAL AREAS VIA 2 TO 3% GRADES OUT OF PENN HAVEN JC.

Fig. 3-2 Doubling the hill

THE FASTEST TECHNIQUE FOR TAKING A TRAIN UP A GRADE IN TWO PIECES AND RE-ASSEMBLING IT AT THE TOP VARIES WITH CIRCUMSTANCES, TRACK ARRANGEMENTS, CREW SIZE, ETC. HERE IS ONE WAY OF DOING IT.



Rail Photo Service: Raymond E. Tobey.

Fig. 3-3. With a 2-8-8-2 and a 4-6-6-4 pushing this drag up Williamsport Hill in Maryland, the Western Maryland keeps its steel caboose safely behind all that tractive effort. Running pushers behind the caboose, permitted in some states on some railroads, allows cutting off the helper "on the fly" but eliminates some interesting switching at both ends of the grade which we may

choose to retain in our model railroad practices. On many railroads with less sturdy bridges than WM it would also be necessary to separate the weight of such massive locomotives by two or three cars. Southern Pacific often runs with a number of locomotives spaced throughout a train where both trains and grades are long. This was also seen in the heyday of the narrow-gauge.

state of motive power development, and the ruling grade will determine the size, speed, and number of trains a day that are needed to handle the business on a particular stretch of line. The number of extra light-engine movements involved in providing extra power for helper service must be added to this to get the total number of trains to be handled. (By rulebook definition a locomotive moving outside of yard limits must be considered

and handled as a "train.") The amount of "track space" per train required to keep things moving normally is also affected by train speed. Where trains move along slowly, as while dragging up a hill or coming down at restricted speed (to avoid overheating the wheels from brake action), the track is in use a longer time for each train than it would be if speeds were not restricted.

Thus we find, as illustrated by the Lehigh Valley exam-

Fig. 3-4 Single-ended-siding meets

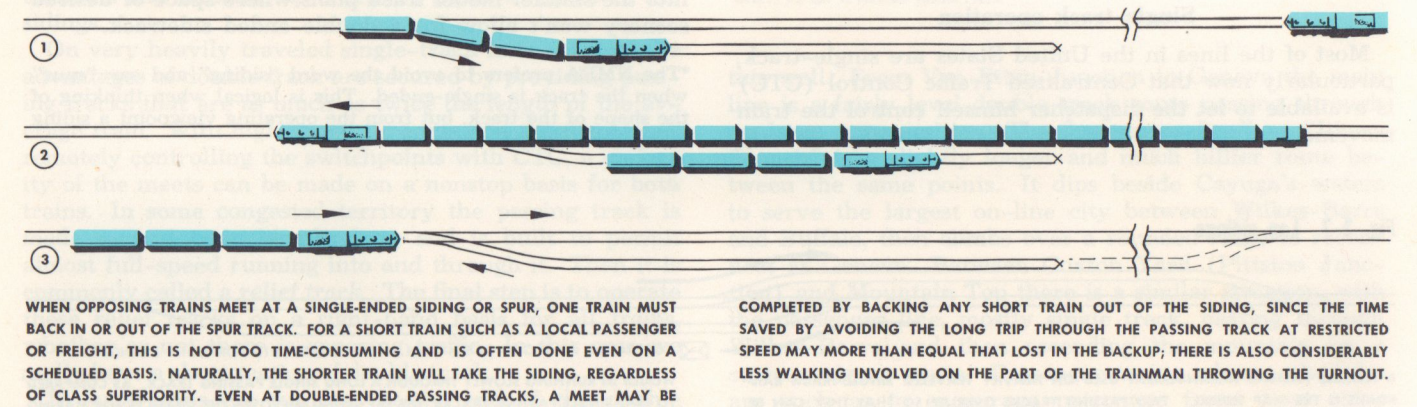


Fig. 3-5 The saw-by

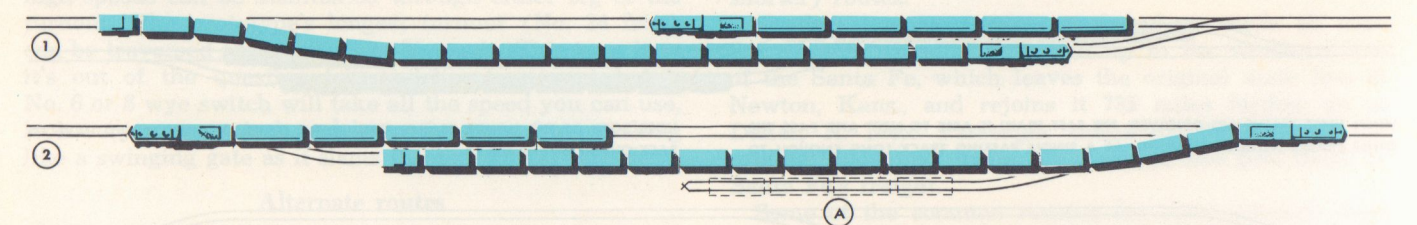
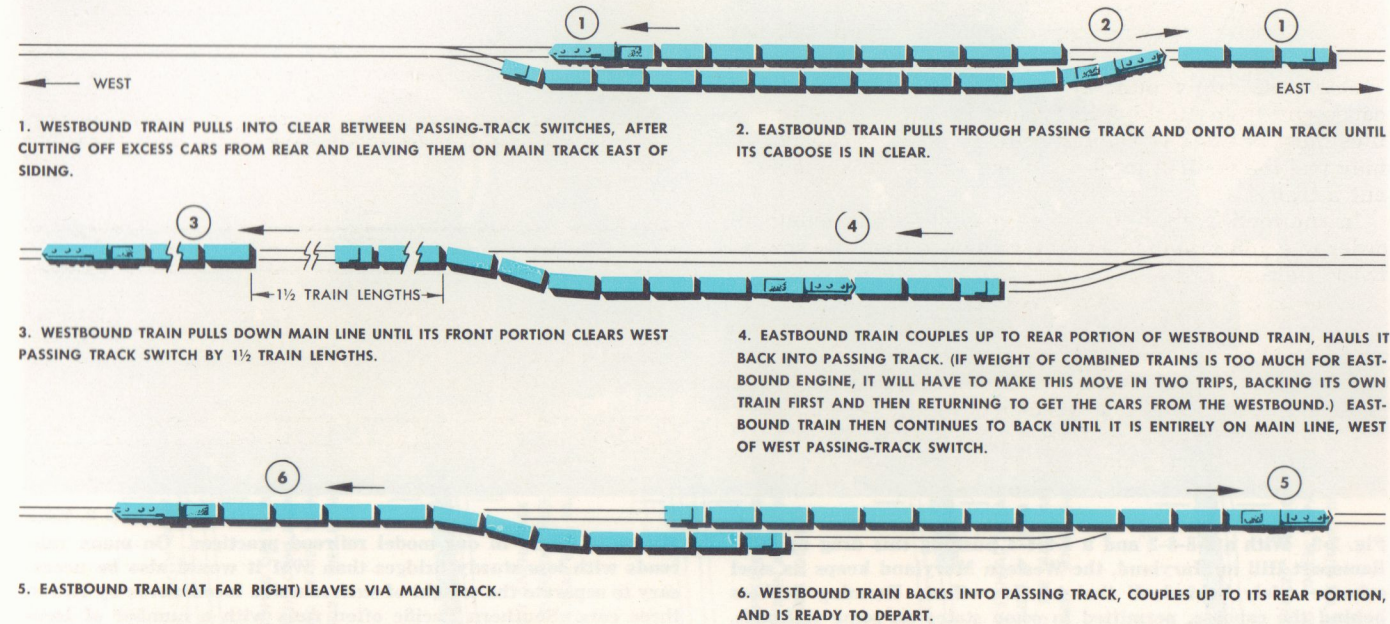


Fig. 3-6 The double saw

WHEN BOTH TRAINS MAKING A MEET ARE LONGER THAN THE PASSING TRACK, IT IS STILL POSSIBLE FOR THEM TO GET PAST EACH OTHER, BUT A REAL PUZZLER, THE "DOUBLE SAW-BY," IS REQUIRED:

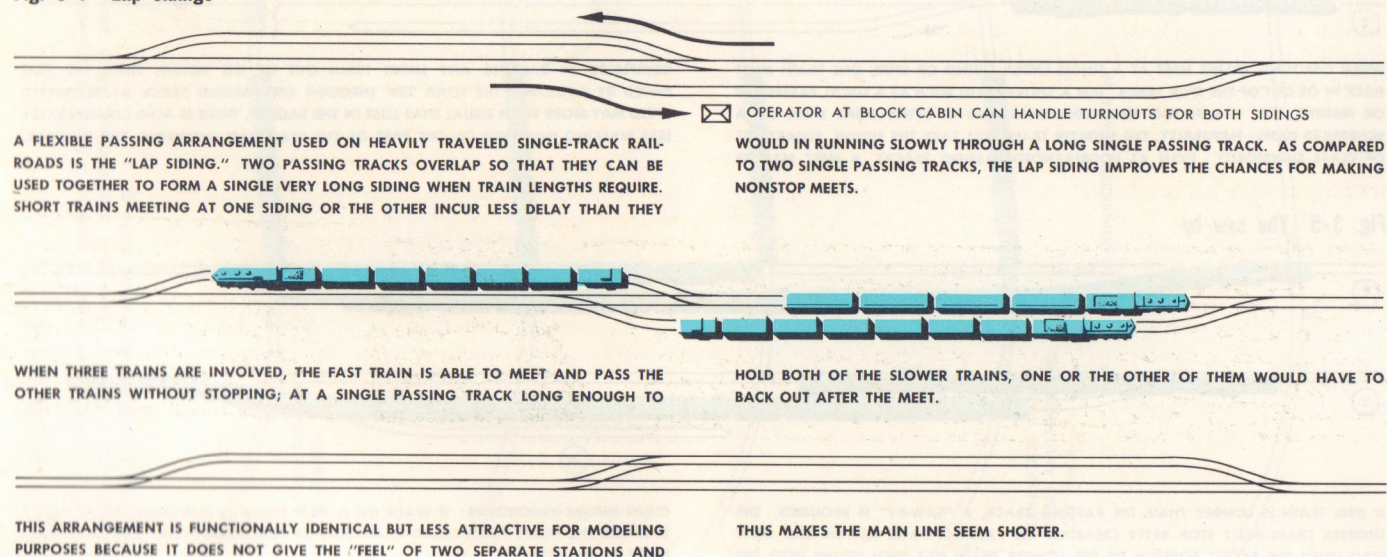


ple, that more trackage is needed per mile of line in going over the mountain from Coxton to White Haven than along the water grade from Lehighon to Easton, even though a good deal of extra eastbound traffic has been dumped onto the main stem at Penn Haven Junction. Since construction of extra track is particularly expensive in mountainous territory, it may not always be possible to provide the additional capacity right at the points where it is most needed—which means that the tough sections of railroad are where you are most likely to find congestion. This further suggests that these sections can be modeled most realistically, since congestion on the model railroad is attained with the greatest of ease.

Single-track operation

Most of the lines in the United States are single-track, particularly now that Centralized Traffic Control (CTC) is available to let the dispatcher himself control the train movements into and out of any passing trackage directly

Fig. 3-7 Lap sidings



Double-ended passing tracks. These, of course, are the backbone of single-track railroading. The key point here is whether the siding is long enough for the train. In the prototype, passing-track length is limited mostly by physical obstacles. Tunnels, bridges, deep cuts, very high fills, and other expensive roadway of any kind will not be widened for a passing track except as a last resort. Sidings are rarely built at grade-crossing locations because any train blocking a crossing for more than 5 minutes must be cut apart to let traffic through. The railroad may feel the teeth of local ordinances when it is unable to cut a train.

In the model, we like to limit passing-track length in order to emphasize the fact that we have a basically single-track railroad and also to get as many passing points as possible along our too-short main line.

We can generally make the best of the situation by making siding lengths uniform and holding most of our trains to this length. The railroad civil engineer also tries to keep passing-siding car capacity about the same over a district, and as great as that required for a full-tonnage train. Except in flat, undeveloped country, however, he usually can't do this, so the dispatcher has variable siding lengths as one of the factors he must keep in mind in planning his meets. As Fig. 3-5 and Fig. 3-6 point out in explaining saw-by and double-saw maneuvers, it is not absolutely necessary to restrict all train lengths to siding capacity. The double saw, however, is an emergency rather than routine matter. What with plenty of walking for the crewmembers to get together to confer and decide who was going to do what, in the old days the double saw could be counted upon to result in a couple of hours' delay. With radio communication now frequently available, the time lost is shorter but still far from compatible with redball schedules.

Lap siding. A track arrangement providing flexibility for quick handling of both long and short trains is the lap siding, shown in Fig. 3-7. It is fine for modeling purposes, and it was also favored in the prototype by many roads because of the relative ease with which one operator stationed at the "lap" could keep things moving in timetable and train-order days by handling the two center turnouts and handing up orders to trains in either of the sidings.

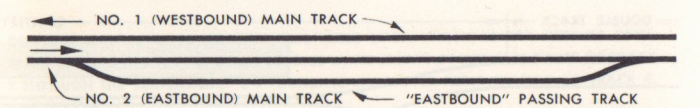
On very heavily traveled single-track lines some of the advantages of double track are secured by providing passing tracks that are as much as twice the length of the average train. With high-speed turnouts and the dispatcher remotely controlling the switchpoints with CTC, a majority of the meets can be made on a nonstop basis for both trains. In some congested territory the passing track is made several train lengths long and is built to permit almost full-speed running into and through it. Then it is commonly called a *relief track*. The final step is to operate these relief tracks on a right-hand basis for all trains, whether or not there is opposing traffic. In this case we really have a short section of double track.

In such cases the turnouts at the end of the double track or very long sidings are usually of the wye or "equilateral" type (both tracks curved equally) so that high speeds can be maintained through either leg of the turnout. The prototype's longest turnout (No. 24 frog) can be traversed at speeds up to 85 m.p.h. This is so long it's out of the question for modeling purposes, but a No. 6 or 8 wye switch will take all the speed you can use, look very prototypical, and keep the train from making like a swinging gate as it slams through at full throttle.

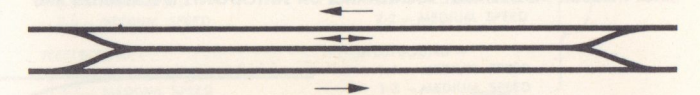
Alternate routes

For various reasons, often more historical than technical, main lines may have alternate parallel routes for some of their mileage. The Lehigh Valley again illustrates

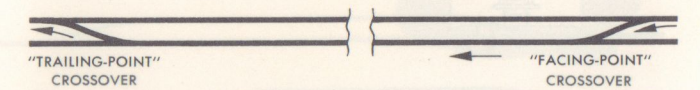
Fig. 3-8 Double-track maneuvers



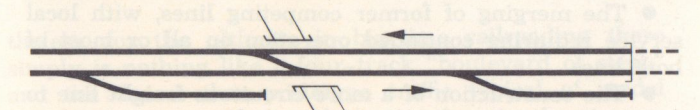
IN DOUBLE-TRACK TERRITORY TRAINS NORMALLY MOVE FORWARD ON THE RIGHT-HAND TRACK. PASSING TRACKS ALLOW A FAST TRAIN TO OVERTAKE A SLOWER TRAIN OR ONE MAKING LOCAL STOPS. IF THE PASSING TRACK IS LOCATED TO ONE SIDE OF THE MAIN TRACKS, IT CAN BE USED ONLY BY TRAFFIC IN ONE DIRECTION. HOWEVER, CREWS CAN PLAN TO USE IT TO CLEAR FOLLOWING SUPERIOR TRAINS WITHOUT REGARD TO OPPOSING TRAFFIC.



"CENTER" PASSING TRACKS ARE MORE FLEXIBLE, SINCE THEY CAN BE USED AS REQUIRED BY TRAINS IN EITHER DIRECTION. THESE MOVEMENTS AFFECT OPPOSING TRAFFIC, HOWEVER, AND SO CAN BE MADE ONLY UNDER DISPATCHER CONTROL.



WITH STRATEGICALLY LOCATED PAIRS OF FACING- AND TRAILING-POINT CROSSEVERS BETWEEN THE MAIN TRACKS, THE LEFT-HAND TRACK CAN SERVE AS A PASSING TRACK WHENEVER OPPOSING TRAFFIC DOES NOT CONFLICT. DISTANCE BETWEEN CROSSEVERS IS USUALLY SUCH THAT MOVEMENTS CAN BE MADE WITHOUT STOPPING EITHER TRAIN. HIGH-SPEED CROSSEVERS ARE PROVIDED WHEREVER SUCH MOVEMENTS ARE COMMON, ALLOWING TRACK-TO-TRACK TRANSFER AT SPEEDS OF 30 TO 50 M.P.H. BECAUSE OF ITS MUCH SHORTER LENGTH AND FASTER BRAKING AND ACCELERATION, A PASSENGER TRAIN CAN MOVE MUCH MORE READILY FROM TRACK TO TRACK THAN A TONNAGE FREIGHT, SO EVEN A STREAMLINER WILL USUALLY TAKE THE LEFT-HAND TRACK IN SUCH A PASSING SITUATION.



CROSSEVERS BETWEEN THE MAIN TRACKS ARE ALSO NECESSARY TO PROVIDE ACCESS TO INDUSTRY TRACKS LOCATED ON THE "WRONG" SIDE OF THE MAIN LINE. IN THIS CASE, TRAILING-POINT CROSSEVERS ARE FAVORED BECAUSE OF GREATER SAFETY FOR HIGH-SPEED TRAFFIC; LESS ELABORATE LOCKING ARRANGEMENTS FOR THE SWITCHPOINTS ARE REQUIRED THAN FOR FACING POINTS. FACING POINTS ON SPURS ARE ALSO TO BE AVOIDED, BUT BRIDGES AND OTHER OBSTACLES MAY MAKE THEM NECESSARY. LOCAL FREIGHTS CAN BACK TO THE OTHER MAIN (WITH PERMISSION FROM THE DISPATCHER ONLY) TO LET A FASTER TRAIN PASS.

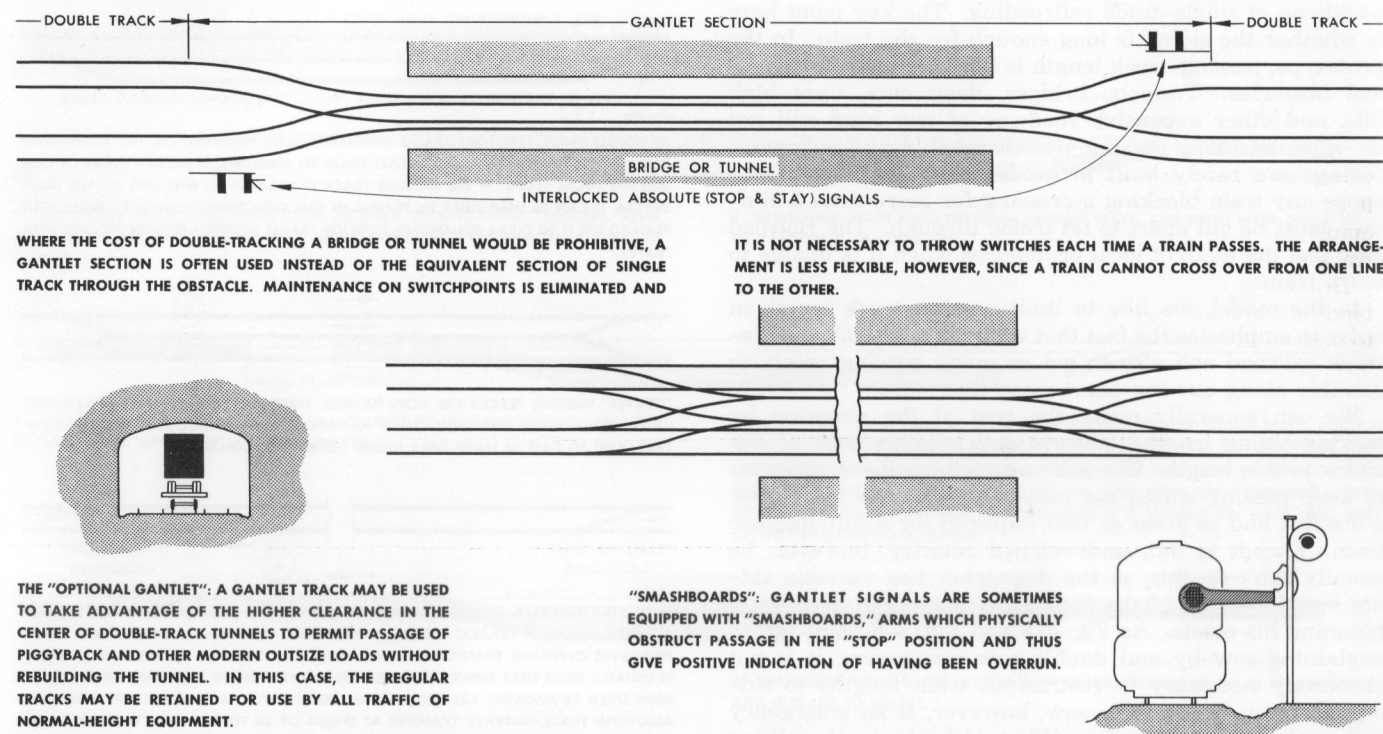
this well. From Van Etten Junction to Geneva the main line is a fairly level double-track route passing through no large communities. The "passenger line" or "Ithaca Branch" is a slightly longer and much hillier route between the same points. It dips beside Cayuga's waters to serve the largest on-line city between Wilkes-Barre and Buffalo, then climbs over a rounded ridge to reconnect at Geneva. Between Coxton Yard (Pittston Junction) and Mountain Top there is a similar situation, with the passenger line, mostly single track, passing through Wilkes-Barre and then ascending the mountain by a steeper zigzag route. Passenger trains whose schedules are such as to encourage patronage from these cities take the more difficult routes; through freights and wee-hour passenger runs take the easier (and in these cases, shorter) routes.

Similar alternate routes are found on roads all over the country, ranging in length up to the southern line of the Santa Fe, which leaves the original main line at Newton, Kans., and rejoins it 735 miles farther on at Dalies, N. Mex. Passenger trains mostly stay on the original main line, while the southern line gets much of Santa Fe's freight.

Some of the common reasons for such alternate lines include:

- Reaching a city near but not on the economical route, as we've already seen.

Fig. 3-9 Gantlet tracks



- Bypassing city congestion for through traffic.
- The merging of former competing lines, with local service requiring continued operation on all or most of both lines.
- The construction of a more circuitous freight line to reduce the ruling grade by the most direct route.
- Paired-track operation by two railroads to get benefits of double track for each without double-track construction by either.

All of these situations can serve as "idea germs" around which to build a track plan, and all of them result in easing congestion in that they are approaches to the remaining principal type of mainline scheme — *multiple-track operation*, which provides two or more tracks at all points so that meets no longer have to be planned and scheduled on an individual basis.

Double-track railroading

Multiple-track operation usually means, of course, a double-track main line with the two tracks on the same right of way. Except on the Chicago & North Western, the "normal" direction of movement on each track is established on a right-hand basis.*

Double track can handle much more than twice the number of trains that can move freely on single track, provided all of the traffic moves at about the same speed. The dispatcher's job for a given level of traffic is much simpler, but since the second track is added only when there are enough trains to require it, he is in practice very well occupied. Double track needs sidings, although not as frequently as single track. Fig. 3-8 shows some of the matters that must be given consideration in locating and using passing tracks and crossovers in keeping things moving on two tracks.

Another fact of life on many double-track lines is the "gantlet" section, discussed in Fig. 3-9. As a way of liv-

*Santa Fe runs left-handed across northern Arizona because the main tracks are separated at some points and grades are more favorable for trains running eastbound on the north track. Southern Pacific does the same in the Sierra, Union Pacific at Sherman Hill and Cajon Pass (the latter also used by Santa Fe).

ing things and also taking care of the very real bottle-necks found in the average basement, the gantlet is a model railroading convenience that shouldn't be overlooked.

Signaling for the most modern double-track lines is installed for operation in both directions on each track

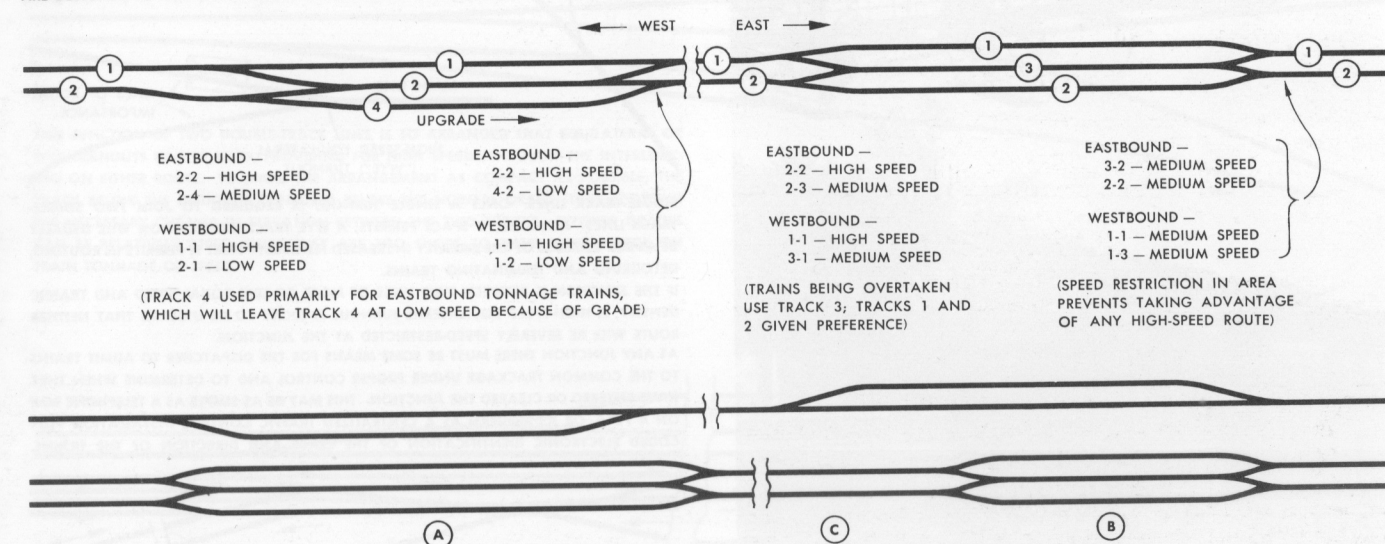


Fig. 3-10. Six-rail track? No — gantlet track plus two guard rails (without tie plates) in the center. The New Haven RR. gantleted the formerly double-track line over Poughkeepsie Bridge to keep the weight of locomotives centered so that the structure, dating from the 1880 era, could handle modern 2-10-2 motive power without being rebuilt.

Fig. 3-11 Double/triple-track combinations

MOST RAILROADS WHOSE TRAFFIC DENSITY EXCEEDS THAT WHICH DOUBLE TRACK CAN HANDLE USE TRIPLE TRACK IN RELATIVELY SHORT SECTIONS WHERE GRADE OR OTHER CONDITIONS TEND TO CAUSE BOTTLENECKS. TRANSITIONS FROM TWO TO THREE TRACKS ARE DESIGNED TO SUIT THE PARTICULAR REQUIREMENTS AT EACH LOCATION, VARYING

CONSIDERABLY IN ARRANGEMENTS DEPENDING UPON WHICH ROUTES REQUIRE HIGH-SPEED CAPABILITIES. IN THE EXAMPLES BELOW, FIGURES "2-2" INDICATE ROUTE OF TRACK 2 THROUGH THE TRANSITION; "2-4" INDICATE CROSSOVER FROM TRACK 2 TO TRACK 4, AND SO ON.



IN MODEL PRACTICE, WHERE MAINLINE LENGTH IS SEVERELY LIMITED, TWO- AND THREE-TRACK RAILROADING MAY ACTUALLY SURPASS SINGLE-TRACK OPERATION IN VARIETY. IN THIS SINGLE-TRACK EXAMPLE, BOTH PASSING TRACKS MUST BE LONG ENOUGH FOR MOST TRAINS IF THE LINE IS TO OPERATE WELL. OPERATIONS ARE MUCH MORE FLEXIBLE WHEN DOUBLE AND TRIPLE TRACK IS AVAILABLE. LONG SIDINGS AS AT "A" CAN ALLOW

FOR NONSTOP PASSES AND OTHER CHALLENGING MANEUVERS. IF DOUBLE TRACK AS AT "C" IS RELATIVELY SHORT, TRAINS CAN USE WRONG MAIN IN MAKING PASSES. IN SUCH A CASE, SINCE TRAINS DON'T HAVE TO RELY ON TRIPLE TRACK FOR PASSES, SIDING AT "B" CAN BE MADE SHORTER THAN SOME TRAINS AND STILL BE EFFECTIVE IN TRAIN MANEUVERING ACTION.

and the crossovers are controlled by the CTC installation which the dispatcher operates. The CTC machine automatically prevents clearing the signal to admit a train to any section of track unless it is clear of opposing traffic and all signals governing any conflicting movements are locked at "stop."

Normal double-track timetable and train-order rules permit the same kinds of reverse-direction train movements, but the process of issuing orders after verifying that the left-hand main is and will remain clear takes so much longer that many time-saving maneuvers done with CTC simply aren't practical for phone dispatching.

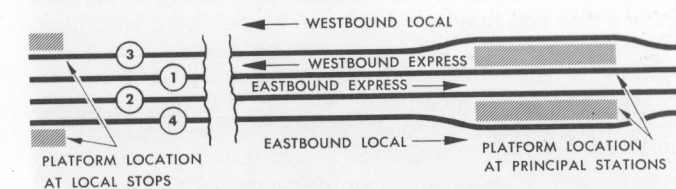
Triple track. A third track, used in either direction as the traffic flow dictates, is, in effect, a continuous passing siding to augment the railroad's capacity and in these days of CTC is sufficient to handle the heaviest requirements of almost all railroads in the United States, except in those places where commuter trains are particularly numerous.

In model practice we are likely to use only short stretches of triple track, but these short stretches can add a great deal of interest. Since the center track has all the possibilities of single track as far as the constant hazard of head-on collision is concerned, we may find, as in Fig. 3-11, that a double-plus-triple-track main line will provide for more interesting railroading in a small space than the more obvious single-track layout. Your choice may depend on the practices most familiar to you.

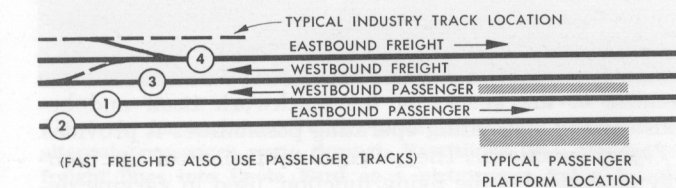
Four-track railroading. Outside of commuter-traffic districts, very few railroads in the United States have had extensive stretches of four-track main line; the Pennsylvania from New York to Pittsburgh and the New York Central from the big city to Cleveland are the prime examples. Some sections of these routes did not have four lines on the same right of way at all points because some of the traffic moved over nearby parallel lines. At many points the installation of CTC, plus the operation of fewer but longer trains, has resulted in the recent reduction to three and two tracks on both railroads. Never-

theless, for the ultimate in big-time railroading there simply is nothing like a four-track "boulevard of steel," and the denser-than-prototype traffic typical of model railroading can amply justify having four tracks at some points if it is to your taste. Fig. 3-12 shows the two radi-

Fig. 3-12 Four-track traffic patterns



DENSELY TRAVELED FOUR-TRACK MAIN LINES MOST OFTEN USE THIS TRAFFIC PATTERN, WITH THE HIGH-SPEED TRACKS BETWEEN THE LOCAL LINES. TRACK NUMBERS ARE ASSIGNED AS EVEN FOR EASTBOUND OR NORTHBOUND TRAFFIC, ODD FOR WESTBOUND OR SOUTHBOUND — THE SAME AS ODD AND EVEN NUMBERS DESIGNATING WESTBOUND AND EASTBOUND SCHEDULED TRAINS. FREQUENT HIGH-SPEED CROSSEVERS BY INTERLOCKING TOWERS PERMIT SHIFTING TRAINS FROM TRACK TO TRACK FOR OVERTAKING MOVEMENTS. A VARIATION OF THIS IS WHERE ALL PASSENGER TRAINS KEEP TO THE CENTER TRACKS AND THE FREIGHT TRACKS, BEING ON THE OUTSIDE, ARE CONVENIENT FOR REACHING INDUSTRIAL SPURS AND SWITCHING LEADS ON BOTH SIDES OF THE RIGHT OF WAY. WHERE THERE ARE VIRTUALLY NO FREIGHT SPURS, PASSENGER TRACKS HAVE BEEN PLACED ON THE OUTSIDE SO THAT STATIONS CAN BE REACHED WITHOUT INTRODUCING FREQUENT REVERSE CURVES TO GET AROUND ISLAND-STYLE PLATFORMS.



ANOTHER TRAFFIC PATTERN CONSISTS ESSENTIALLY OF DOUBLE-TRACK PASSENGER AND FREIGHT RAILROADS LOCATED SIDE BY SIDE. LEFT-HAND RUNNING ON FREIGHT TRACKS IMPROVES SAFETY BY REDUCING THE NUMBER OF TIMES THAT A PASSENGER TRAIN PASSES A FREIGHT RUNNING ON AN ADJACENT TRACK. INDUSTRIES ARE LOCATED ON THE FREIGHT SIDE OF THE RAILROAD WHEREVER POSSIBLE.



Robert Carper.

Fig. 3-13. Mohawk 3064 races east on track 4 of New York Central's four-track main line through Rochester, N. Y. The partially visible signal numbers on the bridge indicate track numbers are, from south (left) to north: 2, 1, 3, 4. Freight tracks 3 and 4 are operated left-handed on the Syracuse and Buffalo divisions. This puts eastward freight farthest left of all four tracks.

cally different schemes which have been commonly used for assigning the direction of traffic in four-track territory.

Junctions

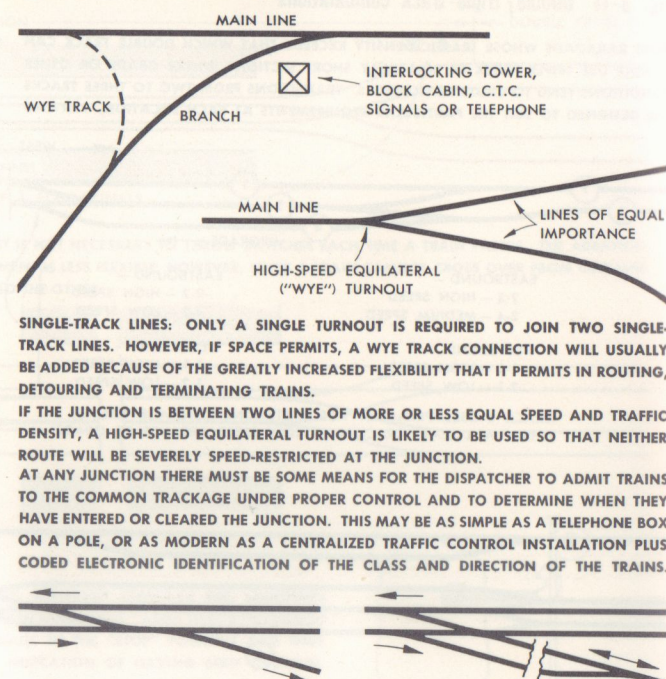
We tend to think of the railroad as a string of stations along a line and maybe a dead-end branch here and there, but few prototype railroads are so simple. One exception is the Richmond, Fredericksburg & Potomac, which runs from Richmond, Va., to Washington, D. C., and in its strategic position handles all the Seaboard Air Line and Atlantic Coast Line trains into the capital city with no worry about other main or major branch lines.

More typically, railroads are the results of mergers and years of expansion, and they form a network rather than a line. Secondary main lines are often almost as busy and as important as the principal line, and besides these are important lines between the mains, crossing them, or feeding treelike into a region of natural resources. Joining all these lines are the junctions.

As Fig. 3-14 notes, trackage at a junction is laid out to favor the unimpeded flow of traffic over the most important routes but using as few expensive and hard-to-maintain trackwork elements as practical — elements such as crossings, special turnouts, or slip switches. As the number of tracks in each of the various routes increases, the junction trackage becomes complicated quite rapidly. Such a junction is an excellent prototype to model both because of the beauty of the trackwork itself and because of the fascinating operating possibilities it provides.

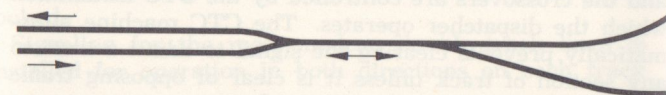
Flying junctions. The railroad equivalent of the highway cloverleaf is the flying junction, used in varying degrees of complexity to prevent delays at busy points. Fig. 3-15 shows a couple of typical examples. Like large passenger station throats, flying junctions are of such a size that they can be included in the smaller track plans only by making them the central theme of the whole railroad.

Fig. 3-14 Junction trackage

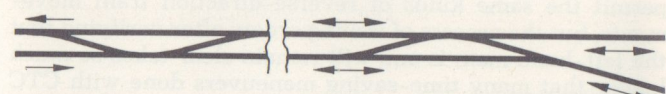


SINGLE-TRACK LINES: ONLY A SINGLE TURNOUT IS REQUIRED TO JOIN TWO SINGLE-TRACK LINES. HOWEVER, IF SPACE PERMITS, A WYE TRACK CONNECTION WILL USUALLY BE ADDED BECAUSE OF THE GREATLY INCREASED FLEXIBILITY THAT IT PERMITS IN ROUTING, DETOURING AND TERMINATING TRAINS. IF THE JUNCTION IS BETWEEN TWO LINES OF MORE OR LESS EQUAL SPEED AND TRAFFIC DENSITY, A HIGH-SPEED EQUILATERAL TURNOUT IS LIKELY TO BE USED SO THAT NEITHER ROUTE WILL BE SEVERELY SPEED-RESTRICTED AT THE JUNCTION. AT ANY JUNCTION THERE MUST BE SOME MEANS FOR THE DISPATCHER TO ADMIT TRAINS TO THE COMMON TRACKAGE UNDER PROPER CONTROL AND TO DETERMINE WHEN THEY HAVE ENTERED OR CLEARED THE JUNCTION. THIS MAY BE AS SIMPLE AS A TELEPHONE BOX ON A POLE, OR AS MODERN AS A CENTRALIZED TRAFFIC CONTROL INSTALLATION PLUS CODED ELECTRONIC IDENTIFICATION OF THE CLASS AND DIRECTION OF THE TRAINS.

DOUBLE TRACK TO SINGLE TRACK: JUNCTIONS OF THIS TYPE USUALLY ARE OF THE SIMPLER PATTERN (LEFT) WITH CROSSOVER FOLLOWED BY A SINGLE JUNCTION TURNOUT. THE LAYOUT AT RIGHT, REQUIRING AN EXTRA CROSSING, IS USED ONLY WHERE THE SLIGHT SAVING IN CONGESTION OF DOUBLE-TRACK TRAFFIC (RESULTING FROM HIGHER SPEEDS MAINTAINED BY TRAINS ENTERING FROM THE BRANCH) JUSTIFIES THE EXTRA TRACKWORK. IF THE BRANCH IS DOUBLE-TRACKED FOR A TRAIN LENGTH, A TRAIN ENTERING THE BRANCH CAN WAIT FOR ANOTHER WITHOUT FOULING THE DOUBLED MAINS.



DOUBLE TRACK TO TWO SINGLE-TRACK LINES: TWO TURNOUTS WILL DO THE JOB, BUT THE SECTION OF SINGLE TRACK CARRYING TRAFFIC FROM BOTH LINES IS A SERIOUS BOTTLE-NECK, PARTICULARLY UNDER TRAIN-ORDER OPERATION.



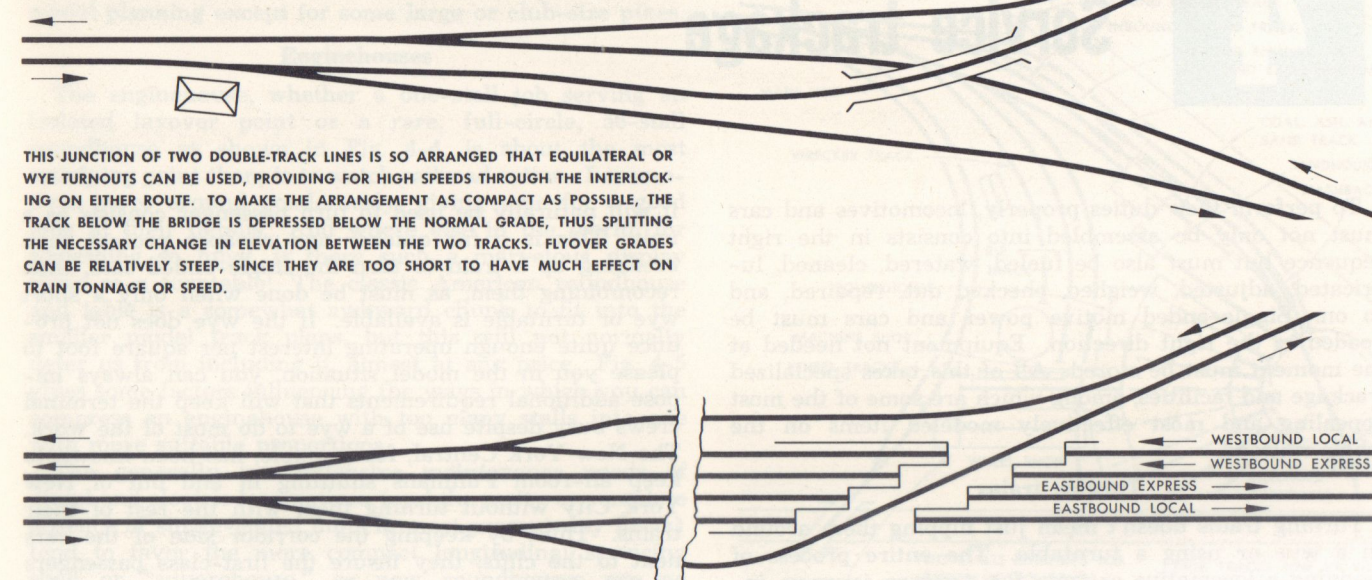
USING TWO CROSSOVERS, AS IN THIS EQUIVALENT ARRANGEMENT, GREATLY EXPEDITES SOME MOVEMENTS BY PERMITTING TRAINS TO MEET WHILE ACTUALLY IN THE JUNCTION. AS YOU WILL SEE BY SOME STUDY OF POSSIBLE TRAFFIC PATTERNS, IF THE DOUBLE-TRACK SECTION IS OPERATED ON AN EITHER-DIRECTION BASIS (AS IS POSSIBLE WITH C.T.C.), THE EXTRA TRACKAGE AT THE JUNCTION IS PARTICULARLY BENEFICIAL.

It is helpful to remember that, as in the prototype, it is practical to use steeper-than-average grades in a flyover because of their shortness — any train long enough to have difficulty with such a grade will not have all its weight on the ascent at any one time. By splitting the difference in elevation to be gained between the two tracks crossing each other and by using grades in the 3 to 5 per cent range, quite compact arrangements can result, and the impact of scenes like Fig. 3-16 may be within your grasp after all. Since flying or burrowing junctions make operations easier, they are generally installed on a model railroad for their appearance only. Operating interest is greater on level junctions.

Crossings. As the railroad network grows, it is inevitable that the various lines will cross each other frequently. This comes home to you quickly when you are trying to work out a track plan. There are only two ways that tracks can get across each other: at grade (meaning on the same level) or via an overpass with a difference in elevation of at least 20 scale feet. Aside from the desirability of including at least one level crossing on a pike for the sake of the pleasant clickety-clack it provides

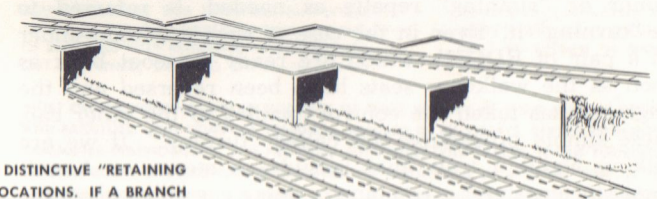
Fig. 3-15 Flying junctions

WHERE TWO MULTIPLE-TRACK, HEAVY-TRAFFIC LINES DIVERGE, THE FLYING JUNCTION OR "FLYOVER" IS OFTEN USED TO REDUCE THE CONGESTION THAT WOULD OTHERWISE OCCUR AT THE CROSSING OF THE INNER TRACKS AT THE JUNCTION POINT.



IN THIS JUNCTION A DOUBLE-TRACK LINE JOINS A FOUR-TRACK MAIN; HIGH-SPEED CROSSOVERS PERMIT BRANCHLINE MOVEMENTS DIRECT TO EITHER EXPRESS OR LOCAL TRACKS.

FOR THE SHALLOW-ANGLE CROSSING OF SEVERAL TRACKS, THE DISTINCTIVE "RETAINING WALL" BRIDGE IS EFFICIENT AND OFTEN USED IN CONGESTED LOCATIONS. IF A BRANCH ROUTE WERE TO GO BELOW TWO OR MORE OTHER TRACKS INSTEAD OF ABOVE THEM, YOU WOULD HAVE A "BURROWING JUNCTION."



and for the operating interest of trains delaying one another, it is difficult to avoid some intersections at grade. For reasonable realism, though, it is good to understand why a real railroad will minimize the number of times it must install a crossing at grade or even at different levels with another line or one of its own.

By law all trains must come to a complete stop before crossing another track at grade unless the crossing is protected by the signals of an interlocking plant. Since either alternative is expensive, a railroad will be particularly careful not to cross one of its own tracks without good reasons. When different railroads are involved, the "junior" road (the one that got there second historically) must bear, forever, the expense of the actual crossing (the crossing diamond or the bridge if grades are separated) and its protection. This may lead to some unusual arrangements, such as the provision of an interlocking plant for a weedgrown but "senior" branch because the junior road can't afford to stop its streamliners.

With us there's no question about who pays. It will be best, however, to try to make most crossings represent an intersection with another railroad. In general, at any crossing with a foreign road there will be an interchange track, as in Fig. 1-9, even if there is ordinarily little or no traffic passing from one line to the other at that point. The interconnecting track may also be worth its weight in gold on occasions where wrecks or other line blockages make detouring necessary. Prototype railroads often maintain elaborate maps showing all the wye connection tracks not only on their own lines but between other companies just so they can plan shoofly routes around a washed-out bridge or to get the second locomotive crane around to the far side of a serious wreck.



Philip R. Hastings.

Fig. 3-16. An eastbound Pennsy passenger train swings onto the alternate passenger route through Harrisburg, Pa., crossing the freight lines into Enola Yard on a picturesque flying junction combining steel girder and masonry retaining-wall bridges. Crossovers to let Buffalo-Enola freight traffic (passing from left to right in the middleground of this scene) cross the passenger line are located on the four-track stone Rockville Bridge. Mainline freight and passenger trains weave among a variety of separate alternate rights of way most of the way from here to Trenton, N. J.

Service trackage

To perform their duties properly, locomotives and cars must not only be assembled into consists in the right sequence but must also be fueled, watered, cleaned, lubricated, adjusted, weighed, checked out, repaired, and so on. Single-ended motive power and cars must be headed in the right direction. Equipment not needed at the moment must be stored. All of this takes specialized trackage and facilities, among which are some of the most appealing and most effectively modeled items on the whole railroad.

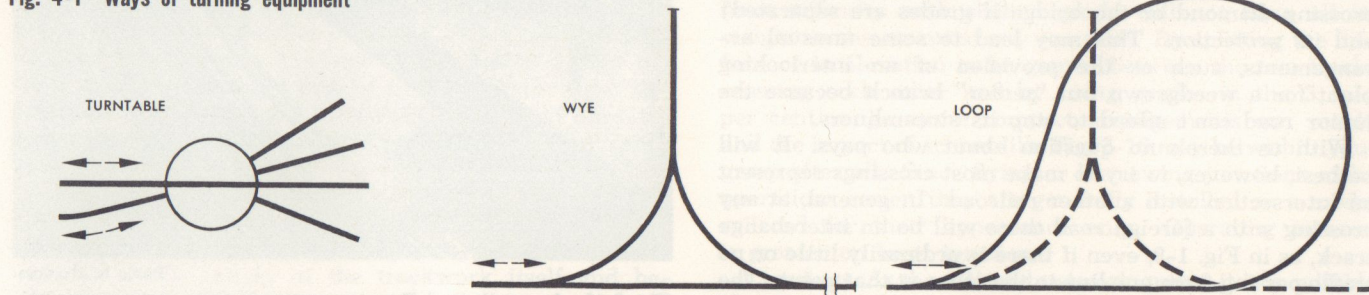
Turning trains

Turning trains doesn't mean just flipping them around on a wye or using a turntable. The entire process of readying a locomotive or train for a return journey, including cleaning, servicing, rearranging, and performing minor or "running" repairs as needed, is referred to as "turning" it. Even in the case of such a double-ender as a pair of RDC-1's which are ready to scoot back as soon as the walkover seats have been reversed and the engineer has taken the control handles to the other cab, these simple procedures are called "turning." If we are talking about a train that includes a steam or A-unit diesel locomotive,* a combine, a dome car or an observation car, or the normal single-ended snowplow, the process will include physically reversing this equipment (or the entire train). Fig. 4-1 points out the usual reasons for favoring a particular one of the three ways of doing this.

Most railroads will use both turntables and wyes (loops are relatively rare) at various points on their property. Where a wye is conveniently available, as at a junction,

*Even the road switcher (commonly called a Geep if it's EMD's version) often has engineer's controls on one side only. For long runs the engineer prefers to be on the right side of the train. Thus single-cab diesels that appear to be double-ended may have a preferred direction. Normally, the short nose goes first, but because the engineer would like to have the cab farther back (in case of an accident), a number of railroad companies order their road switchers specially arranged with the engineer's seat on the side that allows for running long nose first.

Fig. 4-1 Ways of turning equipment



BOTH IN PROTOTYPE AND MODEL, THE COST OF A TURNTABLE GOES UP RAPIDLY WITH INCREASES IN LENGTH, AND IT CAN HANDLE ONLY ROLLING STOCK WHOSE WHEELBASE IS LESS THAN ITS DIAMETER. AS THE MOST COMPACT METHOD FOR TURNING EQUIPMENT, IT IS THE NATURAL CHOICE FOR URBAN LOCATIONS, AND WHEN USED AT AN ENGINEHOUSE ITS ABILITY TO PROVIDE ACCESS TO ANY OF MANY STALLS CANNOT BE EQUALED.

THE THREE TURNOUTS OF A WYE COST LESS AND ARE MUCH MORE EASILY MAINTAINED THAN A TURNTABLE, SO THIS IS THE FAVORED METHOD WHEREVER SPACE PERMITS. IF BUILT AS PART OF A JUNCTION, ENTIRE TRAINS CAN BE TURNED AS A UNIT; IN CASES IN MODEL AND PROTOTYPE WHERE SPACE FOR AN ADEQUATELY LONG TAIL-TRACK MAY BE HARD TO COME BY, ONLY AN ENGINE OR VERY SHORT TRAIN CAN BE TURNED.

FOR A GIVEN RADIUS, THE LOOP TIES UP A LOT MORE REAL ESTATE THAN THE WYE AND HENCE IS QUITE RARE IN THE PROTOTYPE. IT IS THE FASTEST AND EASIEST MEANS OF TURNING COMPLETE CONSISTS OF VIRTUALLY ANY LENGTH AND HAS ONE PARTICULAR ADVANTAGE CAUSING ITS SELECTION IN HEAVY-SNOW TERRITORY: AN ENGINE AND PLOW CAN BE TURNED WITHOUT BACKING UP, MINIMIZING THE CHANCE OF GETTING STUCK IN DRIFTS.

it will naturally be used to turn passenger consists as a unit. This is a far quicker and cheaper process than breaking up a train to turn the single-ended cars, then recombining them, as must be done when only a short wye or turntable is available. If the wye does not produce quite enough operating interest per square foot to please you in the model situation, you can always impose additional requirements that will keep the terminal crews busy despite use of a wye to do most of the work. The New York Central, for example, has been known to keep all-room Pullmans shuttling in and out of New York City without turning them with the rest of their trains. Thus, by keeping the corridor side of the cars next to the cliffs, they insure the first-class passengers a view of the more scenic river side of the route along the Hudson and Mohawk.

Engine service facilities

The table on page 42 lists the principal items needed in servicing locos. In older steam days almost every division point could handle every item, except possibly item 13, the heavy "classified" repairs; engines required a great deal of attention even after running only 100 miles or so, and they went into the roundhouse after each trip. In the late steam and diesel eras (say from 1930 on), the technology was more advanced, and locomotives ran over many divisions with only minor servicing during stops. Switchers and local freight engines stayed out of the engine terminal for days at a stretch. It is thus quite reasonable to have a fairly large yard with minimal servicing facilities even though a large number of engines are turned and assigned there, all major items being taken care of elsewhere. Conversely, a railroad may locate almost all of its heavy periodic service work at some convenient central point through which much of its motive power will pass but where little or no train classification is done, and the yard is then relatively small.

This is fine from the modeling standpoint because it means that we can pick and choose those facilities we

want to emphasize in good conscience, while eliminating or shrinking those for which we do not have space. Figs. 4-2 and 4-3 show medium-size and large engine terminals. These facilities would generally be abbreviated in model planning except for some large or club-size pikes.

Enginehouses

The enginehouse, whether a one-stall job serving an isolated layover point or a rare, full-circle, 56-stall roundhouse as shown in Fig. 4-4, is about the most satisfying point there is to watch railroad action. Locomotives move around ponderously, giving time for a good look at their details. And where else in the world, for something so huge, is there such a marvelous display stand as a turntable! The classic American roundhouse and table is a somewhat awkward chunk to fit into the smaller model track plans, but this will not normally deter us from including it, almost at any price. Fig. 4-5 gives some factors influencing the ways in which you can compress an enginehouse with too many stalls into one with more suitable proportions.

The generally less extensive maintenance needs of diesel and electric locomotives (and the rarity or complete absence of single-ended units in most present-day fleets) tend to favor the more compact longitudinal servicing shed or "squarehouse," so new roundhouses are no longer built. Wherever a variety of motive power is to be handled—perhaps including single-ended units and engines from several railroads not operated together in a common pool—the benefits of being able to get any engine from its stall in one move are still considerable, and the roundhouse is likely to continue to serve the new era. Design of the diesel house has already pretty much settled down to the multilevel pattern shown in Fig. 4-6. Trackage should be arranged as in Fig. 4-3, to provide as many tracks, and as short tracks, as practical and thus at least approach the versatility of the old turntable-centered arrangement.

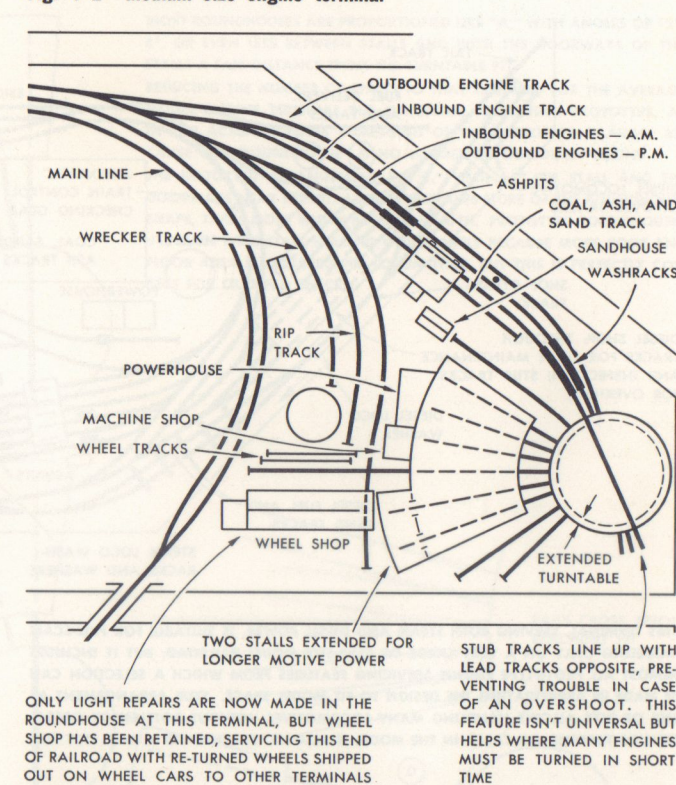
Engine terminal location

Access to the engine terminal is a matter of key importance in busy yards. It's not so much a matter of how far the engine must go, but rather a question of not fouling (or being blocked by) movements on the main line and on switching leads. If motive power is frequently changed at a division point, there will be two movements to the terminal for each train passing through. As the yard examples (Figs. 2-3 and 2-7) show, thoroughfare tracks and even flyovers may be necessary to get a smooth-working arrangement, particularly with the almost continuous flow of cars over the tracks leading to and from the hump.

In recent times, with extended engine runs, not so many trains changed motive power, and the principal traffic then became movements to the water, fuel, and sand facilities. The water tank or penstock located on the main track is a familiar sight. What may not be so generally remembered is the prevalence of trackside coaling stations right on the main line, such as shown in Fig. 4-7. These were preferably located at points where trains had to stop anyway, but were sometimes located in open country at points justified only by their convenience to the source of coal supply. In any case, the distance for through trains from the last previous fueling station had to be considered. Sometimes on small pikes we may not have space at any one location for an engine terminal complete with a track for the hopper cars serving the coal dock, ash facilities, and the rest. Locating the fueling station somewhere on the main line can solve the problem.

As Fig. 4-8 shows, if we are satisfied to stick to the essentials, fuel, sand, and water can be served—even to modern heavy motive power—in a very compact space.

Fig. 4-2 Medium-size engine terminal



MOST ENGINE TERMINALS BEAR EVIDENCE OF THEIR HISTORY IN THEIR PRESENT DESIGN AND FACILITIES. THIS COMPACT TERMINAL, HEMMED IN BY STREETS, SERVES RUSH-HOUR COMMUTER-TRAFFIC NEEDS. IT IS PROVIDED WITH THREE LEAD TRACKS TO THE TURNABLE SO THAT MANY ENGINES CAN BE RECEIVED OR DISPATCHED IN A SHORT TIME IN THE MORNING AND EVENING. THE PLANT HAS ALSO BEEN EQUIPPED WITH A LENGTHENED TURNABLE TO ACCOMMODATE LONGER LOCOMOTIVES NOW IN SERVICE ON THE DISTRICT, AND TWO STALLS WERE EXTENDED IN THE ROUNDHOUSE.

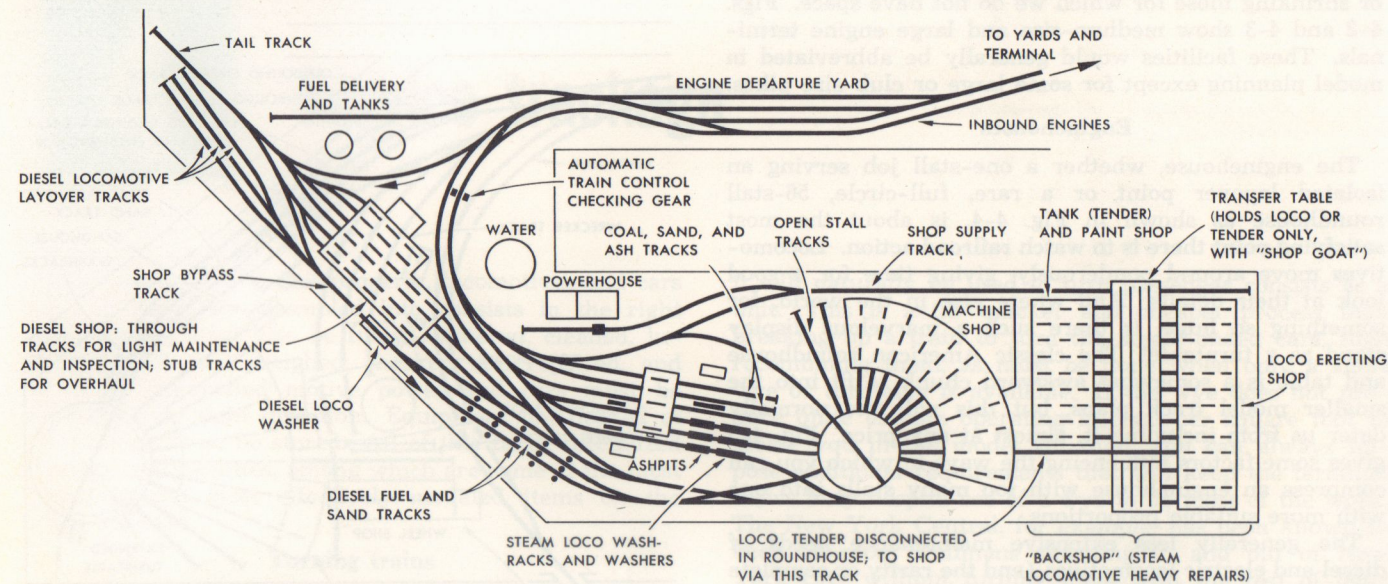
The primitive shovel, bucket, and crane arrangements at shortline and branch terminals are also space-saving and picturesque. So far as trackage is concerned, all such facilities are similar in that a minimum of two tracks are needed, one for delivering the coal and a parallel one for the engines to be served.

Repair facilities

Adjacent to yards and engine terminals at one or more points on the railroad will be shops for performing heavier repairs on the road's locomotives, the "back shops" which in steam days could (and on many roads frequently did) build a locomotive virtually from scratch. Chief distinguishing trackage feature at such points is the transfer table, which serves parallel erection stalls in the same way that the turntable feeds locomotives into and out of the radial roundhouse track. Back shops must have an overhead bridge crane to handle boilers and to set locomotives back on their wheels. The craneway requires a rectangular building and parallel transverse tracks which in turn call for the transfer table, if more than a very few stalls are to be served efficiently.

As Fig. 4-3 indicates, heavy passenger car repairs are also made in shops arranged similarly. For model purposes the shops could be combined. A full-scale heavy repair shop with 20 or more bays (tracks for work) is more or less out of the question unless it is to be the one big feature of the whole model railroad. A four- or five-track building can give an excellent representation of all the necessary movements in shopping rolling stock, and will take much less space. Heavy freight car repairs carried out on much larger groups of units are often done on an assembly-line basis extending for a half mile or more. This is usually indoors. In the model we will

Fig. 4-3 Club-size engine terminal



THIS TERMINAL, SERVING BOTH STEAM AND DIESEL POWER, IS SUITABLE FOR FULL-SCALE MODELING ONLY ON A VERY LARGE OR CLUB-SIZE MODEL RAILROAD; BUT IT INCLUDES ALMOST ALL PROTOTYPE ENGINE SERVICING FEATURES FROM WHICH A SELECTION CAN BE MADE IN ABBREVIATING THE DESIGN TO FIT MODEL SPACE. STUB ARRANGEMENT AT END OF WYE ALLOWS HANDLING MANY LOCOMOTIVES WITHOUT BOTTLENECK OPERATION OF TURNING ON TABLE; IN THE MODEL IT ALLOWS TERMINAL TO BE LAID OUT FOR

VIEWING FROM ALL SIDES. ESSENTIAL OPERATING INTEREST OF TRANSFER TABLE SERVING SHOP COULD BE OBTAINED IN MUCH LESS SPACE BY ELIMINATING SHOP ON ONE SIDE, REDUCING NUMBER OF TRACKS SERVED TO AS FEW AS FOUR OR FIVE. HEAVY PASSENGER-CAR REPAIR SHOPS ARE GENERALLY SIMILAR IN ARRANGEMENT TO THIS LOCOMOTIVE BACKSHOP, USING TRANSFER TABLE TO GIVE READY AND COMPACT ACCESS TO MANY TRACKS.

usually stick to the track provided for light repairs. These are found at many points on the prototype. Such "rip tracks" are located near the receiving tracks where incoming trains are inspected. Paved areas are provided at each side of each rip track for convenient jacking up of

the car bodies for work on trucks, brake rigging, or draft gear. A wild clutter of tools, wood blocking, welding and cutting gear, and new and old car parts are often strewn on these work spaces. If you're a typical model railroader, you have a higher percentage of unserviceable

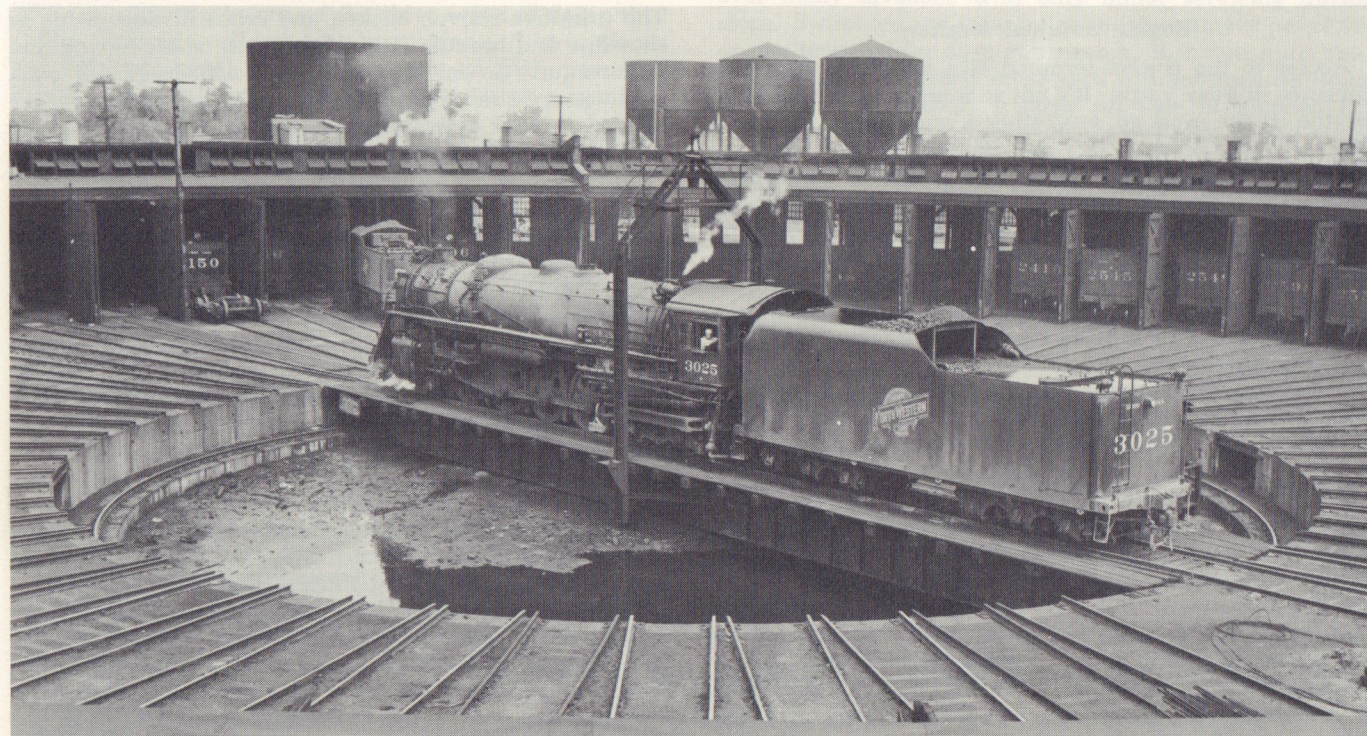
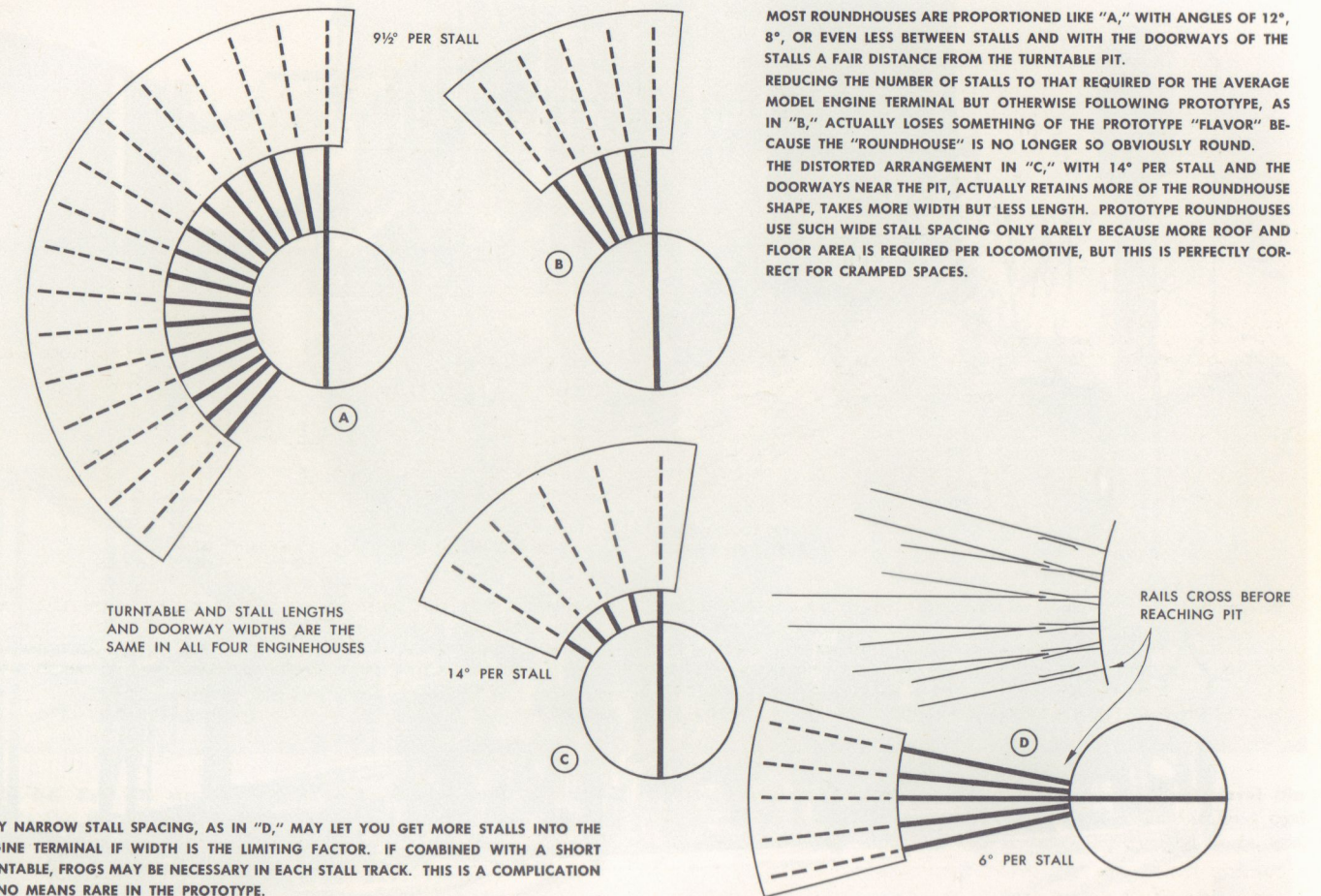


Fig. 4-4. Chicago & North Western's roundhouse serving Proviso Yard was built exceptionally large, extending over a full circle except for a narrow slot through which the lead tracks enter. Radial-stall plan is fine for steam locomotive servicing because it provides the most space between tracks at the front of the locomotive, where most of the maintenance (to cylinders, running

gear, smokebox) is required. If even more than the 56 stalls of this enginehouse were required, two separate half-circle houses with separate turntables would be preferred, because getting locomotives into and out of too many stalls with a single turntable would become a bottleneck at rush periods. Double turntables have been used at Selkirk, N. Y., on the NYC, among others.

Fig. 4-5 Condensing a roundhouse



VERY NARROW STALL SPACING, AS IN "D," MAY LET YOU GET MORE STALLS INTO THE ENGINE TERMINAL IF WIDTH IS THE LIMITING FACTOR. IF COMBINED WITH A SHORT TURNTABLE, FROGS MAY BE NECESSARY IN EACH STALL TRACK. THIS IS A COMPLICATION BY NO MEANS RARE IN THE PROTOTYPE.

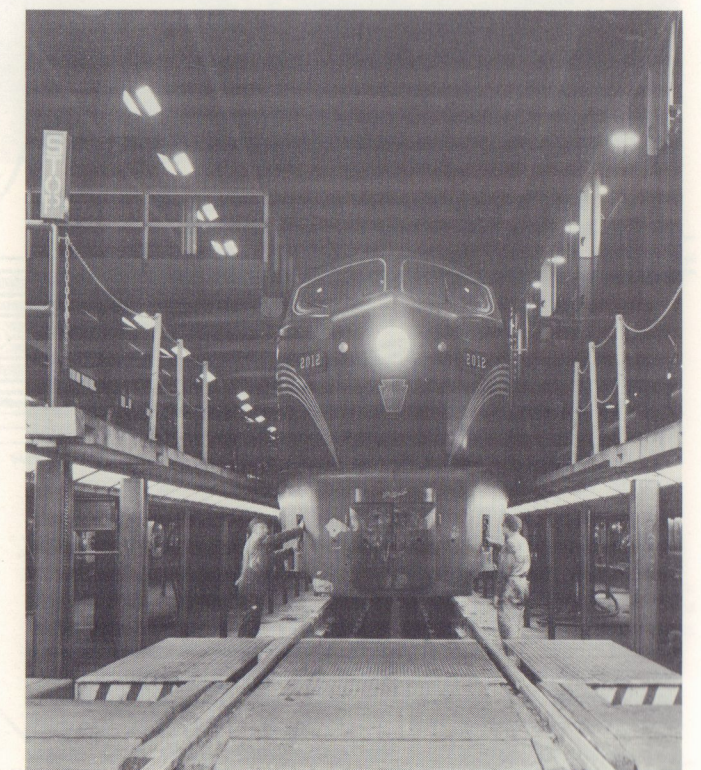
(or marginally serviceable) equipment than even the less affluent class 1 railroad, and you already have more than enough squirreled-away new and old car parts to represent the wild clutter. So, it might not be a bad idea to provide a working-model rip track at some handy, well-lighted location, complete with a hook near by for your NMRA gauge and other nonprototypical but essential model tools.

Coach yards

Passenger train cars, unless serviced right on the station track at the terminal, will lay over in a coach yard between runs. Fig. 4-9 shows a typical arrangement associated with a stub terminal handling both through and commuter trains. Fig. 4-10 shows the platforms provided for servicing cars in the Washington Terminal coach yards. As the second largest in the country, these aren't exactly typical of what the average model railroad should copy literally, but the principle of either-end access to each coach track from thoroughfare tracks leading directly to the station approach tracks is applicable.

Other service trackage

Tracks needed for other aspects of service to trains and the commodities they carry tend to be associated with particular classes of cars. For the wreck train and the snowplow, for example, a ready-storage track near the engine terminal is needed. While in these days when wrecks are happily few it is no longer practice to keep steam up in the wrecking crane, it is still necessary to be able to face the crane promptly in the right direction to pick up a spill, in whichever direction from the division point it may occur. The first available motive power will be used to get the crane to the scene.



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Fig. 4-6. Typical diesel shop provides four levels for mechanics: the pit, the basement, the main floor, and an overhead porch. The steel plates in center foreground will be raised to provide a continuous walkway on the main floor. They are lowered only to permit entry and exit of locomotives.



Fig. 4-7. This Western Maryland passenger train stops for water right on the main line. It passed up the coal dock only because it has been converted to burn oil to meet a Baltimore antismoke ordinance. Freight hogs frequently replenished their fuel supply

Caboose tracks

Since most working contracts call for the individual assignment of cabooses to train crews, the amount of switching involved the country over in getting the cabin on and off the train* at each crew change point is astronomical, painful to the railroads, but a wonderful source of interest to us, in having a reason both for building lots of colorful crummies and for moving them around the yards frequently. The expense of this shuffling causes the real roads to locate caboose tracks carefully, often near the receiving yard so that the cabin cars can be cut off on the fly and rolled in without a switcher's attention. Separate tracks are provided for the cars from the different divisions operating out of a yard. They are usually double-ended tracks so the cars work their way down

*In the case of expedited trains, some roads have negotiated modified work rules with the brotherhoods to permit cabooses to run through under particular circumstances. The Pennsylvania, for example, identifies its cabin cars in pooled service by painting the cupola bright yellow to facilitate handling them correctly in yards.

while on the high iron. This became a reasonably common practice in the later years of steam power, when engines spent more of their life hauling trains and visited division-point engine terminals only after extended runs.

the track in the same first-in, first-out basis on which their crews are assigned.

In planning a model yard to provide for caboose-handling without too much lost motion, it should be remembered that the frequently seen model railroad practice of backing the entire consist of a through freight onto the caboose is not standard in real life. Not only is it uneconomical to move the whole train instead of the one car, but it also is much more likely to result in knocking over the coal scuttle, oilcan and conductor—besides not doing the radio equipment or the contents of the refrigerator any good in the case of the modern luxurious tail-end cars. More properly, a switcher should be used to tack the caboose in its place on the train, and terminal trackage should provide for its movement.

Icing and stock-resting

As was mentioned in chapter 2, train consists must be arranged for efficient icing of refrigerator cars. Typical en route icing platforms are located between two parallel tracks to serve both tracks and are convenient to the main

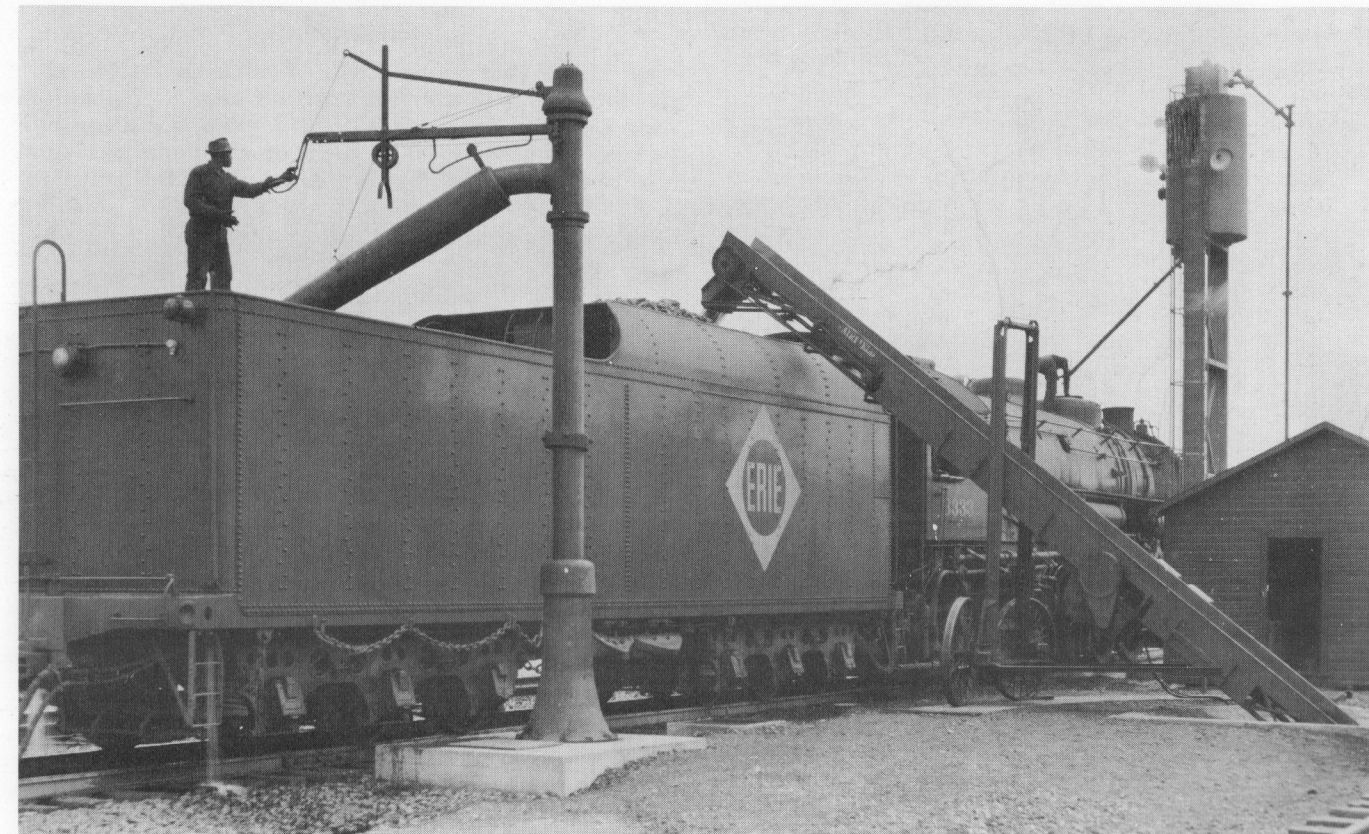
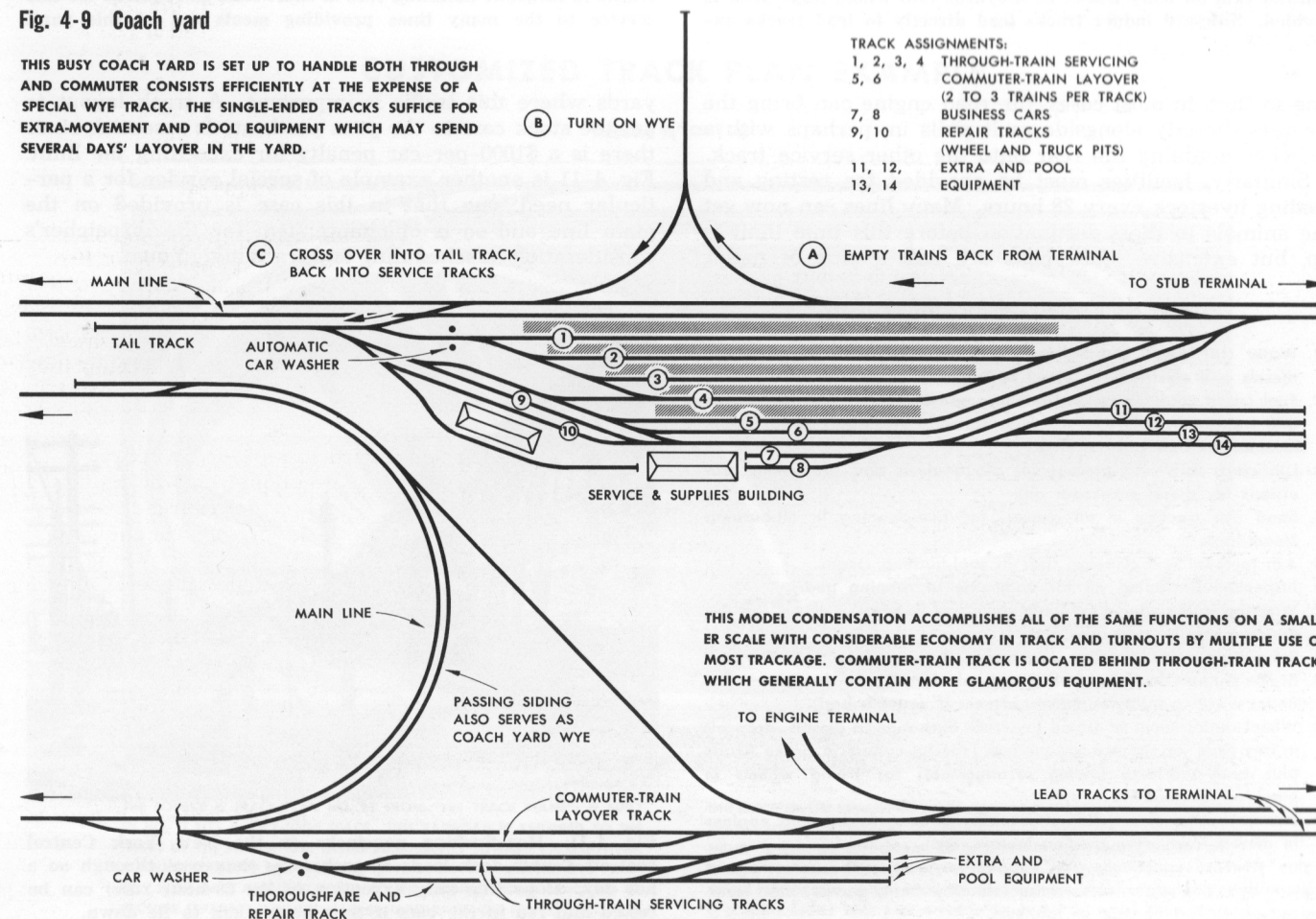


Fig. 4-8. Erie RR. straight-line servicing facility at Marion, Ohio, feeds the S-2 Berkshire water, coal, and sand at one spotting. Bucket-and-belt loader moves the coal directly from a below-

track hopper to the tender without intermediate high-level bin storage. This isn't as photogenic as the big timber-framed coal docks more often modeled, but it takes less space, costs less.

Fig. 4-9 Coach yard

THIS BUSY COACH YARD IS SET UP TO HANDLE BOTH THROUGH AND COMMUTER CONSISTS EFFICIENTLY AT THE EXPENSE OF A SPECIAL WYE TRACK. THE SINGLE-ENDED TRACKS SUFFICE FOR EXTRA-MOVEMENT AND POOL EQUIPMENT WHICH MAY SPEND SEVERAL DAYS' LAYOVER IN THE YARD.



THIS MODEL CONDENSATION ACCOMPLISHES ALL OF THE SAME FUNCTIONS ON A SMALLER SCALE WITH CONSIDERABLE ECONOMY IN TRACK AND TURNOUTS BY MULTIPLE USE OF MOST TRACKAGE. COMMUTER-TRAIN TRACK IS LOCATED BEHIND THROUGH-TRAIN TRACKS WHICH GENERALLY CONTAIN MORE GLAMOROUS EQUIPMENT.



Fig. 4-10. Coach yards serving Washington Union Station are located within the wye track used to turn entire passenger train consists. Note narrow concrete platforms located to serve both sides of cars on body tracks in subyards into which huge yard is divided. Subyard ladder tracks lead directly to lead tracks ex-

tending to station just below national capitol dome in distance. Buildings at left are commissary for dining cars and laundry for Pullman Co. Dining-car yard behind commissary has many short tracks to facilitate handling cars in short cuts, as required for this service to the many lines providing meals out of this yard.

Linn H. Westcott.

line so that, in most cases, the road engine can bring the freezers directly alongside as it pulls in, perhaps with a switcher doubling the rear onto the other service track.

Similarly, facilities must be provided for resting and feeding livestock every 28 hours. Many lines can now get the animals to their destination before this time limit is up, but extensive stock pens are still a part of major

ENGINE SERVICING FACILITY REQUIREMENTS

1. Water (for steam locomotives; for train-heat boiler in passenger diesels and electrics; for diesel radiators).
2. Fuel (sized coal for stoker-fired locomotives; diesel fuel for diesels and train-heat boilers on electrics; Bunker C (residual) oil for steam locomotives and gas turbines).
3. Lubricants (oils and greases for all; analysis and re-refining provisions for diesel crankcase oil).
4. Sand (for traction in all classes; for flue-cleaning in oil-burning steam locos).
5. Ash removal and cleaning fires in coal-burning steam.
6. Inspection (including pit for underside of running gear).
7. Washing and cleaning (running gear and exterior).
8. Running repairs and adjustments.
9. Reversing engine direction — turntable, wye, or loop.
10. Brake, automatic train control, and cab-signal gear check.
11. Boiler wash (monthly minimum, oftener if water is bad).
12. Wheel replacement or truing (by truck exchange in diesels, drop pit in any type, or Lidgerwood method [special cutters in brake heads plus back-and-forth towing arrangement] for truing wheels in place on locomotive).
13. Heavy repairs or rebuilding (retubing boilers, substituting engines in diesels, rewinding traction motors, etc.).

Engine terminal commonly also supplies services such as turning of single-ended passenger cars, steam standby heat, power, and compressed air to rest of yard or terminal.



Rail Photo Service: S. K. Bolton Jr.

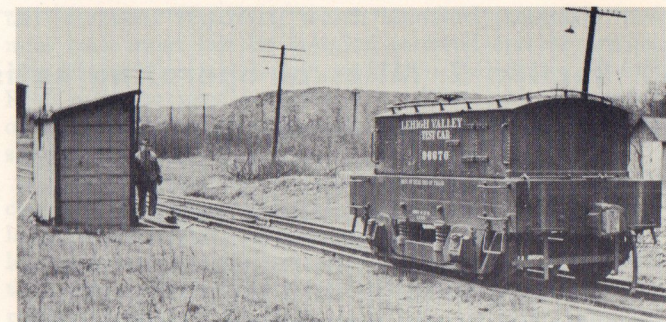
Fig. 4-11. Hog-flushing penstocks on the New York Central cool off double-deck loads of porkers as they pass through on a hot day. Hogs (the only exception to the 28-hour rule) can be rested and fed in the cars if they have room to lie down.

Car weighing

Since cars must be weighed before they reach their destination or before leaving the rails of the originating line, track scales are a part of the scene at yards both large and small. In all cases, a short section of gantlet track, Fig. 4-12, crosses the scale so that engines and non-weighing traffic are kept off the weigh-rails themselves. Calibration of the scales is a legal matter, of course, since it is the basis not only of the freight charge but in many cases of the sale of the commodity as well. There is therefore a complicated procedure starting with the scale-test cars of the National Bureau of Standards which are weighed on the bureau's scale in Chicago. These cars are carried in a special boxcar; they are not allowed to roll on their own wheels. They are used to calibrate 19 master scales throughout the country, and the master scales in turn weigh the little four-wheel scale-test cars owned by the various railroad companies. Hauling these, always on the rear of the train, to the location of every scale on the line completes an interesting operation which you can duplicate with one test car and a scale or two on your pike.

Car storage

Another "service" which the railroads would like to do without but which is as inevitable as hauling empties is that of storing cars which are not needed at a given place or season. The cars must be kept on trackage somewhere since they simply won't disappear until wanted. Also, strategically located track space must be available to build up a reserve of boxcars or reefers for such rushes as the grain harvest on the Great Plains or the potato season in California's Kern County. The roads will first use available industry and yard tracks and then passing tracks, or even second main tracks if traffic conditions



Linn H. Westcott.

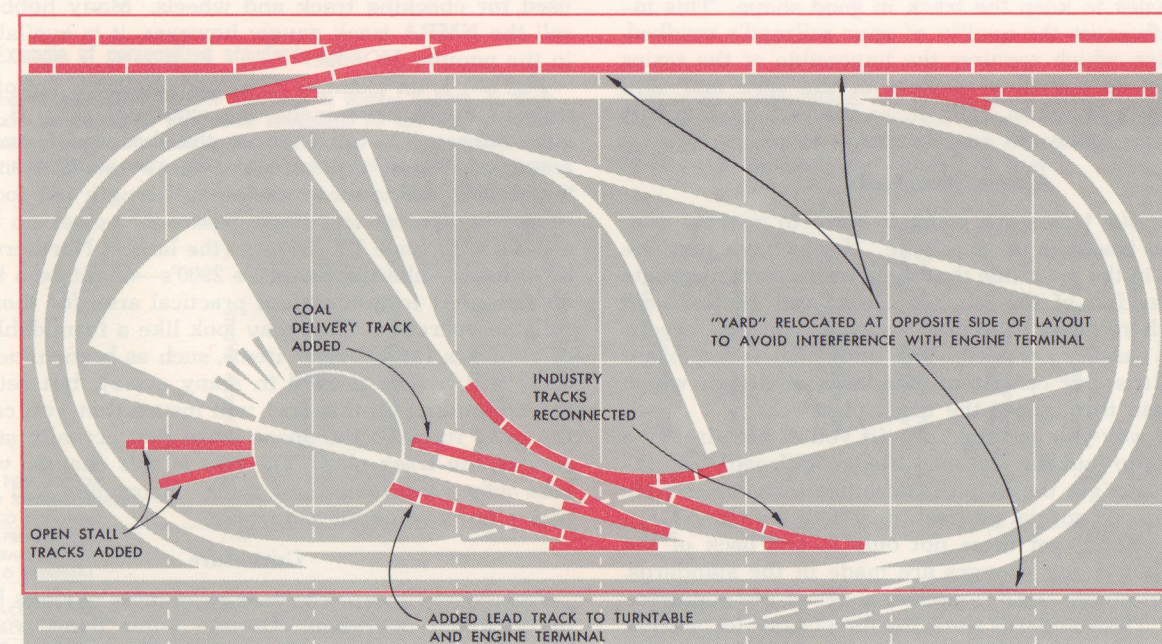
Fig. 4-12. Rather antique-style scale-test car being used to calibrate the Lehigh Valley's track scale at Delano, Pa., in the hard-coal country. To avoid changes in weight, scale-test cars have only hand brakes so brake shoes will not be worn away as car is hauled in regular trains. Brake pipe passes directly through car, allows it to be hauled immediately ahead of caboose, its proper place in the train on most roads. Switchpoints at each end of scale track direct cars to be weighed onto "live" rails of gantlet, keep great weight of locomotives off the scale on "dead" rails.

will permit. If this isn't enough, storage yards will have to be built. These are often single-ended to minimize the capital investment in such unproductive trackage and are usually found in the country or at least in a low-rent area.

We are a little better off in the model, since we can set excess cars on the shelf. It is more fun, more realistic, and easier on the fine detail, however, to do it honestly whenever possible and provide storage trackage. Combining out-of-sight storage and the illusion of interchange with another railroad is a good way of making the best of the matter.

CUSTOMIZED TRACK PLAN EXAMPLE

Scale: 3/4" = 1'-0"



THE SOURCE IS TRACK PLAN NO. 25 FROM "101 TRACK PLANS"; IF BUILT IN HO, IT FITS A 4 x 8-FOOT SPACE. THIS RAILROAD IS TAILORED TO THE NEEDS OF THE MAN WHOSE TASTES RUN HEAVILY TOWARD LOCOMOTIVES. A ROUNDHOUSE OF THIS SIZE WILL HAVE DIFFICULTY FUNCTIONING PROPERLY WITH ONLY ONE LEAD TRACK, SO THE MODIFICATIONS INDICATED TO PROVIDE SEPARATE INBOUND AND OUTBOUND TRACKS FOR LOCOMOTIVES APPROACHING THE TURNABLE ARE ADVISABLE. MOST ROADS END UP FILL-

ING MUCH OF THE REMAINING SPACE AROUND THE TABLE WITH OPEN STALL TRACKS FOR MORE ENGINES, SNOWPLOWS, AND OTHER INTERESTING EQUIPMENT. A FURTHER REFINEMENT IN INCREASING THE ENJOYMENT OF THE ENGINE TERMINAL SCENE WOULD BE TO MOVE THE SMALL YARD TO THE OTHER SIDE OF THE LAYOUT, THUS BRINGING THE ROUNDHOUSE OUT WHERE IT IS MORE EASILY SEEN AND APPRECIATED IN ALL ITS DETAIL AND OPERATING INTEREST.

Section 2: Miles of operating satisfaction on feet of track

Taking prototype operation and developing a practical model railroad track plan which will allow you to duplicate the operation is basically a matter of making a series of intelligent compromises, since a real railroad, even the shortest, is too long to be scaled down directly. The ensuing chapters present an orderly method for working out the track plan that's best for you, along with a few ideas that help get the most and best operation into any given space.

Few of these tricks, of course, will be usable "as is" in any particular case, especially if your desires or space are on the unusual side, but they may serve as springboards to help you invent some of your own. We will even suggest some ways in which you can cheat a bit here and there and get away with it — and we will point out some apparently innocent things about track alignment which could cause trouble.

5

Operating reliability through standards

If the trains don't stay on the track or run smoothly, you are not going to get much operating satisfaction out of your pike, no matter how big and beautiful it may be. Reliable operation requires two things: well-constructed and adequately maintained track and rolling stock, and a track plan that has standards of curvature, clearance, and so on that are appropriate for the period and nature of the railroading you're after.

Ways to construct and maintain track and equipment properly are outside the scope of this book, though we will have a bit to say about the way layout design can make it easier to keep the track in good shape. This indirectly influences the quality of your railroad's roadbed. A track plan which requires the impossible of the trains will always be a pain regardless of the care and skill which may be lavished upon it, so we will go into this aspect of the matter in some detail.

A set of standards

Most of your trains are going to have to operate over most of the trackage of your pike. If you have just one sharp kink in the main line that some trains can't negotiate reliably, the fun of the whole railroad can be lost, and space which you may have used elsewhere for big, sweeping curves has been wasted. The thing that is important is to have a set of consistent standards of design which you maintain throughout the track plan.

The best way you can start out (if you're not already a member) is to join the National Model Railroad Association* and thus get the helpful literature that comes with membership. Of special interest to us here are the NMRA Standards. You'll get these not only in the back of the Yearbook but if any changes are made in the standards, you also get an 8½" x 11" looseleaf sheet of the standards as revised. The standards show the dimensions for wheels, track, and other things that must be interchangeable throughout the hobby. The NMRA's Recommended Practices also come to you in the Yearbook and in looseleaf sheets. They discuss the problems of curve radii, distances between tracks, turnout design, car weight, and other

*For information, write office manager Bob Bast, P.O. Box 1328, Station C, Canton, OH 44708.

things pertaining to reliable operation. They help you build a successful layout on the first try. Both the Standards and the Recommended Practices are of prime importance. The NMRA also issues several Data Sheets to its members each year, and you can get the older sheets at a modest cost. These are very helpful, as they discuss both prototype and model designs of bridges, roadbed, scenery, foliage, equipment, and many other things that affect realism on your pike.

There is one thing you can get whether or not you are an NMRA member, and this is the NMRA's metal gauge used for checking track and wheels. Many hobby shops sell the NMRA track gauge; however, it is available only in the popular HO size.

Fig. 5-1 is an example of a "personalized" set of standards. I could have made the example in O, S, TT, or any other scale, but I chose this because it would be among the most typical. It is for a medium-sized HO layout intended to accommodate full-length (85-foot) passenger equipment and steam passenger power up through 4-8-4's with scale 73" drivers (the largest Northerns, with 80" wheels—like the Santa Fe 2900's—might be a bit tight on this line) in a minimum practical area for thoroughly reliable operation. This may look like a formidable array of numbers (and several items, such as branchline standards, will not be needed in many cases), but setting all the minimums up this way will insure that you can pack the most fun into the space when you actually start designing the track plan. The rest of this chapter will discuss why each item is of some importance and how to pick a good value for your pike.

Curvature

Excessively sharp curves are the most obvious barriers to satisfying operation. On the other hand, you can't adopt any amply big radius arbitrarily and thereby have a good track plan. This is because an excessively large curve radius seriously limits the amount of interesting railroading you can design into your space. Radii, therefore, deserve the most serious consideration, and we need to go into the subject in depth.

Equipment characteristics versus curvature. The

NMRA Recommended Practices sheet No. RP11 suggests minimum radius values in all popular scales for 14 different equipment classifications ranging from traction lines with single-car operation up through trunkline steam railroads with 4-12-2's on their rosters. The recommendations are conservative figures for the most part, but should be followed if you expect to have much visiting equipment operating on your pike. With these curve recommendations almost anyone's rolling stock can be accommodated comfortably if it is of the general type for which your railroad is planned. Club layouts, naturally, should use these minimum figures or better. On the other hand, for an individually owned pike where "foreign" equipment is not an important factor, it may be desirable to cheat a little. So, let's see how curves cause trouble.

Fig. 5-2 shows that there are two rather different effects that cause problems, and that the problems caused are related to different characteristics of the rolling stock being rolled through them. The effects of sharp curvature are associated mostly with the behavior of individual cars and locomotives — when the curve gets too sharp for an eight-coupled steam locomotive, for example, the drivers simply bind and won't go through the curve smoothly; they may derail or may actually move the rail out of gauge. Likewise, you may have quite a time modifying the gear underneath an 85-foot Pullman so that the trucks won't interfere with center sill, steps, or other underbody detail when rounding a 22" radius curve in HO or its equivalent in your scale. You can go only so far in overcoming this effect before you depart from scale more than is generally acceptable. For example, to get our full-length Pullman around an 18"-radius curve, it would be necessary to eliminate its center sill completely in the area where the trucks swing, and it would probably be necessary to raise the whole body away from the wheels considerably more than it should be for reasonably scale appearance.

It may also be necessary to avoid coupling long and short cars directly together if they are to get around such excessively sharp bends. This isn't necessarily bad. Even the Pennsylvania RR. has to have rules on cer-

tain divisions regarding which standard passenger and m.u. cars must not be coupled to head-end or freight cars below a certain length, so if you find that a 60-foot RPO must be used between your diner and the tender of one class of your passenger locomotives you may be strictly prototypical.

Changes of curvature. Changes from straight track to curved or between curves of different radii, and particularly reverse curves, can cause similar mechanical problems even between identical pieces of rolling stock, and they can maximize the mismatches between varieties of rolling stock.

Well, these are the problems. Let's see what we can do to alleviate them.

Easements. It is relatively simple to relieve the problem of change of curvature and there are several ways to do it without using up too much layout space. In the case of the reverse curve, some straight track can be inserted between the curves. A curve of intermediate radius (or even a turnout, as we'll soon see) can be placed between straight and curve. The professional way to do these things, however, is to use a "spiral" or "transition curve." This is merely a curve with gradually increasing radius that is inserted between tangent (straight track) and circular curve. As Fig. 5-3 illustrates, the amount of lurching associated with a curve of a given sharpness can be drastically reduced by the use of such easements. The improvement is so great that operation is better with the sharp but eased curve than with a more gentle (and much more space-consuming) curve which springs directly from the straight track.

Therefore, transition spirals are a real bargain in space, appearance, and performance. They let you get away with the minimum curve radius which your longer cars can negotiate. This is particularly true if passenger cars with diaphragms are your weakness, even if the diesel (or small steam) power with which you haul them is otherwise capable of getting around the sharp curves handily. For all equipment, easements greatly improve the appearance of trains as they enter curves. In chapter 8 we will show how to allow for easements in laying out mainline

Fig. 5-1 Example of personalized standards table

IT WOULD SERVE NO PURPOSE TO PRESENT THIS TABLE IN SEVERAL GAUGES, AS EACH MODELER SHOULD SELECT CURVES AND TRACK STANDARDS TO SUIT NOT ONLY HIS CHOSEN GAUGE BUT ALSO HIS CONCEPT OF WHAT EQUIPMENT WILL BE OPERATED AND HOW HE MUST ADAPT TO HIS SPACE. HOWEVER, FOR ROUGH COMPARISON, THIS TABLE

IS FOR AN HO GAUGE RAILROAD. YOU MAY DOUBLE THE INCH MEASUREMENTS FOR AN O OR Q GAUGE COMPARISON, OR YOU MAY ADD ONE THIRD FOR S GAUGE, OR TAKE TWO THIRDS OF THE FIGURES FOR ROUGH TT GAUGE COMPARISON. TURNOUT SIZES AND PER CENT OF GRADE WILL BE THE SAME FOR ALL GAUGES.

	MINIMUM RADIUS	MINIMUM LENGTH EASEMENT	MINIMUM TURNOUT NO. (SINGLE) ¹	MIN. TURNOUT NO. (CROSSOVER)	MIN. TURNOUT NO. (LADDER TRACK) ²	MIN. TRACK CENTERS ON TANGENT	MIN. TRACK CENTERS ON MIN. CURVE	S-CURVE MINIMUM STRAIGHTAWAY	MAX. GRADE ON MOUNTAIN DIVISION OR HILLY DISTRICT	MAX. GRADE ON BALANCE OF MAIN LINE	MAX. MOMENTUM GRADE (FLYOVER, ETC.)	MIN. VERTICAL CLEARANCE ³	NORMAL VERTICAL CLEARANCE ³
MAIN LINE — FIRST TRACK; PASSENGER STATION TRACKS; STEAM LOCO TERMINAL	24"	16"	5 ³	6 ⁵	6	2¼"	2¼"	12"	4.0%	1.3%	3.0%	3"	3½"
MAIN LINE — FREIGHT-ONLY PASSING TRACKS; DIESEL LOCO TERMINAL	21¾"	14"	5	5	5	2¼"	2¾"	8"	4.0%	1.3%	5.0%	3"	3½"
BRANCH LINE	18"	12"	4	5	—	2¼"	2¾"	10"	—	2.5%	—	3"	3½"
INDUSTRY TRACKS — ROAD	18"	—	4	4	4	2¼"	2¾"	6"	—	—	6.0%	3"	3½"
INDUSTRY TRACKS — CITY	12"	—	3	4	—	2"	2½"	6"	—	—	8.0%	2¾"	3½"
FREIGHT YARD	36" ⁴	—	4	5	5	2"	2"	—	—	0.5%	—	—	—
FREIGHT YARD SWITCHING LEADS	24" ⁷	16"	5	5	5	2"	2¼"	10"	—	1.0%	—	—	—

- 1 WYE TURNOUTS — NO. 4 ON MAIN LINE, NO. 3 ELSEWHERE. SPECIAL TURNOUTS PERMITTED WHERE NEEDED; RADIUS TO MATCH MINIMUM CURVATURE STANDARDS.
- 2 ALSO APPLIES WHERE CONNECTING TWO PARALLEL TRACKS AT MINIMUM TRACK CENTER SPACING.
- 3 RAILHEAD TO RAILHEAD WHERE ONE TRACK CROSSES OVER ANOTHER; ACTUAL MINIMUM CLEARANCE ABOVE RAIL TO BE 19 SCALE FEET ON AT LEAST ONE TRACK AT ALL

- 4 POINTS ALONG MAIN LINE, 16% SCALE FEET ELSEWHERE.
- 5 FOR APPEARANCE RATHER THAN OPERATION.
- 6 APPLIES WHERE MAIN ROUTE GOES THROUGH CURVED LEG OF TURNOUT.
- 7 2" WHERE NO CROSSOVERS ARE INVOLVED.
- TO PROVIDE RELIABLE OPERATION PUSHING LONG CUTS OF CARS.

trackage. Incorporating them is easy, and from here on in we are going to assume that you will use them generally.

Curvature classes. The variety of classification of rolling stock and associated curve radii listed in NMRA's RP11 is a bit bewildering for everyday use, so most pikes can be divided roughly into three different classes as far as their minimum curve radii are concerned:

	N	TT	HO	S	Q*	O*
BROAD CURVES	17"	22"	30"	41"	54"	58"
CONVENTIONAL CURVES	14"	17"	24"	32"	43"	46"
SHARP CURVES	11"	13"	18"	24"	33"	35"

No harm is done in rounding out the figures an inch or so for convenience, such as using 18" for 17" or using 36" for 35".

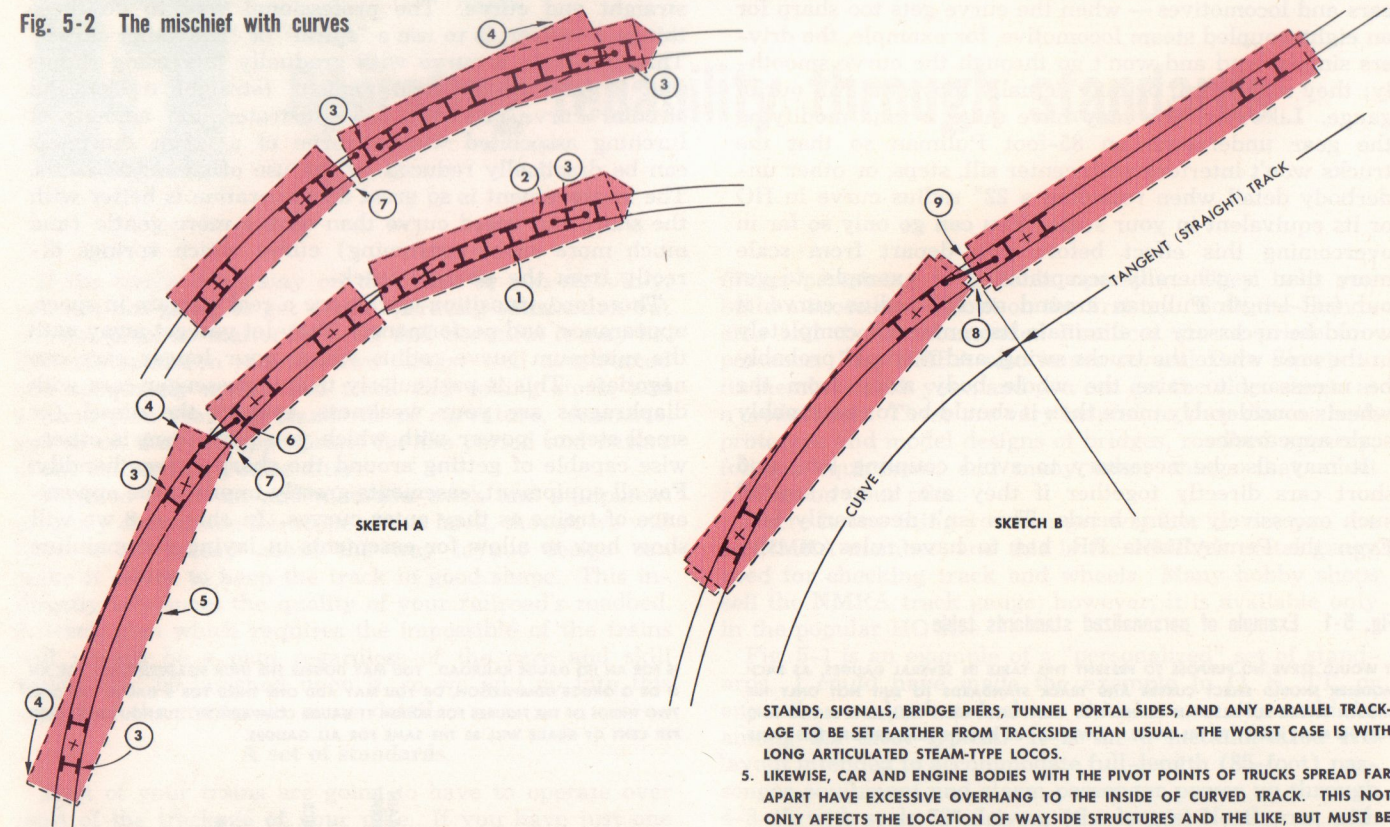
*It is doubtful that a distinction need be made between Q gauge and O gauge on such an arbitrary matter as the limits of classes of curves. However, there are other areas where the distinction is more important. In 1/4" scale, O gauge corresponds to a track gauge of 5 feet between railheads instead of the standard 4'-8 1/2"

Broad curves can take full-length passenger cars and virtually all classes of motive power, including articulated steam locomotives, with a minimum of tinkering with running gear or scale proportions. Appearance of all trains is much better than on less generously proportioned track.

Conventional curves can take full-length passenger equipment gracefully only if the curves are provided with easements and if some rolling stock is worked over to

of the prototype. Therefore, any attempt to reduce prototype dimensions for standard-gauge turnouts and certain other trackage will produce a small but noticeable error if 1/4" scale is used for O gauge: The frog angle will come out wrong and the closure rail curve will not be able to follow prototype location. For reducing prototype track tables to O gauge, the scale of 1 7/64" to the foot should be used. A few modelers use a more correct gauge for 1/4" scale. This is Q gauge, with railheads 1.177" apart. You can use prototype track dimensions literally in 1/4" scale with Q gauge. Distinctions between these two gauges are not always necessary and so will not be made everywhere in this book.

Fig. 5-2 The mischief with curves



CURVES INTRODUCE TWO FAMILIES OF MECHANICAL PROBLEMS WHOSE EFFECTS AND REMEDIES ARE SIMILAR BUT NOT QUITE THE SAME. THE FIRST TYPE OF EFFECTS OCCURS IN PROPORTION TO THE SHARPNESS OF CURVATURE (SKETCH A). THE SECOND TYPE OCCURS IN PROPORTION TO THE AMOUNT AND RATE OF CHANGE FROM STRAIGHT TO CURVE OR BETWEEN CURVES OF DIFFERENT SHARPNESS (SKETCH B). THE WORST CASE OF THESE IS THE S-SHAPED "REVERSE CURVE" IN WHICH CURVATURE CHANGES FROM LEFT TO RIGHT, OR VICE VERSA.

A. EFFECTS OF SHARP CURVATURE:

1. LONG RIGID-WHEELBASE EQUIPMENT WITH FLANGES ON ALL WHEELS WILL TEND TO BIND IN THE TRACK. THIS BINDING MAY POP THE FLANGES OVER THE RAILHEAD AND CAUSE A DERAILMENT, OR AT LEAST SUDDENLY INCREASE THE LOAD ON THE MOTOR, THUS AFFECTING SPEED.
2. WHERE LONG-WHEELBASE EQUIPMENT IS USED, WITH OR WITHOUT "BLIND" OR FLANGELESS WHEELS, THE LEADING DRIVER ATTACKS THE TRACK AT A SKEW ANGLE AND WILL TEND TO CLIMB OVER MISMATCHED RAIL JOINTS, FROGS IN TURNOUTS, OR OTHER TRACK IRREGULARITIES.
3. EXCESSIVE CURVATURE TURNS THE TRUCKS SO FAR UNDER CARS OR ENGINES THAT WHEELS OR TRUCK FRAMES MAY STRIKE AGAINST UNDERBODY DETAIL, CENTER SILLS, COUPLER DRAFT-GEAR BOXES, STEAM CYLINDERS, STEPS, ETC. BESIDES CAUSING MECHANICAL INTERFERENCE, THIS CAN ALSO CREATE AN ELECTRICAL SHORT CIRCUIT BETWEEN A PICKUP TRUCK AND THE MAIN FRAME.
4. WHERE A CAR OR ENGINE BODY EXTENDS FAR AHEAD OR BEHIND THE WHEELS THAT GUIDE IT, EXCESSIVE OVERHANG IS CREATED AT THE OUTSIDE OF THE CURVE. THIS MAY CREATE A PROBLEM IN BALANCING. IT ALSO REQUIRES STRUCTURES, SWITCH-

STANDS, SIGNALS, BRIDGE PIERS, TUNNEL PORTAL SIDES, AND ANY PARALLEL TRACKAGE TO BE SET FARTHER FROM TRACKSIDE THAN USUAL. THE WORST CASE IS WITH LONG ARTICULATED STEAM-TYPE LOCOS.

5. LIKEWISE, CAR AND ENGINE BODIES WITH THE PIVOT POINTS OF TRUCKS SPREAD FAR APART HAVE EXCESSIVE OVERHANG TO THE INSIDE OF CURVED TRACK. THIS NOT ONLY AFFECTS THE LOCATION OF WAYSIDE STRUCTURES AND THE LIKE, BUT MUST BE ADDED TO THE AMOUNT OF SPACING ALREADY NEEDED FOR PARALLEL TRACKAGE.
6. WHEN TRUCK PIVOTS OR OTHER GUIDING WHEELS ARE SET FAR BACK FROM THE END OF A CAR OR LOCOMOTIVE, COUPLERS MOUNTED ON THE BODY WILL SWING FARTHER FROM TRACK CENTER THAN WITH SHORTER EQUIPMENT. THE RESULTING COUPLER MISMATCH CREATES TWO PROBLEMS: ON SHARP CURVES IT MAY NOT BE POSSIBLE TO COUPLE LONG CARS TO SHORT ONES AUTOMATICALLY; EVEN MORE SERIOUS, THE COUPLERS BEING THROWN AT A SKEW ANGLE PRODUCE A SIDE THRUST ON WHEELS THAT MAY CAUSE DERAILMENT. THE WORST CASE IS WITH TALGO-MOUNTED COUPLERS (COUPLERS MOUNTED DIRECTLY ON TRUCKS) USED ON SHORT CARS; THE MISMATCH BETWEEN THESE AND LONG CARS IS SERIOUS. COUPLERS MOUNTED ON TRUCKS ARE BETTER USED ONLY ON LONG-BODY EQUIPMENT.
7. ATTEMPTS TO CLOSE-COUPLE CARS AND ENGINES TO OBTAIN MORE REALISTIC EFFECT CAN FAIL ON CURVES WHEN CORNERS OF CAR OR ENGINE BODIES, OVERHANGING CAB ROOF, FOOTBOARDS, ETC., STRIKE EACH OTHER. THIS NOT ONLY CAN DAMAGE EQUIPMENT AND CAUSE DERAILMENTS, BUT IN SOME CASES, SUCH AS WITH A STEAM-TYPE ENGINE AND ITS TENDER, AN ELECTRICAL SHORT CIRCUIT CAN DEVELOP AND INTERRUPT OPERATION.

B. EFFECTS OF CHANGE OF CURVATURE:

8. EVEN CARS OF THE SAME LENGTH WILL HAVE COUPLER MISMATCH WHEN ENTERING CURVES. THIS CREATES TROUBLES SIMILAR TO THOSE IN ITEMS 6 AND 7, BUT NOTE THAT THE CAUSE IS NOT THE SAME.
 9. A SIMILAR ALIGNMENT MISMATCH CAN CAUSE DIAPHRAGMS OF PASSENGER CARS TO HANG UP.
- BOTH OF THESE EFFECTS ALSO HAPPEN AT PLACES WHERE RADIUS MERELY CHANGES. THE WORST CASE IS ON REVERSE CURVES, BOTH ON THE MAIN LINE AND AT CROSSOVERS.

eliminate such trouble spots as inadequate coupler swing. Passenger diesels will have no trouble if reasonable coupler and truck swing is allowed for. All freight equipment (except the new 85-foot-long varieties) will take these curves readily even without easements. It usually is not practical to adapt the very largest steam power to such curves.

Sharp curves are really suitable only for cars up to about 60 feet long, and some careful adjustment may be needed on them to avoid diaphragm troubles unless easements are provided. Somewhat longer cars, if without diaphragms, can be handled, but appearance suffers pretty badly. Pacifics and Mikados can get around these curves if some liberties are taken in providing extra trailer-truck swing, extra clearance between front truck and cylinders, etc.; larger engines are pretty much out of the picture unless your principal interest in the hobby is specifically in seeing just how big a loco you can trick into bending itself around such a curve. Nevertheless, pikes based on this radius can operate well, and the added operating interest favors sharp curves for most railroads which must be built in a cramped space.

Extra sharp curves are useful only in unusual situations and in special classes of railroading such as interurban traction, industrial switching pikes, and narrow-gauge. The possibilities of enhancing a larger railroad by the addition of secondary trackage of this nature should not be lost sight of, however.

Experimentation as an aid to selection of curves. Selecting your minimum radius is a matter of compromise. You may find it best to start planning with a radius figure on the big side, recognizing the possibility of making a change later if this large radius turns out to be too costly in terms of what you can get into a particular part of the space. Manufacturers' statements regarding the curvature which their rolling stock will take are rare, and the basis on which such statements are made is often nebulous. In these days of prefab or flexible track, it's most sensible to run some tests of your own before committing yourself to any marginal radius. Tests will also give you a much better feeling for the effect of curvature upon appearance.

Turnout standards

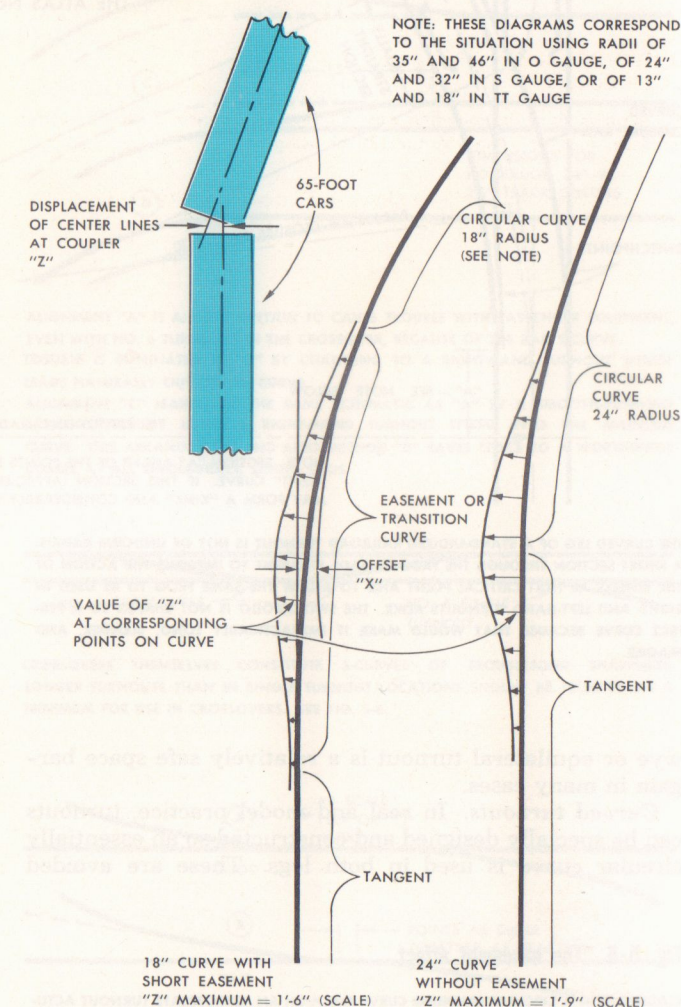
Next comes the matter of the minimum turnout frog number (or sharpest turnout angle or radius) to be used in various situations. What we want, of course, is the shortest turnout that will give operation equal to that obtainable with the basic radius of curvature we have already selected. If you build your own turnouts you are fortunate, for you can then use a curved line all the way through each turnout. This saves much space. Commercially made turnouts and those built from the NMRA tables take more valuable space because they don't use your minimum radius. They even contain short stretches of straight track. There is no simple relationship between curvature and frog angle for these turnouts, but Fig. 5-4 presents some helpful equivalents to throw a little light on the subject.

As in the case of ordinary curved track (Fig. 5-2), there are two things to consider. One is the matter of how your long-wheelbase engines and other "stiff" equipment will go through the curved leg of the turnout. As Fig. 5-4 shows, the radius of the closure rail is the key dimension in this case. This should be not less than the minimum radius your longest-wheelbase engines will take.

The second consideration is the over-all substitution radius of the turnout. This affects how the train as a whole will negotiate the switch. As the table shows, this figure is considerably greater than the closure rail radius and so ordinarily won't be a governing factor. It is interesting to note that even a No. 4 turnout has a substit-

Fig. 5-3 The coefficient of lurch

TO STUDY THE EFFECTS OF A TRANSITION CURVE OR EASEMENT ON SMOOTHNESS OF OPERATION, SCALE DRAWINGS OF 65-FOOT PASSENGER CARS WERE LOCATED AT VARIOUS POINTS ALONG THE ENTRANCE TO CURVES AND THE RELATIVE DISPLACEMENTS OF THEIR COUPLERS FROM TRACK CENTERLINE WERE PLOTTED. NOT ONLY IS THE MAXIMUM DISPLACEMENT LESS FOR THE SHARPER BUT EASED CURVE, BUT THE MAXIMUM IS ALSO REACHED MORE GRADUALLY, INDICATING THE REDUCED LURCH UPON ENTERING AN EASED CURVE AT SPEED.

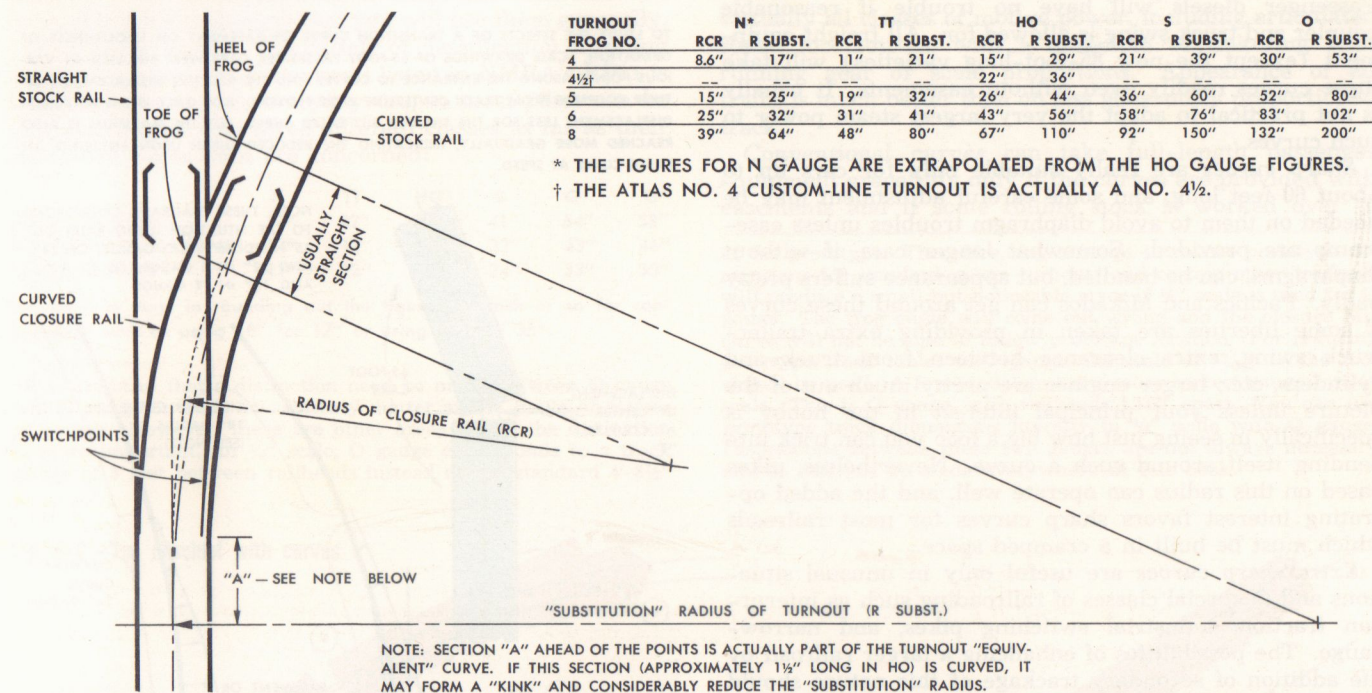


tion radius that is greater than we have considered a "conventional" radius curve. If you use a No. 5 with conventional curves (such as 24" radius in HO, etc.) you actually get an "easement effect," as shown in Fig. 5-5. For 6's and 8's the closure rail and substitution radii are comparatively astronomical, and although commonly preferred, the use of these sizes is probably more costly of space than their advantages in appearance warrant.

Single-turnout minimum frog number. What it comes down to is that the use of No. 6 turnouts on most pikes with conventional radius curves or less is extremely wasteful of valuable space (except, as we shall see later, in the case of crossovers) at any point where the length of the turnout affects how much track you can get in the space. This means at most turnout locations. In place of No. 6 size, No. 5 turnouts are ideal; they're not commercially available, which restricts their usefulness to those of you who roll your own. The No. 4 1/2 turnout, which is available in HO gauge in a slightly mislabeled form (see Fig. 5-4), is very well suited for use with any HO radii up to about 30".

Wye turnouts. The "wye" turnout of any given frog angle has just half as sharp a curve in each of its legs as that in the curved leg of a regular turnout. Subject to the S-curve considerations pointed out later, the

Fig. 5-4 Turnout radius relationships



THE CURVED LEG OF A STANDARDIZED RAILROAD TURNOUT IS NOT OF UNIFORM RADIUS. A SHORT SECTION THROUGH THE FROG IS MADE STRAIGHT TO IMPROVE THE ACTION OF THE WHEELS AT THAT CRITICAL POINT AND TO ALLOW THE SAME FROG TO BE USED IN RIGHT- AND LEFT-HAND TURNOUTS ALIKE. THE SWITCHPOINT IS NOT SHAPED TO A PERFECT CURVE BECAUSE THAT WOULD MAKE IT IMPRACTICABLY LONG, SLENDER, AND FRAGILE.

FOR ANY STANDARD TURNOUT THERE IS AN EQUIVALENT SUBSTITUTION RADIUS, AS SHOWN IN THE DIAGRAM, WHICH CAN BE SUBSTITUTED FOR THE ACTUAL RAIL LOCATION IN FITTING THE TURNOUT INTO A SECTION OF A CURVE. APPROXIMATE VALUES FOR SUBSTITUTION RADII (R SUBST.) ARE GIVEN IN THE TABLE ABOVE. THE MOST SHARPLY CURVED SECTION OF THE TURNOUT IS THE "CLOSURE RAIL" PORTION BETWEEN THE POINTS AND THE TOE OF THE FROG. THIS VALUE (NMRA RP12 DIMENSION 11) IS ALSO GIVEN ABOVE.

TURNOUT	N*		TT		HO		S		O	
FROG NO.	RCR	R SUBST.	RCR	R SUBST.	RCR	R SUBST.	RCR	R SUBST.	RCR	R SUBST.
4	8.6"	17"	11"	21"	15"	29"	21"	39"	30"	53"
4½†	--	--	--	--	22"	36"	--	--	--	--
5	15"	25"	19"	32"	26"	44"	36"	60"	52"	80"
6	25"	32"	31"	41"	43"	56"	58"	76"	83"	102"
8	39"	64"	48"	80"	67"	110"	92"	150"	132"	200"

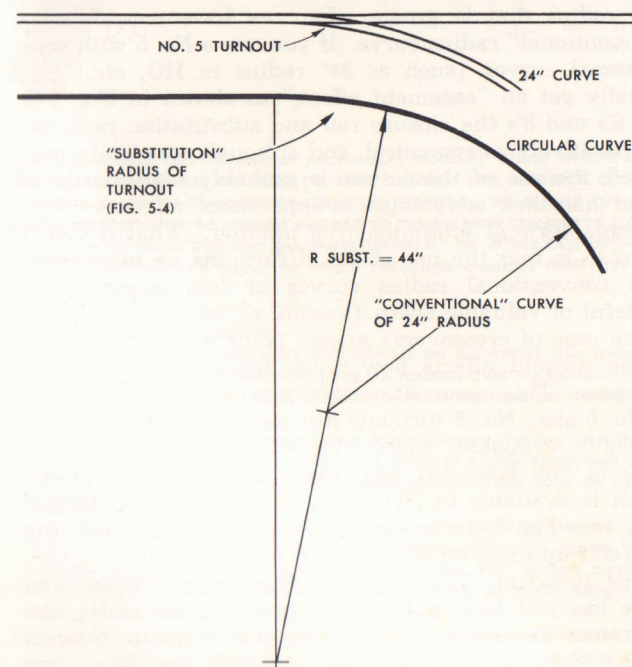
* THE FIGURES FOR N GAUGE ARE EXTRAPOLATED FROM THE HO GAUGE FIGURES.
† THE ATLAS NO. 4 CUSTOM-LINE TURNOUT IS ACTUALLY A NO. 4½.

wye or equilateral turnout is a relatively safe space bargain in many cases.

Curved turnouts. In real and model practice, turnouts can be specially designed and constructed so an essentially circular curve is used in both legs. These are avoided

Fig. 5-5 The easement effect

LEADING INTO A CIRCULAR MAINLINE CURVE THROUGH AN APPROPRIATE TURNOUT ACTUALLY PRODUCES THE EFFECT OF AN EASEMENT OR TRANSITION CURVE, AS SHOWN BELOW.



on the prototype and model alike because they must be built up individually instead of being fabricated from stock parts, but the resulting space-saving can be extremely important. Fig. 5-6 illustrates this in a true, though somewhat hand-picked, example. Turnouts within any long curve present similar space problems.

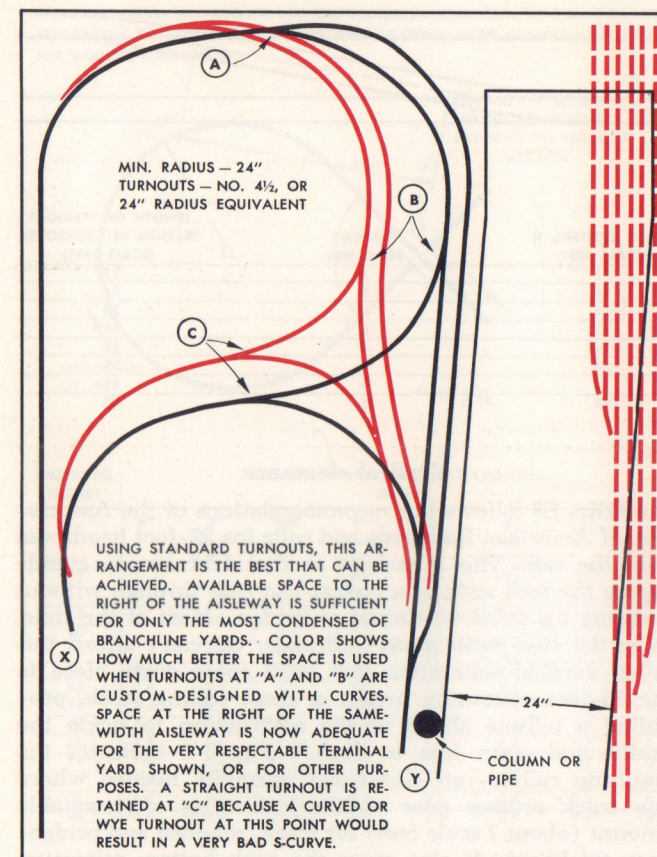
To make full use of the space-saving properties of the curved turnout, the frog area itself is made on a curve. This requires very careful construction to secure reliable operation. You should not plan to build one of these in a key location as your very first exercise in building switches from scratch, but with a little experience the construction will be no more tedious than that of regular turnouts. There is no reason for any loss in performance, smoothness, and dependability.

S-curve standards

The wild coupler angles we observed when passing from curved to straight track (Fig. 5-3) are doubly accentuated in passing from one curve to another bending in the opposite direction. The resulting binding or sidewise pull is probably the largest single cause of derailments in well-built but poorly designed track plans. S-curves insidiously creep in on you unless you specifically watch out for them. Getting rid of them once the pike is built can be almost impossible short of re-laying the track for many feet in both directions, or even shifting part of the roadbed. Fig. 5-7 points out some of the less obvious places S-curves can occur.

If there is a section of straight track between reverse curves which is at least as long as the wheelbase of the longest car passing through them, the effect is no worse than that of two separate curves, and the S-curve problem disappears completely. Our "S-curve minimum straightaway" standard (Fig. 5-1) is therefore essentially chosen as one car length.

Fig. 5-6 Space-saving with curved turnouts



IN CERTAIN SITUATIONS THE USE OF CURVED TURNOUTS AT A FEW KEY LOCATIONS WILL SAVE ENOUGH SPACE TO AMPLY REPAY THE EXTRA EFFORT NECESSARY IN CUSTOM-BUILDING AND FITTING THEM INTO THE OTHERWISE STANDARD TRACKWORK. IN THIS EXAMPLE THE TRACKAGE AT THE LEFT IS TO BE LOCATED IN THE ALCOVE SPACE SO AS TO LEAVE A 24" AISLEWAY TO THE RIGHT, BUT TO PASS THROUGH FIXED POINTS "X" AND "Y."

Crossover S-curves. A crossover between straight tracks is automatically an S-curve. It's not quite as bad as the S-curve between two long curves, because the turnout curves aren't a whole carlength long and passenger equipment won't feel the full effect of their sharpness. On the other hand, as Fig. 5-8 shows, even gentle crossovers do not have a straightaway length "L" up to our one-carlength standard. Since we are obviously not going to have much of a railroad without using crossovers, what do we do?

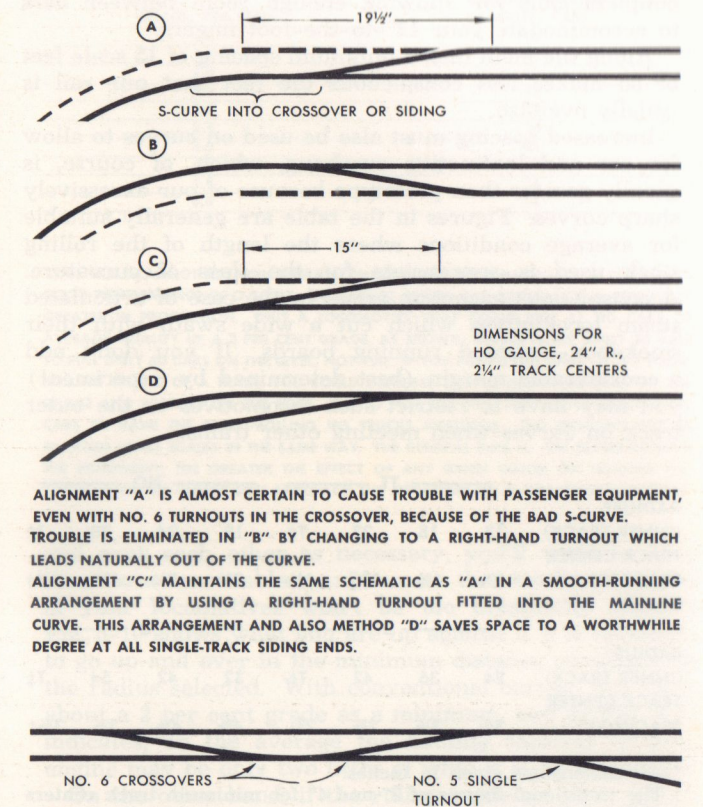
First, never try to shorten a crossover by putting curves between the turnout frogs. If you do, you are really asking for trouble.

Second, use longer turnouts in crossovers than in single-switch locations. This is where No. 6's do make a difference and they should be considered more or less a minimum if any passenger equipment is to be run. Also, track center spacing should not be too close.

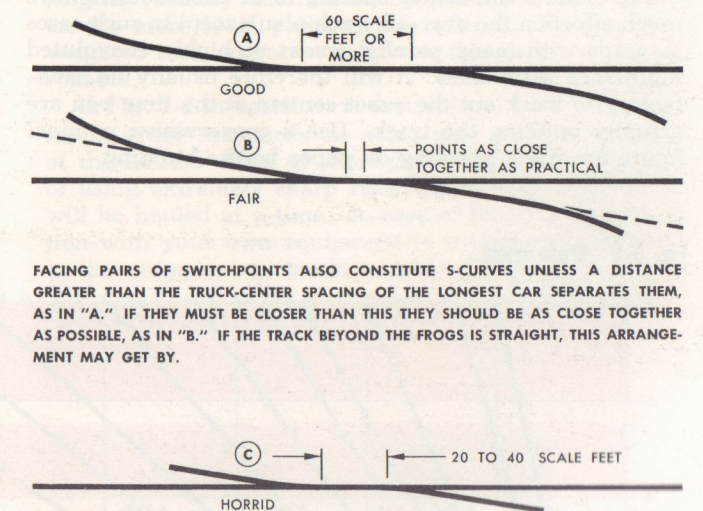
Other S-curve lurking places. The first track coming off a ladder track constitutes another crossoverlike S-curve location which, in extreme cases, may call for use of a longer turnout. Likewise, the alignment at the end of a passing track should be watched (Fig. 5-7). As shown at C in Fig. 5-6, some applications of wye turnouts can lead to S-curve troubles.

The best thing to do if you find that getting a particular alignment in the space depends on a shorter-than-standard S-curve is to set up the situation, full-scale, with pre-fab track and try running your longest cars and locomotives through it in various combinations. You may be very glad you did!

Fig. 5-7 S-curve problem alignments



CROSSOVERS THEMSELVES CONSTITUTE S-CURVES OF TROUBLESOME SHARPNESS. LONGER TURNOUTS THAN IN SINGLE TURNOUT LOCATIONS SHOULD BE SELECTED AS A MINIMUM FOR USE IN CROSSOVERS. SEE FIG. 5-8.



FACING PAIRS OF SWITCHPOINTS ALSO CONSTITUTE S-CURVES UNLESS A DISTANCE GREATER THAN THE TRUCK-CENTER SPACING OF THE LONGEST CAR SEPARATES THEM, AS IN "A." IF THEY MUST BE CLOSER THAN THIS THEY SHOULD BE AS CLOSE TOGETHER AS POSSIBLE, AS IN "B." IF THE TRACK BEYOND THE FROGS IS STRAIGHT, THIS ARRANGEMENT MAY GET BY.

THE INTERMEDIATE SPACING, AS IN "C," IS ALMOST CERTAIN TO CAUSE TROUBLE AND SHOULD BE AVOIDED AT ALL COSTS IF ANY PASSENGER EQUIPMENT IS TO NEGOTIATE THE TRACKAGE. TO AVOID THIS, A SLIP SWITCH MAY BE PREFERABLE DESPITE ITS GREATER COMPLICATION.

Track centers

Most railroads space adjacent tracks on 13-foot centers, which works out to about 1¼" in HO and 3¼" in Q (¼" scale). In model practice, it is common to use considerably wider spacing, particularly in yards where extra space is needed for coupling cars. The type of couplers you use, in fact, is one of the main factors determining the proper figure for yard track spacing. With automatics of some highly reliable type on all your equipment, fairly

close spacing is acceptable, whereas the use of dummy couplers calls for allowing enough room between cars to accommodate your 12"-to-the-foot fingers.

Along the main line, a minimum spacing of 15 scale feet or so makes less conspicuous the fact that our rail is usually oversize.

Increased spacing must also be used on curves to allow for car and locomotive overhang, which, of course, is grossly greater than prototype because of our excessively sharp curves. Figures in the table are generally suitable for average conditions where the length of the rolling stock used is appropriate for the class of curvature. A conspicuous exception arises in the case of articulated steam locomotives which cut a wide swath with their smokebox-mounted running boards. If you don't add a considerable margin (best determined by experiment) you may have to restrict such locomotives to the outer track on curves when meeting other trains.

	TT				HO			
RADIUS* (INNER TRACK)	13	18	22	T _‡	18	24	30	T _‡
TRACK CENTER								
SPACING*	1 7/8	1 1/2	1 1/4	1 1/2	2 1/2	2 1/4	2 1/2	2 1/2

	S				Q			
RADIUS* (INNER TRACK)	24	36	42	T _‡	32	42	54	T _‡
TRACK CENTER								
SPACING*	3 1/4	3 1/2	2 3/4	2 3/4	4 1/2	4 1/2	3 3/4	3 3/4

* All dimensions given in inches.

† The traditional figures of 2" and 4" for minimum track centers in HO and Q (1/4") scales are far from consistent, since they represent about 14 1/2 and 16 scale feet, respectively, and if anything, the smaller gauge should allow extra working space more than the larger.

‡ Tangent.

The exact track center spacing to be used doesn't have much effect on the over-all track plan except in such cases as yards with many parallel tracks or highly convoluted multitrack main lines. It will therefore usually be satisfactory to work out the exact centers at the time you are actually building the track. Use a conservative nominal figure for track planning on paper before building.

Fig. 5-9 Grade chart

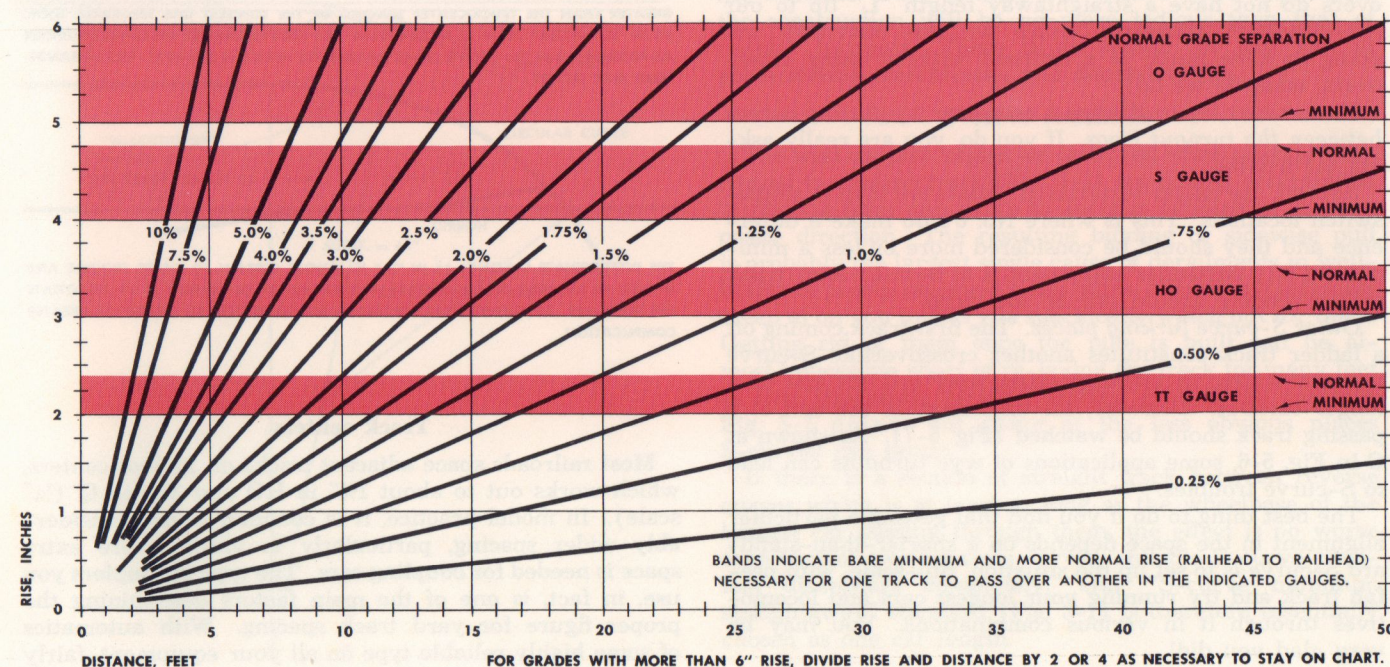


Fig. 5-8 Crossover S-curve table

TRACK CENTERS, C (SCALE FEET)	TURNOUT FROG NO.	LENGTH OF STRAIGHT SECTION IN CROSSOVER (SCALE FEET)
13	4	21
13	5	24
13	6	28
13	8	36
16	4	33
16	5	39
16	6	46
16	8	60

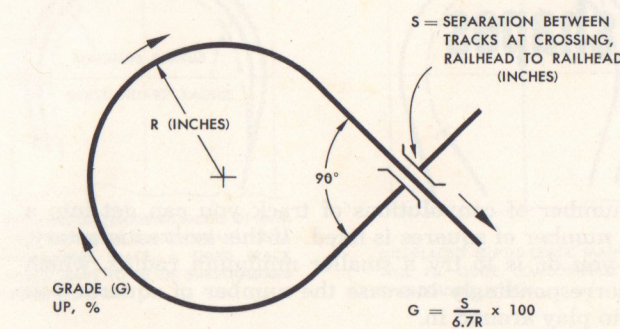
Vertical clearance

NMRA S8 follows the recommendations of the Association of American Railroads and calls for 22-foot headroom over the rail. This is enough so that a brakeman standing on the roof walk of a boxcar can ride through without creasing his skull on tunnel or bridge. Most of the time, as is the case with many railroads, we can't afford this much vertical separation and must come down close to the 16-foot maximum height of most rolling stock, providing a telltale ahead of the obstruction to tickle the brake and warn him to duck.* Fig. 5-9 indicates the resulting rail-to-rail clearances normally needed where one track crosses over another, allowing a reasonable amount (about 7 scale feet) for track, roadbed and bridge-floor thickness. It also gives the rock-bottom minimum grade separation which you can use if you are willing to go to the trouble of building an abnormally (in fact, almost dishonestly) thin-floored bridge for the upper track.

*Warning: Sometimes "scale models" have been built with more than scale height. You will want to avoid purchasing such models, as they cannot pass under your bridges and other minimum-clearance points. Check wrecking cranes and steam-type locomotives that look high before using them. Also, avoid models of more than proper scale width unless your track-to-track separation allows for them.

Fig. 5-10 Up-and-over grade, per cent

THIS TABLE GIVES THE AVERAGE CONTINUOUS GRADE NECESSARY TO PROVIDE A GIVEN SEPARATION BETWEEN TRACKS IN THE "UP-AND-OVER" LOOP ARRANGEMENT SHOWN, FOR VARIOUS CURVE RADII.



RADIUS (R), INCHES	GRADE SEPARATION (S) AT CROSSING, INCHES						
	6" (MIN. O GA.)	5" (MIN. S GA.)	4 1/2" (MIN. S GA.)	4" (MIN. S GA.)	3 1/2" (MIN. HO GA.)	2 1/2" (MIN. TT GA.)	2" (MIN. TT GA.)
12	--	--	--	5.0	4.4	3.8	3.1
15	--	--	--	4.0	3.5	2.9	2.5
18	--	--	3.7	3.4	2.9	2.5	2.1
20	--	--	3.4	3.0	2.6	2.2	1.9
22	--	4.2	3.1	2.8	2.4	2.1	1.7
24	3.8	3.1	2.8	2.5	2.2	1.9	1.6
30	2.8	2.5	2.3	2.0	1.7	1.4	1.2
36	2.4	2.1	1.9	1.6	1.4	1.2	1.0
42	2.2	1.8	1.6	1.4	1.2	1.1	0.9
48	1.9	1.6	1.4	1.2	1.1	0.9	0.8
54	1.7	1.4	1.2	1.1	1.0	0.8	0.7
60	1.5	1.2	1.1	1.0	0.9	0.7	0.6
72	1.2	1.0	0.9	0.8	0.7	0.6	0.5
96	0.9	0.8	0.7	0.7	0.6	0.5	0.4

Since restrictive overhead clearances are very much a fact of life on the railroads, particularly in these days of high piggyback and trilevel auto-rack cars, it will add to operating realism to do as note 3 on Fig. 5-1 indicates and maintain different standards on different tracks.

The overhead-wire electric railroad enthusiast, of course, will have to maintain different standards in this department.

Grade

The first thing to decide about the steepness of grade to be allowed on your main line is your attitude toward it. If grades are to be used simply to get the tracks under

Fig. 5-11 Table of grades*

GRADE, PER CENT	RELATIVE HAULING CAPACITY, CARS
0.0	100
0.5	80
1.0	63
1.5	50
2.0	43
2.5	36
3.0	31
4.0	23
5.0	18
6.0	14
8.0	8

*THIS TABLE CANNOT BE TAKEN LITERALLY IN PLANNING YOUR RAILROAD. IT REPRESENTS GOOD PERFORMANCE IN O SCALE. IN SMALLER SCALES CAR RESISTANCE IS GENERALLY GREATER IN PROPORTION. THUS A LOCOMOTIVE THAT COULD PULL 31 HO CARS OF AVERAGE QUALITY UP A 3 PER CENT GRADE, AS SHOWN, WOULD MORE LIKELY BE ABLE TO PULL ONLY 60 CARS ON THE LEVEL, NOT 100. IF YOU PICKED OUT HALF OF THE POOR-ROLLING TRUCKS OF A TRAIN, YOU COULD INCREASE THIS TO ABOUT 40 CARS ON THE GRADE AND 80 CARS ON THE LEVEL, BUT TO PULL THE FULL 100 WOULD REQUIRE ALL CARS TO HAVE THE FREEST-ROLLING HO TRUCKS AVAILABLE. THE PRINCIPLE APPLIES IN OTHER SMALL SCALES IN THE SAME WAY. THE GENERAL RULE IS: THE BETTER-ROLLING THE EQUIPMENT, THE GREATER THE EFFECT OF ANY GIVEN GRADE ON HAULING CAPACITY (AND THE CLOSER YOU APPROACH THE SITUATION ON A FULL-SCALE RAILROAD).

and over each other as necessary, you'll want to keep them to a reasonable maximum so that hauling capacity of your locomotives won't be too drastically affected. Fig. 5-10 shows what you are up against if it is necessary to go up and over in the minimum distance permitted by the radius selected. With conventional curves, this takes about a 2 per cent grade as a minimum, and as Fig. 5-11 indicates, on the average the hauling capacity of your engine may be only two fifths of what it is on level track.

On the other hand, if the ruling grade on your pike is to be an operating attraction in itself, calling for helper service, heavy motive power and short trains, experience indicates that a figure of about 4 per cent is right. Grades less than this simply will not hold present-day locomotives down enough to provide noticeable contrast with train lengths (usually determined by passing-track capacity) on the more level parts of the railroad. With properly weighted cars, operation on grades this steep can be quite reliable.

As Fig. 5-1 indicates, it is desirable to have several different grade standards on a big pike to take advantage of the limited effect of short grades and the possibilities of using extremely sharp rises where only a car or two will be hauled at a time. In case of doubt, experimentation with your own equipment is strongly recommended as the ultimate way to set suitable standards.

6

Pike locations and shapes

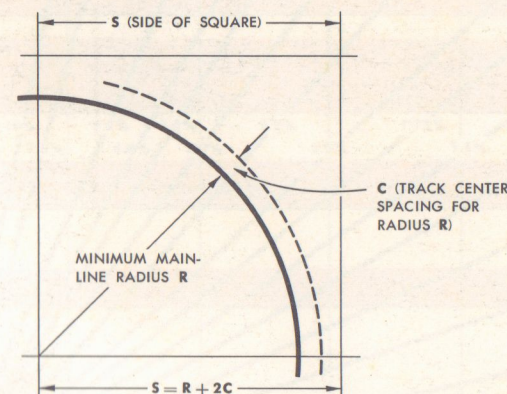
Which comes first—the space into which the track plan must be fitted or the track plan for which space must be found? Sometimes it's one way, as when you acquire carte-blanche title to a walled-in space with the definite understanding that no more territory will become available, *period*. Sometimes it's the other—although other family functions must be provided for in the same general area, the space is ample and the precise limits of the empire are subject to negotiations. Usually, it's somewhere in between—the better the plan, the brighter the prospects for being able to get the necessary use franchise for the space it takes. In these cases, the best track plan comes from attacking the problem alternately from both ends, and it doesn't matter much where you start. Therefore, this chapter and chapter 7 should more or less be looked at together; here we consider the possible shapes a pike might take, and there we start from the standpoint of basic track arrangements worth seeking space for.

This "squares" business

First, let's get used to a unit of space that will come in handy throughout the actual pike-planning business—the "square." The key dimension in any track plan that determines the space it takes is the minimum radius of a mainline curve. By using this as the basis for our unit (Fig. 6-1), we can then discuss most plans in terms of squares, independently of the particular gauge in which they are to be built and free of such other considerations as whether they are for modern-day or period operation, with sharp or broad curves, and for long or short equipment. Use of the square will also be the basis for using the process of "controlled pessimism" later on in hunting around for the best possible mainline arrangement that will fit.

Fig. 6-2 shows what we can expect to get into a square.

Fig. 6-1 Definition of a square



(MINIMUM TRACK CENTER SPACING MAY BE OBTAINED FROM NMRA STANDARD S-8)

SQUARES ARE OF THE FOLLOWING APPROXIMATE SIZES:

	N	TT	HO	S	O AND Q
SHARP CURVES	13"	18"	22"	32"	42"
CONVENTIONAL CURVES	16"	21"	28"	38"	50"
BROAD CURVES	20"	26"	34"	48"	64"

The number of convolutions of track you can get into a given number of squares is fixed. If this isn't satisfactory, what you do is to try a smaller minimum radius, which will correspondingly increase the number of squares you have to play around in.

How big is big? In discussing the merits of various pike shapes and track schematics, we shall review their strengths and weaknesses as they vary with the general size of pike—what's fine for a club-size railroad may or may not be worth considering in a 5 x 10-foot railroad, and vice versa. By calling pike sizes out in terms of squares, we can make such terms as "small" and "average" mean something in terms of your situation, whatever gauge and era you may be railroading in. Assuming that small pikes will tend to use sharp curves and the larger ones will lean more in the direction of broad radii, here is some idea of the size scale for roughly rectangular track plans:

Pike size	Typical dimensions	Corresponding sizes in feet				
category	in squares	N	TT	HO	S	O or Q
Small	2 x 4	2½ x 4½	3 x 6	4 x 8	6 x 12	8 x 15
Average	3 x 5	4 x 7	5 x 9	7 x 12	10 x 16	14 x 22
Medium	4 x 6	6 x 9	8 x 12	10 x 15	12 x 21	18 x 28
Large	5 x 8	7 x 12	10 x 15	12 x 20	15 x 27	22 x 35
Club	6 x 12	10 x 20	14 x 28	18 x 36	27 x 48	35 x 65
	(and up)	(and up)	(and up)	(and up)	(and up)	(and up)

Note that size of square in a given gauge varies, as discussed in Fig. 6-1.

What are we looking for?

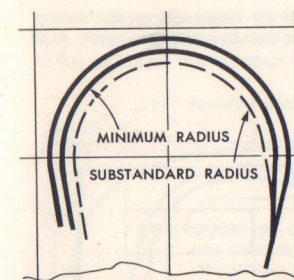
Before we start talking about doughnuts, walk-ins and the other oddball shapes that should be considered, it will be best to pause a moment and think about what it is that makes one design more desirable than another. We are looking for two principal things: efficiency in use of the available space, and accessibility. As secondary goals, we usually want a shape that is easy to build with available and economical materials, and it may be important that the railroad be adaptable to a different space in case it must be moved.

Actually, the largest number of pikes are the shape they are for the secondary reason of ease of construction; the small rectangular layout which most of us start with gets its size from the dimensions of available sheets of plywood. As Fig. 6-4 points out, this is not a particularly ideal shape from either access or efficiency standpoints. It is too wide for easy access, and the ovals of track which are inevitable in their size of track plan leave the four corners rather poorly utilized as far as the mainline track-age is concerned.

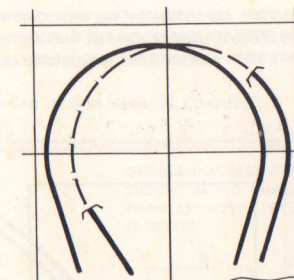
As the plight of the troubleshooter in Fig. 6-3 illustrates, only the edges of a layout are really comfortable and convenient to work on. Even if your operation is of such quality that rerailing is rarely needed, long reaches to the track do nothing to increase the pleasure of running trains. What we need, in general, is a layout shape that has more edge and less middle.

"Island" and "along-the-wall" types of layout. The alternate approach, particularly in the larger gauges, is the track plan which hugs the walls of the room for the most part. Fig. 6-5 traces the development of

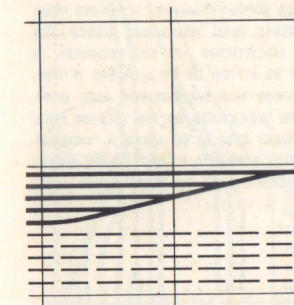
Fig. 6-2 What will go in a square?



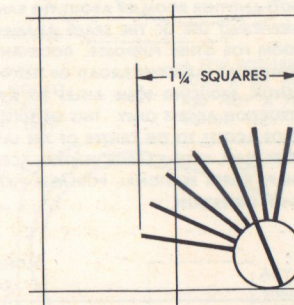
TWO CONCENTRIC SEMICIRCLES OF MINIMUM OR BETTER RADIUS WILL FIT IN A TWO-SQUARE SPACE; A THIRD TRACK WOULD HAVE TO BE OF SUBSTANDARD RADIUS TO FIT.



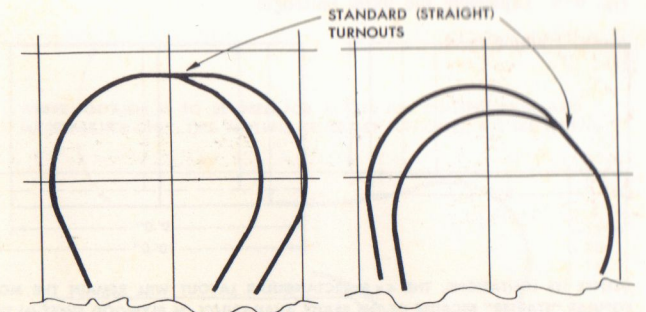
INTERLACED SINGLE-TRACK MAIN LINES WILL FIT QUITE COMFORTABLY IN A TWO-SQUARE WIDTH.



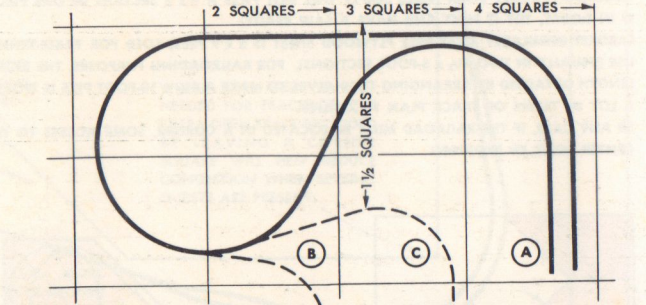
TEN TRACKS OR MORE WILL FIT SIDE BY SIDE IN ONE SQUARE. HOWEVER, IT TAKES APPROXIMATELY TWO SQUARES OF LENGTH TO CONNECT ONLY FIVE TRACKS WITH A SIMPLE LADDER.



A TURNTABLE AND ROUNDHOUSE OF APPROPRIATE SIZE FOR THE CLASS OF RAILROAD BEING MODELED WILL TAKE A SPACE 1¼ SQUARES BY ¾ TO 1¼ SQUARES, DEPENDING UPON THE NUMBER OF STALLS DESIRED.



A STANDARD TURNOUT CENTERED IN THE TWO-SQUARE SPACE WILL NOT QUITE FIT; LOCATING IT AT AN ANGLE WILL MAKE THIS ALIGNMENT PRACTICAL.



IN HIGHLY CONVOLUTED ALIGNMENTS, LENGTH IN ONE DIRECTION CAN BE SUBSTITUTED FOR ANOTHER (AND VICE VERSA) TO SOME EXTENT. TO GET THE WASP WAIST OF ALIGNMENT "A," A LENGTH (LEFT TO RIGHT OF DIAGRAM) OF ALMOST FOUR SQUARES IS REQUIRED; IF LENGTH OF ONLY TWO OR THREE SQUARES IS AVAILABLE, EXTRA WIDTH REQUIRED FOR ALIGNMENT "B" OR "C" MUST BE PROVIDED.

both the "island" or "free-standing" and "along-the-wall" types as they become larger and more advanced. The factor which is most important in guiding the benchwork design for the larger pikes is the allowable reaching distance for comfortable construction, maintenance, and operation. It isn't just a matter of modern American love of luxury. Reaching far into the interior is rough on rolling stock and scenic accessories in the foreground; the necessity to reach leads to skimpy maintenance and unreliable running (and therefore more reaching, in chain-reaction fashion), and it leads to neglect of operating possibilities if they involve switching maneuvers too far from the operating area.

Benchwork width limits. The distance you can reach varies with your height and even more with the height of benchwork. For 30" or 36" high benchwork you should never plan tables where you have to reach more than 30", and a 24" maximum is much better for any places where attention may be needed frequently. For benchwork that is 42" or higher (and these heights are not only much better from the operating and viewing standpoints, but they also make construction and maintenance work on the underside much more comfortable) you should plan so that you need not reach beyond 24", with 18" at most locations. A few substantial wooden footstools 6" to 12" high will make things easier while you're building and repairing the railroad on tables of any height.

The walk-in layout

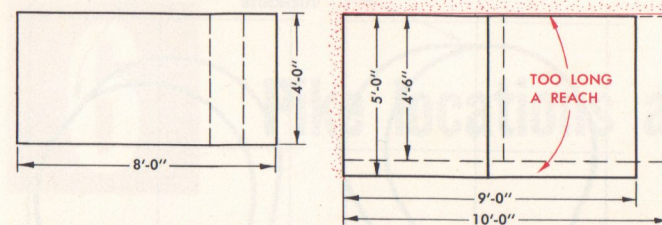
As Fig. 6-5 indicates, as both island and along-the-wall pikes become larger they can and usually should tend to evolve into one form or another of walk-in plan. These no-stoop layouts eliminate or minimize access problems by letting you and your guests step right up to all the more interesting busy and scenic parts of the railroad. If you wish, you can walk along as you watch or as you run a train. For medium-size and bigger track plans some



Linn H. Westcott.

Fig. 6-3. Occasional operating incidents must be expected on the best-regulated railroads, especially where turnouts are involved. A 3-foot reach is a long one and tends to be hard on rolling stock closer to the access area. As a rule, the distance to the rear track should be kept well below 24'.

Fig. 6-4 Expanding the basic rectangle



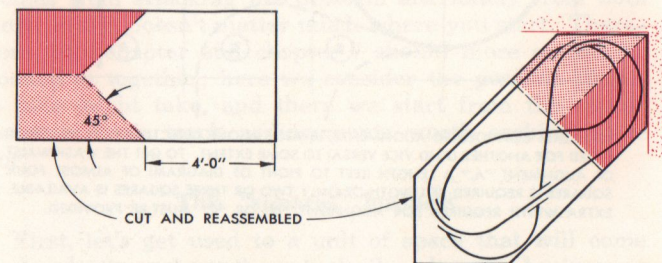
DESPITE ITS LIMITATIONS, THE 4 x 8 RECTANGULAR LAYOUT WILL REMAIN THE MOST POPULAR "STARTER" BECAUSE OF THE READY AVAILABILITY OF PLYWOOD SHEET IN THIS SIZE.

4 x 6 AND 4 x 7 MATERIAL IS ALSO USUALLY AVAILABLE; THE 4 x 6 SIZE IS WORTH CONSIDERING IN THE MOST SEVERELY RESTRICTED SPACE CONDITIONS BECAUSE IT CAN BE STORED HORIZONTALLY UNDER A STANDARD DOUBLE BED.

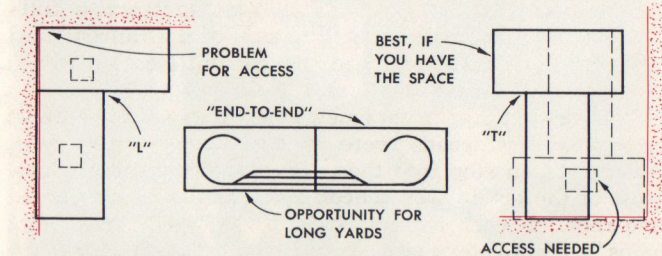
THE EXTRA COMPLICATION OF BUILDING A 4 x 8 PIKE IN SEPARABLE HALVES MAY BE NECESSARY; MANY STAIR WELLS SIMPLY WILL NOT PASS A 4 x 8 SECTION IN ONE PIECE. IF IN DOUBT, TRY IT FIRST AND HAVE A SAW READY!

LARGEST REGULARLY AVAILABLE PLYWOOD SHEET IS 5 x 9 FEET, SOLD FOR TABLE-TENNIS USE (USUALLY IN TWO 4½ x 5-FOOT SECTIONS). FOR RAILROADING PURPOSES, THE EXTRA LENGTH OBTAINED BY ARRANGING THE HALVES TO MAKE A 4½ x 10-FOOT PIKE IS WORTH A LOT IN TERMS OF TRACK PLAN FLEXIBILITY.

IN ANY CASE, IF THE RAILROAD MUST BE LOCATED IN A CORNER, SOME ACCESS TO THE CENTER MUST BE PROVIDED.



THE END CURVES OF A SMALL TRACK PLAN DO NOT FIT INTO A RECTANGLE PARTICULARLY WELL. A CONSIDERABLY MORE EXTENSIVE MAIN LINE MAY BE FITTED INTO THE SAME AREA BY REARRANGING THE PLYWOOD INTO A POINTED-END BOAT-SHAPED PLAN. FITTED INTO THE CORNER OF A ROOM, THIS PIKE ALLOWS EXCELLENT ACCESS TO ALL IMPORTANT OPERATING AREAS. MORE EFFICIENT USE OF THE SPACE FOR A LONG MAIN LINE DOES MEAN SOME LOSS OF ROOM FOR INDUSTRY SPURS IN THE CORNERS.



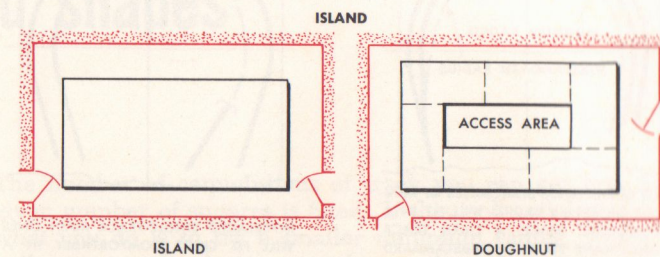
IN ADDING A SECOND RECTANGULAR AREA TO EXPAND THE RAILROAD, LENGTH IS TO BE PREFERRED TO WIDTH. IF THE ROOM IS LONG ENOUGH TO PERMIT IT, THE END-TO-END SCHEME IS EXCELLENT. THE L-SHAPED PIKE IS ALSO GOOD, PROVIDED ACCESS ARRANGEMENTS ARE ADEQUATE FOR THE BACK CORNER. THE "T" ARRANGEMENTS OFTEN WORK WELL IN ADAPTING A MEDIUM-SIZE RAILROAD TO A PARTICULAR SPACE.

type of walk-in design is almost always the best arrangement. There may be a few particular track schematics for which no continuous-access benchwork plan can be found or where the use of a drawbridge or a duck-under at one point opens up worthwhile possibilities of more realistic railroading in the space, but it is certainly worth the effort to look first for the more ideal scheme.

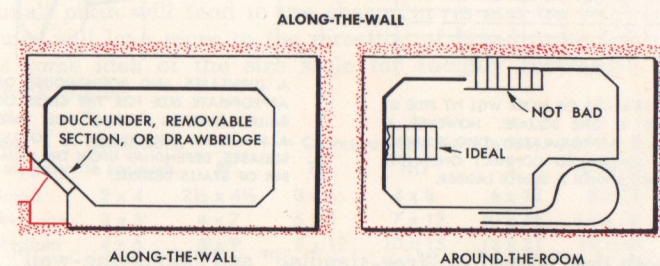
Aisleway standards. The big advantage of the walk-in is the ease of access it provides for building, operating, or viewing the railroad. Skimping too much on the width of the aisleways can defeat the purpose, so the standards shown in Fig. 6-6 should generally be observed, particularly for clubs or other situations where there will be fair numbers of guests at one time. On the other hand, ease of access itself is not the primary reason for build-

Fig. 6-5 Basic layout shapes

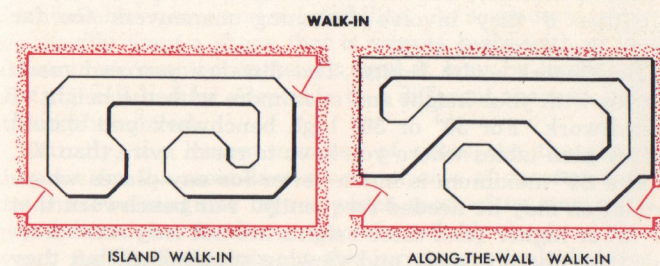
ALMOST ALL LAYOUTS FALL INTO ONE OR THE OTHER OF TWO BASIC TYPES, "ISLAND" OR "FREE-STANDING" ON THE ONE HAND, OR "ALONG-THE-WALL" ON THE OTHER. EACH HAS BOTH ADVANTAGES AND WEAKNESSES:



THE ISLAND PIKE HAS THE GREAT ADVANTAGE OF PORTABILITY. IT WILL USUALLY FIT INTO ANOTHER ROOM OF ABOUT THE SAME SIZE IF YOU HAVE TO MOVE. IT MAKES VERY INEFFICIENT USE OF THE SPACE AVAILABLE AND PRETTY WELL PRECLUDES USING THE ROOM FOR OTHER PURPOSES. DOOR AND WINDOW LOCATIONS ARE NO PROBLEM. A SOMEWHAT LARGER RAILROAD OF ISLAND TYPE MAY BE FITTED IN BY MOVING IT OFF-CENTER, REDUCING SOME AISLES TO WIDTHS ALLOWING FOR EMERGENCY AND CONSTRUCTION ACCESS ONLY. THIS EMPHASIZES ANOTHER WEAKNESS OF THE ISLAND PIKE: POOR ACCESS TO THE CENTER OF THE LAYOUT. THE NEXT STEP IS TO MAKE A "DOUGHNUT" PLAN, WITH A LARGE CENTRAL ACCESS AREA. THIS MAKES A PARTICULARLY GOOD SHAPE FOR A SECTIONAL, PORTABLE PIKE, BUT THE DUCK-UNDER TO THE ACCESS HOLE IS AN IRRITATION.



THE ALONG-THE-WALL RAILROAD HAS TO BE PRETTY MUCH TAILOR-MADE FOR THE PARTICULAR ROOM AND WILL HAVE TO BE REBUILT EXTENSIVELY TO ADAPT IT TO ANOTHER LOCATION. DOOR LOCATIONS MAY BE A PROBLEM. IN ANY GIVEN ROOM, HOWEVER, IT PERMITS CONSTRUCTION OF A MUCH LARGER PIKE, AND THE ROOM MAY STILL BE USEFUL FOR OTHER PURPOSES. THE AROUND-THE-ROOM PIKE BECOMES MORE ATTRACTIVE IF A CENTRAL STAIRWAY IS THE ONLY ENTRANCE TO THE AREA; MANY BASEMENT RAILROADS MAKE THE MOST OF THEIR SPACE DESPITE A STAIRWAY ALONG THE WALL BY TUNNELING THROUGH A RISER. A COMMON DIFFICULTY IN ALONG-THE-WALL PIKES — DIFFICULTY IN TURNING THE TRAINS AROUND — CAN BE LICKED IF A SPACE WIDE ENOUGH FOR A LOOP CAN BE FOUND SOMEWHERE.



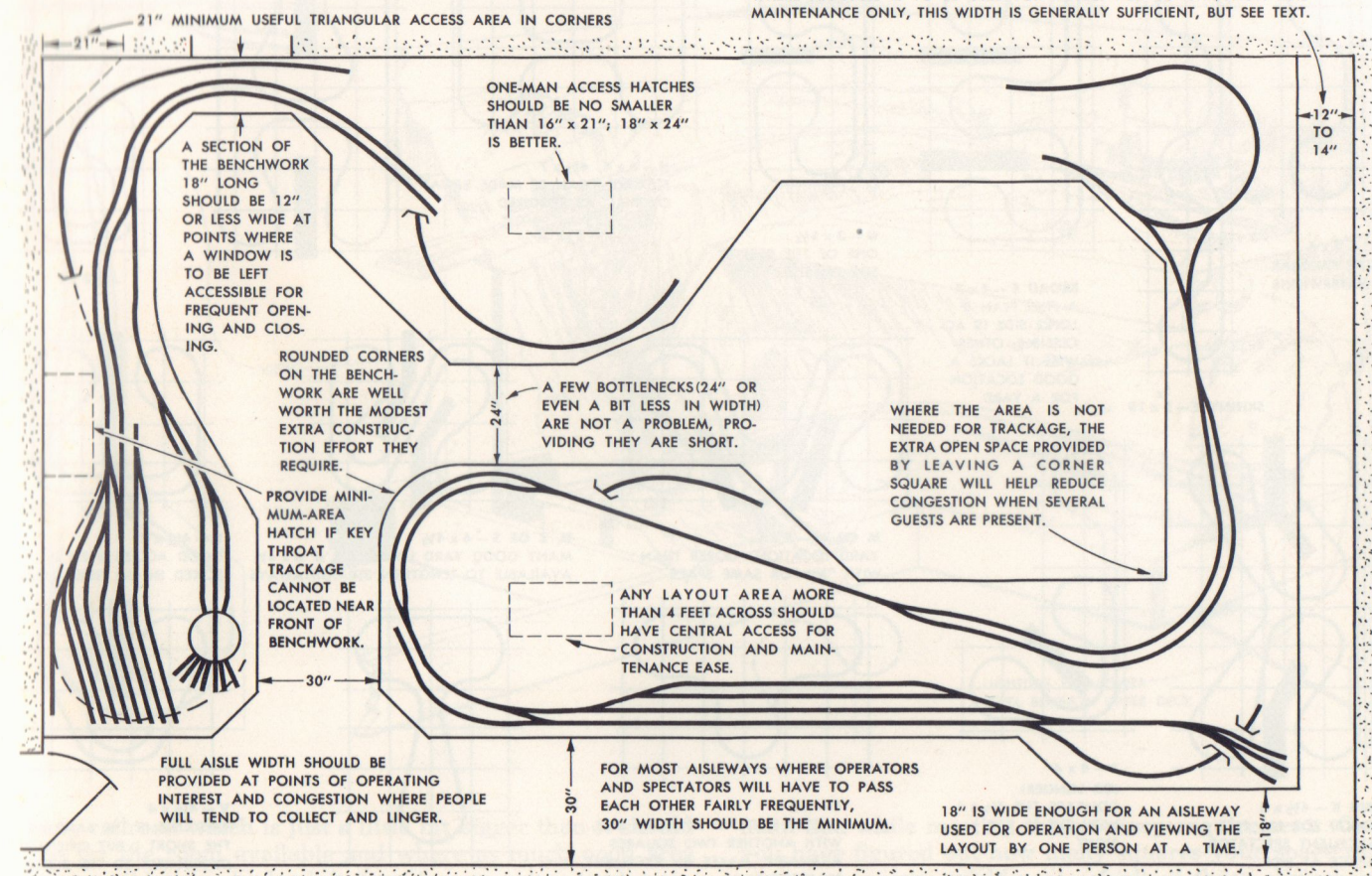
IN THE LARGER SIZES, MODIFYING EITHER THE ISLAND OR THE ALONG-THE-WALL SCHEME TO MINIMIZE ITS PROBLEMS AND TAKE ADVANTAGE OF ITS STRONG POINTS LEADS TO SOME FORM OF "WALK-IN" PIKE: THE ISLAND WALK-IN HAS THE MAXIMUM IN ACCESSIBILITY FOR OPERATING, VIEWING CLOSE UP, AND BUILDING, AND IT RETAINS THE ADVANTAGES OF ADAPTABILITY AND EASY SECTIONALIZATION FOR MOVING IF NECESSARY. IF YOU DON'T HAVE TO MOVE, THE WALK-IN PIKE, BUILT AGAINST THE WALL, PACKS THE ABSOLUTE MAXIMUM IN RAILROADING INTO THE SPACE WITHOUT LOSING EASE OF ACCESS. THIS SCHEME IS ALSO ADAPTABLE TO SPACES REACHED BY ONE OR TWO DOORS IN THE WALL RATHER THAN BY STAIRWAY.

ing a railroad in the first place, so these rules should not be regarded as holy. If squeezing an aisleway down to 20" width at one point will let you get a whole extra loop of main line into your basement, and you want a long main line, by all means squeeze it!

For really club-size pikes, an access aisle 1 foot or

Fig. 6-6 Access standards for walk-in layouts

TO GET FULL BENEFIT FROM THE EASY ACCESSIBILITY OF THE WALK-IN TYPE OF PIKE PLAN, THESE STANDARDS FOR AISLEWAY WIDTHS SHOULD BE MAINTAINED, REGARDLESS OF THE GAUGE OF THE RAILROAD, FOR AVERAGE-SIZE MODEL RAILROADERS.



more wide all the way around the pike (as indicated at the right of Fig. 6-6) is very nice — it makes the work of the scenery and wiring crews much more a pleasure than a chore. A person can move only sideways in a walkway that is 1 foot wide. To be able to turn or walk normally, a 16" width is needed. If the railroad is near shoulder height, even more aisle width is needed. Unless you have enough space to the point where you can afford to throw some of it away, it is good to remember that by squeezing the rest of the pike down a matter of

an additional 12" or 18" it is possible to leave a full-fledged operating aisle along that side of the railroad and get a lot more main line into an up-front location where you can really enjoy it.

The walk-in pike is not a new idea. Many of the earliest scale model railroads were of the "waterwings" type, which let you step into the middle of the display where most of the action was concentrated as the trains passed and repassed each other in their orbits around the "idiot loops." Old Waterwings is still a very good shape for

HOW BIG IS TOO BIG?

Reading this book, and particularly this chapter, may give you the idea that the best railroad for you is the biggest and most complicated one that can possibly be squeezed into your space. This may be far from the case; many model railroaders have started out to build pikes that they have eventually discovered were too big, and have either retreated to a more suitable size for their next railroad or have left the hobby.

Operationally, a good big layout still beats a good little layout, so let's look at the pitfalls of the too-big model railroad and see how they can be avoided:

● It may become a "maintenance Frankenstein" that can't be kept operating satisfactorily. This is not so much a matter of too big a railroad or of too much main line as it is of too much track complexity. Turnouts should be

limited in number to those really required. Where fancy trackwork is necessary, it should be made easily accessible. Each section of railroad should be checked out thoroughly by operation before the next is started. Jerry-rigged temporary construction and wiring should be kept to a minimum. Use of quality materials should be mandatory.

● It may take so long to get operating that interest may be lost. The chief remedy for this is the progressively constructed pike which starts with a master plan for the whole railroad but which is planned to be built and put into operation in stages — easy stages, but ones which promise increased operating fun with each new addition. You may reach a stage where you're having so much fun that no more construction gets done — so what? This is a hobby, man, and if that's the way it is, you're really living!

Fig. 6-7 An alphabet of walk-in pike shapes

SIZES GIVEN (IN "SQUARES"—SEE PAGE 52) ARE THE MINIMUM PRACTICAL AFTER ALLOWING FOR EXTERNAL AISLES ALONG SOME OR ALL SIDES; HALF A SQUARE HAS BEEN ALLOWED FOR WALK-IN AISLEWAYS AS INDICATED.

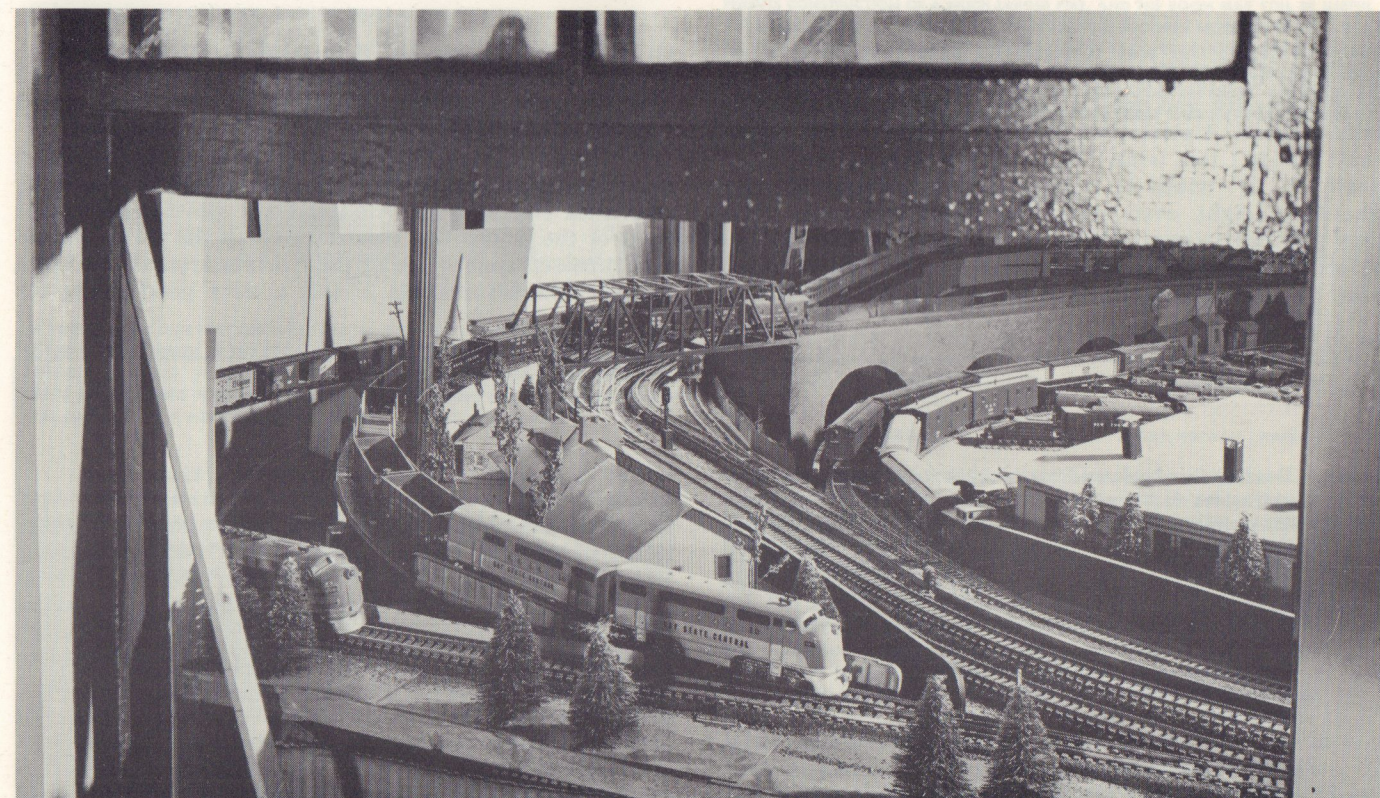
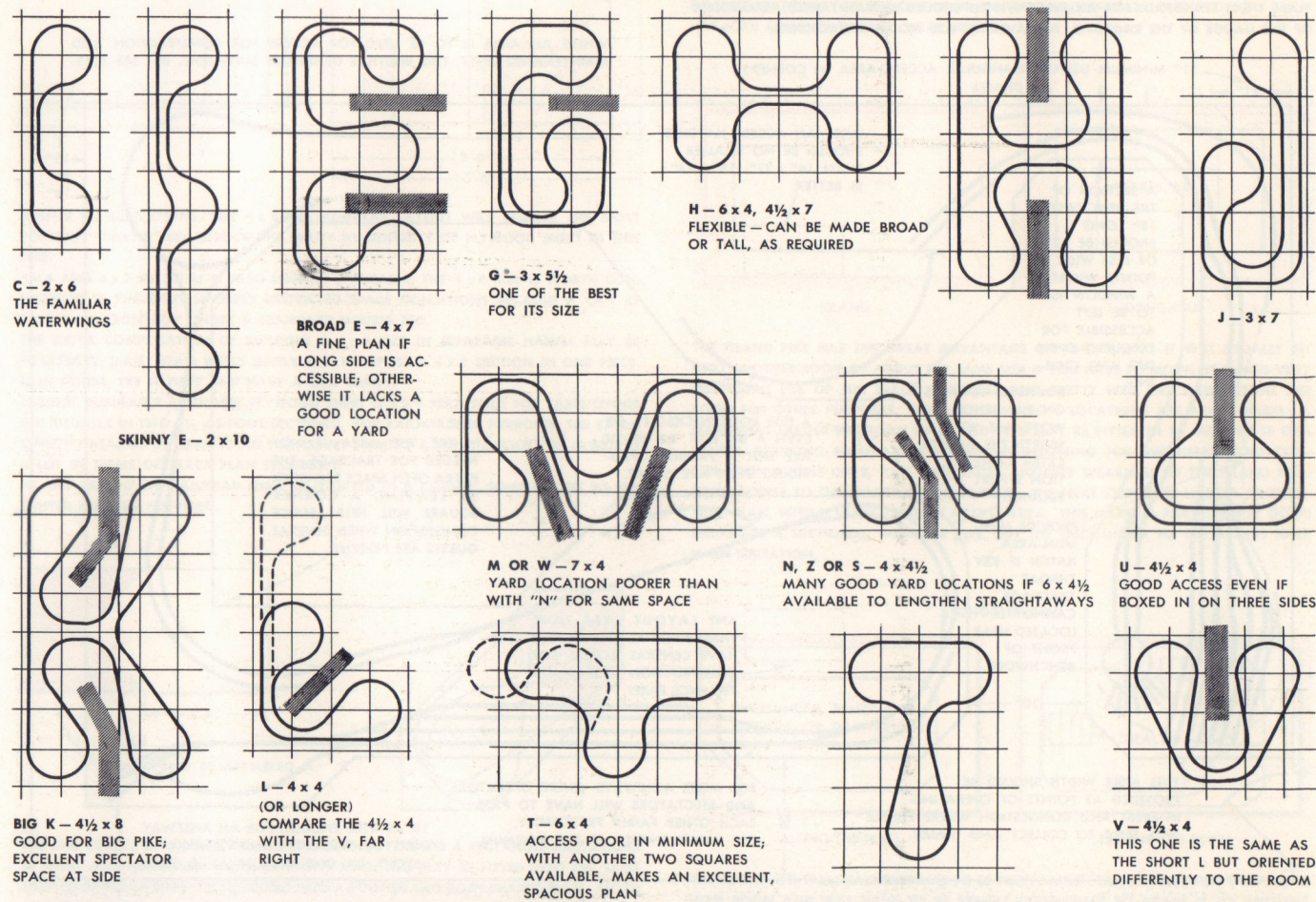


Fig. 6-8. The Bay State Central Lines of Howard Jenkins, Worcester, Mass., benefits from the convenient vantage point provided

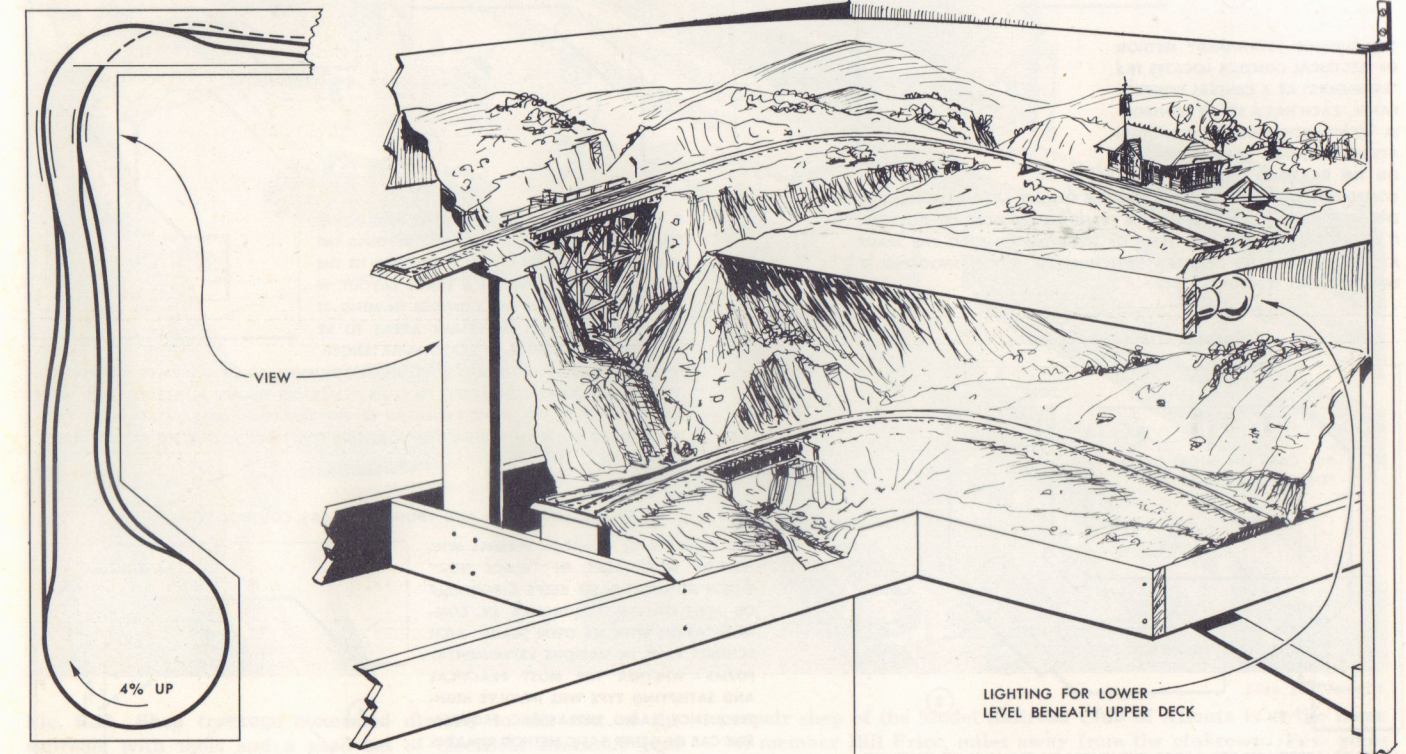
by a window off the porch—a potential liability turned into an asset from the access standpoint.

Linn H. Westcott.

Fig. 6-9 Transition to double-shelf construction

SMALL BUT ADVANCED PIKES CAN WELL USE TWO LEVELS, BOTH SCENICKED AND EXPOSED TO VIEW, AT SOME POINTS AS A MEANS OF DOUBLING UP OPERATING POSSIBILITIES IN THE SPACE (AT THE EXPENSE OF SOME TRICKY CARPENTRY AND ENGINEERING).

HERE IS AN EXAMPLE OF A SCHEME FOR EASING THE TRANSITION FROM SINGLE TO DOUBLE DECK.

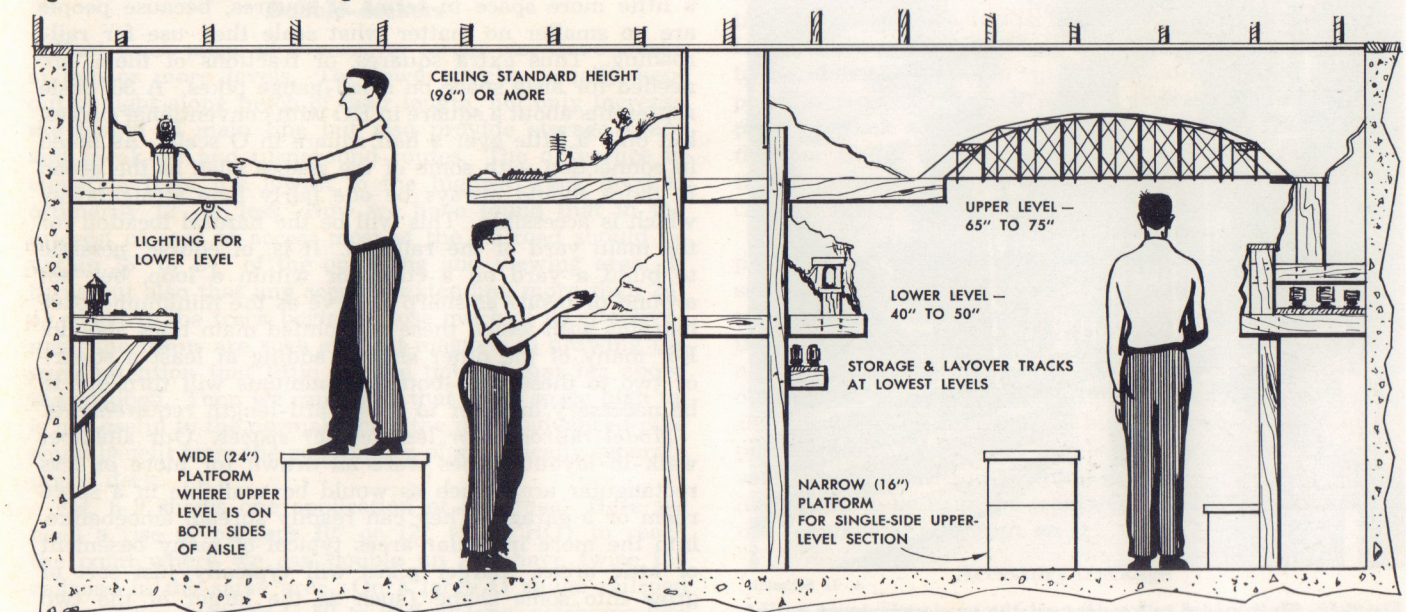


any railroad which is just a little bit bigger than it should be for the room available and where as much open area as possible should be left free for operators and train watchers. To give you a start toward thinking of all the possibilities, Fig. 6-7 offers an "alphabet" of walk-in shapes which can accommodate a reasonably usable

main line while meeting the no-stoop requirement. Once you have figured out how many squares your space represents, you can quickly see which of these choices can be considered for your own space.

You must add some space to the minimum requirements shown so as to leave an aisle along one or more edges of

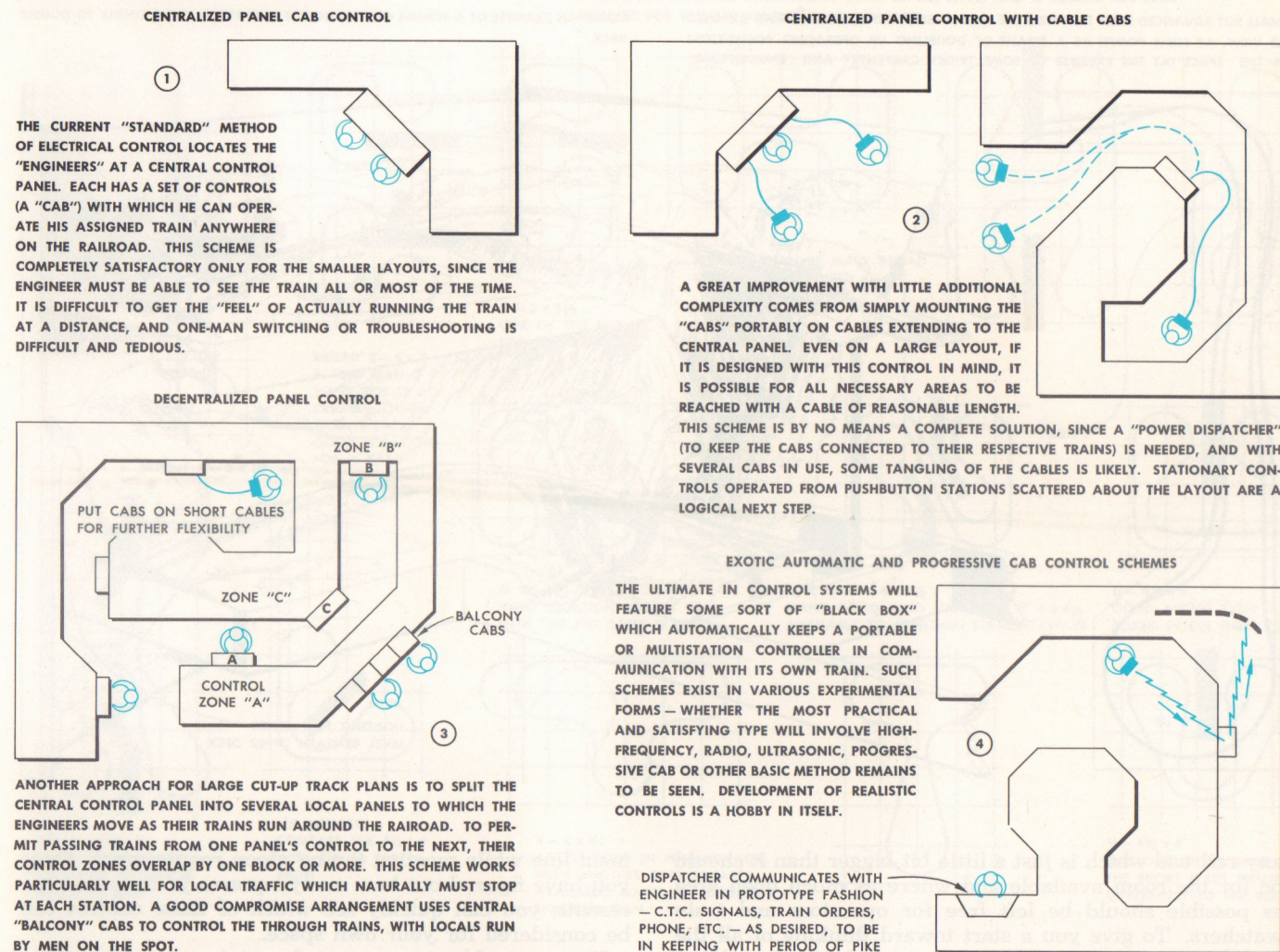
Fig. 6-10 Full double-deck arrangements



IT WILL TAKE REAL PIONEERING IN THE THIRD DIMENSION, BUT THE FUTURE WILL BRING DOUBLE-DECK PIKES WITH UNPRECEDENTEDLY REALISTIC OPERATION BECAUSE OF THE EXTRA LINE LENGTH, STORAGE CAPACITY, AND HEIGHT OF SCENICKING POSSIBILITIES. WITH BRIDGES ON THE UPPER LEVEL SO HIGH THAT THEY ARE "NO-STOOP" CROSSINGS FOR ALL BUT THE TALLEST RAILROADERS, TRACK PLAN FLEXIBILITY IS GREATLY INCREASED. TO

GET A FEELING FOR THE SPACIOUSNESS OF THE LOWER LEVEL ON SUCH A RAILROAD, SET A CARD TABLE ON TOP OF A REGULAR TABLE. IN DESIGNING A MONSTER OF THIS SIZE, IT IS WORTH GOING TO SOME TROUBLE TO MOCK UP KEY FEATURES AND SEE HOW AISLE WIDTHS, CEILING CLEARANCES, ETC., LOOK IN FULL-SIZE 3-D.

Fig. 6-11 Control location philosophy

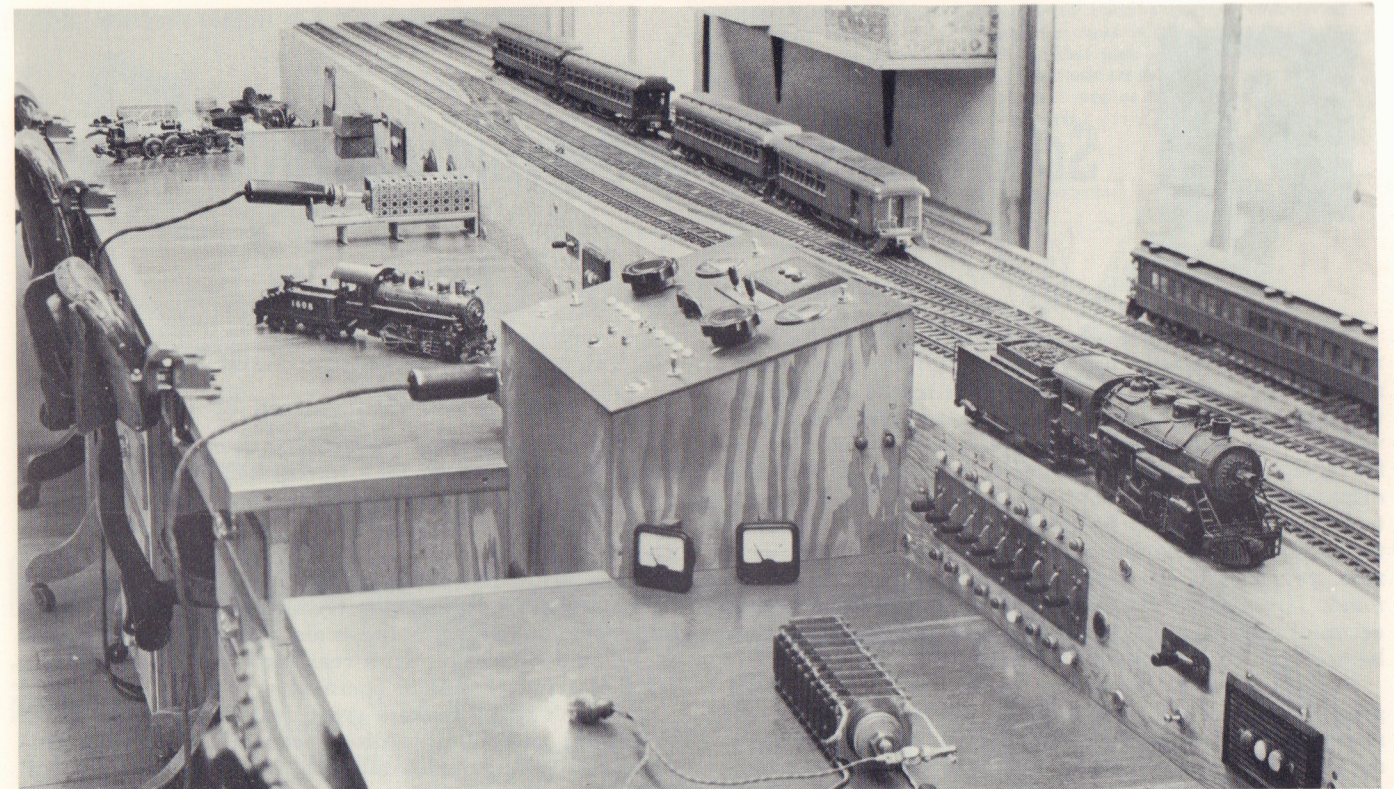


A. L. Schmidt.

Fig. 6-12. Most model railroaders get the most enjoyment out of operation when they're close enough to the trains to see clearly what is going on and to hear the clickety-clack over joints and through turnouts, as in this Model Railroad Club of Milwaukee scene. High (42" to 54") benchwork and plenty of aisles are important to that feeling of realism which makes a pike worthwhile.

the benchwork areas indicated. It should also be noted that if built in the smaller gauges these pikes will require a little more space in terms of squares, because people are no smaller no matter what scale they use for railroading. Thus extra squares, or fractions of them, are needed for aisle space on small-gauge pikes. A 30" aisle represents about a square in HO with conventional curves, but only a little over a half square in O scale. As noted in connection with some of the shapes such as the broad E, there should always be one fairly long straightaway which is accessible. This will be the natural location for the main yard of the railroad. It is, of course, possible to build a yard on a curve or within a loop, but not around or inside as sharp a curve as the minimum-space hairpins with which these convoluted main lines abound. For many of the other shapes, adding at least a square or two to these rock-bottom minimums will turn out to be necessary in order to meet yard-length requirements.

Model railroads for less regular spaces. Our alphabet walk-in layout shapes were all drawn for more or less rectangular areas such as would be available in a spare room or a garage. They can readily spread, amoebalike, into the more irregular areas typical of many basement or attic areas. Larger pikes will typically just sort of grow into some shape (such as the larger of the two walk-ins of Fig. 6-5) that doesn't classify as anything in particular, but does minimize problems with such obstacles as doors that must be kept open. You're on your own when it comes to making the best of such awkward areas as a second-floor hallway with a stairwell right



Linn H. Westcott.

Fig. 6-13. Shop trackage connected directly to the rest of the railroad, with tools and a good set of electrical checkout gear handy, can do a lot for satisfying operation by encouraging adequate maintenance and reducing the handling of rolling stock. Actually, while this picture does illustrate the point, this particular

repair shop of the Model Railroad Club of Atlanta is at the home of member Bill Price, miles away from the clubroom. Few pikes need or can afford as spacious and well-organized a shop as this but we all can benefit from the inspiration to do likewise on an appropriate scale.

in the middle, but persistence will usually pay off in a practical and interesting track plan if you try to look at each obstacle as a possible opportunity. Fig. 6-8, for example, shows how a window opening on a porch can work out as an access point and also provide a different and interesting viewing angle.

Double-deckers

Most track plans of average or larger size have tracks at two or more levels. The lower tracks, usually kept out of sight along much of their length, not only increase the length of main line but also provide storage space and sneak-off and turnaround routes. The difference in elevation from the lowest to the highest track level is ordinarily 12" or less. Now we have found that in the interest of ease of access most of the railroad should be within 18" or 24" of the operating and viewing area. It turns out also that any scenery extending more than 24" or so above the track begins to lose much of its effectiveness; the trains are such efficient magnets in drawing the eye's attention that little will be noticed that far above the roadbed. Then we can argue that if the space high up is not useful to the normal scene, the more-advanced pike could benefit from the possibilities of a scenically separate upper deck.

Fig. 6-9 shows one application of this idea. Here we need a rise of perhaps 10" or 12" (if in HO) to reach the point where we can double up and have twice the railroad in the same area. On a large O gauge railroad with a 4 per cent grade 50 or 60 feet long, a scheme like that of Fig. 6-10 becomes practical. Neither of these features is what you might choose for a beginner's pike or for a pike where you have all the space you need, but each represents a real new horizon for the matured larger layout which literally has no way to grow but up.

Control locations

You're not going to push the trains around the track by hand (at least not when anyone is watching you), so the matter of where you must be to control them is worthy of the most careful thought. In fact, the medium-size or large walk-in track plan can't be operated satisfactorily on a one-man basis from the stereotyped centralized control panel with fixed cab. Even on the 4x8-footer there are times when it would be a lot more fun to be able to watch an operation more closely than is possible from the panel. When you're checking out a piece of track or hunting for just what it is that makes the rear trailer of the Hudson pick the point every third time it passes the turnout at North Misery, an on-the-spot cab can really be appreciated.

Fig. 6-11 shows some of the types (or more properly, philosophies) of control location which should be considered for all but the smallest railroads. The cable-mounted cabs are electrically not much different from their stationary counterparts. The electrical circuitry necessary to make the more advanced schemes work is outside the scope of this book, but in any group of the size likely to be involved in building one of the larger pikes there is likely to be an electrically minded member who can take this sort of thing in stride and enjoy doing it. It's fun to be near the trains (Fig. 6-12) — don't make the "engineers" miss out on it.

Accessory trackage

You must have space for a shop for building and servicing your rolling stock and structures. It is highly worthwhile to provide direct track connection to the shop area, perhaps even working this branch into the operating scheme of the railroad even though it may not be possible to do such an elegant job as that in Fig. 6-13.

7

Schematics for satisfying operation

Operationally, it's the schematic plan of your model railroad that determines what you can do in the way of running trains. That is, it is the way the tracks are hooked together, not the way they may be twisted and interwoven, that tells whether your pike will be most suited for straightaway running, terminal switching, or intricate dispatching. When you actually get down to cases in your track planning, it may be that you will find it necessary to modify the schematic plan you started with, but as a rule, you should start out with an operating scheme in mind. It will save you from coming up with a plan that occupies the space just beautifully but which simply can't be operated realistically or conveniently.

Fig. 7-1 gives a tip or two on the reverse process of going from a track plan back to a schematic plan—a necessary part of the design procedure. Most track plans are confusing—usually deliberately so since we're trying to create an illusion—but we need to be able to check

them continually as they evolve to see that the trains can actually run in the way we desire.

Which comes first, railroad or model?

Some of us, strongly attracted to some one prototype railroad, will want to take it (or some part of it) and make as faithful a copy of it as we can. Others will want to provide for as interesting (and generally as realistic) operation in the model as possible and then worry later about whether it will be labeled the Georgia Short Line or the Louisville & Nashville (Attic Division). Still others will enjoy inventing a full-scale railroad, laying it out as soundly as possible on a real map, and then making a track plan that models its operations.

It doesn't really make a great deal of difference which procedure you follow. All are capable of creating eminently satisfying model railroads, and in all cases you will be backtracking from time to time, selecting a slightly dif-

Fig. 7-1 The track plan schematic

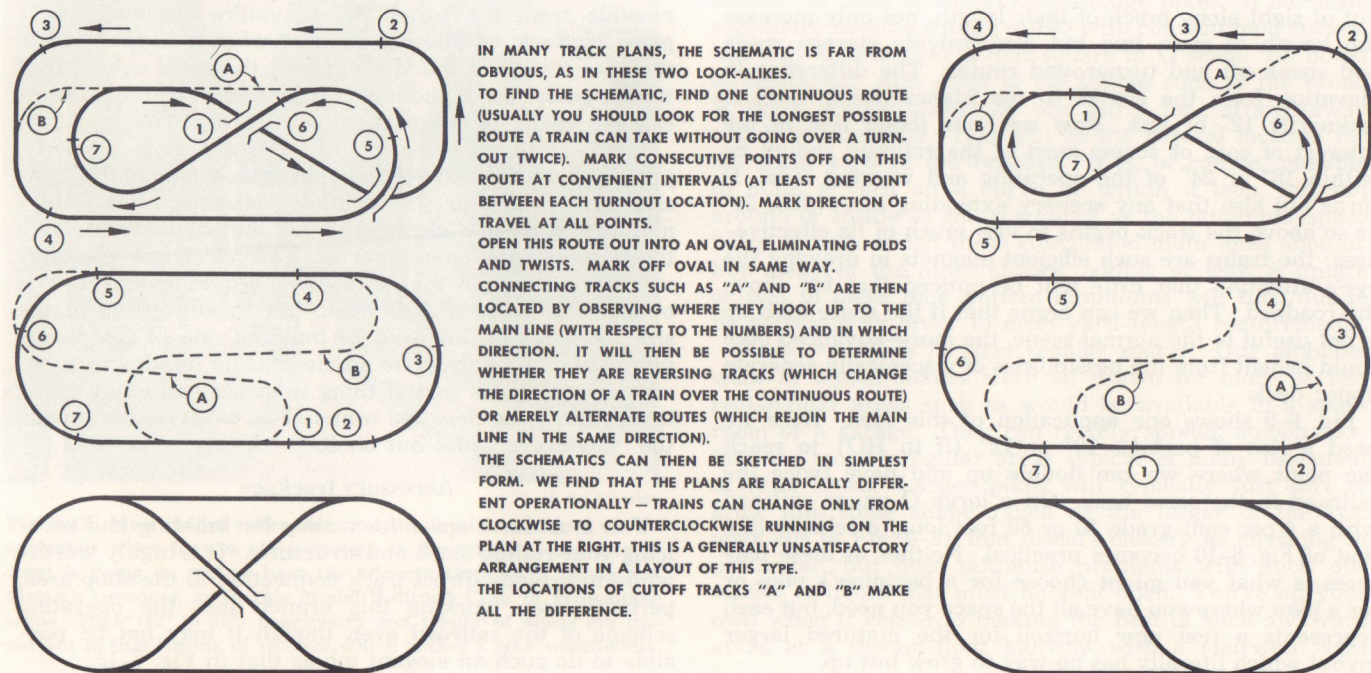
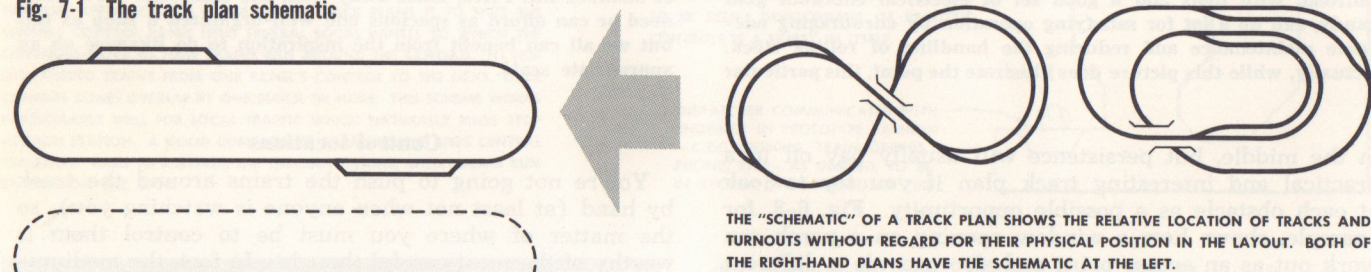
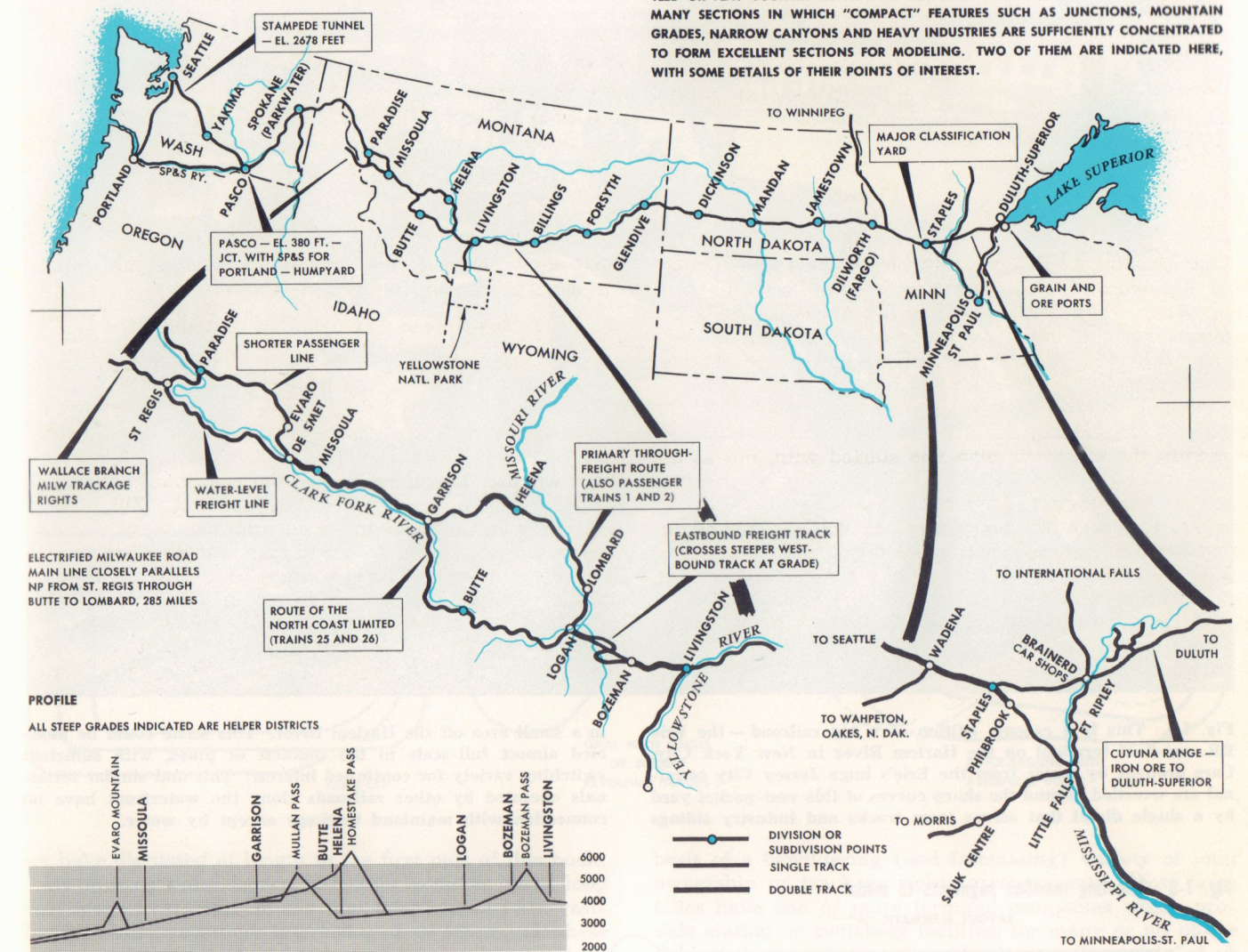


Fig. 7-2 Modelgenetic sections of a transcontinental railroad



ferent part of your favorite railroad to make it a better model or changing your track plan to make it more like some real railroad scene that has caught your fancy. We'll say a little bit in this chapter about selecting parts of a prototype line that will model well, and the case history in chapter 10 is based on the third choice, "freelancing" an imaginary full-scale railroad and then reducing some of it to a model. You can omit this part of the process if it doesn't particularly appeal to you.

Picking your spots

If you were modeling the Kennebec Central, you would have no modification whatsoever to do in coming up with a schematic drawing for your track plan. This Maine 2-footer had a total of nine turnouts, two turntables and 5 miles of main line with no connection to any other railroad, standard- or narrow-gauge. You could simply copy the exact arrangement of yard trackage at each end, shorten the main line to fit (which, schematically, is no change at all) and have the plan for your pike completed. And no one could say that you weren't set up for completely realistic operation.

Most of us choose slightly bigger prototypes, and it then becomes necessary to pick sections of the railroad to be depicted in model form, with the rest of the system taken care of by imagination aided by such tricks as sneak-off and layover trackage. It is also usually necessary to compress many of the trackage arrangements, as

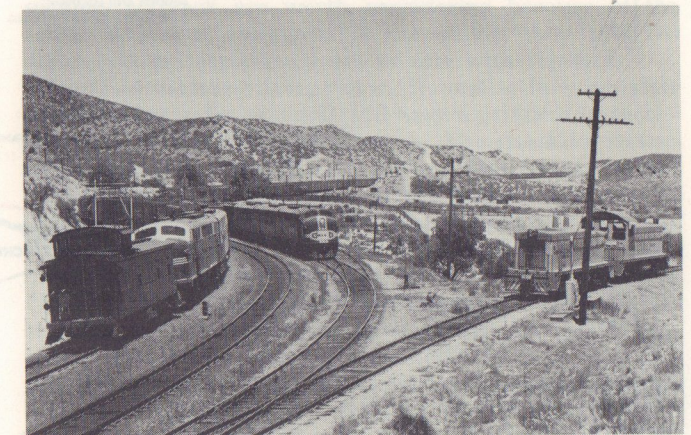


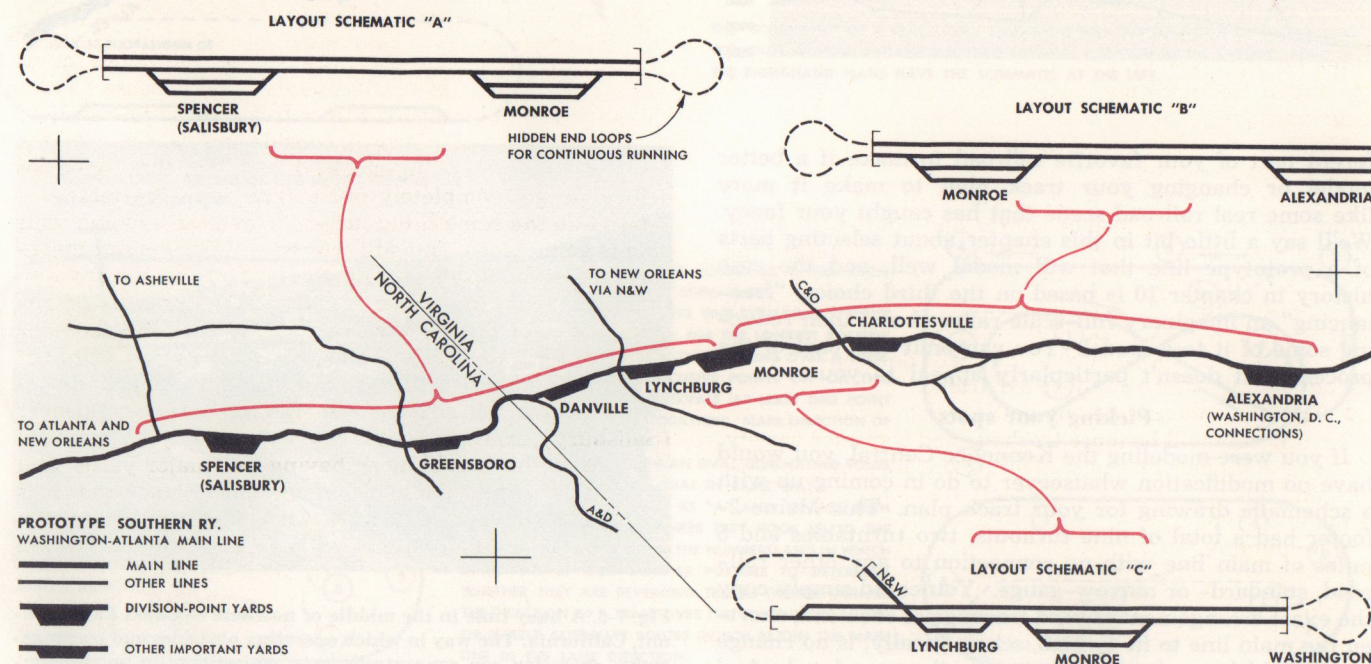
Fig. 7-3. A busy time in the middle of nowhere — Cajon Pass Summit, California. The way in which operating obstacles and trackage-rights operation can concentrate train movements in an unpopulated area is dramatized by this scene at the top of the grade bringing trains out of the Los Angeles area. An eastbound Santa Fe freight, helped by a two-unit diesel pusher operating in reverse ahead of the caboose, has just reached the summit. (Left-hand operation is in effect over Cajon to take advantage of the easier grade on the left-hand track.) A westbound diesel freight with white flags showing it's an extra is in the hole waiting to be passed by a passenger train. At the right, a Union Pacific cow-and-calf helper waits for clearance to return westbound.



Fig. 7-4. This is a capsule edition of a big railroad—the Erie RR. car-float terminal on the Harlem River in New York City. Cars brought by water from the Erie's huge Jersey City terminal are wrestled around the sharp curves of this vest-pocket yard by a single diesel that serves team tracks and industry sidings

in a small area off the Harlem River. This scene could be modeled almost full-scale in the smallest of pikes, with sufficient switching variety for continued interest. This and similar terminals operated by other railroads along the waterfront have no connection with mainland trackage except by water.

Fig. 7-5 Selecting mainline segments to model



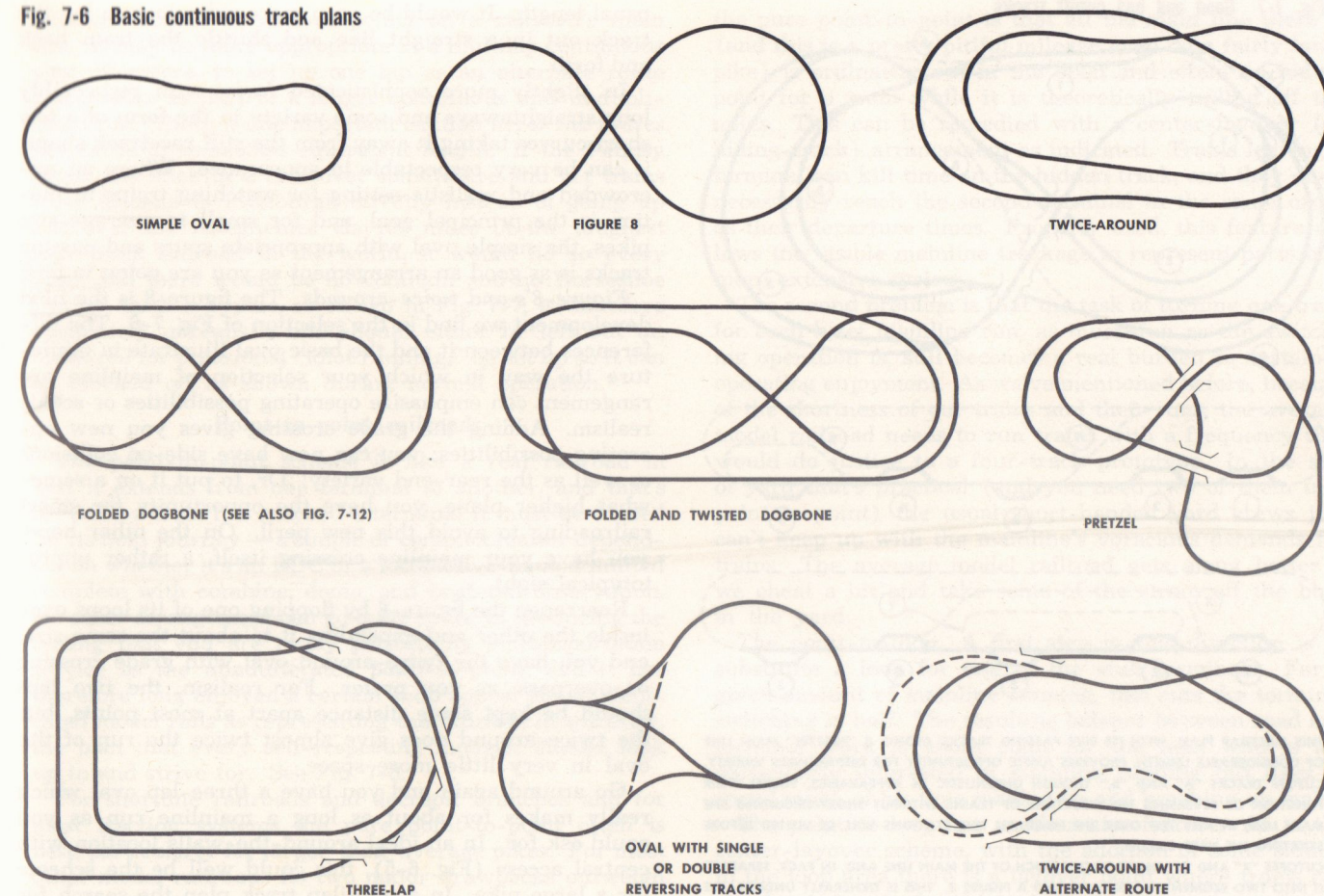
IN MODELING A LARGE RAILROAD IT IS GENERALLY BEST TO PICK A SECTION OF ITS MAIN LINE AND RE-CREATE IT IN CONDENSED BUT RECOGNIZABLE FORM RATHER THAN TO LABEL YOUR STATIONS AFTER TERMINALS 1000 MILES APART.

IN SELECTING A SECTION TO MODEL, A PARTICULAR DIVISION MIGHT BE CHOSEN, AS IN "A" ABOVE, WITH TRAINS ON THE LAYOUT SHUTTLING ACROSS THE DIVISION FROM ONE YARD TO THE OTHER. A SIMILAR ARRANGEMENT MIGHT INCLUDE ONE OF THE ROAD'S TERMINALS, THUS BRINGING CONNECTING ROADS INTO THE PICTURE, AS IN "B." A MORE PRACTICAL SCHEME FOR MOST SITUATIONS, HOWEVER, IS A SCHEMATIC LIKE "C" IN WHICH A SINGLE LARGE YARD IS MODELED AND THE "FAR ENDS" OF THE DIVI-

SIONS LEADING TO IT ARE REPRESENTED ONLY BY HIDDEN END LOOPS. THIS ALLOWS COMPLETE DUPLICATION OF MAINLINE RAILROAD OPERATIONS WITH A SINGLE LARGE YARD, WITHOUT THE MENTAL GYMNASTICS OF TRYING TO HAVE ONE YARD REPRESENT TWO DESTINATIONS.

IN SCHEMATIC "C" ADVANTAGE IS TAKEN OF THE FACT THAT SOUTHERN RY. TRAINS GO TO NEW ORLEANS BOTH VIA ATLANTA AND VIA THE N&W CONNECTION AT LYNCHBURG (RETURNING TO SOUTHERN RAILS AT BRISTOL, VA.-TENN.). THE START OF THE LOOP CAN THUS REALISTICALLY REPRESENT AN ACTUAL JUNCTION, AND EQUIPMENT OF ANOTHER RAILROAD IS BROUGHT INTO THE SCENE CORRECTLY.

Fig. 7-6 Basic continuous track plans



we have discussed at length in the first part of this book.

By picking your section carefully you can go a long way toward realism. On any line some sections are vastly more busy and more interesting than others. Of these better territories some are more compact and just naturally suited for modeling. Figs. 7-2, 7-3, and 7-4 discuss some examples.

"Compacting" factors. Generally speaking, you will want to look for sections where:

- Natural obstacles force track elements close together and require frequent curves and sharp curvature, holding train speeds down. The slower the trains go, the longer a given length of track will seem and the bigger your space will be, in effect. Even the fastest trains usually have some portions of their runs which must be covered at low speed, so a preference for limited does not rule out the advantages of reduced-speed traffic.

- Traffic is concentrated by bottlenecks. At these points there naturally will be more trackage and a greater variety of trains and operating maneuvers. The junctions, crossings, and obstacles forming the bottlenecks are interesting to model in their own right.

- Mountain grades require extra train- and engine-miles. Helper movements or doubling the hill treble the number of engines going past a point in moving the same tonnage. This is painful to the railroad but a bonus for us.

- Urban, industrial, or mining areas add spurs, short branches, switching and commuter runs to the picture.

Most roads are not so considerate as to have all these compacting factors in the same territory, but we can cheat a bit and move them close together in many cases without seriously violating reality or losing the flavor of the particular railroad.

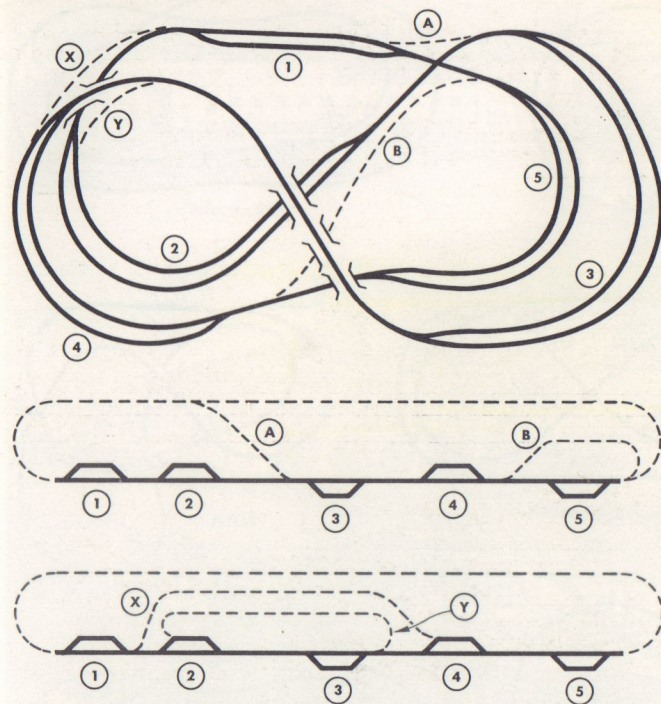
Trackage rights and terminals. Thousands of miles of line in the U. S. are used by two or more railroads on the

basis of a bewildering (and fascinating) variety of joint ownership or trackage-rights arrangements. Most large cities have one or more terminal companies which provide station or switching facilities for many or all of the through lines entering the urban area. Since few of us can remain "pure" in our locomotive and caboose rosters and stick completely with one railroad, these jointly used sections of track are worth considering because of the extra choice of rolling-stock ownership they give us before we get completely out of line with the facts.

Don't do the same thing twice. No matter how big your pike is going to be, you still will have a problem in incorporating all the things you want. The most important single thing to remember in picking features to be included is to avoid modeling two of the same major items. Offhand, it might seem sensible, when selecting part of the Southern Ry.'s main line to be duplicated in your basement, to take the stretch from Monroe, Va., to Spencer (Salisbury), N. C., with the division-point yards at each end. To do this would mean having two major yards, and within the definite limits of the amount of track that it is practical to have in any pike, each yard would have to be considerably undersize. Building the second one would also be considerably less fun than building the first. Granted, you might do a better job on the second by virtue of your previous experience.

A considerably better scheme is to plan your pike with one principal yard, as in Fig. 7-5, and represent one or both ends of the main line by simple loops or other turn-arounds. This does not mean, of course, that we will not have other smaller, special-purpose yards on the layout, but our one big yard can now spread out to where it is a much more worthy representation of the vast sea of tracks that is typical of even the smaller division points in the prototype.

Fig. 7-7 Good and bad cutoff tracks



THIS MULTILAP PLAN, WITH ITS FIVE PASSING TRACKS ALONG A "PRETZEL" MAIN LINE OF CONSIDERABLE LENGTH, PROVIDES AMPLE OPPORTUNITY FOR DISPATCHING VARIETY. CUTOFF TRACKS "A" AND "B," THOUGH UNREALISTIC IN APPEARANCE, FULFILL THEIR FUNCTION OF REVERSING THE DIRECTION OF TRAINS WITHOUT SHORT-CIRCUITING THE MAIN LINE; IN ANY TRIP OVER THE ROAD ALL FIVE STATIONS WILL BE VISITED BEFORE STARTING THE NEXT CIRCUIT.

CUTOFFS "X" AND "Y" SHORT-CIRCUIT MUCH OF THE MAIN LINE AND, IN FACT, SEPARATE IT INTO TWO SEGMENTS — AN OVAL AND A FIGURE 8. THIS IS GENERALLY UNDESIRABLE EXCEPT WHEN YOU WISH TO SIMPLY LET TWO TRAINS RUN INDEPENDENTLY WITHOUT ATTENTION. WHEN THE LAYOUT IS TO BE OPERATED IN RAILROADLIKE FASHION, THESE SHOULD BE BLOCKED OFF (BY SETTING CARS ON THEM AS THOUGH THEY WERE INTERCHANGE TRACKS, FOR EXAMPLE).

The other side of the mountain. Likewise, if you have a mountain on your main line, you might plan a helper operation up each side of the big hill. Each grade will probably have to be fairly short, though, and not very impressive. A better idea is to model one long grade and do a respectable job of it, with enough change in elevation to really give the impression of mountain railroading. You will need some way to turn helper engines at the top and bottom of the grade; you will do better to contrast the operation of running them around a wye at the top of the hill with the use of a turntable to do the job in the engine terminal at the base.

Schematics for model main lines

Now that we have taken some steps toward seeing what we want to try to represent in our track plan, let's look at the other side of the coin — the available selection of mainline track arrangements that can be considered practical for model railroad operating purposes, and the factors that affect their usefulness from this standpoint. For the moment, we'll pay little attention to whether or not what goes on in the model bears any resemblance to real railroading. Later, we will see what can be done to harmonize the two into a schematic plan that is both practical and realistic in operation.

Continuous and point-to-point. The two basic types of track plan are *continuous* and *point-to-point*. The continuous main line is the most common, since that's what you get in the simple oval of track supplied with a train set. In its simplest form it's pretty ridiculous, with the train chasing its own tail trip after trip, but it is the best that can be done with that much track for a train of the

usual length. It would be even more ridiculous to lay the track out in a straight line and shuttle the train back and forth.

In slightly more sophisticated form, with respectably long straightaways and some variety in the form of a few short curves taking it away from the stiff racetrack shape, it can be very respectable in appearance. Where an uncrowded and realistic setting for watching trains in motion is the principal goal, and for small to average-size pikes, the simple oval with appropriate spurs and passing tracks is as good an arrangement as you are going to find.

Figure-8's and twice-around's. The figure-8 is the next development we find in the selection of Fig. 7-6. The differences between it and the basic oval illustrate in miniature the way in which your selection of mainline arrangement can emphasize operating possibilities or scenic realism. Adding the grade crossing gives you new operating possibilities; you can now have side-on collisions as well as the rear-end variety! Or, to put it on a somewhat higher plane, you have the opportunity for smart railroading to avoid this new peril. On the other hand, you have your mainline crossing itself, a rather unprototypical sight.

Rearrange the figure-8 by flopping one of its loops over inside the other and expanding it to about the same size, and you have the twice-around oval with grade crossing or overpass, as you prefer. For realism, the two laps should be kept some distance apart at most points, but the twice-around does give almost twice the run of the oval in very little more space.

Go around again and you have a three-lap oval which really makes for about as long a mainline run as you could ask for. In an ideal around-the-walls location with central access (Fig. 6-5), this could well be the scheme for a large pike. In a multilap track plan the search for variety in the routing of the various circuits of line may lead to twisting one lap in figure-8 fashion so that a train will appear at times to be going in the other direction. This results in some form of the pretzel layout, usually with some grade crossings to add operating interest (at the expense of realism), lots of main line, and serious access problems in all but the smallest sizes.

A similar variation of the two-lap oval is known as the folded dogbone.

Reversing tracks. On any continuous plan where turning trains at a terminal is not required, most of the operating interest for through trains comes in the meets and passes they must make. With two trains in operation in opposite directions, your dispatcher and crews will be running trains into and out of sidings almost constantly. On the other hand, if the trains are following each other, the faster train will occasionally have to pass its companion to stay on schedule, but at much less frequent intervals. If both are fast or slow runs, they can keep going most of the time. Thus, the one track plan provides excellent versatility — lots of meets when you feel like emphasizing the dispatcher's side of railroading, lots of relatively free running when you're more interested in seeing the trains roll. To make it easy to switch from one style to the other by reversing the direction of one of the trains, many track plans include reversing tracks, sometimes called return cutoffs. A single such connection is not too helpful, since all trains will eventually wind up going in the favored direction and it will be necessary to back through the reversing track to get any train back to running the other way again. Thus, most plans include two of them. As Fig. 7-1 indicates, on a typical spaghetti-bender track plan it may take a bit of analysis to verify that the reversing tracks actually are properly located to do their jobs.

Alternate routes. As the prototype illustrations of Figs. 3-1 and 7-2 show, there are abundant reasons for having

alternate routes at various points on a railroad's main line. It may be more appropriate in a multilap continuous plan, therefore, to set up one lap as an alternate route rather than as part of a longer continuous and unduplicated run. There is one important caution here: *the routes should be of somewhat equivalent length.* If the Pennsy could just stick in a crossover somewhere and get trains from Altoona to Pittsburgh directly instead of going up and over the Alleghenies via 100 miles of the toughest four-track railroad in the world, it would do so every time, and there would be no Gallitzin and no Horseshoe Curve. Such a bypass, as shown in Fig. 7-7, is therefore completely unrealistic and should either be left out or, if desired for occasional "idiot running," be set up so it can be blocked off as shown during normal operation.*

Point-to-point railroads

The point-to-point scheme is like a real railroad in that it extends from one terminal to another, and that's it! Once a train has reached a terminal it must be turned for its next journey — a simple or complex matter depending on whether it's an RDC or a locomotive-hauled limited complete with combine, dome, and boat-tail observation. No other arrangement can go quite so far in producing the feeling that you are really performing a transportation service as the unadulterated point-to-point, and it has therefore long enjoyed a certain snob appeal among dedicated model rails as representing the ultimate in sincerity, the plan that every self-respecting modeler should look up to and strive for. See Fig. 7-8.

For shortline railroads and decrepit branches and for most traction systems the pure point-to-point often is best, particularly for larger-than-average pikes. For most other model railroads its two major drawbacks outweigh the advantages.

The center-layover scheme. The first difficulty with

*There are also quite legitimate reasons for such cutoffs where a particular type of railroading is to be represented as realistically as possible within the inherent limits of practical mainline length and running versus switching speeds. See track plan 11-6.

the pure point-to-point is that all the main line there is (and this is a pretty pitiful mileage even on a fairly large pike) is ordinarily out in the open and offers no hiding point for a train while it is theoretically rolling off the miles. This can be remedied with a center-layover (or hiding-track) arrangement as indicated. Trains leaving a terminal can kill time on the hidden track, and they don't necessarily reach the second terminal in the same order as their departure times. Properly used, this feature allows the visible mainline trackage to represent parts of a more extensive system.

The second problem is that the task of turning one train for each brief mainline run, as much fun as the switching operation is, still becomes a real burden to sustained operating enjoyment. As we've mentioned before, because of the shortness of our trains and their runs, the average model railroad needs to run trains with a frequency that would do justice to a four-track prototype. In the size of yard that's practical (and you need two of them in a point-to-point) the usual short-handed yard crews just can't keep up with the mainline's voracious demands for trains. The average model railroad gets along better if we cheat a bit and take some of the strain off the boys in the yard.

The point-to-loop. A first step in this direction is to substitute a loop for one of the stub terminals. For a given amount of mainline running, this cuts the terminal switching in half. The resulting balance between road and terminal work is about right for the man who is not particularly interested in mainline running but likes to spend much of his time making up and breaking up trains.

The point-to-loop has another nice feature. As in the center-layover scheme, with the addition of some sidings in the loop area there is a layover point where trains can simply stop out of sight to indicate the passage of time before they return. For all you can tell they are battling their way across mountain and plain to the far end of the main line, 100 or 1000 miles away.

Layover trackage is the heart of *all* schemes to make your limited trackage represent a reasonably full-scale

Fig. 7-8 Point-to-point track plans

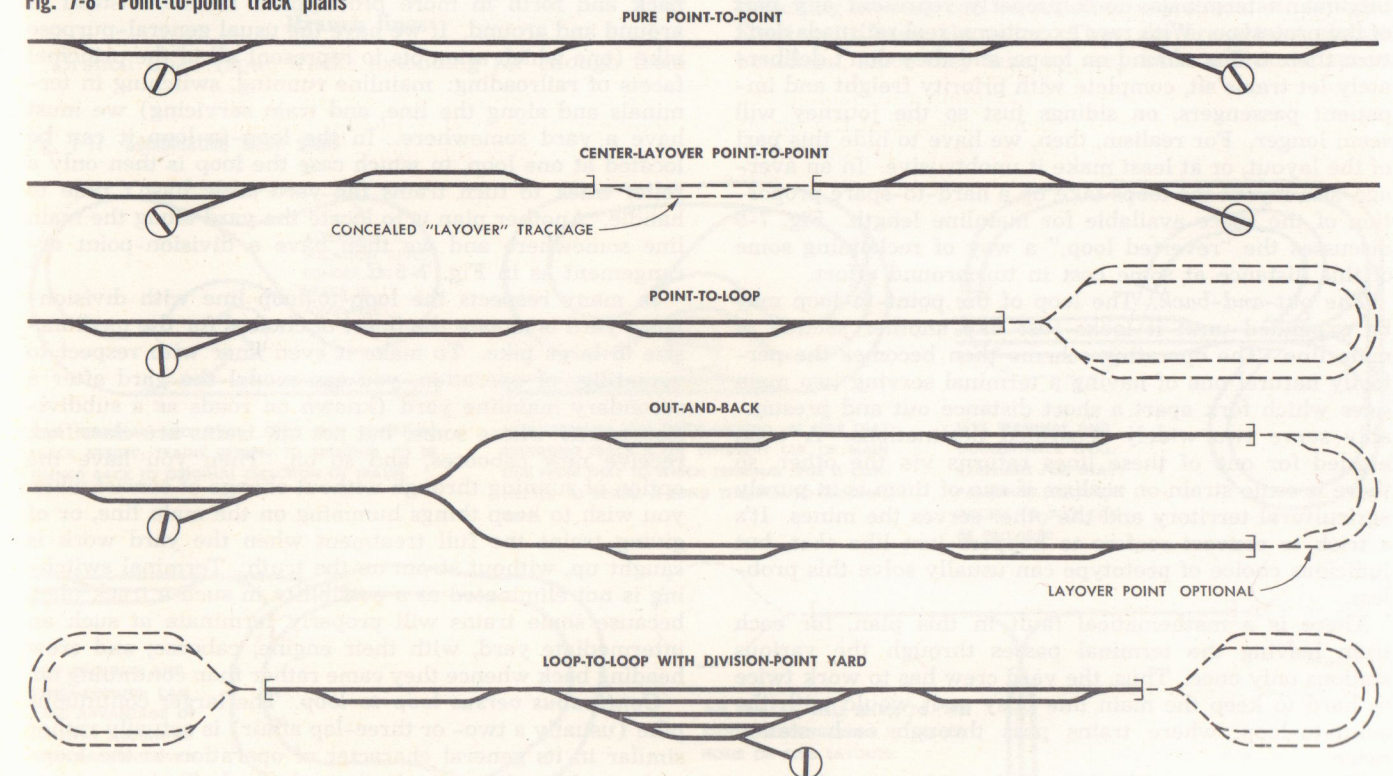
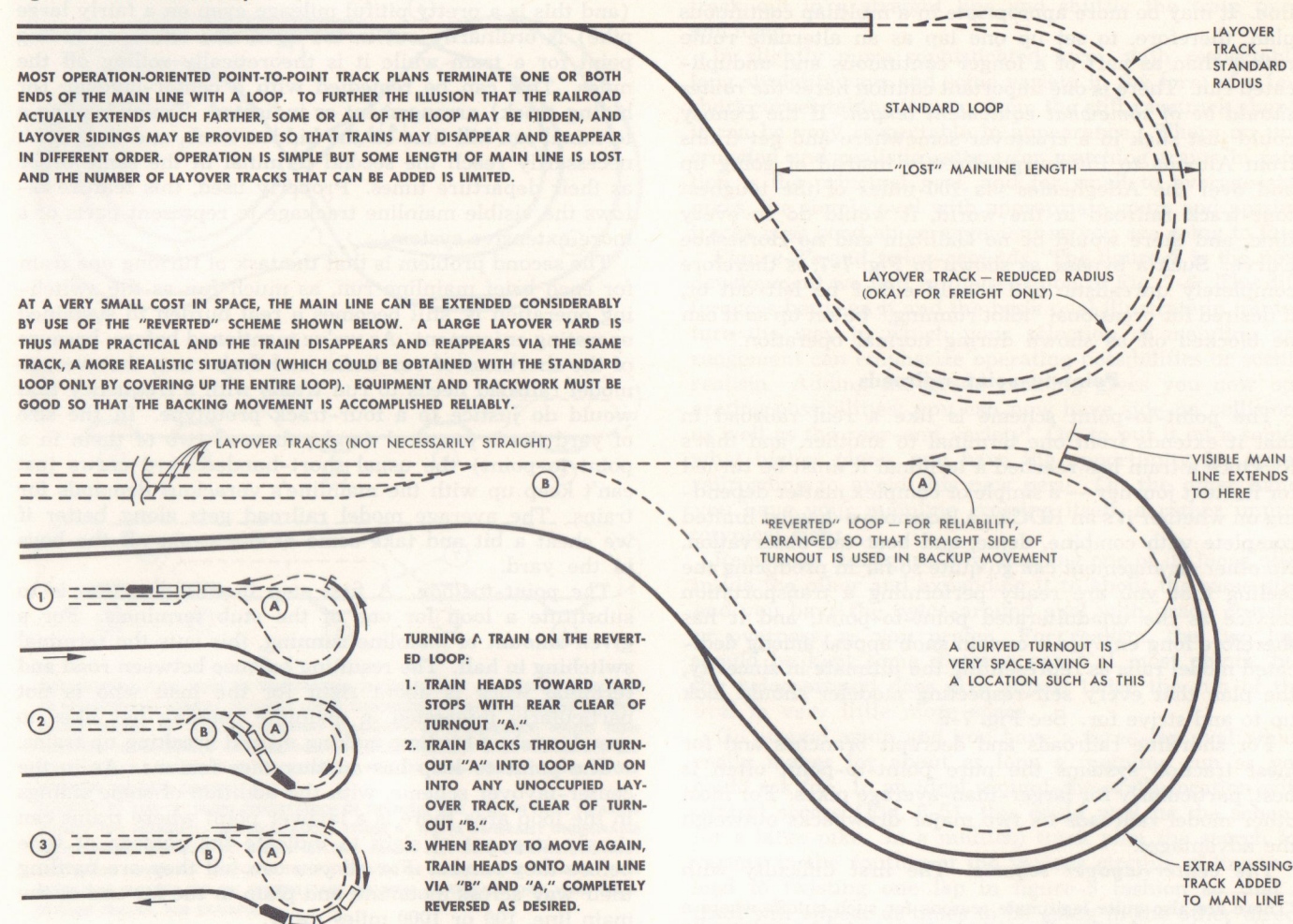


Fig. 7-9 The reverted loop



model of just a chunk of a much longer railroad. The lay-over tracks themselves, however, and the loops we use as lazy-man's terminals, don't properly represent any part of the prototype. With rare exceptions, real railroads don't turn their trains around on loops, and they don't deliberately let trains sit, complete with priority freight and impatient passengers, on sidings just so the journey will seem longer. For realism, then, we have to hide this part of the layout, or at least make it unobtrusive. In an average-size layout the loops take up a hard-to-spare proportion of the space available for mainline length. Fig. 7-9 discusses the "reverted loop," a way of reclaiming some of this distance at some cost in turnaround effort.

The out-and-back. The loop of the point-to-loop may be expanded until it looks just like another section of main line. The operating scheme then becomes the perfectly natural one of having a terminal serving two main lines which fork apart a short distance out and presumably serve two widely separated destinations. A train headed for one of these lines returns via the other, so there is some strain on realism if one of them is in purely agricultural territory and the other serves the mines. It's a trick to convert reefers to hoppers just like that, but judicious choice of prototype can usually solve this problem.

There is a mathematical fault in this plan, for each train leaving the terminal passes through the various stations only once. Thus, the yard crew has to work twice as hard to keep the main line busy as it would with the point-to-loop, where trains pass through each station twice.

The loop-to-loop. The loop-to-loop plan can eliminate

switching completely. When it is used that way it is essentially a continuous scheme, except that trains do run back and forth in more prototypical fashion instead of around and around. If we have the usual general-purpose pike (one which attempts to represent all of the principal facets of railroading: mainline running, switching in terminals and along the line, and train servicing) we must have a yard somewhere. In the loop-to-loop it can be located at one loop, in which case the loop is then only a relief track to turn trains the yard crew hasn't time to handle. Another plan is to locate the yard along the main line somewhere and we then have a division-point arrangement as in Fig. 7-5 C.

In many respects the loop-to-loop line with division-point yard is among the finest of choices for the medium-size to large pike. To make it even finer with respect to versatility of operation, you can model the yard after a secondary mainline yard (known on roads as a subdivision point) where some, but not all, trains are classified, receive new cabooses, and so on. Then you have the option of running through without change of consist when you wish to keep things humming on the main line, or of giving trains the full treatment when the yard work is caught up, without strain on the truth. Terminal switching is not eliminated as a possibility in such a track plan, because some trains will properly terminate at such an intermediate yard, with their engine, caboose, and crew heading back whence they came rather than continuing on.

Continuous versus loop-to-loop. The larger continuous pike (usually a two- or three-lap affair) is actually rather similar in its general character of operation to the loop-to-loop plan with a single through yard. Trains can op-

erate over the main line without interruption if desired, and the impression you receive, if you watch trains at any one point on the line, is that of traffic moving in both directions over the railroad, just as it should. As Fig. 7-10 shows, the choice may well depend on the nature and extent of your road's business in commodities carried in open-top cars.

Combination schematics

Many successful track plans combine continuous and point-to-point aspects into a scheme that has some of the virtues of both as shown in Fig. 7-11. The continuous oval or twice-around with spur terminal is much like, but actually better than, the out-and-back. It's versatile. A train leaves the terminal, makes as many circuits of the continuous oval as desired, runs through the single reversing track, and returns to the yard to be broken up. For small to average-size track plans it's about the best you can do. In a pinch, it can be fitted into $2\frac{1}{2} \times 4$ squares.

Further variations of the combination theme include the wye-connected stub-and-oval or stub-and-twice-around plans. These are particularly well suited to pikes which wish to emphasize passenger traffic, since they duplicate the operations of stub-on-wye terminals (Fig. 1-14), which are fairly common for the varnish trade but rarer for handling freight.

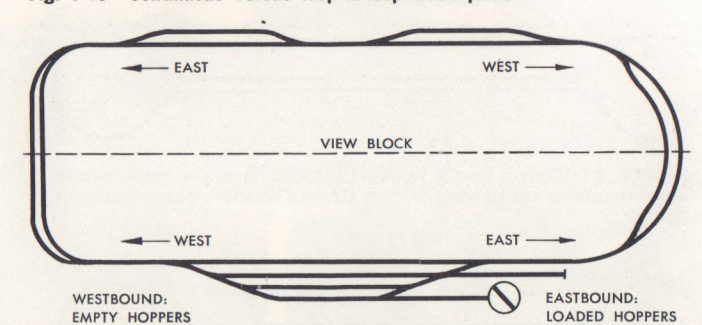
For large and club-size pikes, the *riata* scheme combines the loop-to-loop main with a stub-terminal appendage which can be operated either in head-in or back-in fashion as suits the prototype situation being modeled.

Where a specific prototype segment that involves a number of interconnected branches is being copied operationally (such as the area around Staples and Brainerd, Minn., Fig. 7-2), the schematic won't fit into any of the basic track pattern classifications. The various ideas we have discussed about the ways of terminating lines (loops versus stub terminals) and the problems and virtues of out-and-back arrangements may be of some help, but basically you are on your own. Terminal and belt-line railroads, excellent prototypes because of the diversity of their operations and equipment, fall into somewhat the same category.

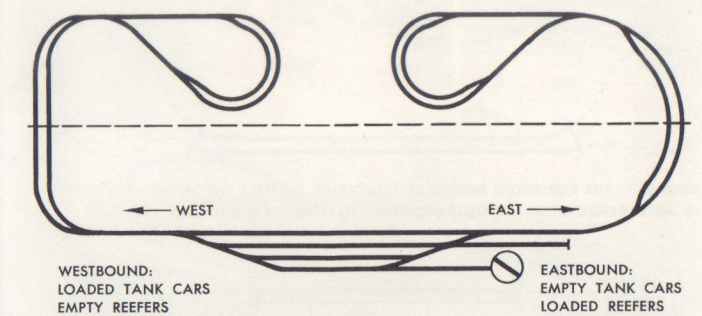
Branch lines

Branch lines (spur tracks extending far enough from

Fig. 7-10 Continuous versus loop-to-loop track plans



IF THE ENTIRE CIRCLE OF MAIN LINE OF A CONTINUOUS TRACK PLAN CANNOT BE SEEN AT ONE TIME (AS IS THE CASE IN AN AROUND-THE-ROOM LAYOUT), OPERATION OF TRAINS PAST ANY POINT IS SATISFYINGLY REALISTIC, EXCEPT THAT THE SAME EQUIPMENT CAN PASS TIME AFTER TIME IN THE SAME DIRECTION WITHOUT EVER RETURNING - NOT TOO OBVIOUS A FLAW ON A HEAVY-TRAFFIC LINE. MOVEMENT OF OPEN-TOP CARS IS REALISTIC, AS EMPTIES ALWAYS MOVE IN ONE DIRECTION, LOADS IN THE OTHER.



ON A SIMILAR LOOP-TO-LOOP LINE, APPEARANCE OF OPERATIONS AT ANY POINT ON THE MAIN LINE IS MUCH THE SAME, BUT A TRAIN THAT HAS DISAPPEARED TO THE EAST MUST RETURN FROM THAT DIRECTION - A MORE REALISTIC SITUATION FOR PASSENGER AND "CLOSED-TOP" FREIGHT TRAFFIC. HOWEVER, YOU WILL GIVE THE APPEARANCE OF HAULING THE SAME COAL BACK AND FORTH JUST FOR THE FUN OF IT UNLESS YOU ARE ENERGETIC ENOUGH TO EMPTY AND LOAD YOUR OPEN-TOPS EACH TIME THEY REACH AN END LOOP.

the main line to allow actual train movements, not just switching moves) can be added to any schematic without altering its basic character. They are almost always beneficial, since they take up very little additional space.

Fig. 7-11 Combination track plans

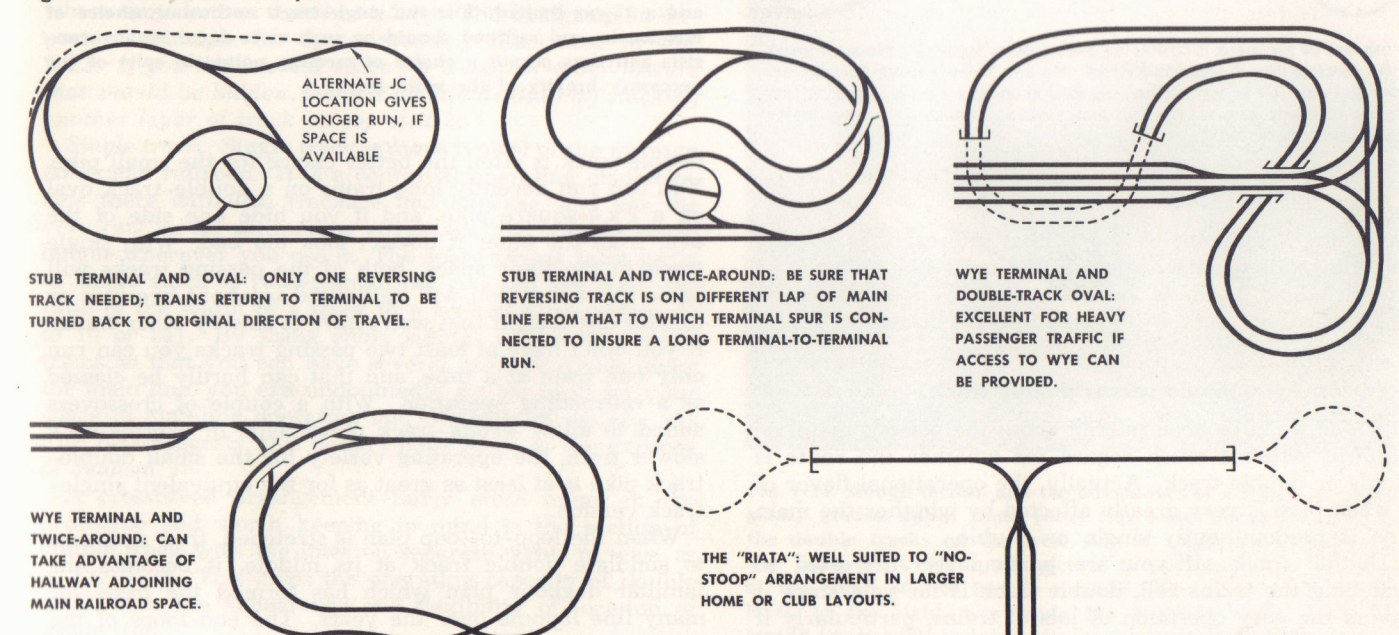
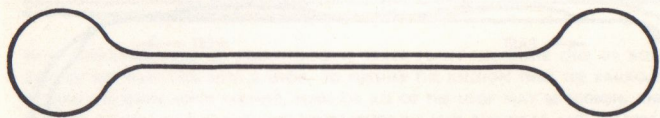
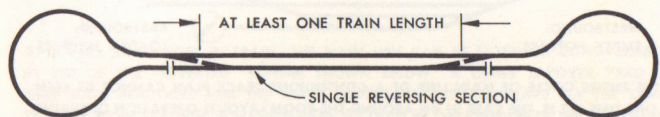


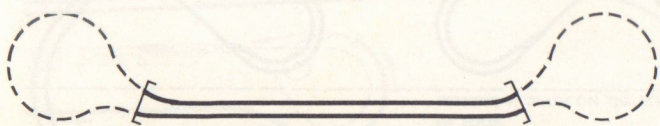
Fig. 7-12 The dogbone track plan



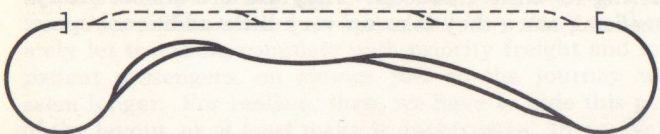
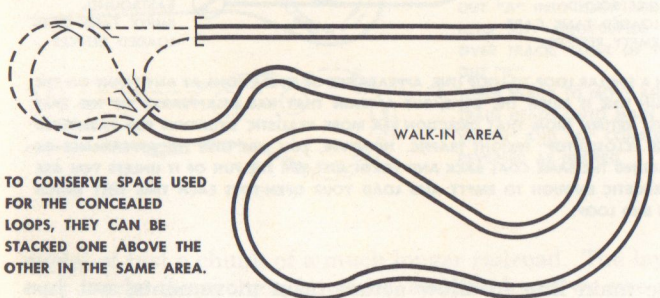
DESERVEDLY A FAVORITE IS THE OLD FAITHFUL "DOGBONE" MAIN LINE. USED INSTEAD OF LOOP-TO-LOOP, IT ALLOWS POINT-TO-POINT RUNNING WITHOUT FREQUENT TURNOUT-THROWING.



WHEN CROSSOVERS ARE ADDED IN THE "SHANK," ELECTRICAL "REVERSING LOOPS" ARE CREATED AT THE ENDS — A MATTER WHICH HAS CAUSED SOME HESITANCY IN ITS USE WITH TWO-RAIL WIRING. HOWEVER, IF THE SHANK IS AT LEAST ONE TRAIN LENGTH LONG, IT CAN BE HANDLED AS SHOWN WITH A SINGLE REVERSING SECTION AND WITH EXCELLENT FREEDOM IN CROSSING OVER BETWEEN THE DOUBLE TRACKS WITHOUT CONFUSION.



SCENICALLY, THE END LOOPS SHOULD BE CONCEALED SO THAT THE SHANK WILL GIVE THE APPEARANCE OF A DOUBLE-TRACK POINT-TO-POINT RAILROAD LINE.



IF ONE SIDE OF THE SHANK IS CONCEALED, THE DOGBONE BECOMES A GLORIFIED SIMPLE OVAL, REPRESENTING A SINGLE-TRACK LINE. THE END LOOPS BECOME SOCIALLY ACCEPTABLE AND CAN BE LEFT VISIBLE. THE CONCEALED SIDE OF THE SHANK IS NOT WASTED TRACKAGE, AS IT PROVIDES LAYOVER, STORAGE, AND RUNNING ROOM SORELY NEEDED ON MOST LAYOUTS.

From the standpoint of operational interest it is usually advantageous to attach them to the main line as far from the principal yard as possible, and to hook them on "backward" so that a train going into the branch will have to reverse direction at the junction.

Single versus double track

So far we have been talking about the various mainline patterns without much regard for whether the route is single or double track. Actually, the operational flavor of a track plan is very greatly affected by whether the main line is predominantly single or double.

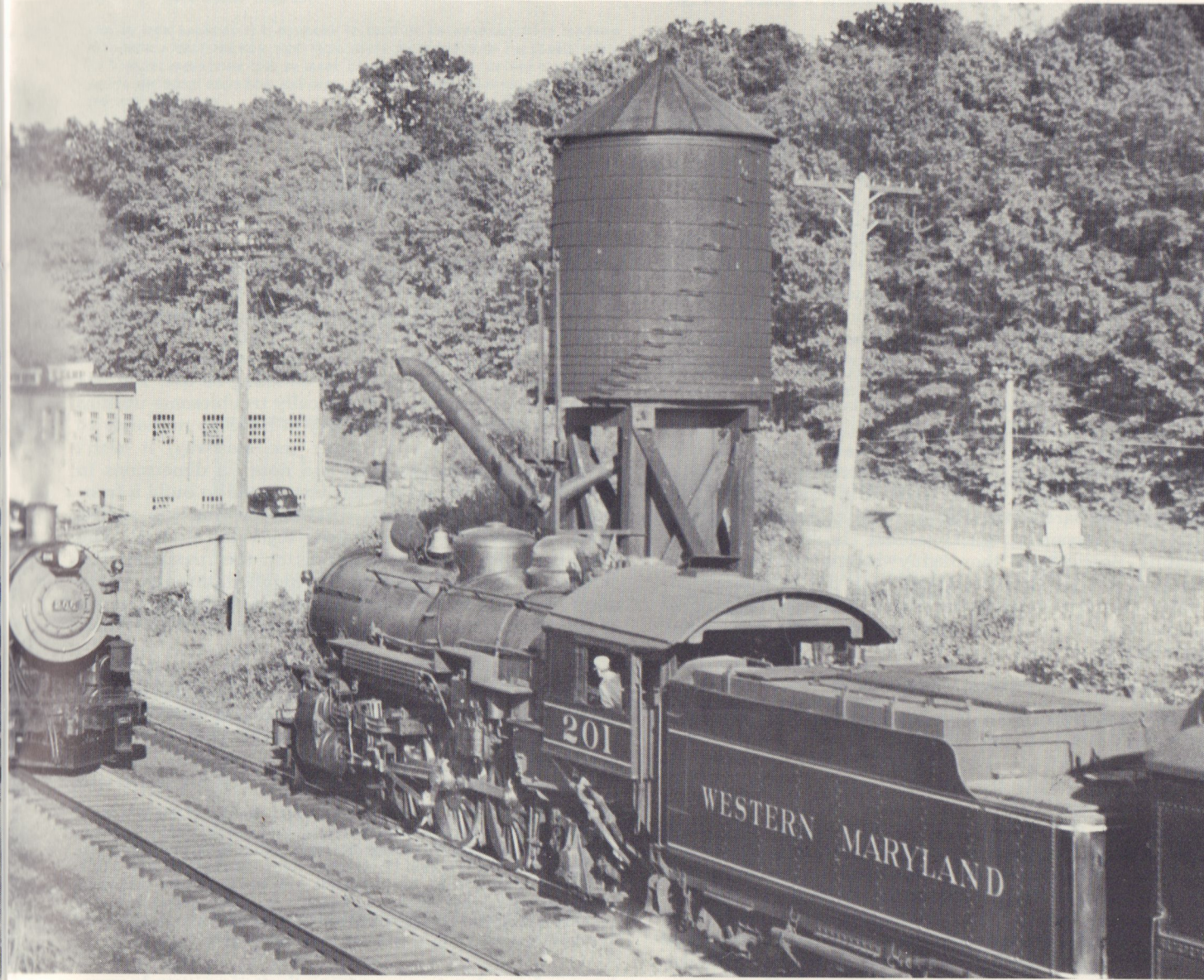
Double track. If you are particularly interested in watching the trains roll, double track is for you, since it favors the easy operation of lots of trains, particularly if they are long ones. Contrary to what you might expect,



Fig. 7-13. Two immaculate Western Maryland three-car passenger trains stage a classic meet at Westminster, Md. To the dispatcher such a meet looks the same as a meet between a 100-car drag and a 17-car limited. For the single-track enthusiast, choice of era, locale, and railroad should be such as to favor stubby consists and thus permit a choice of meeting points in spite of the necessary brevity of the main line.

double track is often the better choice for the small pike. You can run decently long trains on a double-track oval on a 2x4-square pike, and if you hide one side of the oval from the other it doesn't look too bad. With single track in the same space, both of the passing tracks will be so short that you will be limited to about five cars or less for any freight that won't have to saw by other trains. If you don't have at least two passing tracks you can run only one train at a time, and that can hardly be classed as a railroading operation. With a couple of crossovers added to allow wrong-track movements in overtaking a slower train, the operating variety for the small double-track pike is at least as great as for the equivalent single-track version.

When the loop-to-loop plan is stretched, then squeezed to simulate double track at its middle, it becomes the familiar dogbone plan which has formed the basis for many fine layouts over the years. The end loops of the dogbone are scenically essentially worthless unless you're

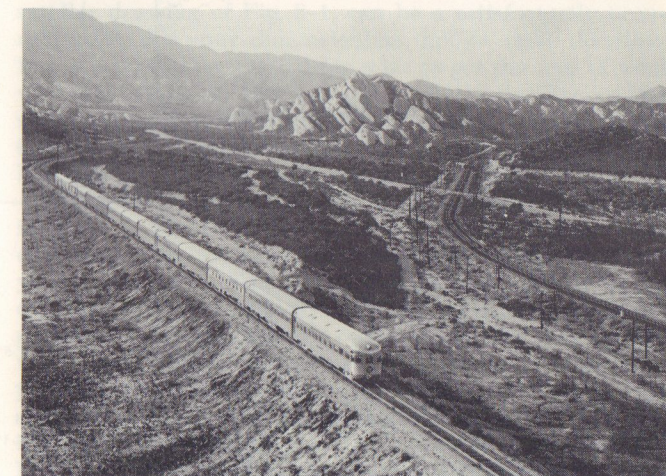


Rail Photo Service: Francis E. Riffle.

modeling an ore pier or Sunnyside Yard (Long Island) where they do turn trains on a loop. This brings up an important principle for space economy illustrated in Fig. 7-12: If you have to use space for a loop or other feature that should be hidden, make it do double duty by stacking another layer of track on top of it.

Single track. Single track is more typical of the average American railroad. It is a continual operating challenge, gets there with less trackage and expense, and has the very real model railroading advantage that it looks much longer wherever you use it. The space saving from going to single track is rather small, as you can see from the ratio of the width of a track to a typical curve radius (1 to 10 or so). By using short sidings and mostly short trains so that you can have several meeting places along the main line, you can undoubtedly get the most for your space in mainline operating and dispatching variety. As Fig. 7-13 suggests, this doesn't have to be at the expense of realism.

A crossbreed arrangement fairly often found in the prototype and worth keeping in mind is the section of double track with the lines on separate rights of way, as in Fig. 7-14. This gives the operating capacity of double track with the appearance and flexibility of location of single iron.



Robert Hale.

Fig. 7-14. Rough terrain and the advantages of a longer but more gently graded uphill route cause this wide separation between the double tracks on the west side of Cajon Pass, California. The Santa Fe Chief in the picture is eastbound near the start of the climb of 2750 feet to Summit. The older track at low level, to the right, was made the downhill track when the second track, with easier grades, was added at the left.

8

Developing the main line

Now we get down to the nub of this track planning business—working out a scale drawing of our railroad accurately enough that we are in position to start construction with assurance that what we have designed will actually fit and will allow us to operate trains as we have planned.

Developing this working drawing is a three-step process, one which should not be hurried and which can be just as enjoyable as any other phase of this fascinating hobby. It consists of developing a sound scale plan of the main tracks (which will be covered in this chapter), detailing these bare bones with railroadlike and efficient yard and other secondary trackage, and checking out its operating possibilities thoroughly before starting to cut lumber. It's the "do-it-yourself" job par excellence because you are creating something that can be tailored exclusively to your own desires and which will be the only one of its kind in the world.

Finding what will fit

Do track plans work out best when you decide what schematic you want and then bend it till it fits the space, or when you let the space suggest where the tracks can go and then modify the resulting scheme until it makes operating sense? It's hard to say. Usually it's a little bit of both, and it doesn't really make much difference. The plan that's "right" never comes out on the first try, and not very often on the second or third or fourth try unless you are exceptionally lucky. Even if you did happen to hit it on the first attempt, you really couldn't be satisfied that there isn't a better plan without looking at

a few alternatives, so we need to plan on sketching several mainline arrangements before we're through.

Available-space diagram. Eventually you are going to have to make a scale drawing of your pike,* so you might as well start out by laying out the available space accurately and noting all obstacles affecting its use. Fig. 8-1 is a basement example with typically troublesome utilities and their piping. Of course, if you have no authority to use space under (or through) the stairway, it won't be necessary to measure up and note its dimensions in such detail. If you are already committed to build a free-standing pike, a much less accurate drawing will suffice, since you won't be building along the walls anyway. You may, however, want some details on the maximum-size chunks of railroad that can be handled through doorways and stair wells in this case, since portability is one of the usual reasons for restricting yourself to an island-type railroad.

For an attic pike, it will be necessary to make up a three-dimensional drawing showing the headroom at various widths, since in working out the best plan you will be making compromises between width and height, and you'll also probably find you want to cheat as much as you can on headroom over the stairs. Fig. 8-2 shows one

*Some modelers like to work from a rough sketch of the proposed track plan, determining final locations of turnouts and curves in detail while actually building the line. This idea has some advantages, for you are able to visualize improvements as you work. It is best suited only for railroads (or parts of the railroad) where limited space is not a factor. Just the same, you are actually doing the things discussed in this chapter in 12" scale in wood instead of in a smaller scale on paper.

Fig. 8-1 Typical available-space diagram

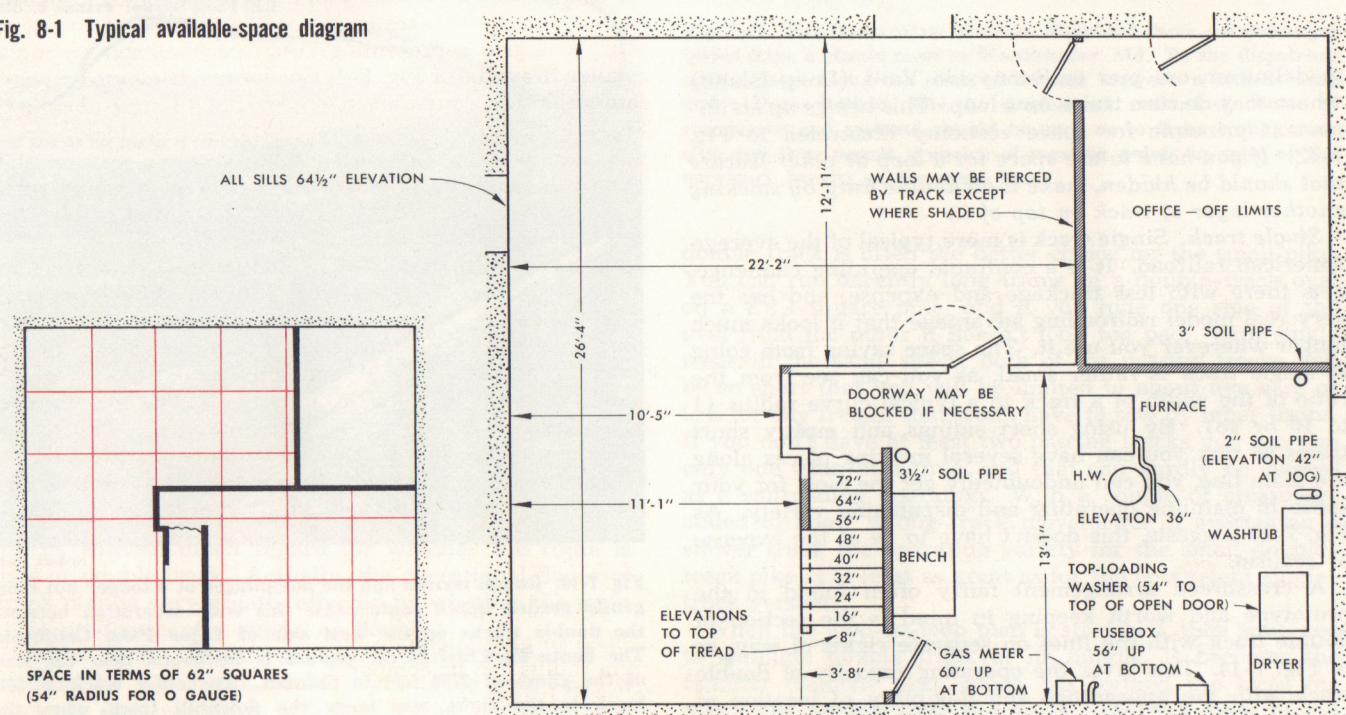


Fig. 8-2 Attic-space diagram

FOR AN ATTIC RAILROAD IT IS DESIRABLE TO MAKE UP AN AVAILABLE-SPACE DIAGRAM INCLUDING A CROSS-SECTION VIEW FROM WHICH PROJECTIONS OF THE USABLE WIDTH AT VARIOUS ELEVATIONS CAN BE MADE ON THE PLAN VIEW. IN THIS EXAMPLE, 4" ABOVE THE TRACK ELEVATION HAS BEEN ALLOWED AS THE MINIMUM CLEARANCE TO THE SLOPING CEILING.

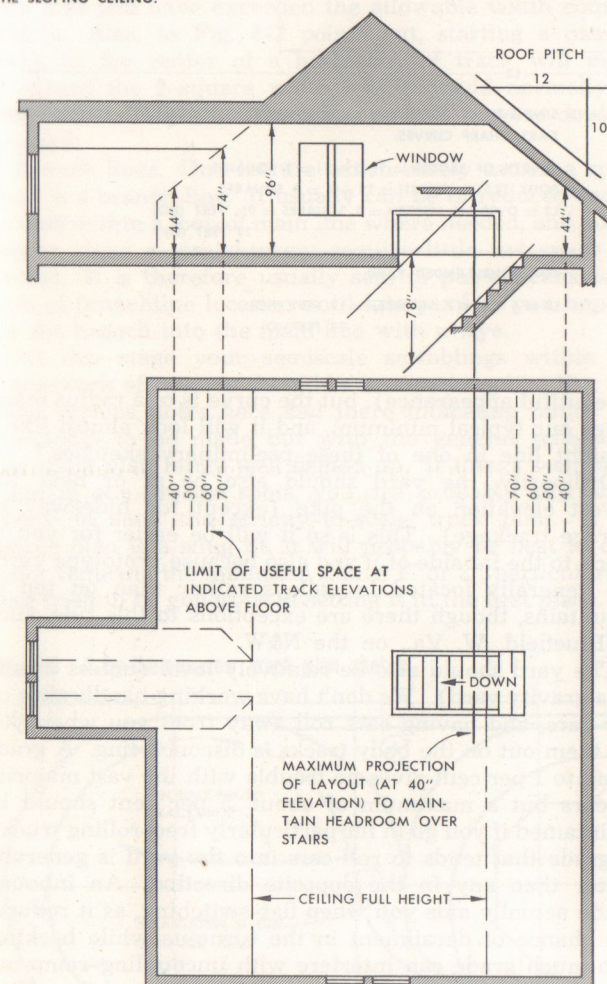
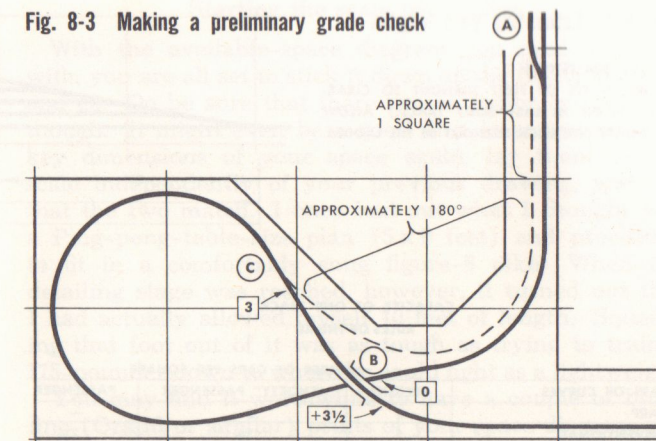
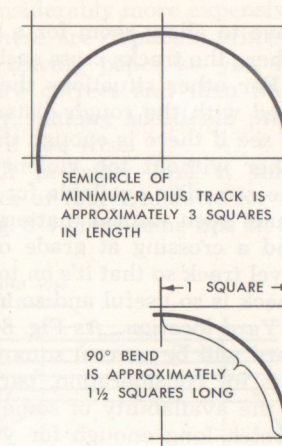


Fig. 8-3 Making a preliminary grade check



WHAT MUST THE GRADE OF CONNECTING TRACK "A-C" BE IF TRACK FROM "A" TO "B" IS LEVEL? SIZE OF SQUARES = 30"

1. ELEVATION AT "C" IS ESTIMATED AS ABOUT 3", BASED ON 3 1/2" SEPARATION ALLOWANCE AT "B," WHERE TRACKS CROSS OVER EACH OTHER. RISE FROM "A" TO "C" IS THEREFORE 3".
2. DISTANCE "A-C" CONSISTS OF A STRAIGHT PORTION 1 SQUARE LONG, PLUS APPROXIMATELY 180° (1 SEMICIRCLE) OF CURVED TRACK. LENGTH = 1 SQUARE + 3 SQUARES = 4 SQUARES AT 30" (2 1/2 FEET) PER SQUARE = 10 FEET.
3. FROM GRADE CHART (FIG. 5-9), 3" RISE IN 10-FOOT DISTANCE = 2.5 PER CENT, AVERAGE. (ACTUAL MAXIMUM WILL BE SOMEWHAT MORE BECAUSE GRADE CANNOT BEGIN ABRUPTLY AT EITHER END.)
4. IF GRADE OF 1 PER CENT WERE PERMITTED FROM "A" DOWN TO "B," "A-C" GRADE WOULD BE REDUCED TO ABOUT 1 1/2 PER CENT.



for dividing our space into squares based on minimum radius with an allowance for extra tracks, clearances, etc.

You can't carry a compass with you everywhere you go, and clever ideas on how to rearrange things to open up new possibilities will occur to you in the darnedest places where you literally have only the back of an envelope to work on. You can easily judge how many quartercircles and semicircles it takes for a particular track route, however, so a grid representing your space, as shown in the smaller drawing of Fig. 8-1, can be a satisfactorily accurate guide for your dimensionless, not-to-scale doodling. Fig. 6-2 should be studied for a bit to get the feel of what will and won't go into a square. Your doodles at this stage will look like Fig. 6-7. As is pointed out in chapter 6, for walk-in aislesways you will need to allow about a half square in O scale and one square in HO.

Equipped with these simple relationships you are now in shape to dream and scribble with some check on your optimism as to just how much spaghetti you can bend into your space. The first order of business will be to try out the various kinds of mainline arrangements which match up with the kind of operation you're seeking and which aren't out of the picture in your area. In making a preliminary selection, there are two other matters to consider: the practicability of the grades involved (assuming you are considering something more than a single-level pike) and the location of the principal yard.

Preliminary grade check. Fig. 5-10 gives an idea of the grade required for the up-and-over situation frequently encountered in track plans. The minimum grade needed to give adequate track separation for your minimum radius can be compared with your desired standards to see if it is acceptable to go around and over in a 2 x 2-square area or not. If the slope is too much, you will

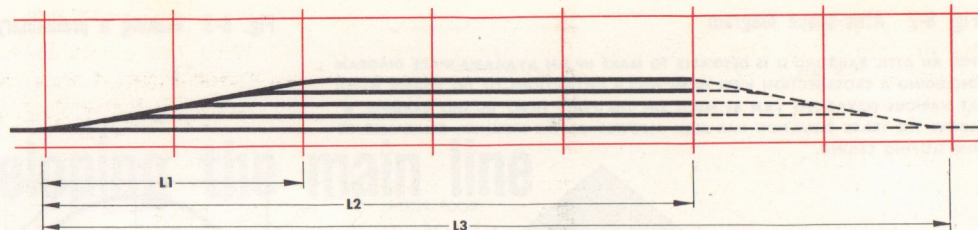
way of putting both dimensions on one piece of paper in handy form.

Drawing scale. The scale you use for your drawing isn't critical, provided it doesn't result in requiring impracticably precise draftsmanship (if it's too small), or too big a bedsheet to work with conveniently. Generally speaking, I have found a scale of 3/4" to the foot best for basement-size track plans in the larger gauges and 1 1/2" to the foot fine for small or average-size pikes. These are handy scales because they are 1/16 and 1/8 full size, respectively. This means that any ordinary ruler divided in sixteenths of an inch will allow you to read off inches directly. A scale of 1" to the foot sometimes is nice for intermediate-size pikes where 1 1/2" scale won't fit on your drawing board. In this case, you will do well to get an architect's scale which has 1/12" marked as scale inches on it, or make up such a scale on a piece of cardboard. Otherwise you'll waste time figuring out that 2 1/2 scale inches is 5/8 of an actual 1 1/4", and similar brain twisters.

Controlled pessimism. Since it's quite a chore to draw up a track plan to scale just to see if a particular mainline convolution will fit, we need some process for having reasonable assurance that a basic scheme is possible before going to work on it with the drawing instruments. Here in the doodling-around stage is where those squares that we defined back in chapter 6 (Fig. 6-1) come in. By and large, the space necessary for a semicircle of track determines what will and won't fit, so that is the basis

Fig. 8-4 Estimating yard lengths

L1 — LADDER LENGTH
(FROM POINTS OF FIRST TURNOUT TO CLEAR-
ANCE POINT IN LAST BODY TRACK.) ALLOW
½ SQUARE FOR EACH TURNOUT IN THE LADDER.



EXAMPLE: SINGLE-ENDED FIVE-TRACK YARD, SHORTEST BODY TRACK TO HOLD 12 FREIGHT CARS, SHARP CURVES:

LENGTH OF LADDER = ½ (5 - 1) = 2 SQUARES
BODY TRACK LENGTH = 12 ÷ 4 = 3 SQUARES
L2 = OVER-ALL LENGTH = 5 SQUARES = 9½ FEET (HO)
17 FEET (O)

FOR DOUBLE-ENDED YARD:

L3 = 5 + 2 = 7 SQUARES = 13 FEET (HO)
24 FEET (O)

CAPACITY OF ONE TRACK
RULES OF THUMB

CLASS OF CURVES	NUMBER OF CARS PER SQUARE		
	FREIGHT	"SHORTY" PASSENGER	PASSENGER
SHARP	4	3-	-
CONVENTIONAL	5	3+	2½
BROAD	6	4	3

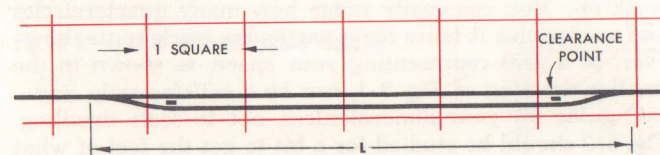
have to allow room for a wider radius or shift the point where the tracks cross each other to lengthen the climb.

For other situations the grade chart, Fig. 5-9, can be used with the rough distance approximations of Fig. 8-3 to see if there is enough distance to get one line over another without too violent a grade. At this early stage the remedies available for impossible grades will still include such radical matters as interchanging an overpass and a crossing at grade or even relocating the bottom-level track so that it's on top. This is why this preliminary check is so useful and so important.

Yard location. As Fig. 8-4 shows, even a rather modest yard will be several squares long. One of the early matters for consideration, particularly in a continuous plan, is the availability of some accessible, reasonably straight stretch long enough for your main yard. Yards can be, and are in the prototype, built on curves (it makes for

Fig. 8-5 Estimating passing-track lengths

SINCE THE LENGTH OF TURNOUTS AND LOCOMOTIVES USED WILL VARY WITH THE CURVATURE STANDARDS SELECTED FOR A TRACK PLAN, OVER-ALL LENGTH "L" FOR A PASSING TRACK CAN BE APPROXIMATED BY THE FOLLOWING RULES OF THUMB BASED ON THE WIDTH OF A SQUARE.



ESTIMATING PASSING-TRACK CAPACITY
RULES OF THUMB

FOR FREIGHT TRAINS ALLOW 1¼ SQUARES FOR ENGINE AND CABOOSE, TURNOUTS, AND TRACK TO CLEARANCE POINTS. FIGURE CAR CAPACITY (A THIRD DIESEL UNIT COUNTS AS ONE CAR) OF BALANCE OF PASSING TRACK AS FOLLOWS:

SHARP CURVES	4 CARS PER SQUARE
CONVENTIONAL CURVES	5 CARS PER SQUARE
BROAD CURVES	6 CARS PER SQUARE

EXAMPLE: CAPACITY OF PASSING TRACK 5½ SQUARES IN LENGTH ON LINE WITH SHARP CURVATURE STANDARDS (18" RADIUS IN HO, 32" IN O): 5½ - 1¼ = 4¼ SQUARES × 4 CARS PER SQUARE = 17 CARS, ENGINE, AND CABOOSE.

FOR PASSENGER TRAINS ALLOW 1 SQUARE FOR ENGINE, TURNOUTS, AND TRACK TO CLEARANCE POINTS. FIGURE CAR CAPACITY OF BALANCE OF PASSING TRACK AS FOLLOWS:

	SHORTY (60-65-FOOT) CARS	STANDARD (80-FOOT) CARS
SHARP CURVES	2¼ CARS PER SQUARE	-
CONVENTIONAL CURVES	3¼ CARS PER SQUARE	2½ CARS PER SQUARE
BROAD CURVES	4 CARS PER SQUARE	3 CARS PER SQUARE

EXAMPLE: LENGTH OF TRACK FOR SIX-CAR STANDARD PASSENGER TRAIN, CONVENTIONAL CURVATURE: "L" = 6 ÷ 2½ = 2-2/5 SQUARES + 1 = 3-2/5 SQUARES.

a beautiful appearance), but the curve is of a radius many times our typical minimum, and it will look almost like a straight line in one of these preliminary sketches.*

Ordinarily, the yard should also be at or near the lowest elevation on the pike (except for hideaway or storage trackage). This is so it will be easier for you to reach to the far side of it and also because prototype yards are generally located in valleys rather than on top of mountains, though there are exceptions to this rule, such as Bluefield, W. Va., on the N&W.

The yard should also be relatively level (unless it is to be a gravity yard). We don't have working handbrakes on our cars, and having cars roll away from you when you set them out on the body tracks is disconcerting. A grade of up to 1 per cent gives no trouble with the vast majority of cars but a maximum of about .5 per cent should be maintained if you go in for particularly free-rolling trucks. A grade that tends to roll cars into the yard is generally better than any in the opposite direction. An inbound grade actually aids you when flat-switching, as it reduces the chance of derailment in the turnouts while backing. Too much grade can interfere with uncoupling-ramp action, producing slack where you don't want it while pulling (an electric ramp overcomes this), or preventing slack when you do want it.

At this time it is also good to look for a suitable engine terminal location, particularly if you are featuring steam power. As Fig. 6-2 shows, even a small roundhouse is a bit fussy about the smallest area into which it will fit. Also, since it will be one of the principal points of action and interest on the railroad, it deserves a high priority for an up-front spot where it can be seen from at least one side with few, if any, intervening tracks.

Passing tracks. If you are modeling a single-track line, it is now appropriate to consider where the passing tracks can be located. Fig. 8-5 gives the rules of thumb for estimating the capacity of a passing track in terms of its over-all length, including turnouts, in units of squares. You have probably already found out from your yard calculations about how long a train you may consider as normal tonnage for your line, and most of the passing tracks should be of about this length. While it's important to leave enough of the main line single-track to give the layout the general appearance of a single-track railroad, from an operating-fun standpoint it's the number of meeting points that is most indicative of the possibilities, so you will want to fit in as many meeting points as reasonably possible.

*If you must build a yard on a curve, try your cars on the proposed yard radius for coupling and uncoupling abilities. Try a very long car and a short one together — also a long locomotive and a freight car (with Talgo trucks if you use them on your pike).

Passing tracks are easily slid along the main line in the process of detailing the final scale track plan; the reason for locating them in a preliminary sense now is that if too many of them happen to run alongside each other at any particular point on the plan you may later find that you have exceeded the allowable width considerably. Also, as Fig. 6-2 points out, starting a passing track in the center of a horseshoe of track will make it exceed the 2-square width which would normally be ample for a loop of such radius even if it were double-tracked.

Branch lines. One feature which rarely causes a space bind is a branch line. It usually can be of reduced radius to nest within a loop of main line where needed, and added tracks along a straightaway require little net space increase. It is therefore usually safe to put off consideration of branchline location until later, unless you hope to tie the branch into the main line with a wye.

At this stage your semiscale scribbles within the framework of squares should look something like Fig. 8-6, with various notes here and there indicating minor adjustments to be made but with the general scheme of the track plan fairly well firmed up. If things seem a bit tight in one or two spots, you are probably still about ready to start the strictly-to-scale track plan. If the whole plan is a snug fit, it will probably be best to consider reducing the minimum radius 1" or 2", particularly if you tried to be generous in setting it in the first place.

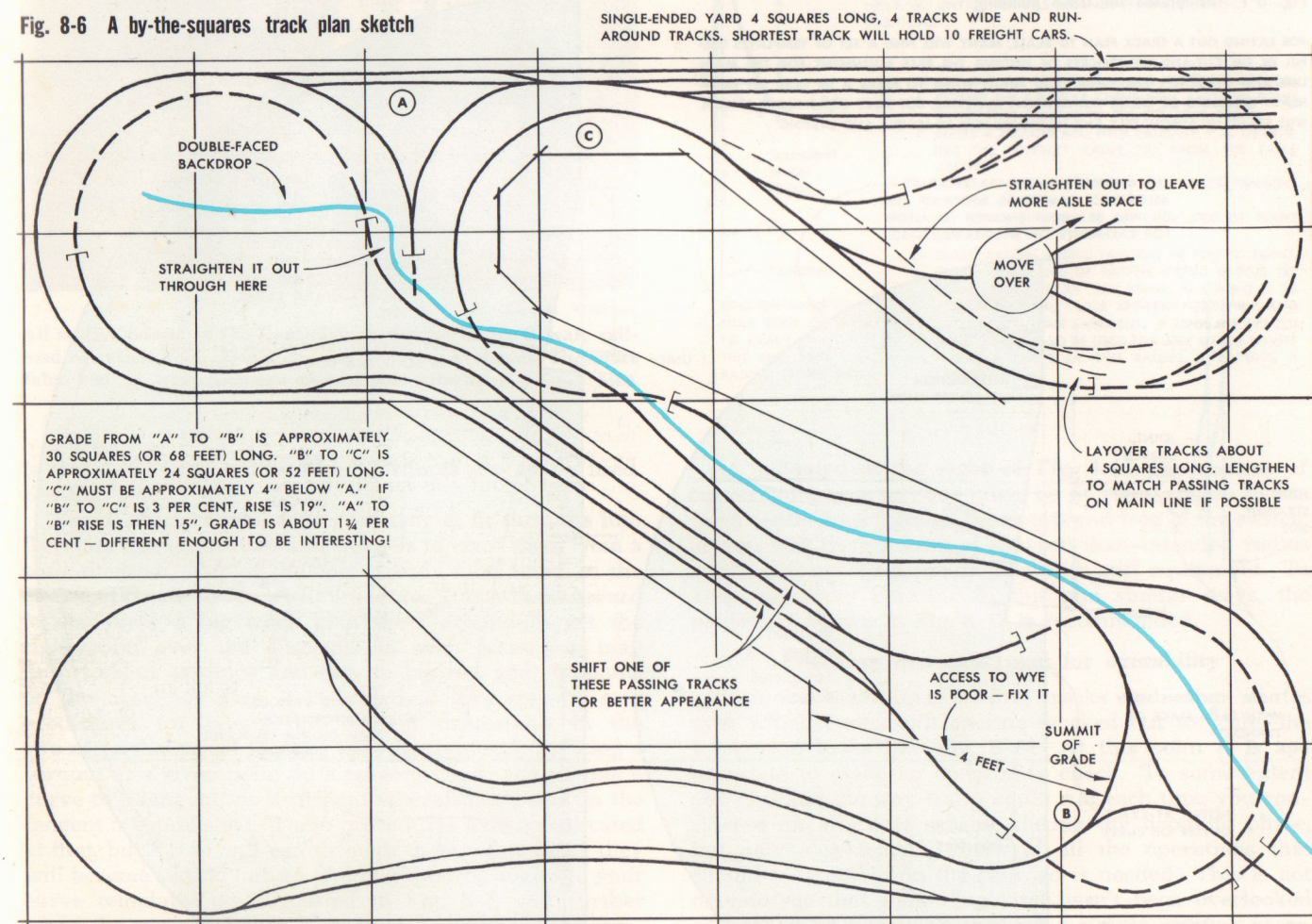
Starting the scale track plan

With the available-space diagram you made to start with, you are all set to stick it down on the drawing board and go. Do be sure that there are no major errors in it, though. It might even be a good idea to measure a few key dimensions of your space again, lay them out to scale independently of your previous drawing, and see that the two match. I once laid out what I thought was a Ping-pong-table-size plan (5 x 9 feet) and proceeded to fit in a comfortably snug figure-8 pike. When the detailing stage was reached, however, it turned out that I had actually allowed myself 10 feet of length. Squeezing that foot out of it was as tough as trying to train a 175-pounder down to where he could fight as a lightweight.

You may find it worthwhile to have a couple of blue-line (Ozalid or similar) prints of your space diagram run off at the local blueprint shop (if you have made it on tracing paper) so that you can start on a fresh one when the first gets pretty badly beaten up late in the design process. Even handier (but considerably more expensive) are "Ozalid intermediates." These are duplicate prints of your work photographed on tracing paper so you can simply trace the parts that are correct and then finish the drawing on the clean copy, making additional prints from this when it's completed, if you wish.

Curve templates. You will probably find it time-saving to make up a set of three or four templates for the radii to be used most often. Fig. 8-7 gives some tips on the

Fig. 8-6 A by-the-squares track plan sketch



THIS 5 x 7½-SQUARE "ISLAND" TRACK PLAN SKETCH SHOWS THAT MOST OF THE PROBLEMS HAVE BEEN SOLVED AND THAT IT IS NOW TIME TO START LAYING THE MAIN LINE OUT TO SCALE, WITH MODIFICATIONS AS NOTED TO CLEAN UP THE REMAINING TIGHT SPOTS. AS THIS IS A POINT-TO-LOOP PLAN CROSSING A MOUNTAIN RANGE VIA A SPECTACULAR LOOP-BACK ON ONE OF THE SLOPES, THE RAILROAD WILL BE SAVED FROM A BOWL-OF-SPAGHETTI APPEARANCE BY A DOUBLE-FACED BACKDROP DOWN THE CENTER LEG OF THE "S" SEPARATING THE ASCENDING AND DESCENDING LINES. THE PLAN CALLS

FOR CONVENTIONAL CURVES, APPROXIMATELY 29" SQUARES (PLAN 12 x 18 FEET). AISLEWAYS TO BE ONE SQUARE WIDE, IF POSSIBLE (PROPER FOR AN HO PIKE). PASSING TRACKS ARE ABOUT 4½ SQUARES LONG; CAPACITY IS APPROXIMATELY 18 CARS, ENGINE, AND CABOOSE. BECAUSE THERE IS NO GOOD PLACE FOR A FULL ENGINE TERMINAL AT "A," IT IS LOCATED AT "C" AND A WYE IS PROVIDED AT "A."

design of these which will make them handy to use and simple to make. In the back of the book *Practical Guide to Model Railroading* there is a template for use with tracing paper. It looks like it is intended for ovals only, but that's not how to use it. You trace only parts of curves and connecting turnouts from it, shifting your paper over the templates as you work.

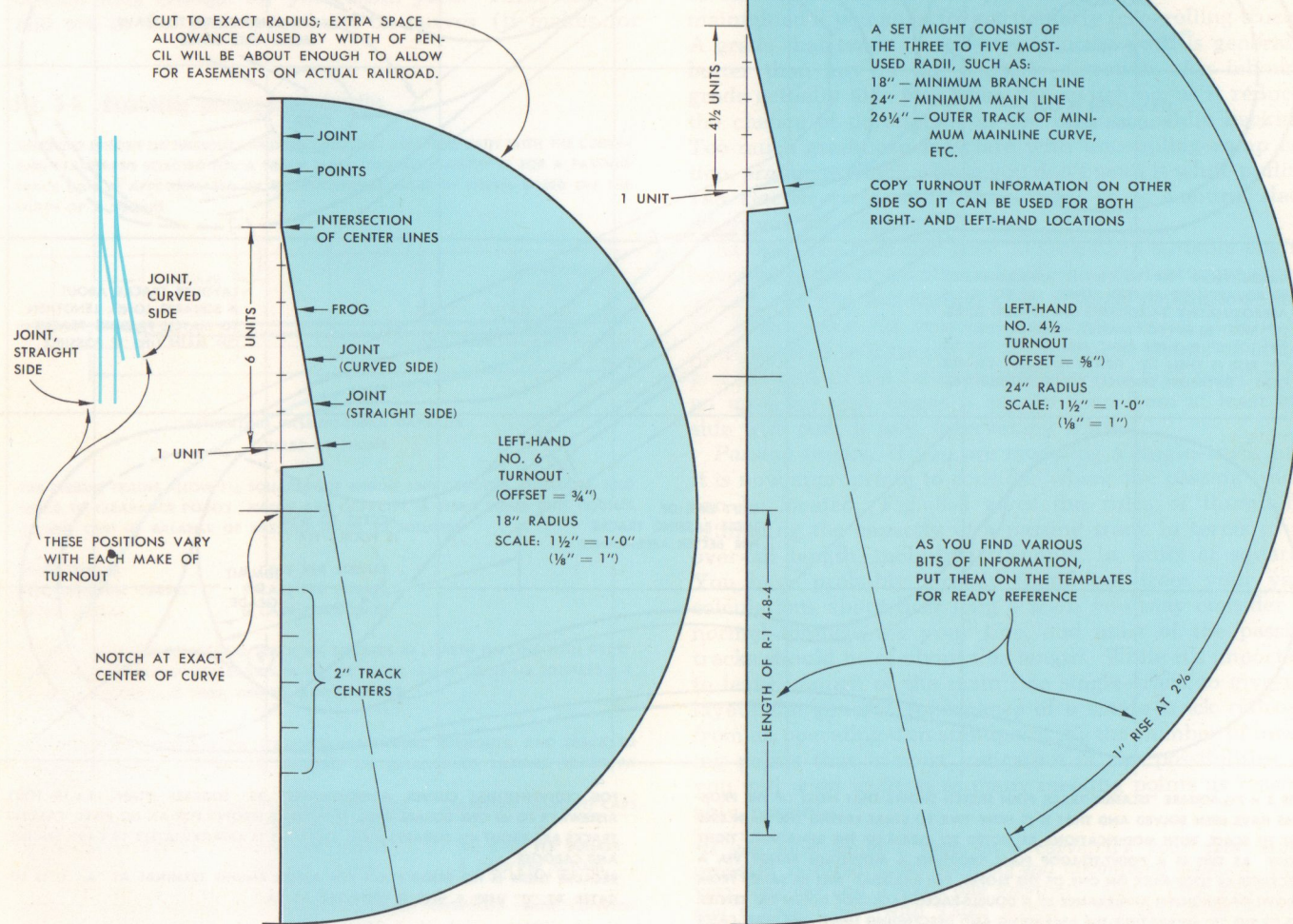
It is not worth the extra effort involved to show easements on your track plan. The width of your pencil mark away from the edge of the template can provide the slight offset needed to make sure that there will be room for them on the actual layout. When it comes time to lay the easements out on the trackboard, Fig. 8-8 gives suggested key dimensions for common situations and one of many good ways to generate a satisfactory easement. A more detailed discussion will be found in the NMRA Data Sheets.*

Curves of uncommon radii will be laid out with a compass, or you may find that you prefer to use a compass for the whole job. In this case you can add the offset distance "X" from Fig. 8-8 to your radius to be sure that you have easement space on your sharpest mainline curves.

*If you can fathom the method, the "cubic spiral" is the best form of curve to use. The advantage of ellipses, parabolic curves and bent sticks is ease of laying out. Engineeringwise they are not as compact nor as perfect.

Fig. 8-7 Templates for track planning

FOR LAYING OUT A TRACK PLAN TO SCALE, MANY WILL FIND A SET OF TEMPLATES USEFUL IN THE CUT-AND-TRY PROCESS OF FINDING THE BEST ALIGNMENT FOR THE MAIN LINE AND OTHER KEY TRACKAGE. YOU MIGHT WANT TO MAKE A DE LUXE SET FROM HEAVY CELLULOID OR OTHER TRANSPARENT MATERIAL, BUT 5-PLY STRATHMORE BRISTOL WILL STAND UP ADEQUATELY AND MARKINGS WILL BE LEGIBLE AND LASTING.



Laying out the main line

Fig. 8-10A shows the first stage in the derivation of a scale plan from the "by the squares" sketch of Fig. 8-6. It's pretty much catch-as-catch-can so far as any rules go in working out the plan, and in any case you'll do a lot of erasing, so stay loose and keep your pencil lines light until the whole thing has taken shape fairly well. As indicated, it's usually best to start with the loops near the corners of the layout. These have the least leeway in their location. However, they may shift a little as the plan evolves. After this, lay out other loop-back curves at table ends, etc. Then you can connect the various arcs with straight or sinuous lines until you have the main line going to all the places it is supposed to and reaching them in the right order.

Fig. 8-10B is a slightly later stage where some bends have been added to keep tracks from running into each other and to make the plan look better. At this approximate point it is possible to indicate where passing-track and junction turnouts will come. Some of these are on straight sections, so they won't affect the course of the main track. Others, in mainline curves, become keys to the practicability of the mainline alignment. This is because including them means that the mains cannot follow a smooth circular curve. We must allow for these now, or we may be in trouble later on. (An exception

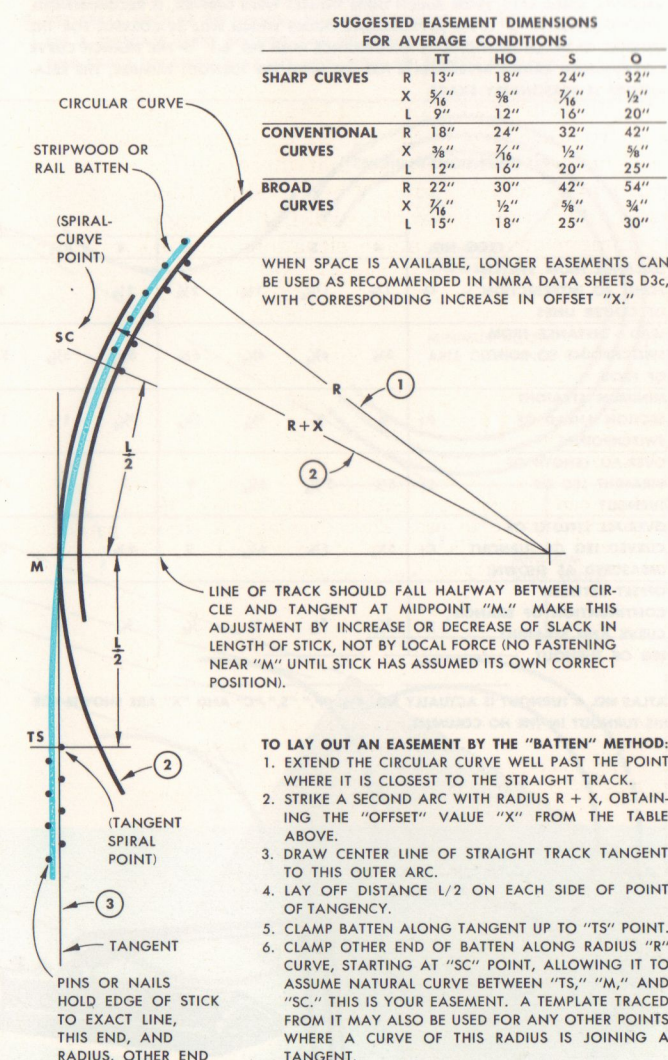


Linn H. Westcott.

All motive power on the Canandaigua Southern, the O scale railroad of author John Armstrong, has Belpaire fireboxes. Therefore John had to scratch-design this Super Allegheny 4-6-6-6 loco.

Fig. 8-8 Laying out an easement or transition curve

RAILROADS USE A MATHEMATICALLY GENERATED "CUBIC SPIRAL" AS THE TRANSITION CURVE OR EASEMENT AT THE ENDS OF A CIRCULAR CURVE. A FAIR, PRACTICAL APPROXIMATION CAN BE GENERATED BY THE PROCEDURE BELOW:



is when specially built curved turnouts are to be used. See Fig. 5-6.)

Laying out turnouts. One good way to fit turnouts into the main line accurately and easily is to trace them from a scale diagram, such as the one, already mentioned, in the *Practical Guide to Model Railroading*. It can be awkward to maneuver a big track plan sheet around to get the right point over the diagram. In such cases you may find it about as quick and easy to lay out your turnouts on the drawing. Figs. 8-11 and 8-12 give step-by-step procedures for laying out turnout centerlines in the two cases that cover most of the requirements: locating a turnout at a given point on a tangent track, and joining a curve to a tangent via a turnout where some point on the tangent is established. These procedures look complicated at first, but if you will run through them a few times they will become second nature. Adding the frog angles to your curve templates, as suggested in Fig. 8-7, will further speed the process. The key dimensions you need for commonly used turnouts are given in Fig. 8-9.

When actually constructing turnouts from scratch on your railroad, these approximate dimensions won't be enough, and you will want to use the NMRA Recommended Practice data or their templates. For track planning purposes, though, these will be plenty close enough.

As indicated at the right of Fig. 8-11, the centers of curves joining a turnout must be at right angles to the track centerlines through the points and frog of the switch, or you will have a kink of sharper-than-intended radius which will surely cause trouble with stiff equipment. To keep you from cheating in this and similar ways, the procedure shown in Fig. 8-13 is recommended.

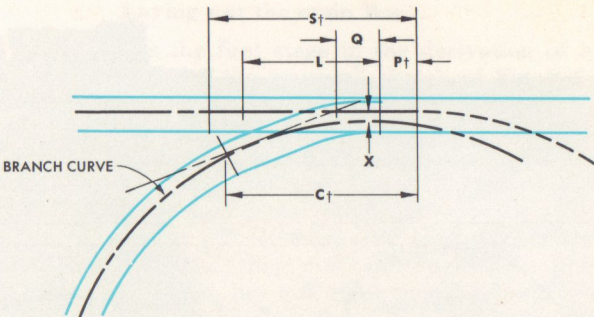
Checking the track plan for operability

With the main line, passing tracks and other routes over which trains will operate worked out to scale, the track plan looks like Fig. 8-14. At this point it is appropriate to make an operability check. To some extent you checked the way trains could run each time you considered an alternate scheme during the doodling phase, but now a systematic check of all the operations that should be possible on the railroad is needed. This is not only to see that something vital hasn't been overlooked or hooked up backward through a simple copying error, but also because such a check will often suggest ways in which slight modifications or additions will open up new possibilities you hadn't really expected to be able to work into the plan.

The way you check the plan is simplicity itself, and fun as well — the next most fun to actually running the

Fig. 8-9 Turnout dimensions

THIS TABLE GIVES KEY TURNOUT DIMENSIONS USEFUL FOR LAYING OUT CENTERLINE TRACK DIAGRAMS TO A SCALE ACCURATE ENOUGH TO INSURE THAT THE ALIGNMENT CAN BE BUILT SUCCESSFULLY IN THE INDICATED SPACE. FOR ACTUAL CONSTRUCTION OF TURNOUTS, NMRA RP12, FROM WHICH THESE FIGURES WERE DERIVED, IS RECOMMENDED. OFFSET DIMENSION "X" IS AN APPROXIMATE FIGURE WHICH WILL BE CORRECT FOR THE PURPOSES OF TRACK PLANNING IN ACCORDANCE WITH FIG. 8-1. IF THE BRANCH CURVE IS OF MINIMUM RADIUS APPROPRIATE FOR USE WITH THE TURNOUT NUMBER, THE RELATIONSHIP IS REASONABLY EXACT.



ALL DIMENSIONS IN INCHES

FROG NO.	TT				HO					S				O				
	4	5	6	8	4	4½*	5	6	8	4	5	6	8	4	5	6	8	
DISTANCE FROM SWITCH-POINT TO INTERSECTION OF CENTER LINES	Q	1⅞	1⅓ ₁₆	1¾	2½		2⅞	2⅝	3¼	3⅞ ₁₆	3¼	3⅝	5⅓ ₁₆	4⅞ ₁₆	4½	4⅝	7⅓ ₁₆	
LEAD — DISTANCE FROM SWITCHPOINT TO POINT OF FROG	L	3¾	4⅓ ₁₆	4⅞ ₁₆	6⅝	5⅓ ₁₆	5⅓ ₁₆	5⅓ ₁₆	6¼	9	6⅓ ₁₆	7⅝	8⅝	12⅓ ₁₆	9⅞ ₁₆	10¾	11⅝	17⅓ ₁₆
MINIMUM STRAIGHT SECTION AHEAD OF SWITCHPOINTS	P†	¾	⅞	1⅞ ₁₆	1⅞ ₁₆	1⅞ ₁₆	1½	1⅓ ₁₆	1⅓ ₁₆	1½	1¼	1⅝	1½	1⅞	1⅝	1⅓ ₁₆	2	2½
OVER-ALL LENGTH OF STRAIGHT LEG OF TURNOUT	S†	5¼	5⅓ ₁₆	6⅞ ₁₆	9	7	9	7⅓ ₁₆	8⅝	12	9⅞ ₁₆	10⅝	11⅝	15⅓ ₁₆	12⅓ ₁₆	14⅝	15⅝	22⅓ ₁₆
OVER-ALL LENGTH OF CURVED LEG OF TURNOUT (MEASURED AS SHOWN)	C†	5⅓ ₁₆	5⅞	6⅞ ₁₆	9	6⅞	8	7¾	8⅝	12	9⅞ ₁₆	10⅞ ₁₆	11⅝	15⅓ ₁₆	12⅓ ₁₆	14⅞ ₁₆	15⅝	22⅓ ₁₆
OFFSET BETWEEN CONTINUATION OF BRANCH CURVE AND STRAIGHT LEG OF TURNOUT	X	⅓ ₁₆	⅓ ₁₆	⅝	⅓ ₁₆	⅓ ₁₆	⅝	⅓ ₁₆	½	⅝	½	⅞ ₁₆	¾	1⅓ ₁₆	⅝	¾	1⅓ ₁₆	1⅝

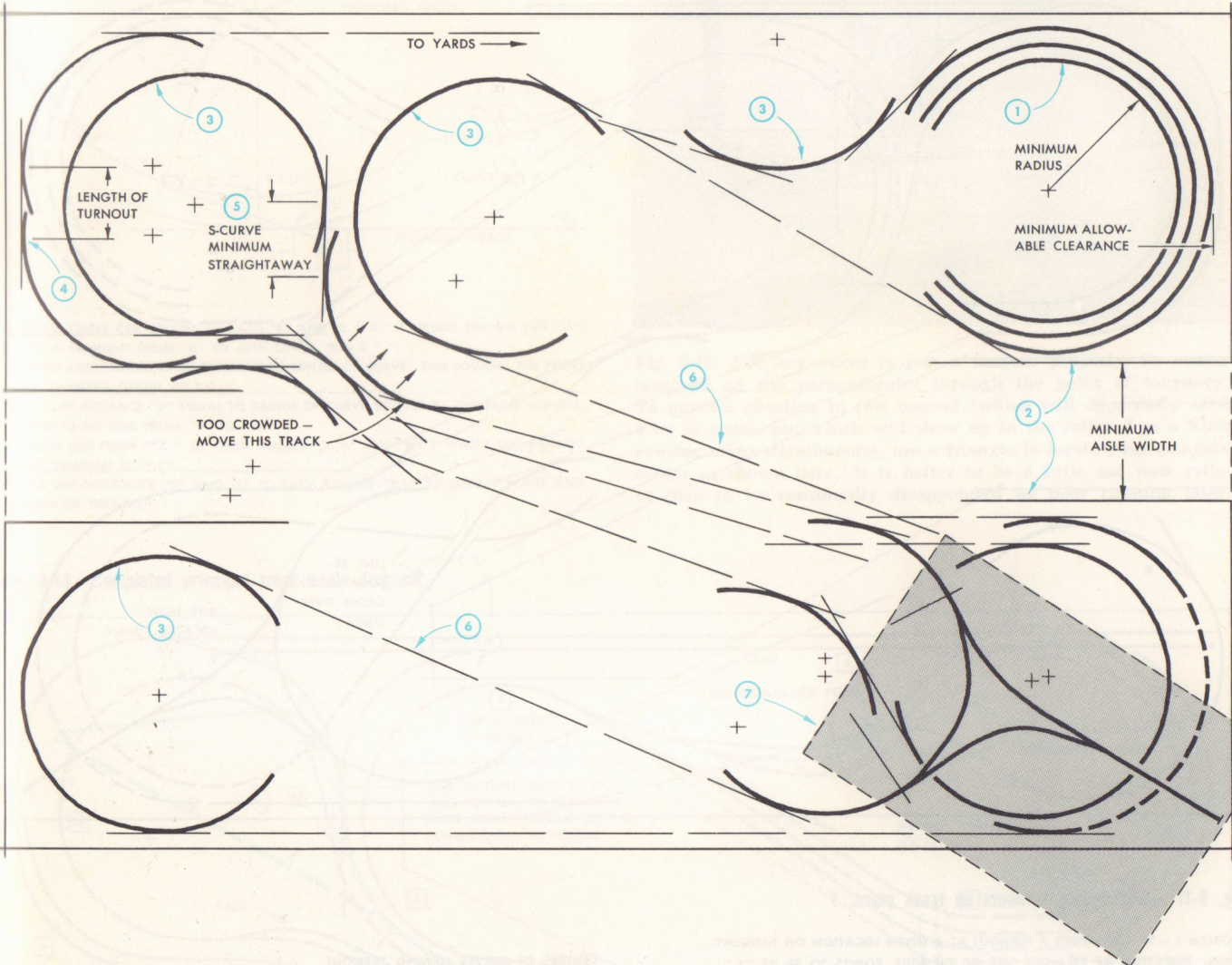
*ATLAS NO. 4 TURNOUT IS ACTUALLY NO. 4 1/2. "P," "S," "C" AND "X" ARE SHOWN FOR THIS TURNOUT IN THE HO COLUMNS.

†FIGURES GIVEN ARE MINIMUMS; IF USING PREFAB OR KIT TURNOUTS, SUBSTITUTE ACTUAL DIMENSIONS MEASURED FROM BRAND TO BE USED. FOR EXAMPLE, ATLAS NO. 6 (HO): P = 1 1/2", S = 12", C = 10".



Fig. 8-10A Early steps in working out a scale track plan

1. LOOPS WHICH CAN GO IN ONLY ONE LOCATION ARE DRAWN IN FIRST, WITH TRACK SPACING TO SCALE.
2. MINIMUM-WIDTH AISLEWAY CAN NOW BE SKETCHED IN TO RESERVE ITS SPACE.
3. OTHER KEY ARCS ARE DRAWN IN APPROXIMATE LOCATIONS, EXTENDING THEM WELL PAST PROBABLE POINTS OF TANGENCY.
4. SPACE FOR TURNOUT CAN BE RESERVED NOW AT SOME POINTS.
5. S-CURVE ALLOWANCE DETERMINES MINIMUM SPACING OF SECOND INTERSECTING ARC IN CASES SUCH AS THIS.
6. TENTATIVE STRAIGHTAWAYS BETWEEN ARCS SKETCHED IN TO KEEP BASIC PLAN IN MIND; INDICATE WHERE SECONDARY CURVES WILL BE NEEDED.
7. KEY AREAS, SUCH AS THE TURNING WYE AT THE SUMMIT, ARE DESIGNED ACCURATELY ON A SEPARATE SHEET SO THEY CAN BE MOVED AROUND EASILY AS A UNIT TO FIND EXACT LOCATION THAT FITS BEST, THEN ARE TRACED IN PLACE.



finished railroad, if you are really interested in operation. You just run through each operation on the track plan, seeing what moves you would make to get the trains put together, over the road, past each other, and broken up or turned around. If one of the main reasons you're building the railroad is so you can indulge in timetable operation, you could even try running through a typical schedule to see if the meeting points are in the right locations or if things get jammed up on one end of the line while the other half of the road is deserted. It is quite possible, for instance, that you will need two sidings at some particular station where a combination meet and pass between three trains will occur.

The object is not to make it easy to make all the moves, but to make the over-all operating as varied and as interesting as the size of the pike will allow. Any good plan includes some situations where it is possible to do some maneuvers only the hard way, but as you go through your check you will get a feeling as to whether or not you have about the right amount of difficulty to suit your desires.

Grade checking. It is now essential to make an accurate grade check. You know that at least minimum clearance

must be maintained at all points where tracks cross each other, so, starting at the lowest point, it is possible to work out how high the tracks on the upper lines must be. To measure the distance along the track from one height checkpoint to another, the wire method shown in Fig. 8-15 is handy and more accurate than trying to estimate the distance around curves. The results of this check will almost always show extremely uneven grades at various points, including some that are clearly excessive. Much of the trouble can be fixed by changing the elevations at the key points to favor the excessively steep track. Sometimes it will be necessary to move tracks horizontally to change the points where they cross each other. Even with the grade chart (Fig. 5-9) to help, this grade-adjusting job may take some time. The work and effort involved in changing grades after the railroad is built is so much greater, however, that you should not skip or slight the process now while only paper is involved.

Access checking. If your plan is one in which the table-work area is fitted to the trackage, it is also now necessary to check your aiseways. Have they suffered in the evolution of the scale track plan? If the standards of Fig. 6-6 have been compromised by a matter of a few inches

Fig. 8-10B Continuing main track development

1. LOWER-LEVEL TRACKS DRAWN IN DASHED LINES AS A REMINDER.
2. WYE, DRAWN IN FINAL POSITION, INDICATES THAT MAINLINE OXBOW WILL HAVE TO MOVE OVER TO RIGHT.
3. WITH SURROUNDING TRACK LOCATED, AISLEWAY CAN BE LAID OUT MORE OR LESS FINALLY.

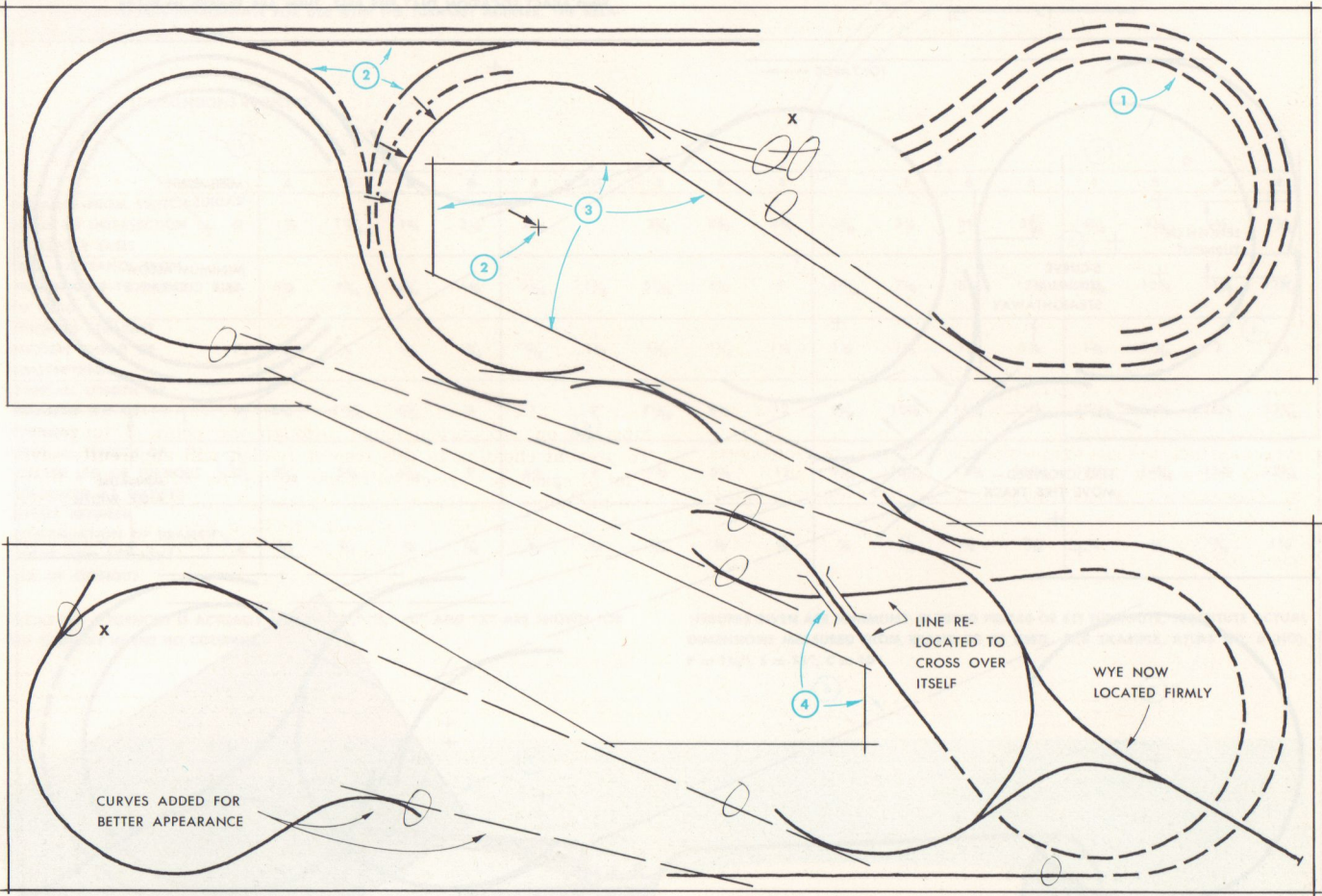
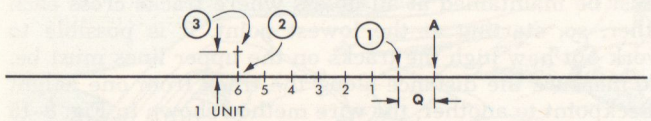
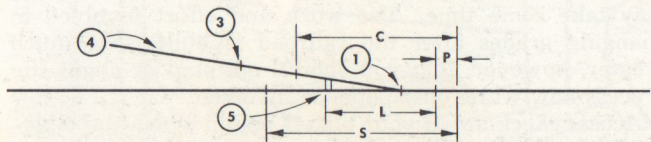


Fig. 8-11 Constructing turnouts on track plans: 1

PROBLEM 1 — TO CONSTRUCT A TURNOUT AT A GIVEN LOCATION ON TANGENT.
GIVEN: DIRECTION OF STRAIGHT SIDE OF TURNOUT, POINTS TO BE AT "A."



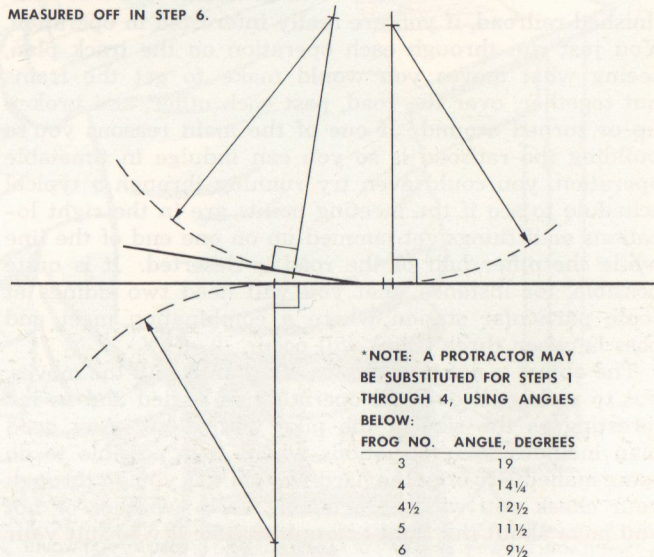
1. *MEASURE OFF POINT-TO-INTERSECTION DISTANCE "Q" (FROM FIG. 8-9).
2. *MEASURE OFF A NUMBER OF UNITS (OF CONVENIENT LENGTH) EQUAL TO TURNOUT FROG NUMBER.
3. *ERECT PERPENDICULAR AND MEASURE OFF ONE UNIT.†
4. *DRAW LINE THROUGH POINTS 1 AND 3.
5. MEASURE OFF LENGTH "L" (FROM TABLE 8-1). THIS LOCATES FROG.



6. MEASURE OFF DISTANCE "P" AND THEN "S" AND "C" FOR TURNOUT TYPE (NMRA, KIT OR PREFAB) TO BE USED. THIS LOCATES RAIL JOINTS OR OTHER POINT AT WHICH CURVED TRACK CAN JOIN TURNOUT RAILS.

4. PROVIDING ACCESS TO THE SUMMIT WYE REQUIRES LONGER AISLE. TWISTING THE MIDDLE-LEVEL OXBOW HELPS GET IT.
5. PASSING-TRACK TURNOUT LOCATIONS ON MAIN LINE CAN NOW BE APPROXIMATELY DETERMINED AND MARKED: — THE TURNOUTS MARKED WITH AN "X" WILL AFFECT THE ALIGNMENT, SO SHOULD BE LAID OUT NEXT.

CENTERS OF CURVES JOINING TURNOUT MUST LIE ON LINE PERPENDICULAR TO TRACK CENTERLINE THROUGH POINTS MEASURED OFF IN STEP 6.



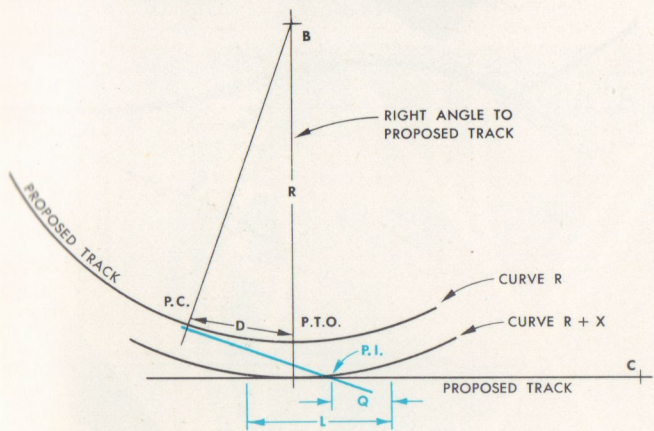
*NOTE: A PROTRACTOR MAY BE SUBSTITUTED FOR STEPS 1 THROUGH 4, USING ANGLES BELOW:

FROG NO.	ANGLE, DEGREES
3	19
4	14 1/4
4 1/2	12 1/2
5	11 1/2
6	9 1/2
8	7 1/2

†FOR EQUILATERAL OR "WYE" TURNOUT, MEASURE OFF 1/2 UNIT ON EACH SIDE.

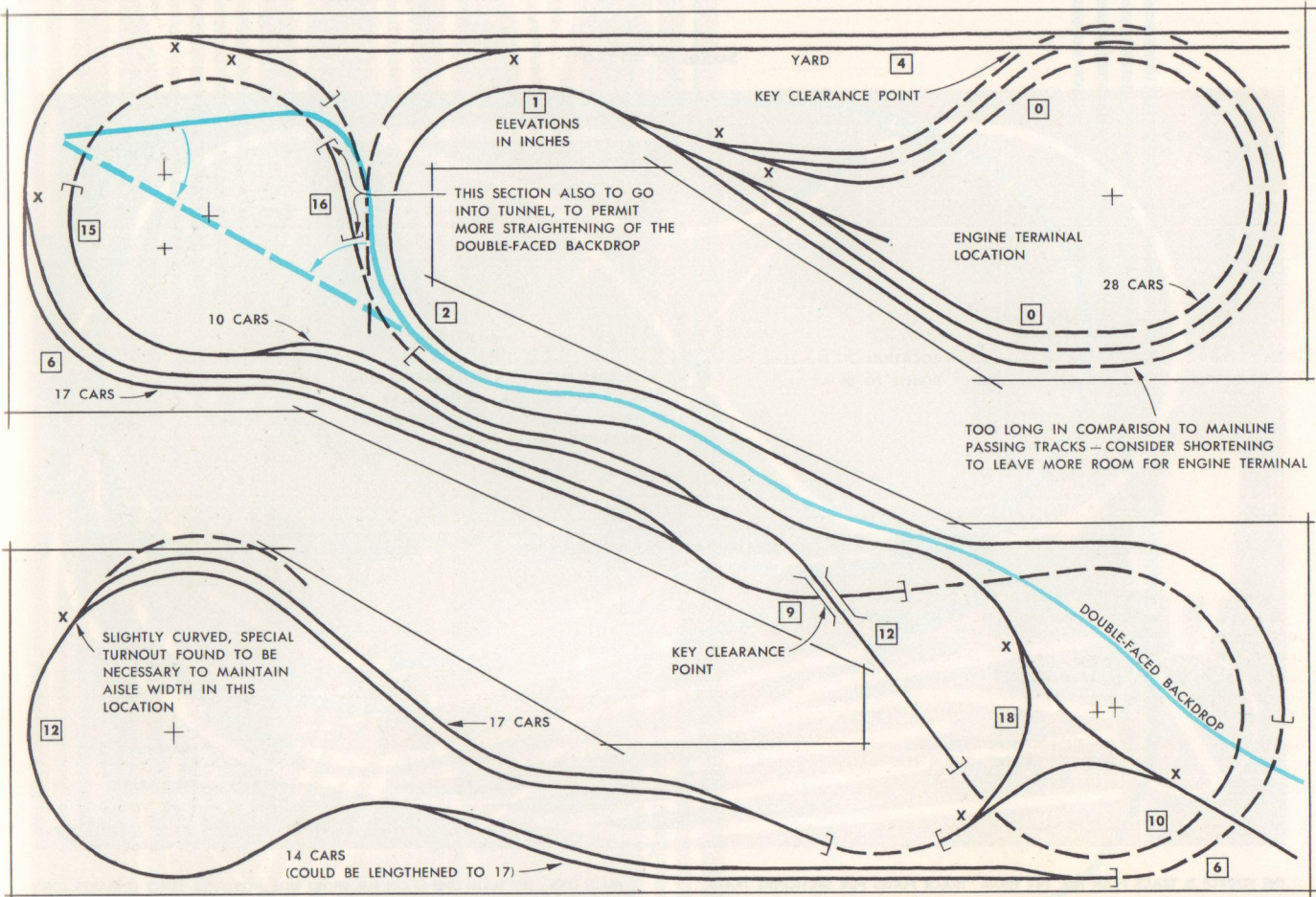
Fig. 8-12 Constructing turnouts on track plans: 2

PROBLEM 2 — TO JOIN CURVE TO TANGENT VIA A TURNOUT.
GIVEN: CURVE WITH CENTER "B." TANGENT IS TO PASS THROUGH "C."



1. DRAW CURVE CENTERLINES OF RADII "R" AND "R + X." (CONSULT FIG. 8-9 FOR "X.")
2. DRAW TANGENT FROM "C" TO JOIN CURVE "R + X."
3. DRAW RIGHT ANGLE FROM TANGENT TO CENTER OF CURVE. THIS LOCATES THE POINT OF TANGENT OFFSET ("P.T.O.")
4. LAY OFF DISTANCE "D" EQUAL TO RADIUS OF CURVE DIVIDED BY THE FROG NUMBER. THEN DRAW LINE FROM "B" TO "P.C."
5. DRAW LINE FROM "P.C." AT RIGHT ANGLES TO "B" AND "P.C." WHERE THIS CROSSES THE TANGENT IS "P.I."
6. LAY OFF DISTANCES "Q" AND "L" TO EACH SIDE OF "P.I." TO LOCATE POINT AND FROG OF TURNOUT.

Fig. 8-14 Completed principal-track scale diagram



ADDING THE PASSING TRACKS REQUIRES MINOR ADJUSTMENTS TO THE MAIN TRACK ALIGNMENT BOTH FOR THE ELIMINATION OF S-CURVES OR OTHER PROBLEMS THAT WOULD AFFECT OPERATION AND FOR THE SAKE OF APPEARANCE. ONLY THE CRITICAL TURNOUTS NEED TO BE LAID OUT TO SCALE; OTHERS (NOT MARKED "X") DON'T AFFECT MAINLINE CURVATURE NOR REQUIRE EXTRA SPACE. ELEVATIONS CAN NOW BE WORKED OUT FOR

THE FINAL, ACCURATE GRADE CHECK AND ADJUSTMENT. KEY POINTS WHERE ONE TRACK CROSSES ANOTHER AT MINIMUM CLEARANCE ARE MARKED FIRST. ALL OTHER ELEVATIONS ARE THEN FIGURED ON BASIS OF PRELIMINARY ESTIMATE (FIG. 8-6) MODIFIED BY MORE ACCURATE MEASUREMENTS OF DISTANCE ON SCALE DIAGRAM.

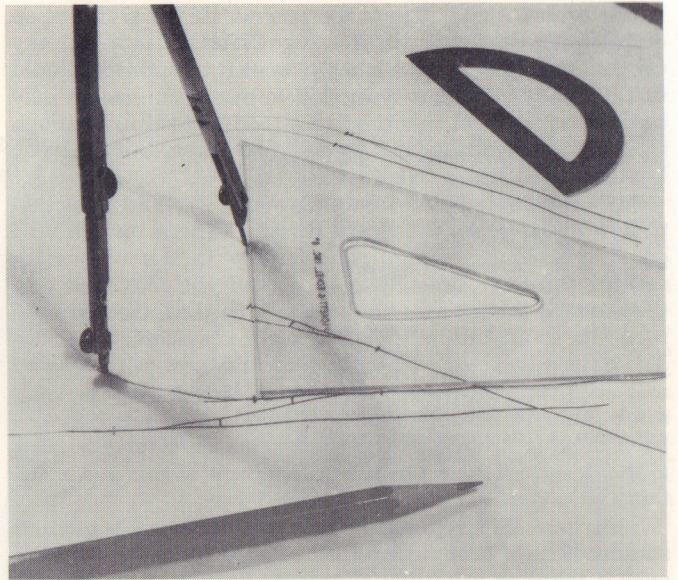


Fig. 8-13. For any curve to join a tangent properly, its center must lie on the perpendicular through the point of tangency. To prevent cheating in this respect (which will apparently save a lot of space, but which will show up in the railroad as a kink causing many derailments), use a triangle to locate your compass center as shown here. It is better to be a little sad now rather than to be continually disappointed by poor running later.

in one or two spots, it's not too serious. If the width of an entire alleyway has shrunk significantly, though, any necessary revision of the track plan or its standards should be done now. A slight reduction in minimum radius may have to be made at this time. You may be skinny enough to get into a substandard access space now, but will you be as thin 10 years from now?

Another matter that bears checking is that of access to key trackage such as yard throats. These have a way of sliding along the line considerably in the process of making the main lines fit to scale, and you may find that they are no longer near the access area that was once directly in front of them. Some prize scenic feature may also have migrated to a point where it is now too far away to be appreciated properly or where it is now hidden by some other structure or piece of landscape that has also been moving around as the track plan has evolved. Now is the time to finagle these features back where you want them.

S-curves. Finally, be sure that your S-curve minimum standards have been maintained. If they haven't, do whatever it takes to bring the alignment back into conformity with them. Not only are S-curves the most certain of all track plan faults to cause continual derailments, but they are the most difficult to eliminate by reconstruction once you have built the railroad. It may mean relocating whole 270°-long curves, plus their approaches, to gain enough space to work in an adequate straight section between the reverse curves of a dogbone, for example.

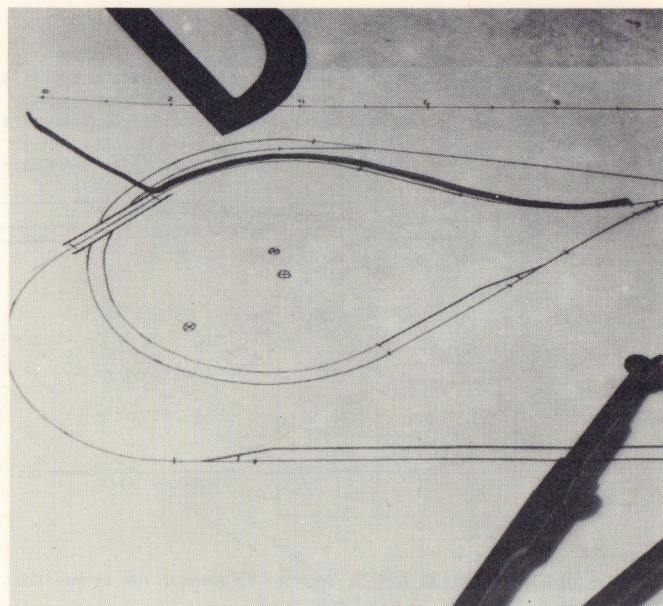
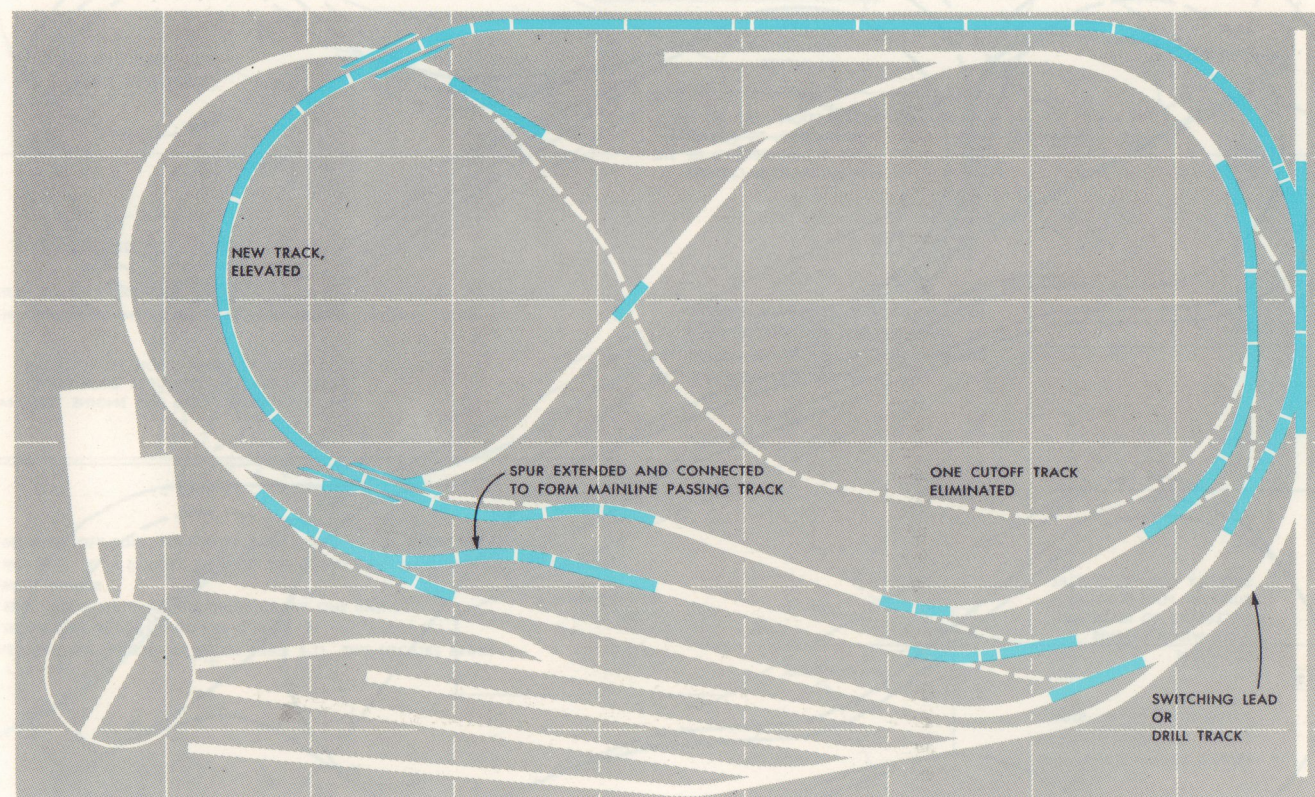


Fig. 8-15. For a reasonably accurate measurement of the length of curved sections of track, bend a piece of soft wire (insulated solid-conductor copper hookup wire is ideal) to match the diagram. The wire can be straightened out along a scale to determine the exact length, in feet or in "squares," as needed to figure grades, passing-track capacity, or yard-track capacity.

CUSTOMIZED TRACK PLAN EXAMPLES

Scale: $\frac{3}{4}" = 1'-0"$



THE SOURCE IS TRACK PLAN NO. 144 FROM "TRACK PLANS FOR SECTIONAL TRACK," PAGE 31: $5\frac{1}{2} \times 9$ FEET (HO), ONCE-AROUND WITH RETURNING TRACKS. THIS TRACK PLAN, WHICH CAN BE FITTED ONTO A PING-PONG TABLETOP WITH A LITTLE CONDENSATION IN THE YARD AREA, IS EXCELLENT FROM THE STANDPOINT OF SCENIC POSSIBILITIES BECAUSE IT IS NOT OVERLY CROWDED WITH TRACK. TWO REVERSING TRACKS ARE PROVIDED SO THAT TRAINS CAN CHANGE THEIR DIRECTION OF TRAVEL AT WILL, AND THE YARD HAS A SWITCHING LEAD OR DRILL TRACK CLEAR OF THE

MAIN LINE. THE MAIN LINE IS ON THE SHORT SIDE, HOWEVER, SINCE IT MAKES ONLY ONE LAP. THE MODIFICATIONS SHOWN CONVERT THE MAIN LINE TO A TWICE-AROUND PATTERN. THE SINGLE REMAINING REVERSING TRACK IS IN THE PROPER DIRECTION TO PROVIDE FOR OUT-AND-BACK OPERATION FROM THE YARD. WITH NO MORE TRACK THAN IN THE ORIGINAL PLAN, THE UNCROWDED APPEARANCE REMAINS. THE MORE COMPLICATED UP-AND-OVER CONSTRUCTION NOW REQUIRED ADDS COMMENSURATELY TO THE SCENIC POSSIBILITIES.

Scale: $\frac{3}{4}" = 1'-0"$



MAINLINE OVAL WITH AS MANY LAYOVER TRACKS AS DESIRED. HIDDEN TRackage ACCESSIBLE FROM REAR OF LAYOUT

ALTERNATE ARRANGEMENT FOR HIDDEN TRACKS PROVIDES BETTER TURNOUT ACCESS

THE SOURCE IS TRACK PLAN NO. 47 FROM "101 TRACK PLANS," PAGE 24: CHAS. SMITH'S 5×12 -FOOT (HO) SWITCHBACK PIKE. FOR THE TRUE POINT-TO-POINT SCHEMATIC THE SWITCHBACKS USED IN CONQUERING OTHERWISE IMPOSSIBLE TOPOGRAPHY TO BRING OUT THE PRODUCTS OF MINE OR FOREST HAVE MUCH TO OFFER. THE TORTUOUS CLIMBINGS OF THE SHORT TRAINS BETWEEN TERMINALS REDUCE THE TASK OF REGROUPING THE TRAINS AT THE ENDS OF THE LINE TO AN ACCEPTABLE AND ENJOYABLE PROPORTION OF THE WHOLE OPERATION, AND THE LOW SPEEDS MAKE THE READILY ATTAINABLE LENGTH OF LINE MUCH MORE ADEQUATE THAN IN THE SAME-SIZE CONVENTIONAL PIKE. FOR THOSE WHOSE INTERESTS INCLUDE HIGHER-WHEELED MAINLINE LOCOMOTIVES, OR WHOSE ROSTER EXCEEDS THE CAPACITY OF SUCH A LINE, A MAINLINE OVAL WITH LAYOVER TRACKS IS EASILY ADDED AS INDICATED. THIS CAN EVEN BE DONE FAIRLY READILY AS AN AFTERTHOUGHT BY JACKING UP THE BRANCH AND SLIDING THE MAIN LINE UNDER IT.

Filling in the details

Your mainline schematic determines the broad pattern of operation of trains over your railroad, but the details of the arrangement of the yard and other secondary trackage in the track plan have at least as much to do with how much fun you get out of it. A yard where you are continually getting in your own way is a challenge for a while, but if that is the only place you can make up trains, you will find yourself either running the same consists for months or else resorting to g.h.a. (giant hand action) far too much. Likewise, siding and spur arrangements out along the main line will determine how much variety you can pack into the way freight's halting journey without clogging through movements so thoroughly that one class of traffic or the other ceases completely while the other class is on the road, thus losing the thrill of

their interaction as it takes place in real-life railroading.

Differences from mainline planning

The general approach to filling in the details should be different from that used in working out the mainline track plan. In planning the main line, we are mostly engaged in making the best of an essentially hopeless operation—at best, we are taking something that is very long and fairly straight and trying to condense and coil it into a small area without being too obvious about what we're doing. Most of the art in getting the most out of the space is just plain trickery, and we have to think about dogbones and end loops which don't really have anything to do with prototype railroading.

In modeling passing tracks, industry sidings, engine

WHY PIKES GROW OLD PREMATURELY

Why do model railroads sometimes go stale prematurely, cease to be operated very much, and suffer early abandonment? Some reasons, such as poor basic design of the main line which simply won't permit satisfying operating variety, are obvious. Poor construction which results in an im-



YESSIR—HE'S A TYPICAL MODEL RAIL—UP TO THERE IN CARS, AND HE'S STILL KNOCKING MORE OF 'EM TOGETHER FOR HIS PIKE!

possible maintenance burden and so many derailments that the game just isn't worth the candle is another readily appreciated road to early retirement of a layout.

A less obvious but possibly even more common fault, which usually becomes apparent only with the passage of time, is *lack of storage capacity for rolling stock*. You don't stop building and otherwise acquiring rolling stock when you get your railroad into operation, and the locomotives and cars never really wear out. As a result, what originally seemed like ample siding capacity soon becomes full to the bursting point. This occurs particularly quickly now that we have ready-to-complete locomotives in great variety and shake-the-box kits available at such reasonable prices. The abundance of equipment is good—after all, operating variety comes not only from the capabilities of the track plan but also from the different consists you can assemble from your roster.

The problem is what to do with all the excess equipment so the road won't become clogged and strangled. The sensible thing to do would be to scrap or rebuild your older and cruder items, keeping only a fixed number of cars and engines of constantly improving quality on the track. This takes so much strength of character that it's out of the question for most of us. Keeping the excess in drawers or on display shelves is an easier possibility, but one with drawbacks. The extra handling doesn't do the rolling stock any good, no matter how careful you are. There is a tendency to use the same equipment all the time, losing the advantage of having such variety and quantity. The nuisance of getting set up for operation means that you run the railroad less and get less good performance when you do. Finally, the process of supplying equipment by hand is not very realistic, to say the least.

The best remedy is ample storage and hideaway track capacity to start with, along with planned-in possibilities for adding a lot more as the railroad matures. Various ways of making this trackage prototypically correct and operationally realistic (or at least inconspicuous if this is not practicable) are discussed in this and the other chapters. Just be sure you are not badly underestimating your requirements in this area.

terminals, and so on, however, we can reproduce them quite faithfully. True, we will foreshorten tracks somewhat (in keeping with the shorter trains that we must be content with) and usually reduce their number in the process of "selective compression" to get a better sampling of a whole railroad into our track plan, but fundamentally we simply copy the prototype. The basic guide for filling in the details of layout trackage is therefore as much understanding and knowledge of real railroad track arrangements as you can acquire. The first four chapters of this book include various examples of selective compression as applied to such common trackage as engine servicing facilities, mining industries, stub terminals, and junctions. Looking over actual yards, industrial areas, and other concentrated chunks of trackage (and, particularly, watching switching crews go about their work) will tell you far more than you can ever learn from reading. If you're any kind of a railfan, it will be more fun too. So consider every fan trip a real opportunity for improving your track planning background.

Dressing up the main line. Minor changes in the main line, not affecting the schematic in any way, can both dress up its appearance and increase operating interest. Fig. 9-1 illustrates one way to make it seem a little longer and introduce a real reason for taking 30 seconds to go a few feet.

A typical prototype curve considered moderately sharp (since it would call for a speed restriction to approximately 65 m.p.h.) is one of 5 degrees. In civil engineering terminology this means that it changes direction by 5 degrees in each 100 feet of distance; its radius is about 1135 scale feet or 13 actual feet in HO. Wow! Well, we certainly aren't going to be able to use such curves for our dog-bone end loops, but on almost any track plan there is at least one place where it is possible to substitute a section of such radius in place of less interesting tangent track. The appearance of a train on this gentle a curve is marvelously realistic and fully worth the minor effort of using a piece of string to swing an arc to lay out a cardboard template for it.

Superelevation (banking) of a curve is essential for operation at speed in the prototype. The laws of physics are such that our scale models do not need superelevation to stay on the track. This even goes for our hairpin curves, unless we run at toy-train speeds four or five times as great as would be realistic. We don't *need* superelevation for operation, but using it adds so much to appearance that many experts consider it a must for mainline track wherever it can be seen.*

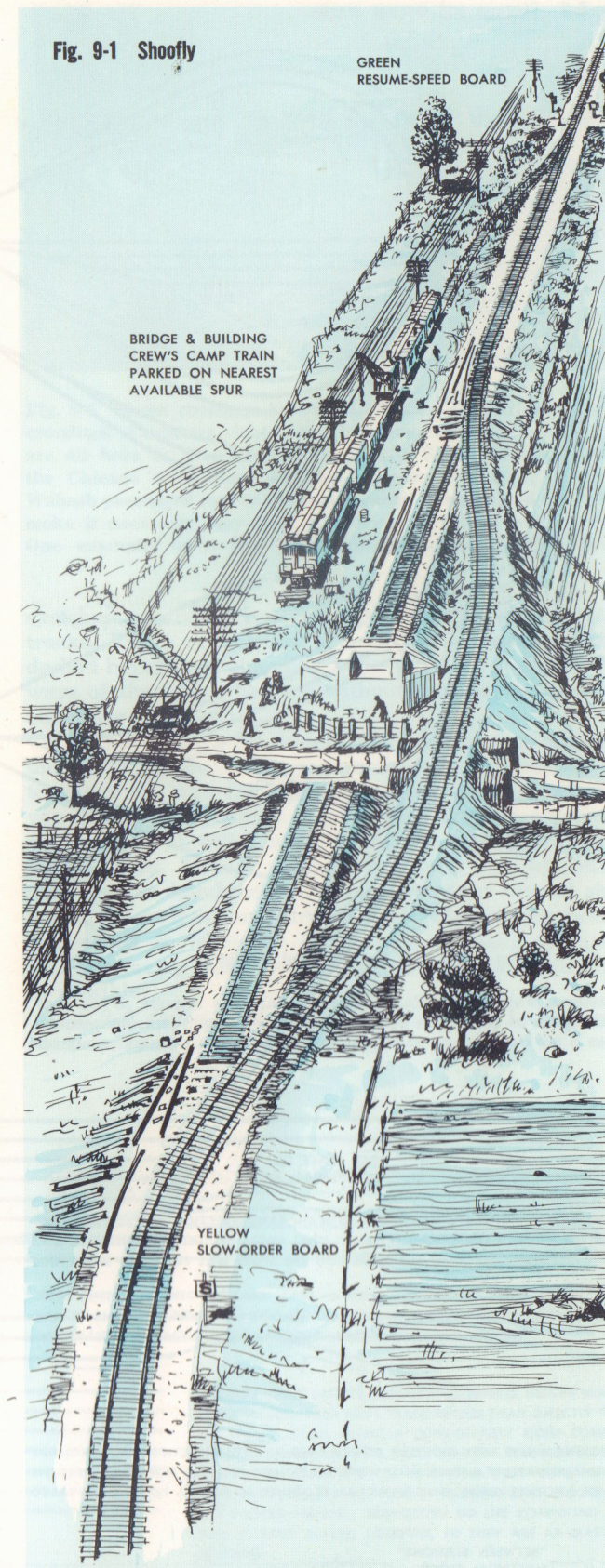
Using loop space. A lot of precious area will very likely be located within return loops on our layouts. One of the best uses for this space is for adding storage tracks, and you can almost always find a way to do it. See Fig. 9-2.

Doubling the loop. The same loops can also be laid with double or triple track. This creates useful double-ended trackage for storage, hiding trains, passing tracks, and other uses—even to serve industries. If you can work in such track only by using a substandard radius for the inner tracks, do it anyway. You may have to keep passenger trains and long locomotives off the inner track but it will be useful just the same for freights and locals.

Mainline spurs. Industry tracks along the main line are about the most valuable trackage per foot on the whole railroad because of the operating interest they furnish. They also add a railroadlike atmosphere. It isn't usually necessary to plan them in detail before starting construction. In fact, if you wait until you see how the space actually looks, you'll probably find ways to squeeze

*Since it is easier to lay perfectly smooth track if you don't have to jack up one rail, it is generally best on *hidden* trackage to leave the curves unbanked—a percentage play to improve reliability where it is most needed.

Fig. 9-1 Shoo-fly



WHILE WAITING TO FINISH THAT SUPERDETAILED BRIDGE, WHY NOT FOLLOW PROTOTYPE PRACTICE AND CARRY MAINLINE TRAFFIC AROUND THE CONSTRUCTION AREA ON A TEMPORARY "SHOOFLY" TRACK? BUILT TO BARE-MINIMUM RADIUS STANDARDS, SO AS TO REQUIRE TEARING UP AS LITTLE TRACK AS POSSIBLE, THE SHOOFLY'S DRASTIC SPEED RESTRICTION ADDS LENGTH TO YOUR MAIN LINE AND ANOTHER FACTOR FOR THE DISPATCHER TO CONSIDER IN HIS SCHEDULING "FOR THE DURATION." A MORE EXTENSIVE OPERATION IN THE SAME VEIN, MORE SUITABLE FOR A PERIOD PIKE OF AN EARLIER ERA, IS THE SWITCHBACK OPERATION OF GETTING TRAINS OVER THE TOP OF THE MOUNTAIN WHILE A MAJOR TUNNEL IS BEING REOPENED AFTER A ROOF COLLAPSE, LINING FIRE, OR LANDSLIDE HAS BLOCKED IT.

Fig. 9-2 Storage and layover tracks

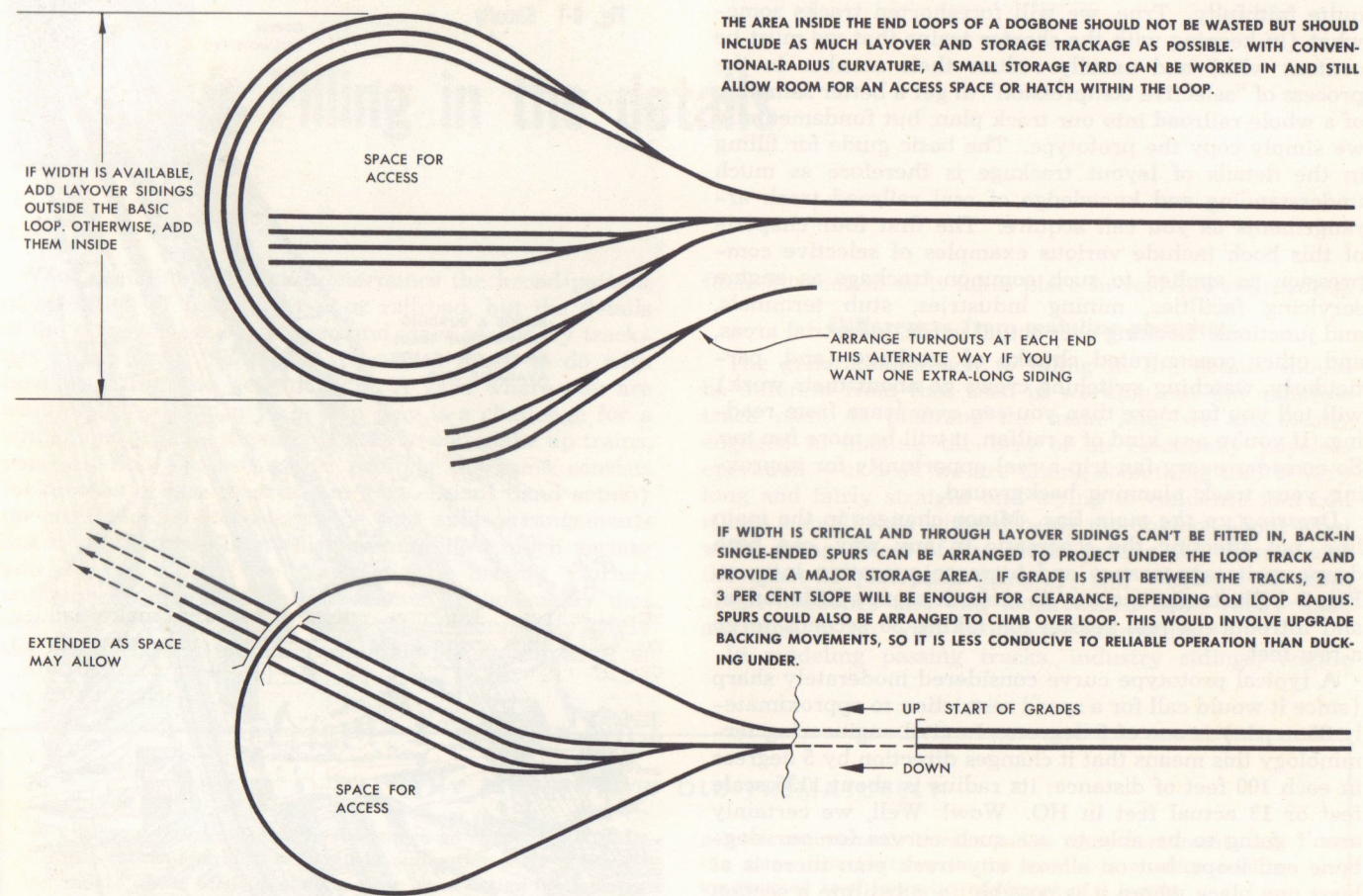
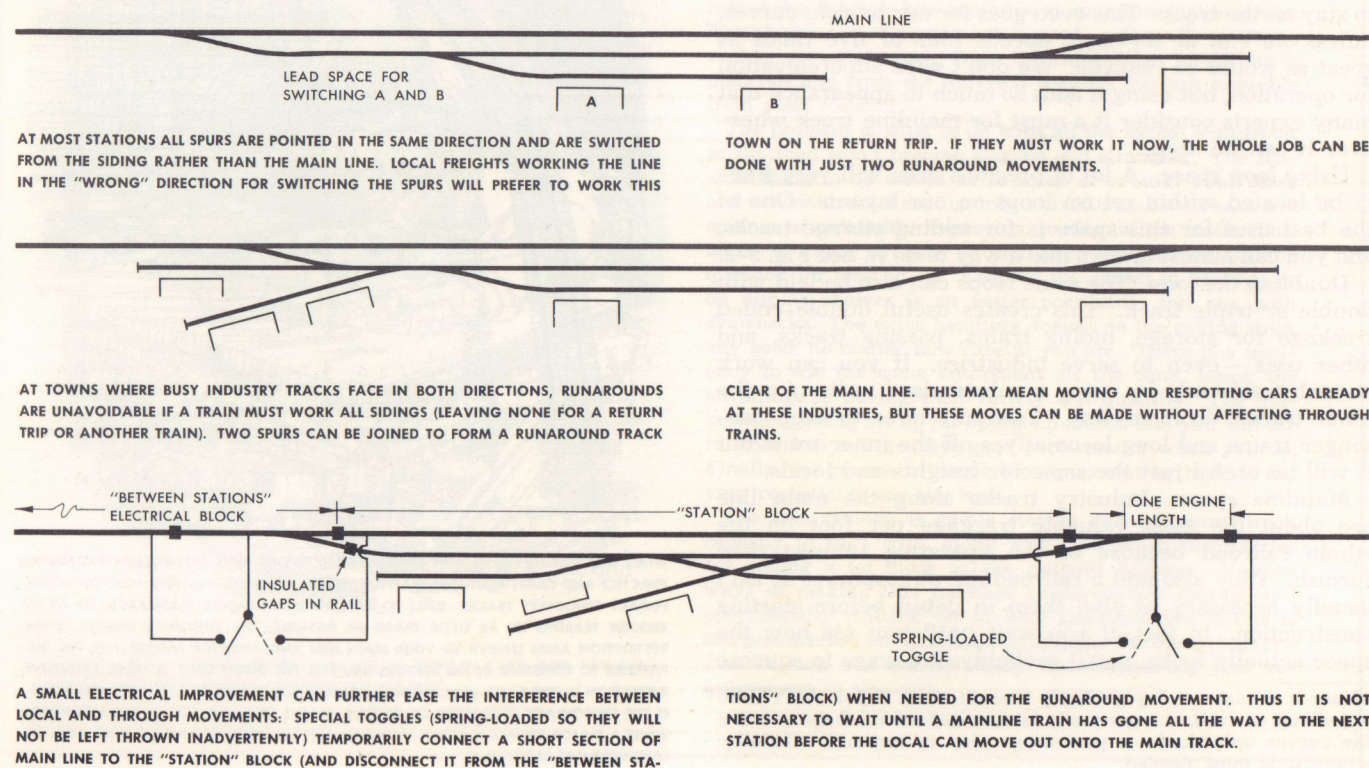


Fig. 9-3 Easing runarounds for the local freight

A FAVORITE (AND PROTOTYPICAL) OPERATION THAT ADDS INTEREST TO THE WAY FREIGHT'S JOB OF GETTING ITS INDUSTRIES SWITCHED WITHOUT DELAYING THROUGH TRAINS IS THE SERVICING OF "FACING-POINT" SPURS. BECAUSE THROUGH TRAINS ARE

SO FREQUENT ON MODEL RAILROADS, HOWEVER, THE LOCAL NEEDS HELP IN SEVERAL WAYS IF ITS RUN IS TO BE COMPLETED WITHOUT UTTER FRUSTRATION:



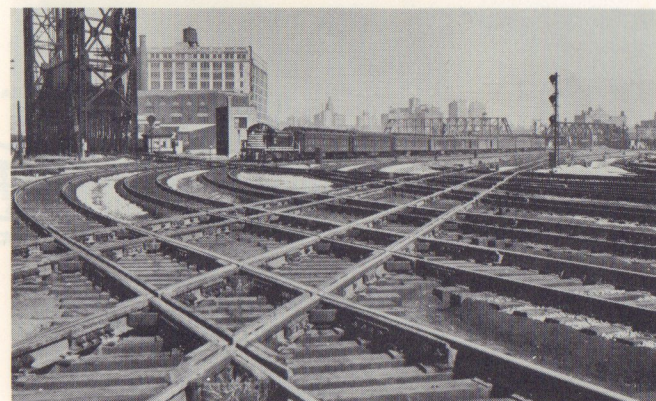
in more than you would have thought possible from the small-scale plan, and probably also work out more interesting alignments.

Some consideration should be given to the general pattern of lineside industry tracks, to see that the way freight can get its work done without infinite delays from the constant parade of through trains. Fig. 9-3 discusses a few ways for easing the runaround interference problem. If you are particularly interested in one of the various ways of giving your local freight realistic chores to perform, such as a "card order" scheme for routing cars to and from the particular industries, the approach of the track plan shown in Fig. 11-6 is worth considering.

Fancy junction trackwork. Frequently, in finishing a track plan it becomes apparent that some unusual, almost freakish, trackwork would really help in several respects. For example, if a crossing could nip across another line where it has already started to branch into a passing track, it might be possible to get three more cars in the siding and still alleviate a bad S-curve problem in the intersecting route. Real railroads don't like to pay for special trackwork any more than you may think you would like to have to build it, but they still use it where it's necessary. Something like Fig. 9-4 is for those whose favorite facet of the hobby is trackwork, but an occasional special crossing or turnout is another matter. Some special trackwork should be welcomed rather than shunned. Building it may be more fun than you thought. Just be sure it's located where you can get at it easily, not only for ease in installation and possible maintenance, but also so you can show it off to your friends. If you use the NMRA track and wheel gauge, your special trackwork can be freer of derailments than commercially made turnouts usually are.

Yard detailing

You'll get the general pattern of your yard design from the railroad you're copying or from such considerations as discussed in chapter 2. When you lay it out to scale, you will be unpleasantly surprised to find that it won't hold nearly as many cars as you'd like. For some reason we all seem to be incurable optimists in our free-hand



TRAINS: Wallace W. Abbey.

Fig. 9-4. Seven crossings in a row! And on each track! Curved crossings! Crossings right through turnouts (in distance)! They are all here in this interlocking at 21st St. in Chicago, where the Chicago & Western Indiana switcher is hauling a cut of Wabash passenger cars to the coach yards. If congested conditions make it necessary, any type of special trackwork will be used. One example, or a few, will enhance advanced track plans.

sketches regarding how compact we can make ladder tracks. There isn't an awful lot you can do about these dashed hopes beforehand, but Fig. 9-5 does mention some ways of shortening ladders without introducing unworkably sharp turnouts.

The rest of the yard design revolves about efficiency in the use of turnouts. It is the number of switches that determines the cost (cash or labor, depending on whether you buy or build them) of your yard and the amount of maintenance it will demand to remain a pleasure rather than a fright. Here is where we run into a slight contradiction. For handy classification, we want lots of short tracks (at least one turnout per). Making the best of it depends on efficiency in the use of tracks, primarily through having each one serve as many alternate purposes as possible.

Fig. 9-6 shows how much can be gained in this way. Ideas to try include the following:

Fig. 9-5 Space-saving ladder arrangements

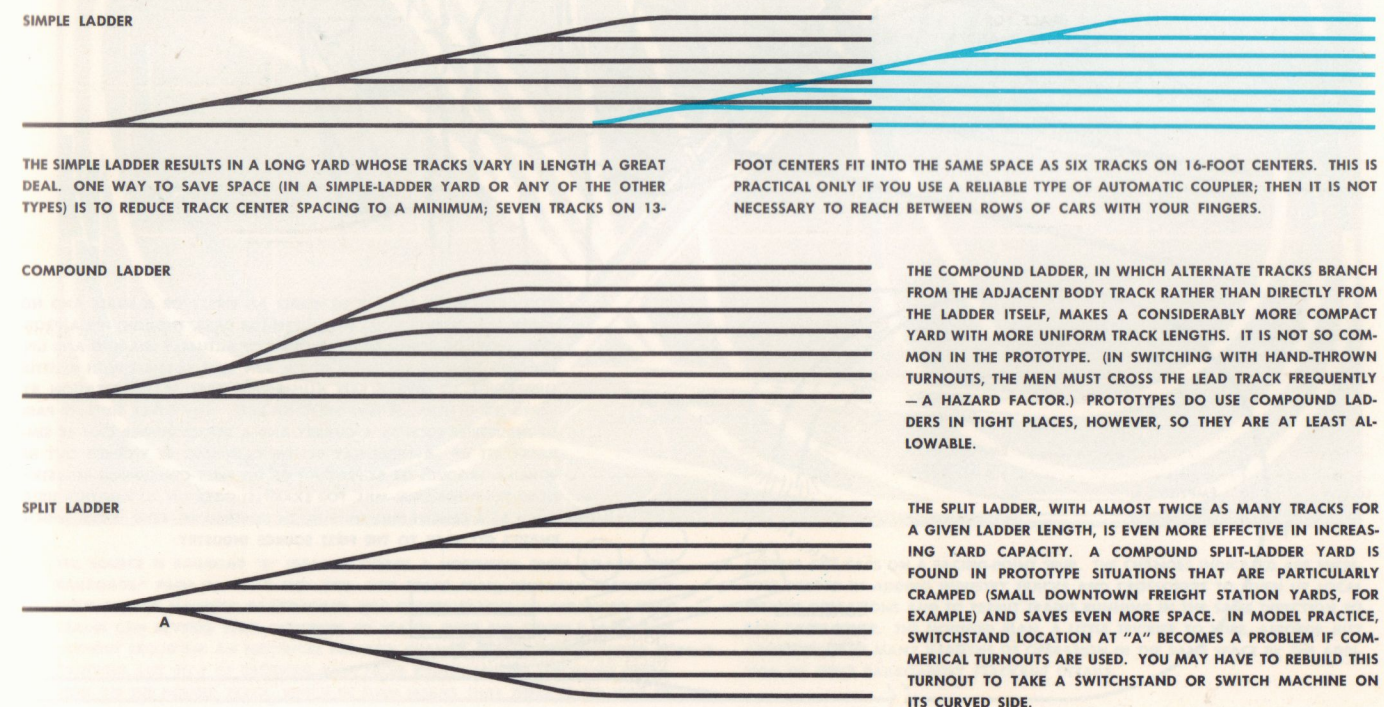
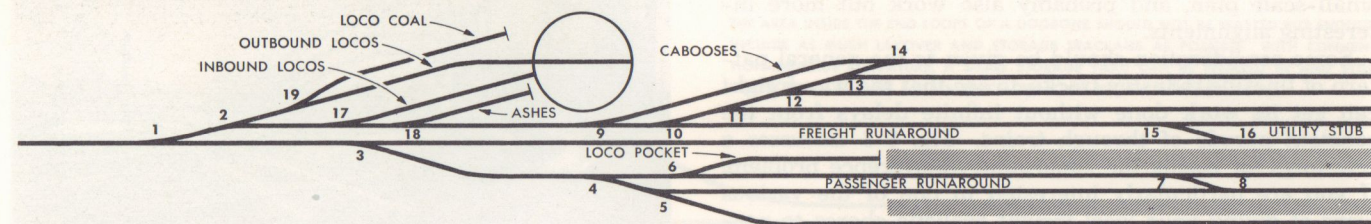
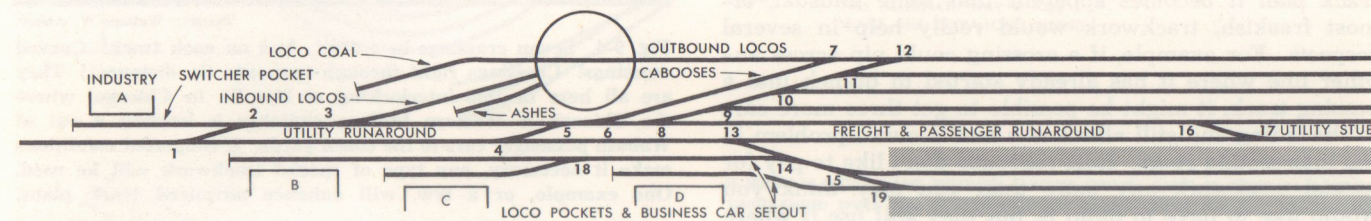


Fig. 9-6 Efficient multiple use of trackage in stub terminals



BOTH OF THESE STUB TERMINALS, OF IDENTICAL STORAGE CAPACITY, HAVE THE SAME NUMBER OF TURNOUTS. MORE EFFICIENT DESIGN IN THE LOWER TERMINAL, CHIEFLY THE USE OF A COMMON RUNAROUND TRACK FOR FREIGHT AND PASSENGER TRAINS, SQUEEZES

IN FOUR INDUSTRY TRACKS AND TWO ADDITIONAL LOCOMOTIVE "POCKETS" (FOR ENGINES AWAITING TRAINS, CLEARING MAIN FOR SWITCHING OR THROUGH MOVEMENTS, ETC.).



THE UPPER TERMINAL CAN HANDLE MORE INCOMING TRAINS BEFORE BECOMING CLOGGED. HOWEVER, THE RUNAROUND FORMED BY THE LOCOMOTIVE TERMINAL TRACKS

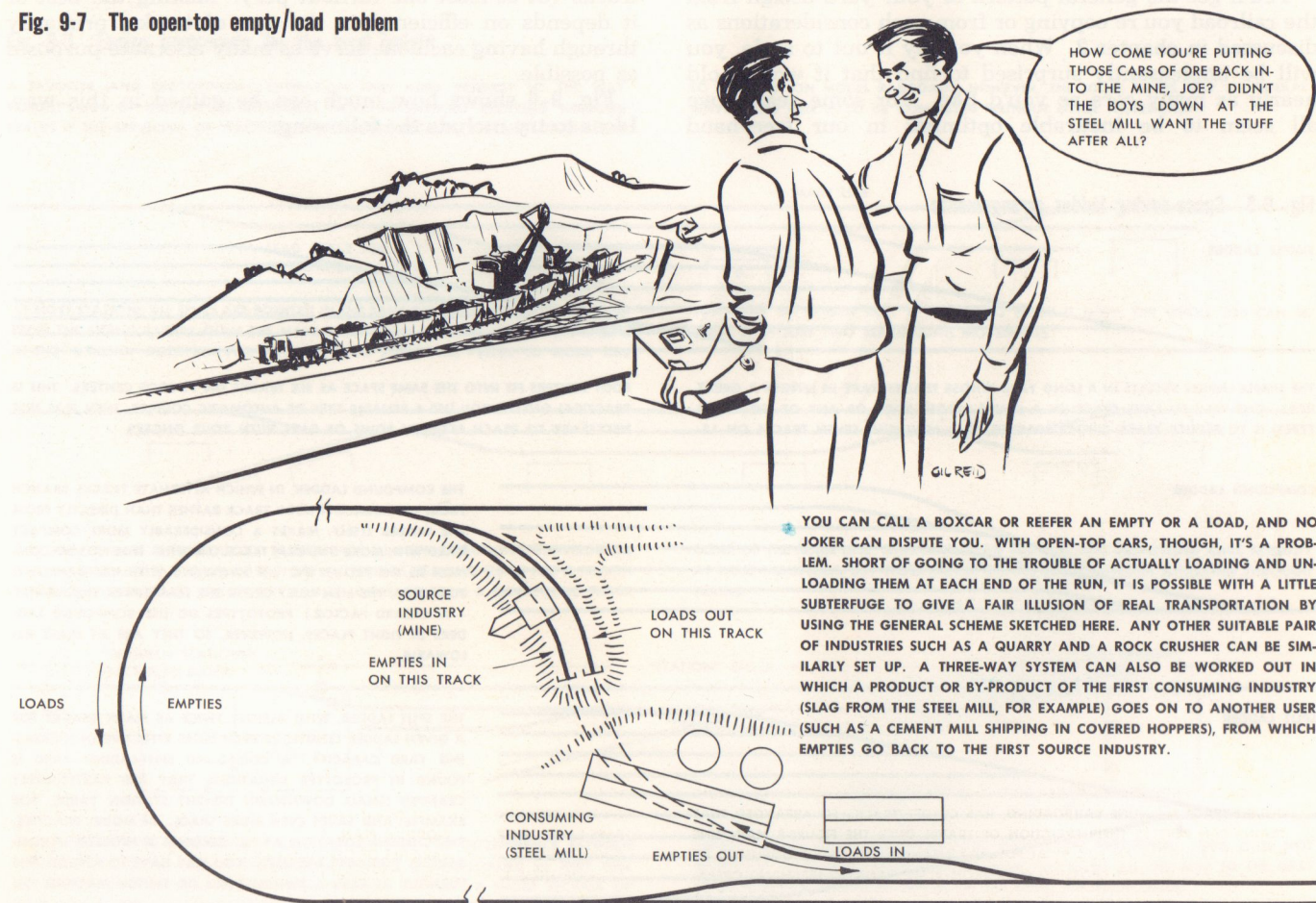
AND THE CROSSOVER 4-5 IN THE MORE COMPACT LOWER TERMINAL MAKE IT MORE FLEXIBLE IN HANDLING TRAFFIC MOST OF THE TIME.

- (a) Make spurs for setting out sleepers or business cars long enough to serve as engine pockets as well.
- (b) Use a common runaround track for passenger and freight yards.
- (c) Let the turntable serve the coal dock, ashpit, and sand tracks, as well as the roundhouse.
- (d) Extend tail tracks and switching leads to serve an industry or two.

Out along the main line you can try some similar shortcuts:

- (a) Industry lead tracks can be equipped with a switch at each end and serve as passing tracks for through trains.
- (b) Wyes for turning helper engines can be extended into branch lines or to serve an industry.

Fig. 9-7 The open-top empty/load problem



Detailing for appearance and realism

Other things being equal, why not locate passing tracks on the side of the main line away from the normal viewing position? Even with the best dispatching, there will be trains waiting in the siding much of the time. You might as well arrange things so that you still get a good look at the mainliner as it rolls past.

In chapter 6 we mentioned the matter of realistic patterns of movement for empty and loaded open-top cars. On the individual-car level of the local freight we have a similar problem; Fig. 9-7 illustrates one solution.

Detailing for reliability and comfort

As a final check, is every turnout accessible? Easily accessible? Even though the turnout is equipped with a switch machine, you will need to get at it occasionally for such maintenance (cleaning gravel out of the points, for example) as cannot be eliminated completely by even the best construction and design. Also, this is where you will have most of your derailments, due to operating goofs if not to less than perfect trackwork and rolling stock. So, it is highly advisable to make sure that you can get at the turnout—if not easily, at least without requiring a major operation or endangering delicate scenery en route. Adding or relocating track simply to move a turnout to a better location in this respect is entirely justifiable, and it's so much easier to do on paper than on the layout!

Finally, there's the possibility of making your service tracks really serve. Fig. 9-8 is a worthwhile example. Think over your railroading operations and you may come up with some other little gimmicks that will help raise the pleasure-to-exasperation ratio in the future.

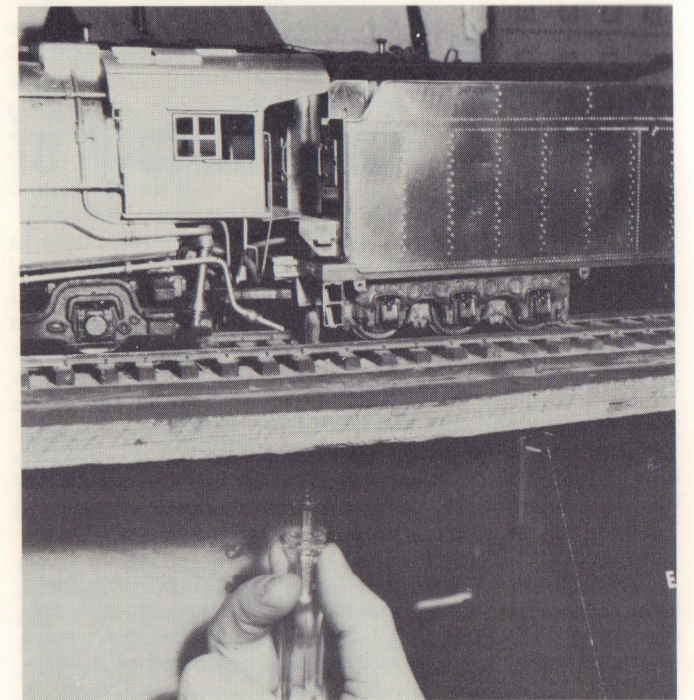
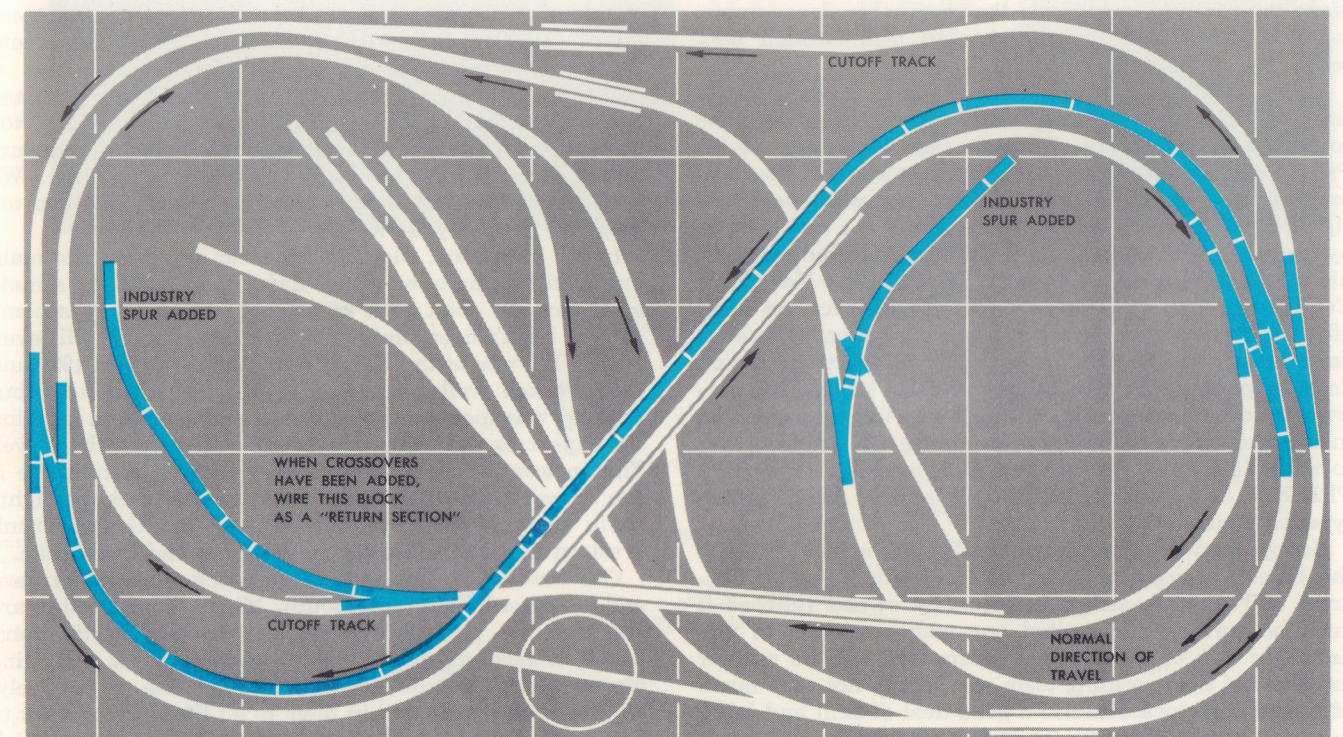


Fig. 9-8. You can let one of your engine service tracks rest on trackboard extending past the layout underframe. Then drill a hole between the rails. This provides a very much handier set-up for performing such tasks as removing tender drawbar screws. It's sort of satisfying, too, to do it with the locomotive on the track rather than on its back—it's much more prototypical.

CUSTOMIZED TRACK PLAN EXAMPLE

Scale: 3/4" = 1'-0"



THE SOURCE IS RAILROAD "E" (GRANITE GORGE & NORTHERN) FROM ATLAS'S "SIX RAILROADS," PAGE 28: 5 x 9 FEET (HO). THIS TRACK PLAN, PRIMARILY FEATURING DOUBLE-TRACK MAINLINE RAILROADING, HAS CUTOFF TRACKS SO ARRANGED THAT TRAINS CAN REVERSE THEIR DIRECTION OF TRAVEL OVER THE FIGURE-8 MAIN LINE WITHOUT REQUIRING AN ELECTRICAL POLARITY CHANGE. THIS IS ACCOMPLISHED BY OMITTING ANY WAY OF CROSSING OVER FROM RIGHT-HAND TO LEFT-HAND OPERATION ON THE DOUBLE TRACK, WHICH IN TURN MEANS THAT THERE IS NO WAY OF

SETTING OUT CARS ON A FACING-POINT SPUR. THE CHANGES INDICATED ARE THEREFORE NEEDED IN ADDING INDUSTRY TRACKS AND CROSSOVERS TO LIVEN UP LOCAL FREIGHT OPERATIONS AND TO PERMIT TRAINS RUNNING IN THE SAME DIRECTION TO PASS EACH OTHER. THE MODIFIED PLAN, A LITTLE TRICKIER TO WIRE, AFFORDS JUST ABOUT TWICE AS MANY VARIETIES OF OPERATION IN THE SAME SPACE BY THE ADDITION OF THESE RAILROADLIKE TRackage DETAILS.

Case history of a track plan

Now let's try all these theories and techniques against a typical layout design problem and see what comes out. To be fair, let's take what is a somewhat tougher than average problem—modeling a Midwestern flat-country line which can't use a steady succession of mountain grades and beetling cliffs as its obvious reason for sharp curves, slow running and short trains.

The St. Clair South Western

The St. Clair South Western is to represent a medium-size railroad extending from the Detroit area through Indiana to Evansville and St. Louis, a line passing through the flat or gently rolling agricultural heartland of America. It taps coal in some strip mining areas, and there is the usual traffic in cement, sand, and gravel at various points. Its principal business, however, is fast freight associated with the automobile industry. Glass, steel, and other raw materials are brought to the manufacturing areas. Automotive parts go from Detroit to assembly plants throughout the Middle West. Finished automobiles on trilevel racks go to distributing centers, and so on.

As the special feature of this pike (and any model railroad should have at least one out-of-the-ordinary item) there is to be a car ferry operation across Lake St. Clair to Canada and connections to the northeast. Local freight traffic is heavy because of the extensive industrialization along the railroad's route and the reasonably dense population in this territory. A light but fast through passenger service is operated.

The tycoon who originally put the road together made use of considerable mileage of other lines, including some competitors such as the Wabash (see map, Fig. 10-1). Presumably he either had something on some of the rival magnates in order to swing so many favorable trackage-rights agreements or else he made use of the fact that, as by far the shortest route between Detroit and Indianapolis, his road could be of use to such giants as the New York Central and Pennsy. These trackage-rights sections won't affect our track plan directly, since it's going to be confined mostly to the section near Detroit, but the fiction does keep alive the possibilities of joint use of locomotives or other equipment, through service, and the like in case they come in handy in the future. It is always nice to have an excuse for running, say, an NYC Hudson, a PRR K-4, or a Wabash Mogul, still lettered for its prototype, on your road.

Background requirements. The StCSW is to be built in the basement area indicated in the available-space diagram of Fig. 10-2. As an individually owned railroad it must be suitable for limited one-man operation at any time, but two or three other railroaders will be regular members of the operating team and supply not only much of the rolling stock but also a good deal of skill and labor in various parts of the construction and maintenance process. Their pooled rolling-stock resources include nine diesel units (Alco A&B passenger, four F-7's, and three GP-9's) for road service; 4-6-0, 4-6-2, 2-8-2, and 4-8-4 steam locomotives of relatively modern detail; two diesel switchers; three 0-4-0T's (this being an HO railroad). The 10 cabooses represent three different railroads besides

the StCSW. There are about 85 freight cars, including 8 new 85-foot piggyback/auto-rack flats, and 18 passenger cars, of mixed conventional and streamline design but all full-length.

Two of the three principal proprietors have built smaller layouts in the past, so a reasonably high quality of construction can be assumed permissible, with easements and special turnouts where required, though most of the trackage will be made with dressed-up prefabricated material to speed the job.

Standards. In consideration of the gently contoured territory traversed by the "prototype" StCSW, which is not provocative of sharp curvature and bad grades, a 30" minimum mainline radius is selected as a trial figure. Other standards are much the same as those in the example of Fig. 5-1, except that there won't be any mountain division with 4 per cent grades on this line. The 30" trial radius would make for good appearance and excellent operation with the full-length cars of the StCSW, so it's worth using at the start, recognizing that it can be shaved considerably, if this should be desirable from a track-plan standpoint, without seriously impairing reliability of mainline running so long as we keep those easements.

The basic schematic

We've already decided that the model will depict a chunk of the northern end of the line, including the car ferry. One way of getting started on the actual layout design is to consider next the basic mainline schematic. A point-to-point plan is not compatible with the assumed fast-freight traffic, since trains would get "used up" too quickly once they finally got turned around in the terminal yards and started on their mainline journeys. We can therefore assume a continuous-type plan or a loop-to-loop will probably be it.

In all likelihood, including the car ferry in this main line would again slow things down too much. As a matter of fact, we don't even know that our car ferry scheme (which hasn't been designed yet in any detail) will even work. The one at the New York World's Fair in 1939 and 1940 worked well, even in the presence of visitors, but \$100,000 was spent on that railroad, and even with inflation we expect to hold this one down well below that level. The answer is to put the car ferry on a branch where it can be worked out later, and consider the trackage-rights route into the heart of Detroit over the Grand Trunk Western our main line for purposes of the track plan.

Our line will be basically single track. Our major yard will represent South Plymouth, Mich., where trains are classified for Detroit or London Junction destinations. Loops at each end of the visible portion of the main line can represent Detroit and the Indiana line respectively, with layover tracks within them to let trains come back to South Plymouth in different sequence from that in which they left it. Our "Trilevel Specials" and "Spark Plug Ex-pediters" handling Detroit hotshot freight can roll right through South Plymouth without change of consist, presumably being blocked at Anderson or even East St. Louis for such through routing.

We can now lay out the available area (Fig. 10-3) in

terms of squares as discussed in chapter 6. The principal area for the pike comes out to equal 3 x 8 squares, using the extra-conservative figure of 36" per square since it happens to come out even that way and is on the safe side. The panhandle into the rec room is a natural for the car ferry branch operation, so we can sort of forget that for the present, after making a mental note to leave the branch connection sticking out the upper left corner of the basic rectangle.

Shaping the benchwork

What type of benchwork arrangements are worth considering? Not a solid one, certainly! An HO train 9 feet away is hardly worth looking at, even if you never needed to reach the rear track. If we leave an operating and viewing aisle between the layout and the basement wall, the width remaining will be only about two squares, reducing possibilities for the main line to simple ovals. A "doughnut" layout would have excellent possibilities for a long run in this size, with a multilap main line and good access once you ducked into the "hole." Since there may be enough room for it, though, let's try for a walk-in, no-stoop arrangement of some sort. (Notice the soft-sell approach in coming around to my favorite type of aisleway plan, just as though it were inevitable!)

A look at the alphabet of pike shapes (Fig. 6-7) shows that in our 3 x 8-square space we are pretty much limited to the C ("waterwings" or "droopy dogbone") or the G scheme. The G is a good one, so let's lay in a supply of

scraps of paper, old envelopes, and paper towels, and start sketching and manipulating. Fig. 10-4 shows what the first one might look like. If the open center of "G" benchwork is 4 or 5 feet wide, providing plenty of operating space, the aisleway into it can be considered adequate if it is 2 feet (2/3 square) or so wide. On this basis, the G plan seems to fit in satisfactorily, and we sketch in a dogbone to fill it.

To evaluate these plans as suggested in chapter 8, we need to know if we have a suitable place for the principal yard. We decide that it would be desirable to have the longest body track hold 18 freight cars. Using the rules-of-thumb of Fig. 8-4, we find that a double-ended yard will then stretch along the main line for a distance of approximately 3 1/2 squares. Additional reasonably straight space will be needed for the switching lead track, even though we probably won't have one long enough to let the switcher "pull" the whole track full of cars in one move, but the straight stretch along the front of the layout should be a satisfactory location—it is a good four squares long.

The main deficiency which suggests that we can do better is in the length of main line. According to a rough by-the-squares count, using the rules-of-thumb of Fig. 8-3, it is about 36 squares (108 feet, or a little less than 2 scale miles) around the dogbone, which isn't bad. However, since the two sides of the shank of the dogbone are parallel to each other, you get the impression that the trains are actually running back and forth over a line less than half that long.

Fig. 10-1 St. Clair South Western RR.

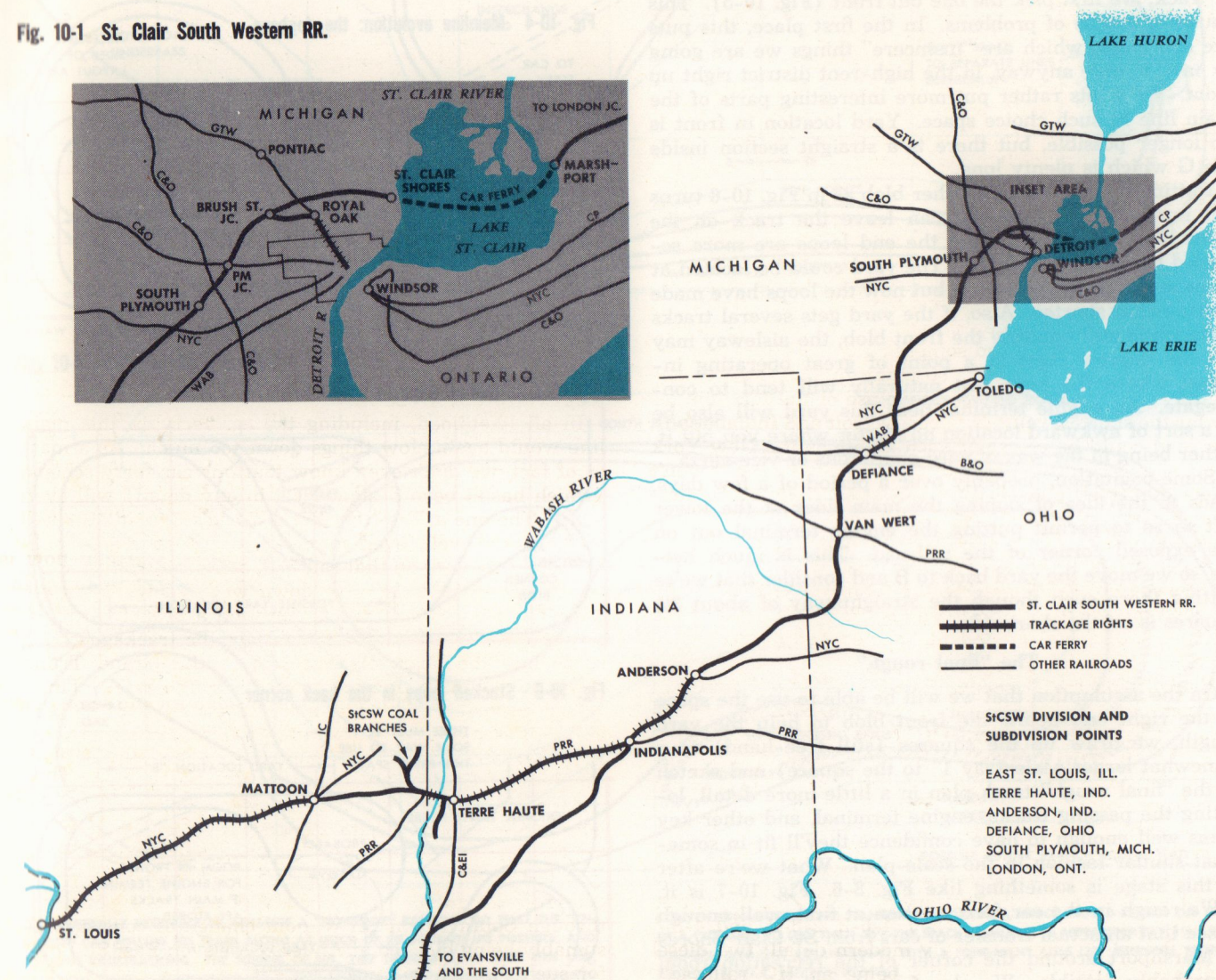
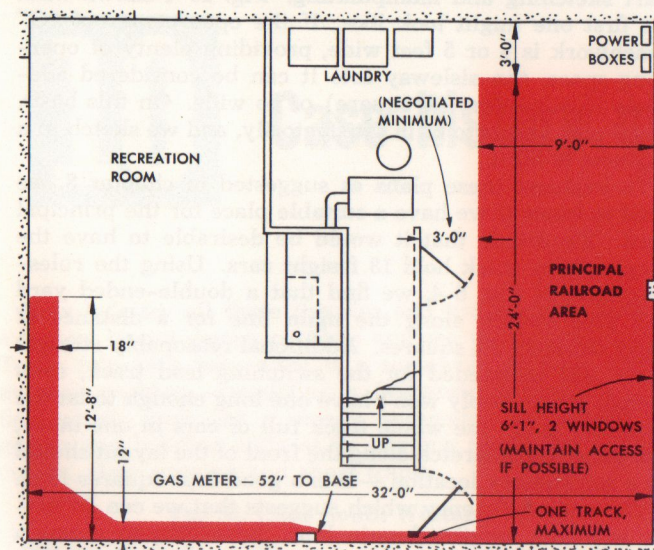


Fig. 10-2 Available-space diagram for St. Clair South Western



Stacking the loops

To get a longer apparent run for our fast freights, we next try a loop-to-loop scheme, with one of the end loops stacked atop the other. The loops can be located in either of the two blobs on the G where we have room for a circle of track; we first pick the one out front (Fig. 10-5). This causes a couple of problems. In the first place, this puts the end loops, which are "insincere" things we are going to have to hide anyway, in the high-rent district right up front. We'd lots rather put more interesting parts of the main line in such choice space. Yard location in front is no longer possible, but there is a straight section inside the G which is plenty long.

Putting the stack on the other blob as in Fig. 10-6 turns out much better, since we can leave the track on the front blob visible and since the end loops are more secluded back in their corner. The yard could be located at A, as in the previous sketch, but now the loops have made it somewhat shorter. Also, if the yard gets several tracks wide while still opposite the front blob, the aisleway may get too narrow right at a point of great operating interest where the boys just naturally will tend to congregate. An engine terminal near this yard will also be in a sort of awkward location no matter where you put it, either being in the way of yard operations or vice versa.

Some cogitation, probably over a period of a few days, leads to the idea of sloping the main lines at the lower left so as to permit putting the engine terminal out on the exposed corner of the railroad. This is much better, so we move the yard back to B and consider that we're getting there even though the straightaway of about $3\frac{1}{2}$ squares is on the short side.

The "final rough"

On the assumption that we will be able to use the space to the right and below the front blob to help the yard length, we draw up the squares (still free-hand) to a somewhat larger scale (say 1" to the square) and sketch in the "final rough" track plan in a little more detail, locating the passing tracks, engine terminal, and other key items well enough to have confidence they'll fit in somewhat similar fashion in the scale plan. What we're after at this stage is something like Fig. 8-6. Fig. 10-7 is it.

We rough in the car ferry section at first, well enough to see that an actual transfer of cars from St. Clair Shores to Marshport around the corner of the recreation room is probably feasible. We also find that there can be a

Fig. 10-3 By-the-squares diagram for the StCSW

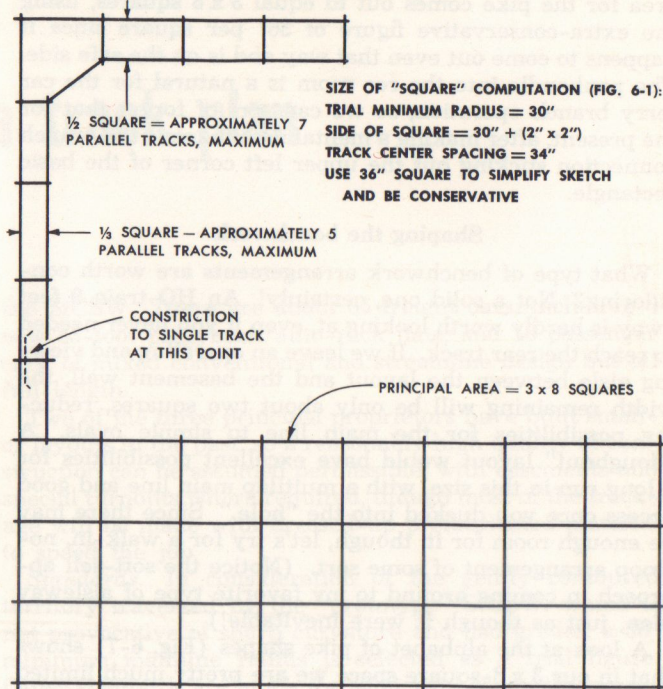


Fig. 10-4 Mainline evolution: the dogbone

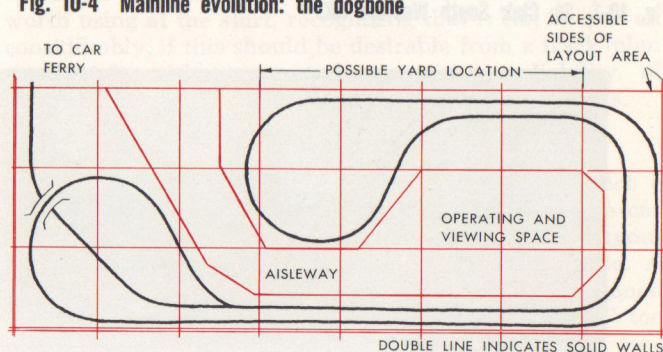


Fig. 10-5 Stacked loops in front

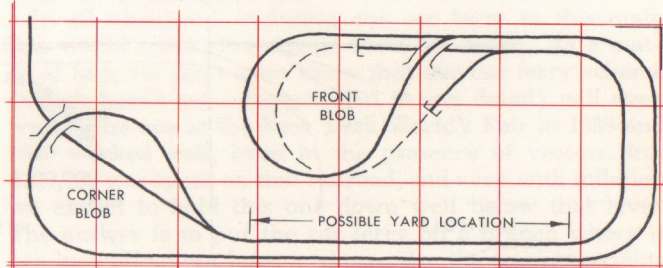


Fig. 10-6 Stacked loops in the back corner

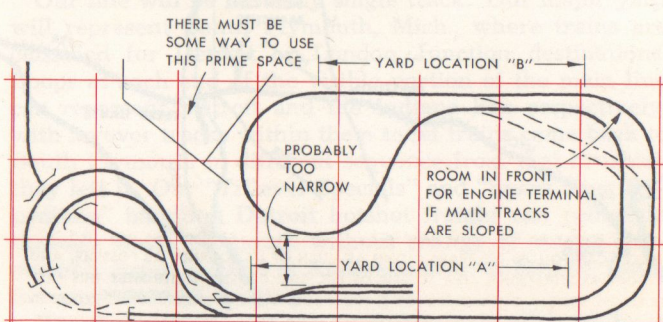


Fig. 10-7 Final rough sketch

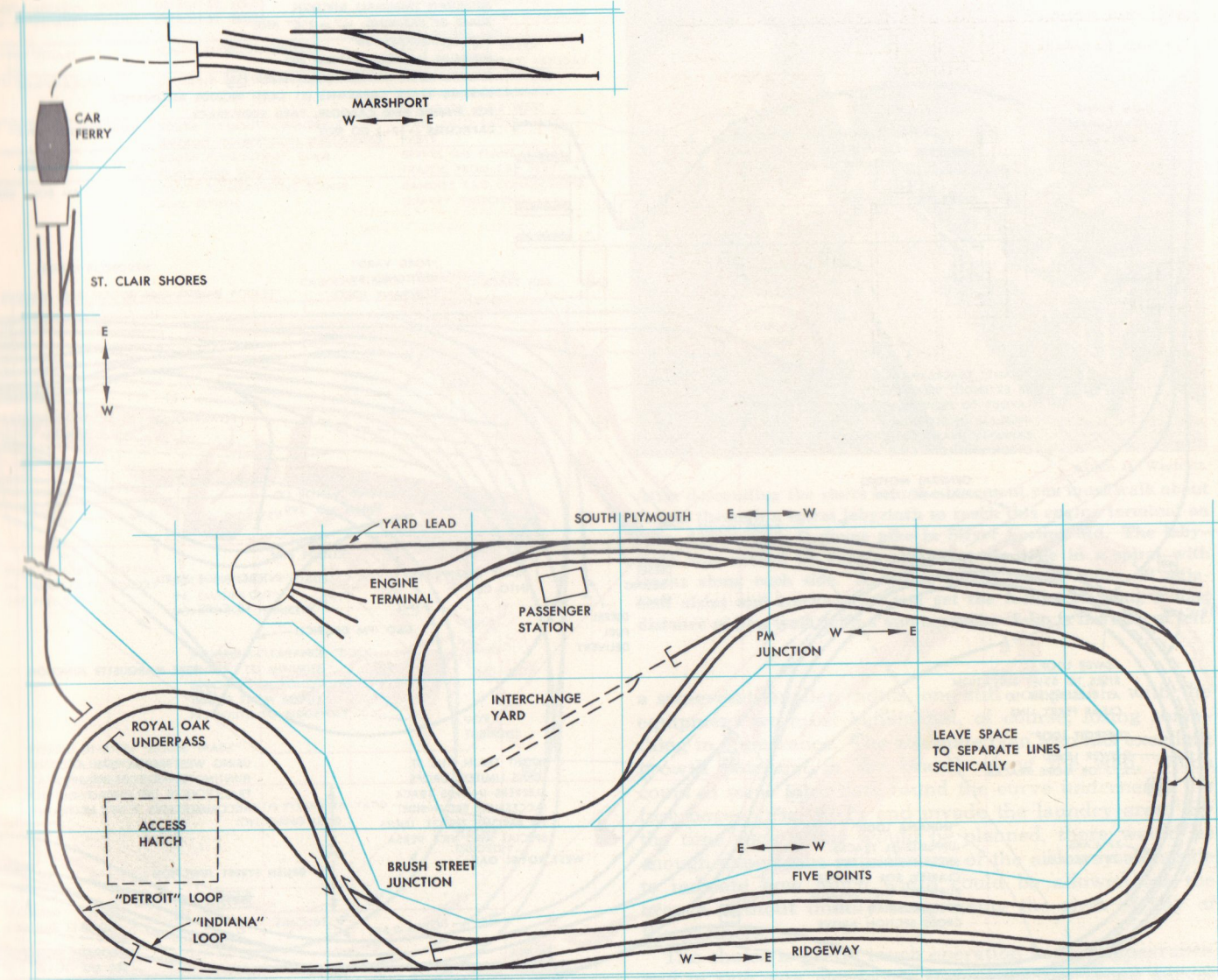
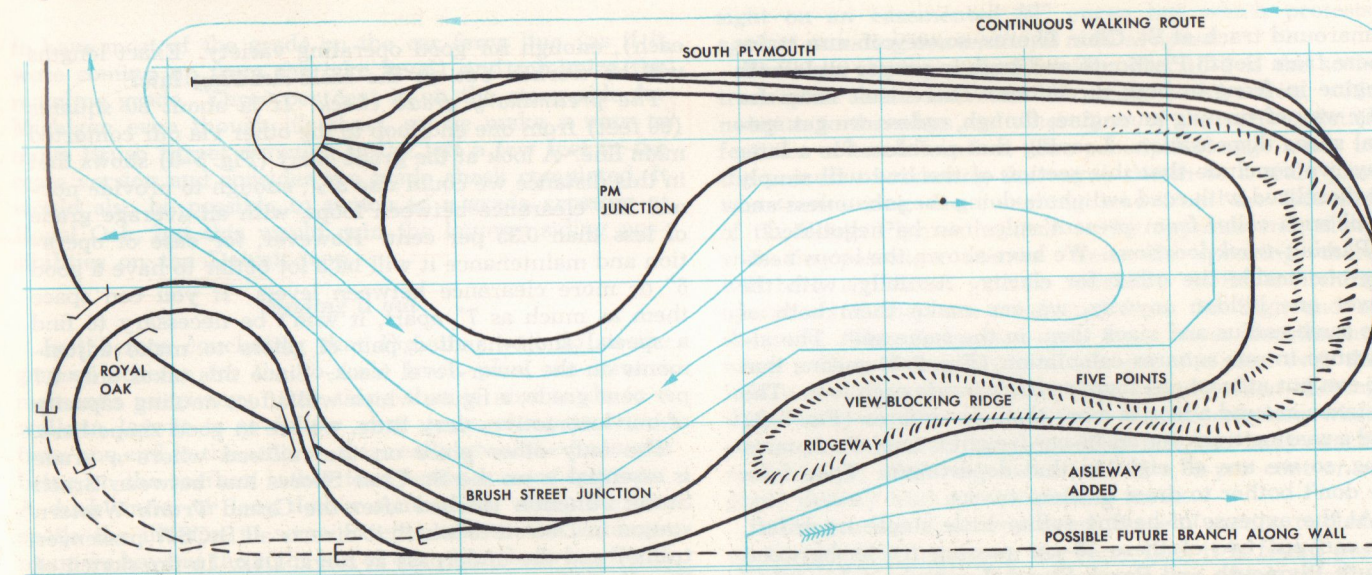


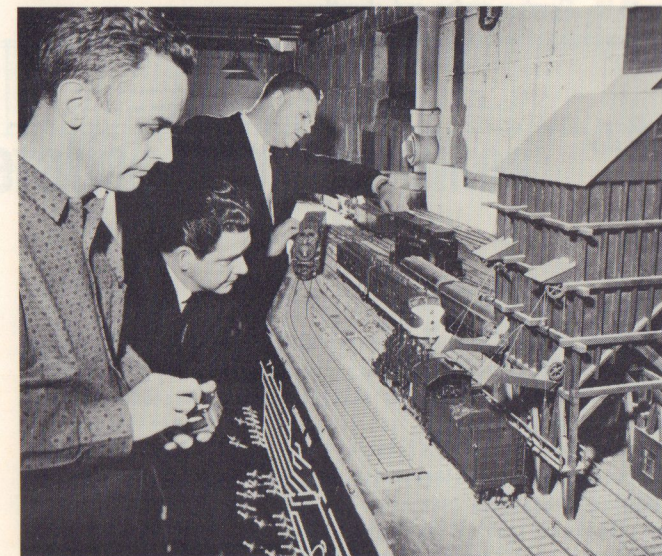
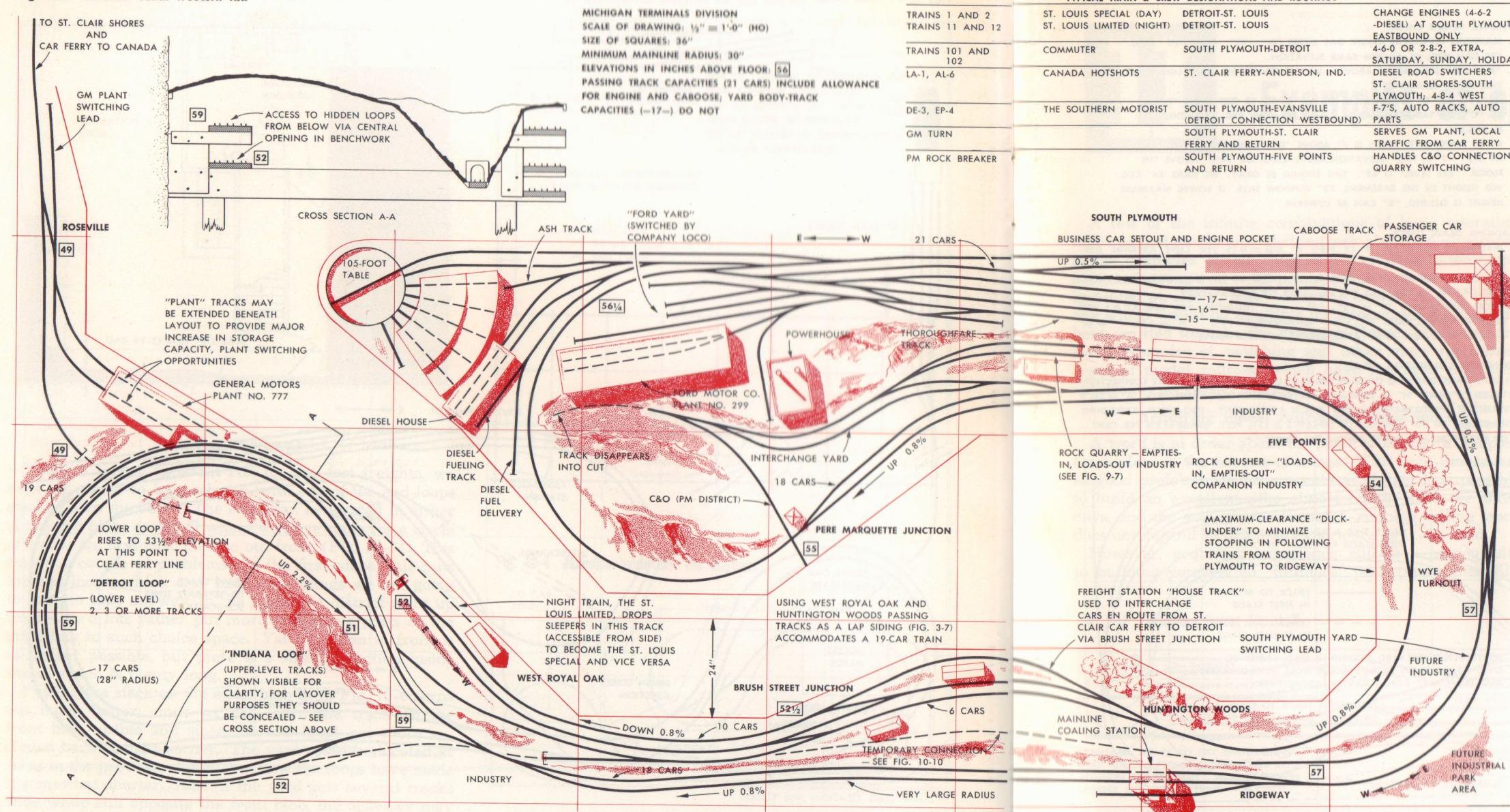
Fig. 10-8 An alternate approach



IT IS GENERALLY DESIRABLE TO ARRANGE A "NO-STOOP" RAILROAD SO THAT THE "ENGINEER" CAN FOLLOW HIS TRAIN ALONG AS MUCH OF ITS JOURNEY AS POSSIBLE, AND WITHOUT BACKTRACKING. THE SCHEME OF FIG. 10-7 DOESN'T QUITE MEET THIS LAST CRITERION, SINCE A DUCK-UNDER (OR A TRIP AROUND THE "PENINSULA") IS REQUIRED IN FOLLOWING THE MAIN LINE FROM SOUTH PLYMOUTH TO RIDGEMAN. BY GOING TO

CONVENTIONAL CURVATURE STANDARDS (24" RADIUS), WHICH WOULD REDUCE THE SIZE OF A "SQUARE" TO LESS THAN 30", THE SPACE AVAILABLE IS APPROXIMATELY $3\frac{1}{2} \times 9\frac{1}{2}$ SQUARES, AND THIS ARRANGEMENT, WITH A "ONE-MAN" AISLE (20" MINIMUM WIDTH) ALONG THE WALL, BECOMES POSSIBLE.

Fig. 10-9 St. Clair South Western RR.



Linn H. Westcott.

After descending the stairs into the basement you must walk about 60 feet through a spiral labyrinth to reach this engine terminal on John Armstrong's O gauge pike in Silver Spring, Md. The labyrinth was caused by John's arranging the aisle in a spiral with tracks along each side. A ceiling-height barrier hides all adjacent aisles and trackage, so you get the feeling of going a long distance as you walk with a moving train. John is the man at left.

a somewhat smaller radius, one still compatible with the equipment we must handle but, of course, losing something in appearance. The alternate plan also has excellent growth potential in the branch along the wall, which could at some later date round the curve underneath the fuse boxes (Fig. 10-2) and invade the laundry area. By the time such a line would be planned, there would be enough experience with the use of the aisleway alongside to indicate how much width could be allowed for the branch without unduly compressing the girth of any of the partners.

The choice is pretty much operation versus appearance, and in this case we decide to go with the broad curves of Fig. 10-7, perhaps primarily because one of the proprietors shows up at this point with an 80"-wheeled 4-8-4 with caterpillar (4-10-0) tender which is a beautiful sight on an easemented 30" curve but which protests against rounding conventional radii at speed.

Revisions during scale planning. Fig. 10-9 is the scale track plan as of the start of actual construction, with notes as to the whys and wherefores of the various detail features of track location. The principal change made in the process of reducing the vague sketch to a scale plan was transferring the switching lead from the left end of the South Plymouth yards to the opposite end, along with the passenger station. Generally speaking, there will be a significant gain in reliability of flat switching operations if they are conducted from the high end of the yard. This is because you have fewer derailments when pulling a long string of cars out of a yard over the ladder track's many turnouts than you do when shoving them back in. The reduced load on the couplers when you push the cut of cars downhill into the body tracks really helps, while the extra load of a 1/2 per cent or so grade doesn't hurt on the pulling move.

In the process of moving Brush Street Junction to clean up the grade situation on the ferry line, it is found possible to work in a lap-siding arrangement which in effect gives us a seventh meeting point. A fake crossing with the C&O at PM Junction introduces some pleasant clickety-clack into every trip, and various other goodies are introduced here and there as space permits. Some are

runaround track at St. Clair Shores, so we can run trains there from South Plymouth and back in proper style with engine in front in both directions. There isn't room for any way of turning an engine, though, unless we get special space dispensation. Leaving that problem for a later day, we conclude that this section of the line will simply be dieselized with road switchers doing the job, unless and until such relief from present rules can be negotiated.

Passing-track locations. We have shown the loops nesting one inside the other for clarity. Actually, with the lower one hidden anyway, we can make them both of the same radius and stack them in the same spot. The allowance in our squares calculation (Fig. 6-2) means that we can put at least one layover track inside each loop. The distance around a loop is more than six squares (Fig. 8-3) and a passing track for an 18-car freight is only 4 1/4 squares long, so we are all right in that department. Therefore, we don't bother to draw these tracks.

At the expense of having rather little single track left, we can put two of these 18-car passing tracks between South Plymouth and Brush Street Junction, and another one on the line heading from our main yard to the loop representing Indiana and points west. This makes a total of six passing points on the line (counting the end loop layover sidings and the yard at South Plymouth as one

each), enough for good operating variety. Exact lengths will be worked out on the scale drawing later.

The preliminary grade check. It is about 30 squares (90 feet) from one end loop to the other via our contorted main line. A look at the grade chart (Fig. 5-9) shows that in this distance we could rise 3 1/2", enough to provide normal HO clearance between loops, with an average grade of less than 0.35 per cent. However, for ease of operation and maintenance it will be a lot better to have a good 6" or more clearance between levels. If you can space them as much as 7" apart, it won't be necessary to find a special short-handled pair of pliers to make adjustments on the lower-level track. Since this takes only 0.7 per cent grade, a figure which will affect hauling capacity of our locomotives very little, we are in good shape here.

The only other place on the railroad where a grade is essential is on the St. Clair Shores line between Brush Street Junction (named after the Grand Trunk Western station in Detroit to which it diverts all StCSW passenger trains) and the underpass at Royal Oak. In the sketch of Fig. 10-7 it appears that the distance between these points will be about two squares, or 6 feet. Splitting the grade between the two lines and going to the bare-minimum clearance figure of 3" between railheads, we still come up with a grade of a bit over 2 per cent. We would like

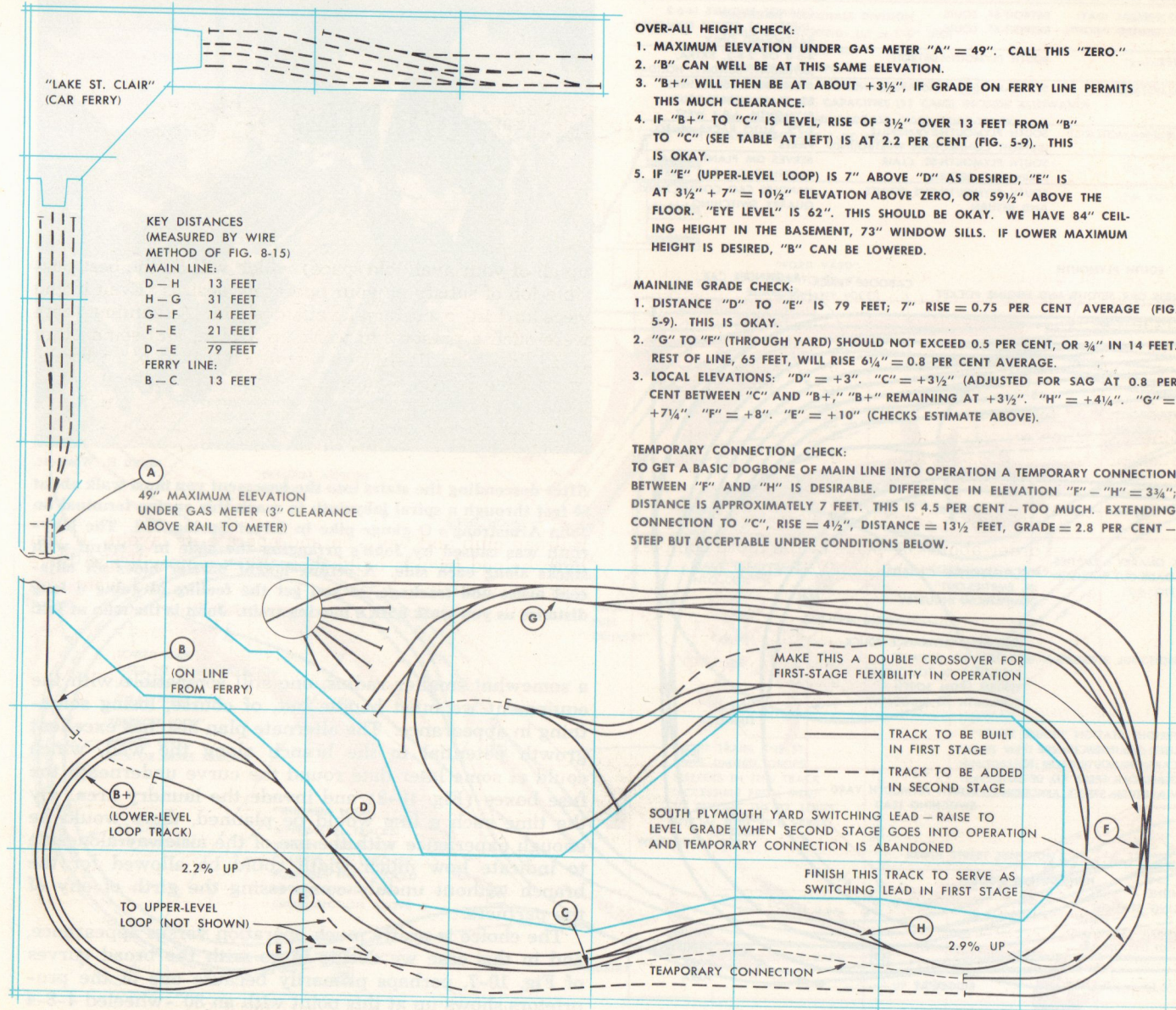
to have most of the grade on the car ferry line (as if it were coming up from the lake level) and minimize the mainline grade. Three per cent is on the steep side for Michigan even though it's short, so we make a note to move Brush Street Junction to the left a few feet in the scale version and consider the grade check completed. It would also be possible to switch to a grade crossing at Royal Oak, but this would ruin the layover siding possibilities on the Detroit loop.

Scaling it out

Just before concluding that Fig. 10-7 will do as the general scheme for the to-scale track plan, we have a moment's misgivings. One thing that is nice to do in a walk-in layout is to follow your train along its route from one end to the other — this really gives the feeling of being on the seatbox rather than being a mere spectator. A duck-under or long detour somewhere along the line spoils the illusion to some extent, and so the arrangement we have at the right end of our plan (between South Plymouth and Ridgeway) is not ideal. If we could have an aisleway between the basement wall and the main layout area alongside Ridgeway, the length of the no-stoop main line would be significantly increased.

As Fig. 10-8 shows, this can be done by going back to

Fig. 10-10 Figuring grades and elevations



drawn to scale now; others are merely put in the "space reserved" category for laying out at the time of actual construction.

Progressive construction possibilities

The last thing checked is the possibility of getting some of the road into operation pending completion of some of the trickier and more time-consuming sections of main line. This is extremely desirable, not only to keep in-

terest at a high pitch but also to check out thoroughly the sections of track which will later be less accessible. The temporary cutoff between West Royal Oak and the South Plymouth yard lead is the key, and some revisions in elevation over the entire line are made to keep this from being too precipitous - a good example of how reasonably thorough planning can make a big difference in the continuing pleasure which a layout can provide. Fig. 10-10 shows what was done in this process.

11

Examples of operation-oriented pikes

A few of the infinite combinations of basic operating features that can be included in track plans are illustrated in the examples of this chapter. To emphasize their operational strong and weak points, scenic aspects are merely hinted at, and in many cases the overlapping of trackage which would be desirable for appearance reasons has been omitted to make the drawings clearer. Included are some examples of switching and other more specialized types of model railroad which have not been discussed specifically in earlier chapters.

Acquiring model railroading experience

A word is in order about the place of the more complex track plans in the scheme of things. With such timesavers as good prefab track components available, it is possible to build an excellent pike almost on the first try these days, and the acquisition of smooth-running rolling stock does not depend so much on experience as it once did.

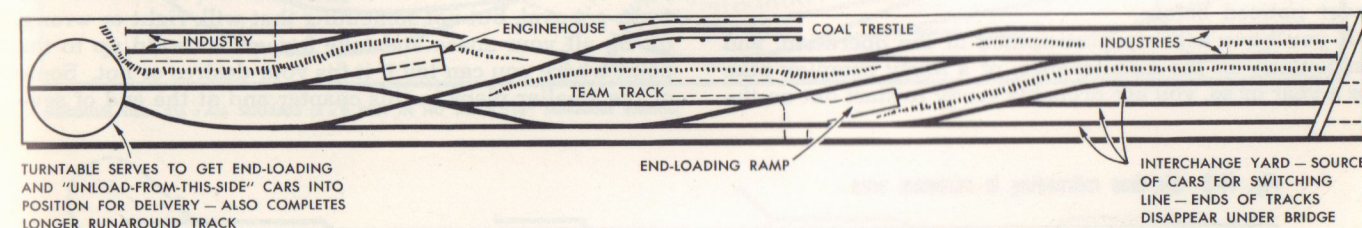
However, acquiring experience still is a prerequisite to building yourself an "ultimate" pike (one which fills

up all of your available space) which will do the best possible job of satisfying your operating desires. Even if you were to hire a custom layout designer (assuming there were such a person) to work up a plan, and some other craftsmen to build it, you would still need some model railroading background just to know what it is that you want. Without some idea of what can and can't be done, and of what does and doesn't appeal to you yourself, you would be in the same position as a cave dweller trying to specify to an architect his desires in modern housing.

So how do you get experience?

One of the best ways is to belong to an established model railroad club and work on and operate its layout. If you have helped friends build their pikes, you will also have a pretty good idea of what it is you like and want and what other things you can do without. In fact, if you are normally outspoken you may occasionally express your ideas along this line out loud, and end up being told to go somewhere and build your own railroad (with heat-resistant ties, too).

Fig. 11-1 Switching layout for shelf



WHERE THERE ISN'T EVEN "ROOM TO TURN AROUND IN" AT MINIMUM RADIUS, A GREAT DEAL OF OPERATION IS STILL POSSIBLE ON A STRAIGHT-SHELF SWITCHING PIKE. THE SAME PRINCIPLES APPLY FOR INCREASING OPERATING INTEREST AS IN MAINLINE TRACK PLAN-

NING. NOTE HOW SWITCHBACK DESIGN REQUIRES ENGINE TO MAKE RUNAROUND MOVEMENT AND TRAVEL ALMOST THREE TIMES THE LENGTH OF THE SHELF IN MOVING THE CAR FROM INTERCHANGE TRACK TO INDUSTRY AT LEFT END, TOP OF LAYOUT.

THE MATTER OF VERSATILITY IN OPERATION

Some of us build primarily so that we can realistically engage in "hard" operation - getting a lot of traffic through more or less on time despite the complexities of single-track operation over tough grades, for example, or duplicating the endless shuffling required to gather cars into trains and then break the trains back down into individual units for distribution and turnaround. Even those of us who are more interested in watching the mainline trains roll off the miles with little opposition, or in building scenery as a prime target, will also want the opportunity for more demanding railroading on occasion, and we should have the trackage and the potential bottlenecks to permit this.

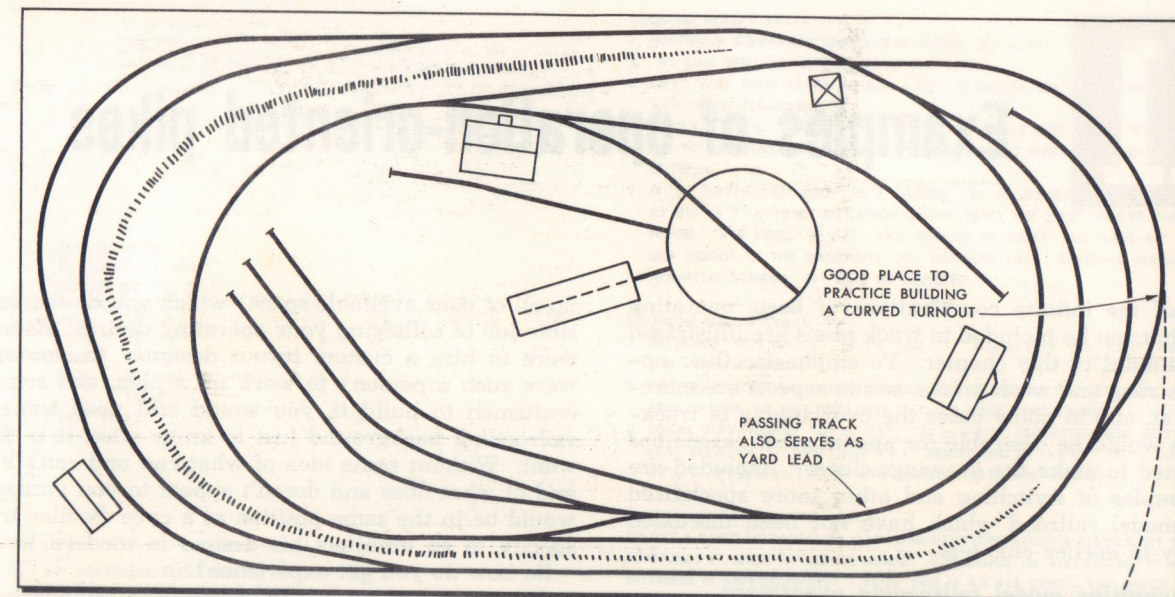
What should not be lost sight of, though, is that there will be many times when you won't have the time nor the inclination nor the manpower to have an extended session of by-the-book, no-hands railroading. If your track plan is designed so that relaxed, spur-of-the-moment, one-man operation is possible, you will get in a lot more railroading

and derive a lot more total satisfaction. When you feel like it and have just a few minutes available, it's wonderful fun to be able to step downstairs and simply run a train or two. Then, too, there is the satisfaction involved in being able to show the monster off to guests of all degrees of interest. Most visitors won't appreciate the finesse involved in pulling off a nonstop triple meet at a lap siding, but they can enjoy seeing a train go through its paces smoothly and reliably.

Therefore, most track plans should provide for continuous running when you want it. Where "hard" operation is to be the norm for real railroading sessions, these continuous-running bypasses should have provisions for being blocked off in one way or another, but as a rule they should exist if the pike is to be as satisfying as it can be.

If at all possible, things should also be set up so that you can leave the trains on the track between times - even if it takes a gimmick such as a tunnel with padlocked end doors.

Fig. 11-2 Twice around with single track



MINIMUM SIZE: 2 x 4 SQUARES (4 x 8 FEET IN HO SCALE, 18" MINIMUM RADIUS)

THIS IS A SUITABLE PIKE FOR GETTING YOUR FEET WET IN SINGLE-TRACK OPERATION TO SEE IF SIX-CAR TRAINS MEETING EACH OTHER INTEREST YOU MORE THAN LONGER ONES IN MORE CONTINUOUS MOVEMENT ON DOUBLE TRACK, AS IN THE TRACK PLAN OF FIG. 11-3. THIS RAILROAD CAN BE BUILT

ON A SINGLE LEVEL AS A STARTER, WITH THE OPERATION OF RAISING THE OUTER LOOP (AS INDICATED) SERVING AS A LATER INTRODUCTION TO CARPENTRY.

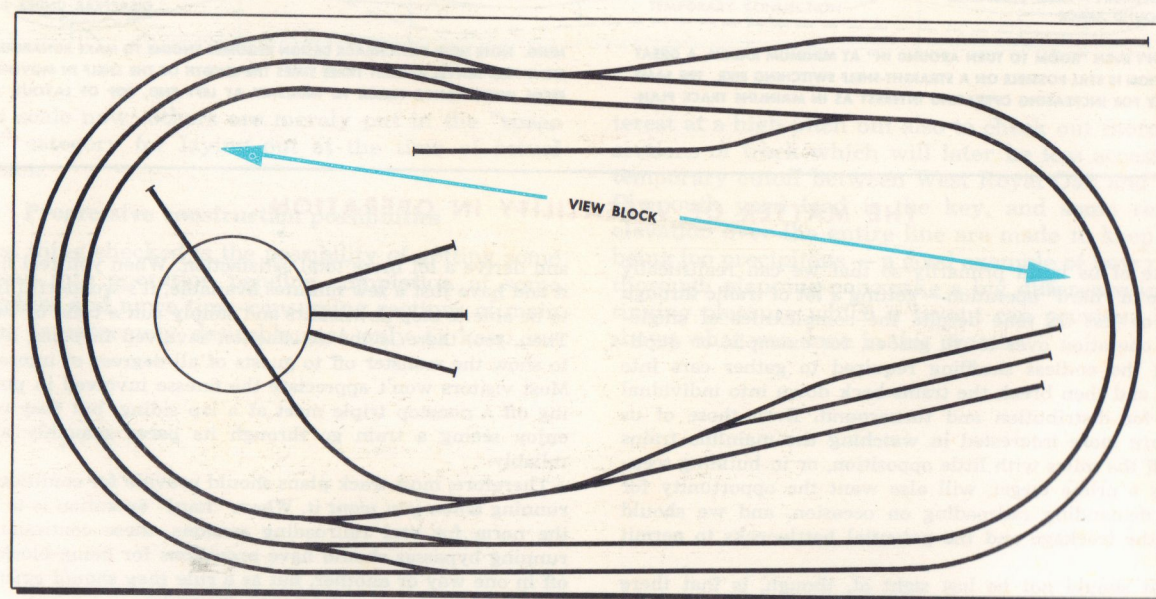
If you are interested in scenic effects, you will want to look for scenery ideas in magazine articles and photos and the book *Scenery for Model Railroads* by Bill McClanahan. Just as important, get the habit of looking at the real railroads and at photos of them to find the things you never noticed before.

If you have actively participated in the operation, and particularly in the maintenance, of a fairly complex pike for a year or so, you are probably ready to start out on the

design and then the actual construction of your own "dream" railroad.

If you haven't had such opportunities, it is best to start off with a first railroad that's really in the nature of a glorified test track — a step beyond the Christmas-tree train-set oval, but *not* something that will, right or wrong, fill up all your space and take 3 years to build up to the point where you can tell if it fits your desires or not. Some of the smaller plans in this chapter and at the end of sev-

Fig. 11-3 Big-time railroading in minimum area

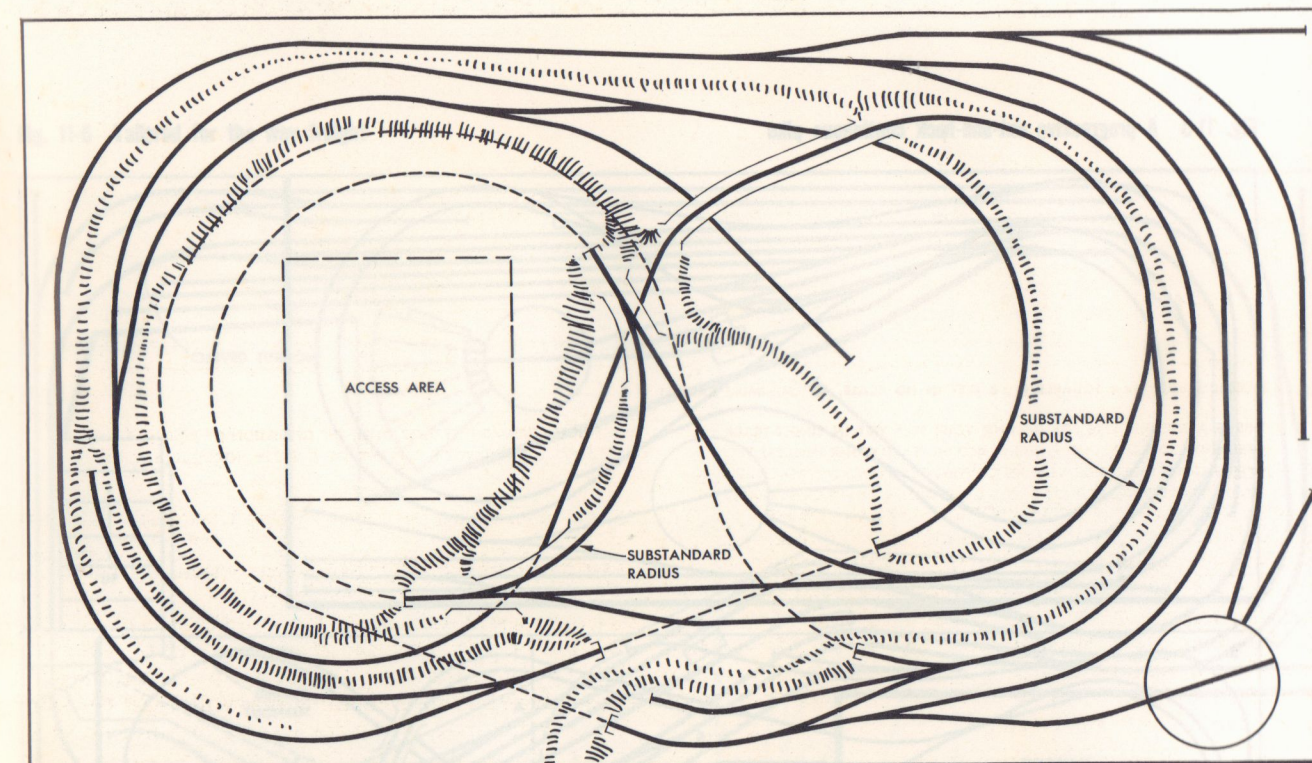


MINIMUM SIZE: 2 x 4 SQUARES (4 x 8 FEET IN HO SCALE, 18" MINIMUM RADIUS)

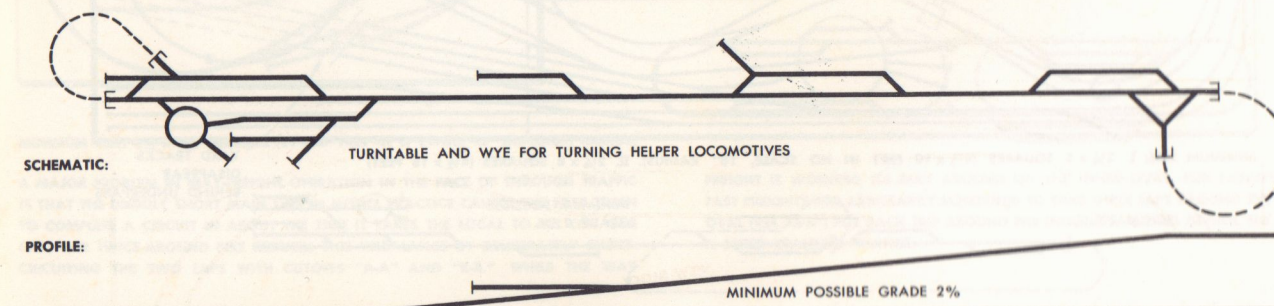
THIS TRACK PLAN IS SUITABLE FOR A "TRIAL HORSE" PIKE IF YOU ARE INTERESTED IN MODERN EQUIPMENT AND LONG TRAINS. THE THIRD TRACK ALSO SERVES AS SWITCHING LEAD FOR THE SMALL YARD, ALLOWING A FAIR VARIETY OF OPERATIONS WITH UP TO THREE LOCOMOTIVES MOVING AT

ONCE. THE UNSUBTLE BASIC OVAL CAN BE CAMOUFLAGED SOMEWHAT BY BLOCKING THE VIEW ACROSS THE LAYOUT WITH A HIGH RIDGE AND RUNNING THE MAIN LINE THROUGH A DEEP CUT OR TUNNEL AT THE RIGHT END.

Fig. 11-4 Minimum-size loop-to-loop



MINIMUM SIZE: 2½ x 4½ SQUARES (5 x 9 FEET IN HO SCALE, 18" MINIMUM RADIUS)



THIS PLAN, AS SHOWN, GOES ALL OUT FOR LOTS OF OPERATION IN THE MINIMUM OF SPACE, WITH VERY STEEP SLOPES NECESSARY BETWEEN THE CLOSELY PACKED SPIRALS OF MAIN LINE. IF BUILT IN A SOMEWHAT LARGER AREA, LAYOVER TRACKS

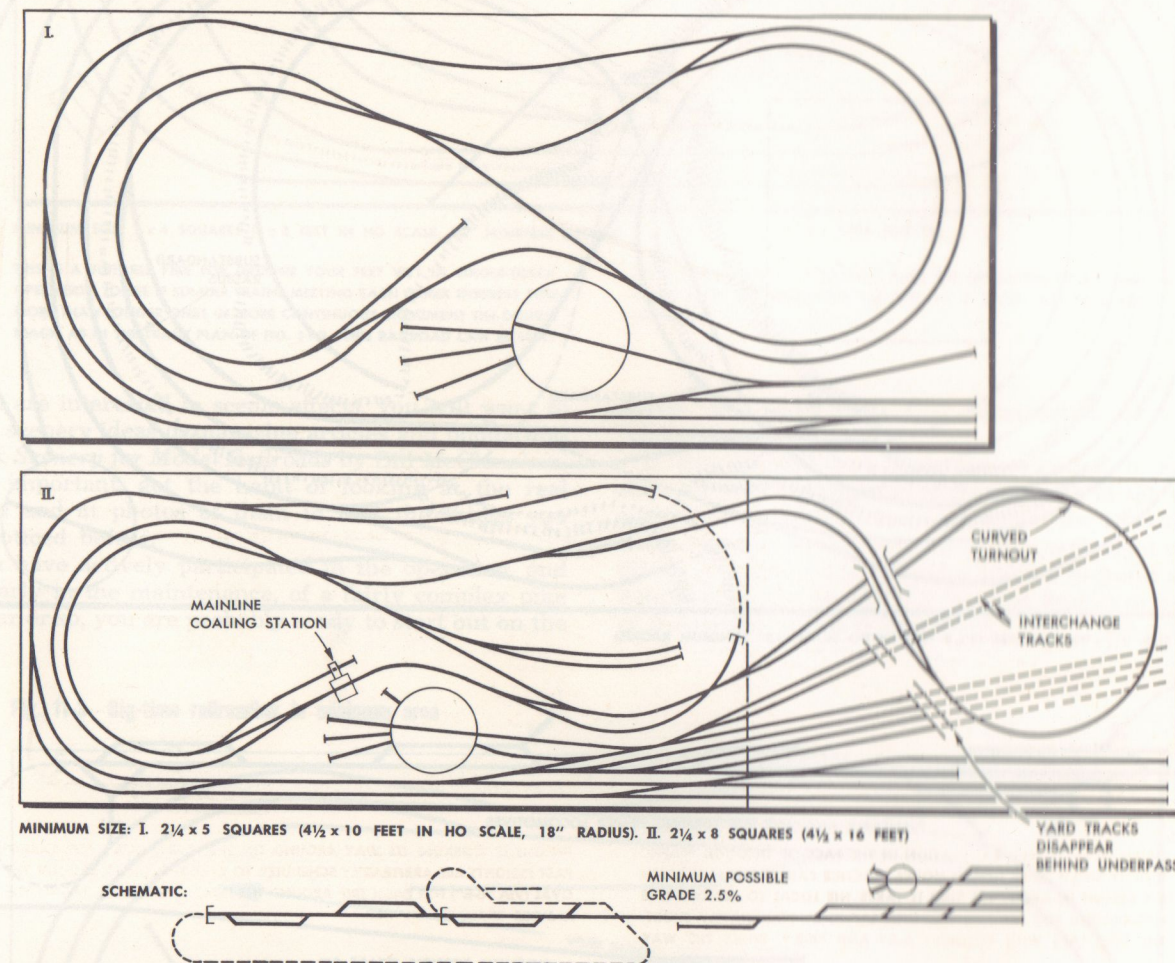
SHOULD BE ADDED INSIDE THE LOOPS. THE ONE THEME THAT KEEPS THE INTERTWINED OVALS OF TRACK FROM UTTER CONFUSION IS THE STEADY GRADE FROM END TO END OF THE MAIN LINE, REPRESENTING A HELPER DISTRICT.

eral other chapters are suitable for this purpose. You will get not only experience but also fun in building and running these railroads, and if you experiment a bit with varied construction methods, track radii, and operating

schemes, you will quickly become wise in the ways of this most fascinating of hobbies without wasting any significant amount of material.

Good luck!

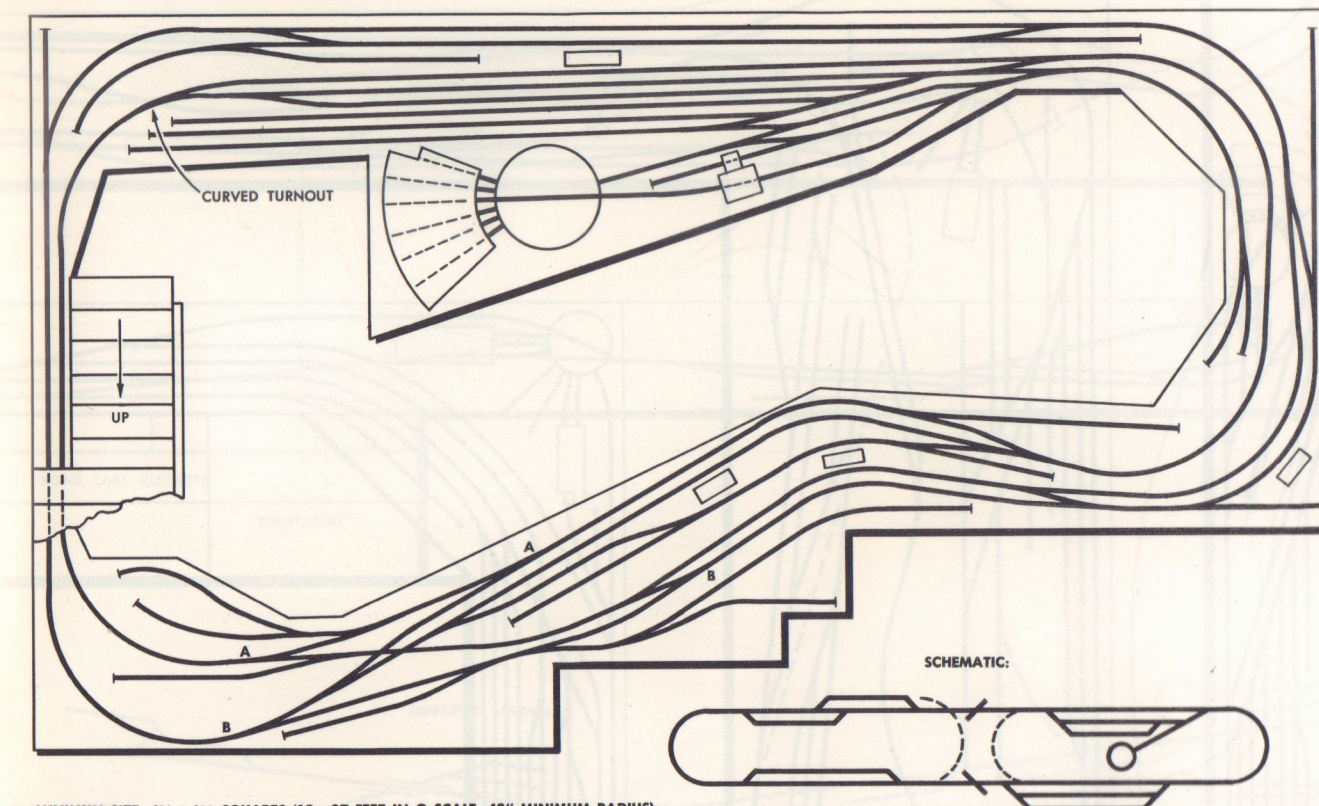
Fig. 11-5 A progressive out-and-back continuous pike



THIS PIKE STARTS LIFE AS A FLAT OVAL WITH SINGLE REVERSING CUTOFF AND BRANCH TERMINAL, PERMITTING AN INTERESTING OUT-AND-BACK OPERATION WITH AS MANY MAINLINE LAPS AS DESIRED. LATER ADDITION OF A HILLY SECTION AT ONE END PROVIDES A THREE-PASSING-TRACK MAIN LINE WITH A CONNECTING JUNCTION RIGGED SO THAT A TRAIN EMERGING

FROM THE BRANCH TERMINAL MUST MAKE MORE THAN A COMPLETE CIRCUIT BEFORE RETURNING TO THE YARD. EXCEPTIONALLY LARGE STORAGE CAPACITY IS PROVIDED TO FIGHT OBSOLESCENCE AS THE ROLLING STOCK ROSTER GROWS.

Fig. 11-6 Tailored for the way freight



A MAJOR PROBLEM IN WAY-FREIGHT OPERATION IN THE FACE OF THROUGH TRAFFIC IS THAT THE UNDULY SHORT MAIN LINE IN MODEL PRACTICE CAUSES THE FAST TRAIN TO COMPLETE A CIRCUIT IN ABOUT THE TIME IT TAKES THE LOCAL TO SET OUT ONE CAR. THIS TWICE-AROUND PIKE REDUCES THIS UNBALANCE BY DELIBERATELY SHORT-CIRCUITING THE TWO LAPS WITH CUTOFFS "A-A" AND "B-B." WHILE THE WAY

FREIGHT IS WORKING ITS WAY AROUND ON THE INNER OVAL, FOR EXAMPLE, THE FAST FREIGHTS ARE ARBITRARILY SCHEDULED TO TAKE THREE LAPS AROUND THE OUTER OVAL (VIA "B-B") FOR EACH TRIP AROUND THE INNER OVAL, THUS GIVING THE LOCAL A MORE REALISTIC CHANCE.

Figure 11-7 on following page

Fig. 11-8 A true point-to-point

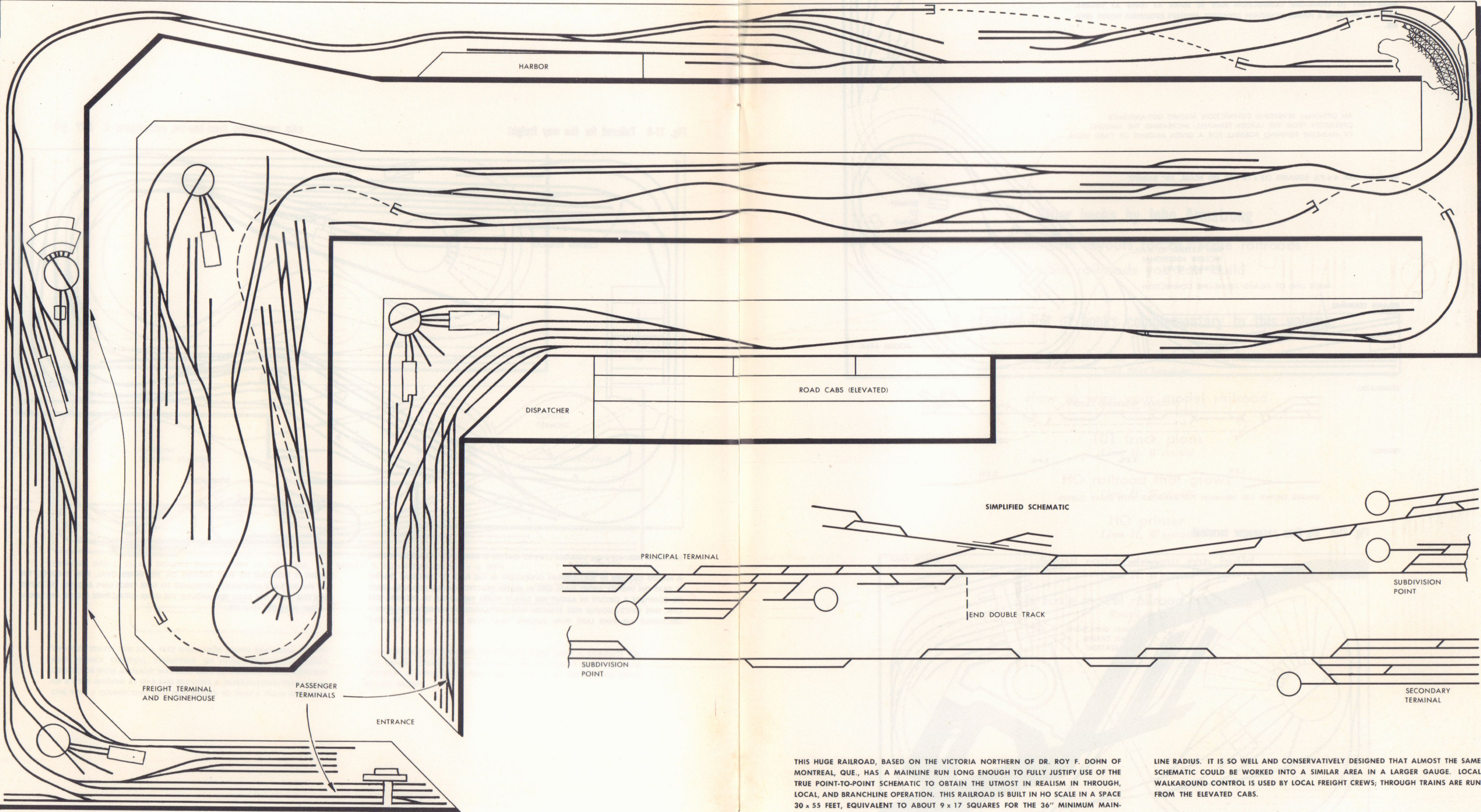


Fig. 11-7 Center-layover point-to-point

THIS RATHER COMPLICATED TRACK PLAN FITS INTO A CORNER IN ORDER TO TAKE ADVANTAGE OF SPACE NOT TOO USEFUL FOR OTHER PURPOSES WHICH MAY THEREFORE BE AVAILABLE FOR RAILROADING. ITS BASIC POINT-TO-POINT MAIN LINE INCLUDES A CONTINUOUS RUNNING CAPABILITY BETWEEN THE TWO TERMINALS SO THAT THE JOURNEY FROM PORT TO TRUNK-LINE CONNECTION MAY BE MADE AS LONG AS DESIRED. EACH LAP INCLUDES A TOUGH MOUNTAIN CROSSING, PERHAPS REQUIRING HELPER SERVICE.

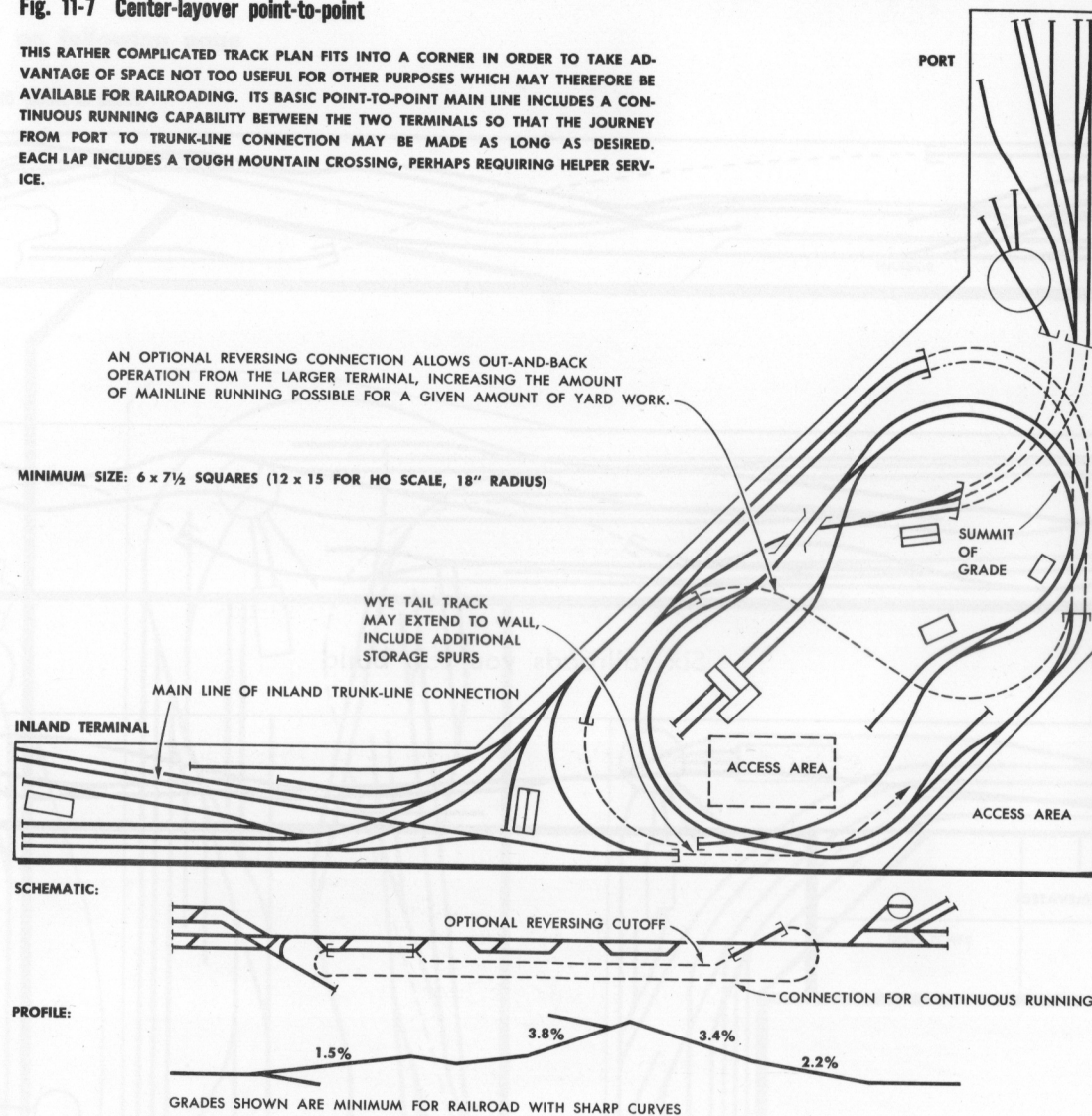
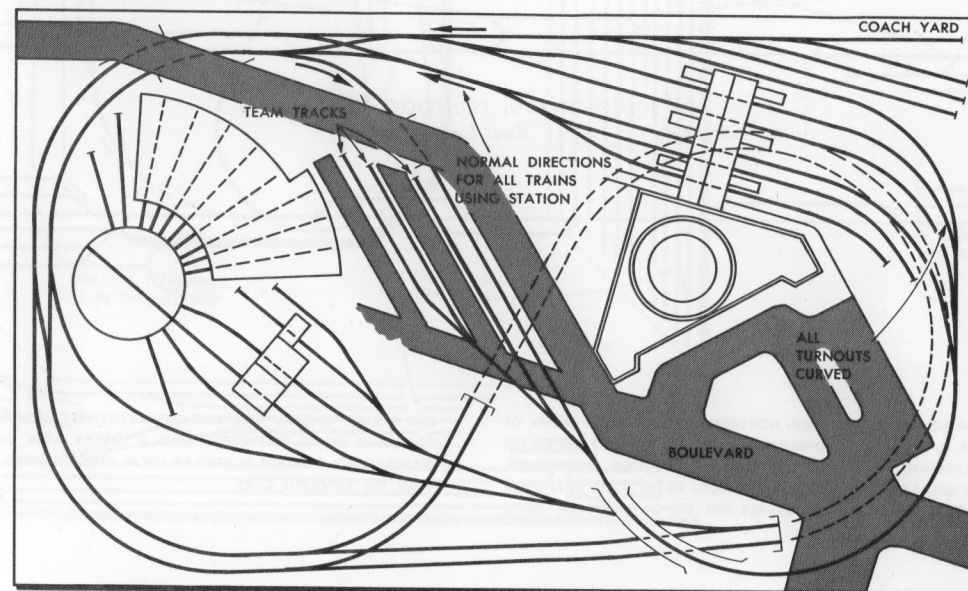


Fig. 11-9 Big-time passenger terminal



MINIMUM SIZE: $2\frac{1}{2} \times 4\frac{1}{4}$ SQUARES (6 x 10 FEET IN HO SCALE, 24" MINIMUM RADIUS)

THIS LAYOUT IS STRICTLY FOR THE MAN WHO LOVES PASSENGER EQUIPMENT AND ROUNDHOUSES AND IS WILLING TO GO ALL OUT TO GET WHAT HE WANTS IN A LIMITED AREA. AT THE COST OF MANY CURVED TURNOUTS AND VIRTUAL ELIMI-

NATION OF FREIGHT SERVICE, THIS TRACK PLAN DUPLICATES FAIRLY WELL THE OPERATING SCHEME OF BROAD STREET STATION, RICHMOND, VA. (SEE FIG. 1-14). IF MORE SPACE IS AVAILABLE, LAYOVER TRACKS ON LOWER LOOP HAVE FIRST PRIORITY.

Other books by John Armstrong

Custom-Line layouts for HO scale railroads
Six railroads you can build

A selected list of books complementary to this volume:

Scenery for model railroads
Bill McClanahan

How to wire your model railroad
Linn H. Westcott

101 track plans
Linn H. Westcott

HO railroad that grows
Linn H. Westcott

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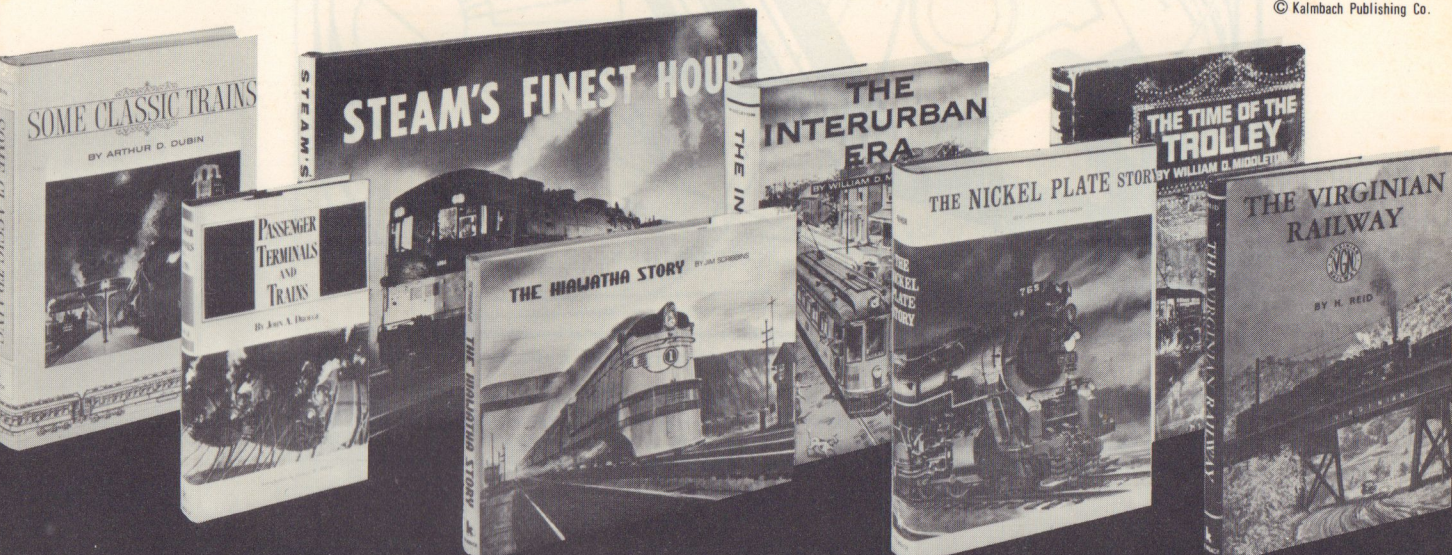
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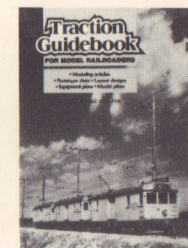
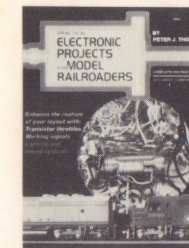
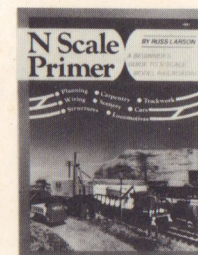


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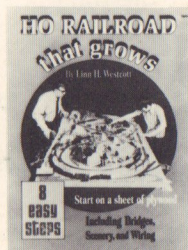
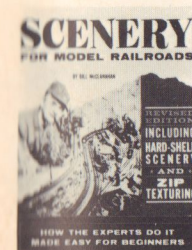
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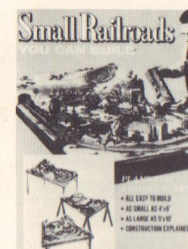
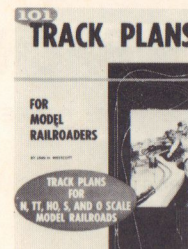
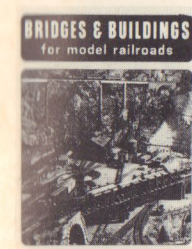
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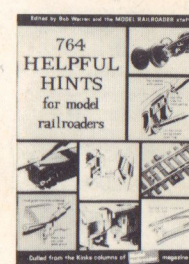
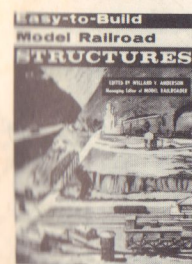
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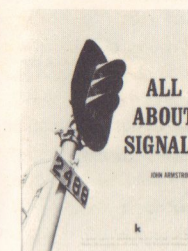
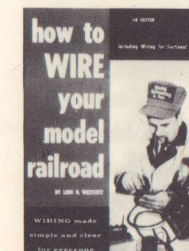


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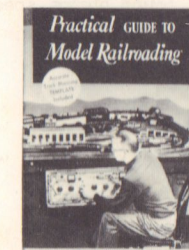


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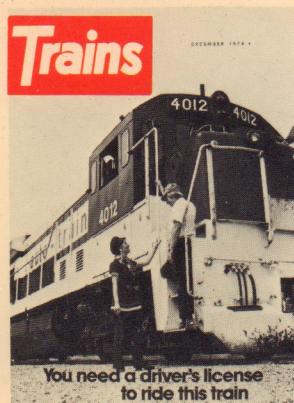


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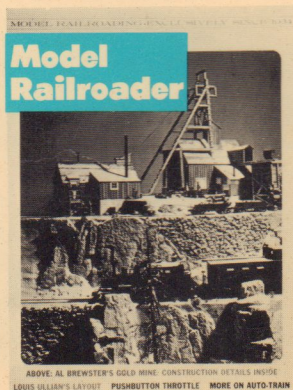
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