THE MÄRKLIN MINIATURE RAILWAY

HO

AND ITS BIG PROTOTYPE

753/2 E

2461

FOREWORD

Our endeavours to bring out a true scale model railway have proved an unqualified success abroad as well as at home, the splendid new types of locomotives and the ever-increasing variety and improvements in rolling stock, together with our scale model track, signals that are so true to their prototypes in both appearance and action, the impressive overhead wire system and the diversity and excellence of all the other accessories all gaining new friends for us every year.

The constructional design of our miniature railways calls for a service comparable with their prototypes in a setting in keeping with the character of a railway generally, and so, as their letters to us show, most of our friends try to give their layouts a scale model setting as far as possible. So far our publications have not been able to keep pace with the ever-increasing demands in this direction and that is why we have decided to publish this Handbook, giving suggestions of our own as well as our friends' experiences. Its purpose is to show the extent to which actual railway working can be simulated by the MÄRKLIN Miniature Railway and the means by which it can be carried out.

We trust that this book may prove to be a welcome adviser to all our numerous friends.

GEBR. MÄRKLIN & CIE. GMBH · GÖPPINGEN/WÜRTT.

Makers of Fine Metal Toys

A 1055 st

Made in Germany

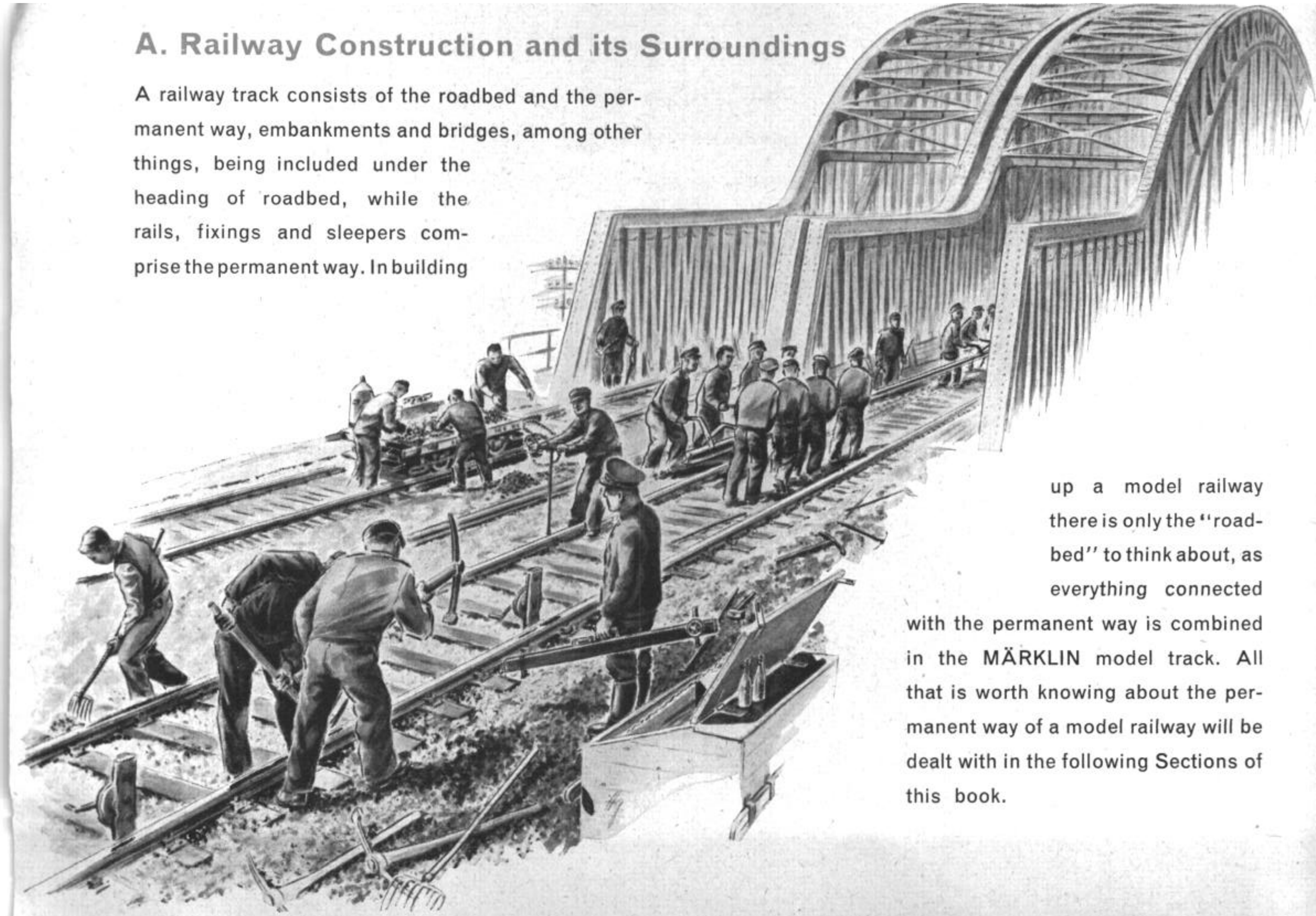
CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Continued)

A. Railway Construction and its Surroundings



A railway track consists of the roadbed and the permanent way, embankments and bridges, among other things, being included under the heading of roadbed, while the rails, fixings and sleepers comprise the permanent way. In building up a model railway there is only the "roadbed" to think about, as everything connected with the permanent way is combined in the MÄRKLIN model track. All that is worth knowing about the permanent way of a model railway will be dealt with in the following Sections of this book.

I. General Information about the Track

1. The Rails

MÄRKLIN rails consist of a head (a), web (b) and foot or base (c) in exactly the same way as the rails on a full-size railway — see fig. 2.

As these rails are also used to transmit the current for working the trains, they must have good joints. Current is fed to the third or centre rail by contact strips and if these should fail to make good contact after lengthy use, they should be bent rather more so as to prevent too heavy a drop in the voltage.

Dust or oil on "live" surfaces carrying current, such as the rail faces and the wheels and current collectors on the engines etc., will interfere with the satisfactory passage of the current and therefore all such surfaces must be well wiped off occasionally with a rag or cloth moistened with paraffin if necessary. If contact is still unsatisfactory, clean the running surfaces with fine emery paper.

On full-size railways cleaning is carried out by climatic conditions or, in exceptional cases, by special rolling stock equipment.

Fig. 2

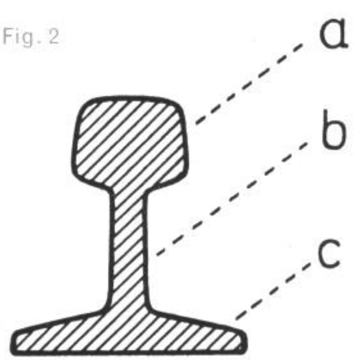


Fig. 2. Section of a Rail

2. The Gauge

The gauge is the distance between the inner cheeks or faces of the two rails – see fig. 4.

A standard gauge o 4ft. 9ins. (1,435 millime res) (in England, 4ft. 8½ins.) has been adopted by practically all countries on the European Continent, so that engines and rolling stock can therefore run freely over the railways of most Continental countries. This 1,435-millimetre gauge is called the standard or normal gauge. The gauges for miniature railways have likewise been standardised internationally and the various sizes of track have been given the following descriptions.

Track	TT	HO	00	S	0	I
Gauge in millimetres	12	16,5	19	22,5	32	45

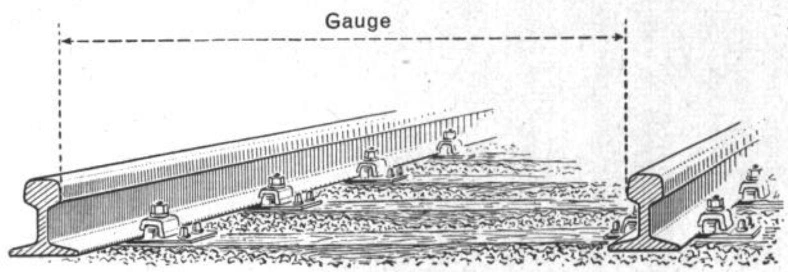


Fig. 4

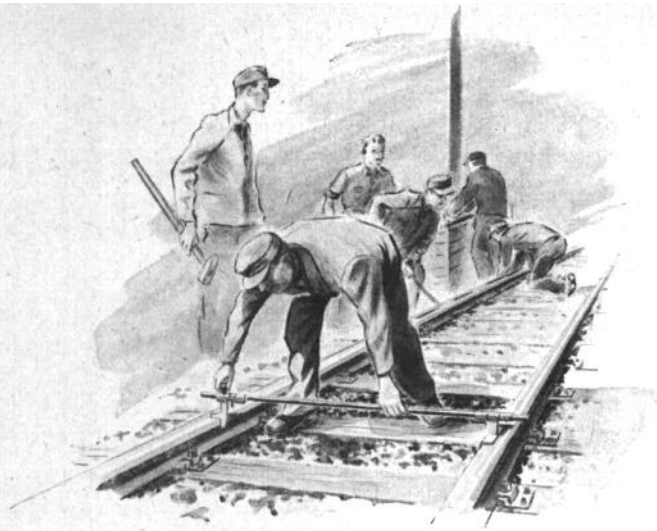


Fig. 3
Measuring the Gauge with a Track Gauge

The MÄRKLIN Miniature Railway uses the HO gauge and is therefore 1,435 ÷ 16,5, or 1/87th the size of the standard gauge. The scale is therefore 1 to 87 and all the major parts of the railway are made to that scale.

3. MÄRKLIN Track Sections

MÄRKLIN enthusiasts have a choice of two types of track sections, viz:

(a) The standard track section (fig. 5).

These sections are numbered 3600 for the small circle and 3700 for the large circle. With their finely-stamped imitation ballast, sleepers and rail fixings they give a faithful reproduction of the permanent way.

Fig. 6 Scale Model Track

(b) The scale model track section (fig. 6).

These sections are numbered 3900 and 3800 in our Catalogue and have sleepers of plastic insulating material that completely isolate all live parts. The large-radius curves of this track enable a highly realistic model railway system to be laid out. The two parallel circles – the outer one built up with the No. 3900 sections and the inner with the No. 3800 sections – are five centimetres apart, measured from centre to centre of each track, this short distance being made possible by the special design of the points and crossings (see fig. 7).

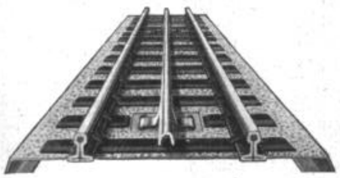


Fig. 5 Standard Track

As in the full-size original, curved track sections have a slightly wider gauge to enable rolling stock to negotiate curves more easily.

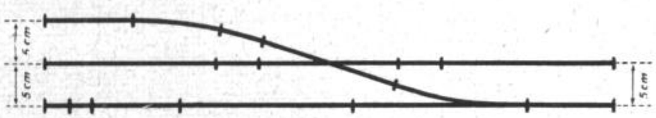


Fig. 7

The principal dimensions of the two track systems are given in the following Table to enable a comparison to be formed.

Track Section No.	3600	3700	3800	3900
Length of straight section in centimetres	18	—	—	22,4
Length of curved section in centimetres	18,6	22,5	20,9	23
Number of sections to circle	12	12	16	16
Diameter of centre rail circle, centimetres	72	87	107	117
Diameter of circle over ballast, centimetres	76	91	111	121

4. Crossing from one Track to another

Points and crossings and, in special cases, turntables and traversers, are used in normal railway practice for crossing from one track to another. The appearance of a miniature railway layout and especially the distance between a double track depends to a great extent on the angle at which the branch track leaves the straight. Where the space between parallel tracks is narrow, direct connection of the reverse curves of the points will be unavoidable (see fig. 8–a)

In regulation railway practice, however, the rule is to lay a short length of straight track between reverse curves, and this should also be followed in a model layout, as far as possible. (See fig. 8–b.)

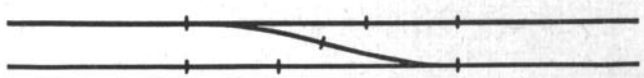


Fig. 8–a

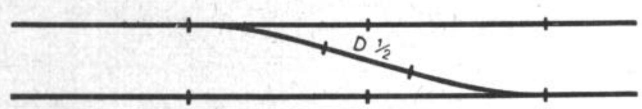
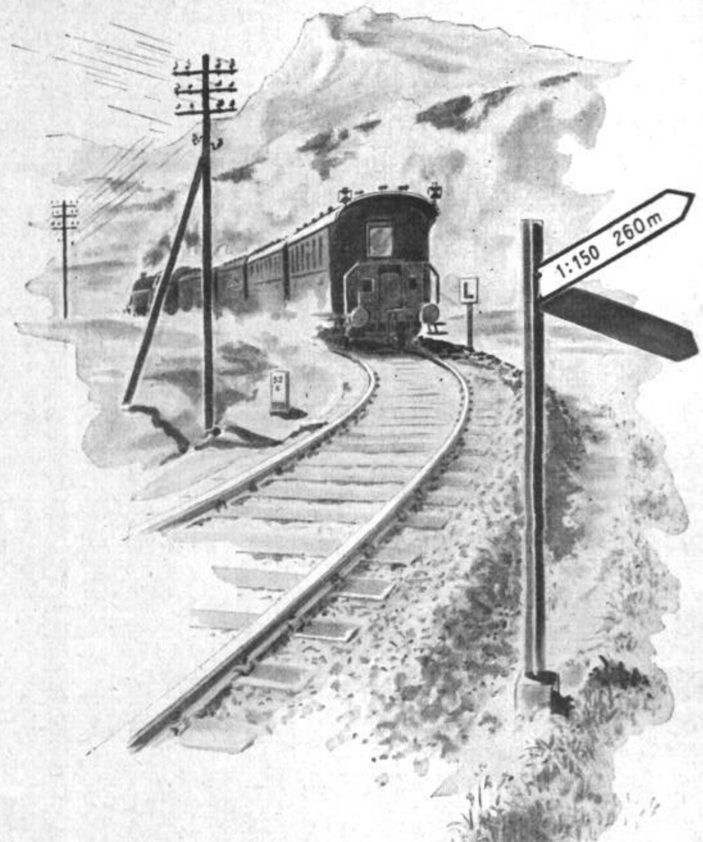


Fig 8–b

In MÄRKLIN model layouts the change from one track to the other can be made by points, double slip points or turntables. If two tracks cross in the same plane, a crossing or double slip points should be provided.

5. Track Gradients

Railway working becomes far more interesting if there are inclines and declines to be negotiated. The extent of the gradient – the terms incline and decline are used according to the direction of travelling – is given either as a ratio or percentage and notified to the driver by gradient boards placed at points where the gradient varies by more than 0.3%. These boards show the ratio and length of the gradient – 1 in 200 means, for example, that the gradient rises or falls one metre in a length of 200 metres. 1 in ∞ (expressed as one in infinity) means that the section is level or horizontal, and the board there would be like that in fig. 10–b or 11–b instead of like fig. 10–a or 11–a. From now on, however, a gradient board like fig. 10–a or 10–b will come into general use on the railways, giving the gradient as so much per 1,000 ("‰") instead of a ratio figure. The figure 4 in the triangle shows, for instance, that the gradient is 4 per thousand, or 0.4%.



This section rises one metre in every 150 metres over a total length of 260 metres.

Fig. 10–a is the front view of a gradient board showing a descent of 1 in 200 while the back of the same board shows an incline of 1 in 350.

Fig. 11–a is a gradient board showing the same gradient ratio as that in fig. 10–a, but in a different way.

If a track section 180 millimetres long (the length of the standard MÄRKLIN track *section) rises* 6 millimetres, the gradient ratio is 6 in 180, or 1 in 30 which, expressed as a percentage is:

$$\frac{\text{Gradient} \times 100}{\text{Length of section}} = \frac{6 \times 100}{180\,^{*}} = 3^1/_3\%$$

All MÄRKLIN trains can negotiate this gradient without any extra help, while engines that have plastic tyres on two driving wheels can manage considerably steeper gradients.

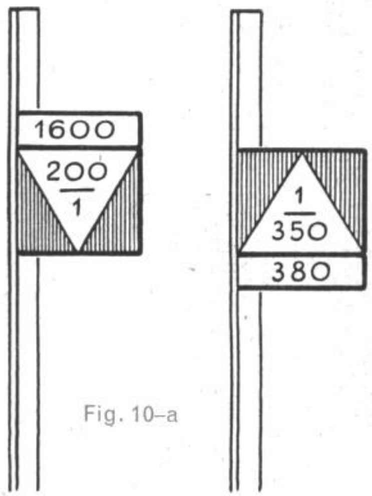


Fig. 10–a

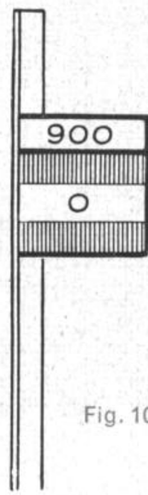


Fig. 10–b

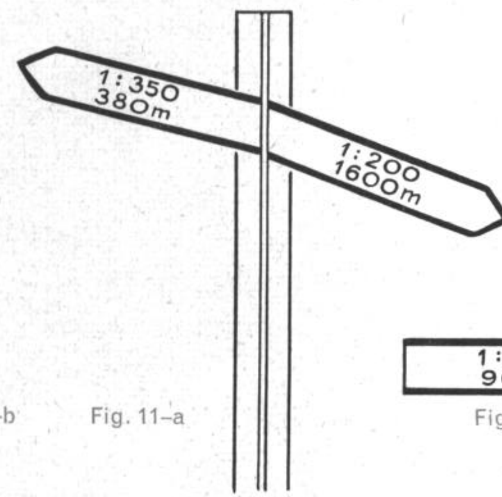


Fig. 11–a

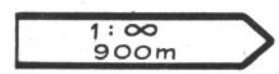
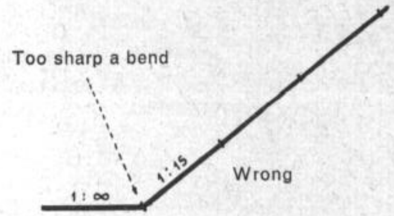


Fig. 11–b

* For more accurate calculations the length of the rail is not used, but its projection on the horizontal.

In ordinary railway practice gradients must not be steeper than 2½% on main lines or 4% on branch lines. Steeper gradients, though permitted – some railways in Germany have gradients up to 6% – must be approved by the Local Authority concerned. The gradient in a station must never exceed 0.25%.



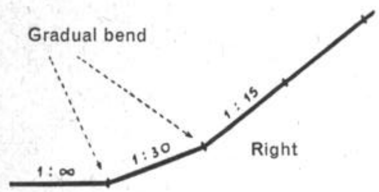
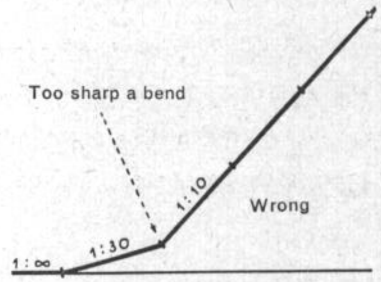


Fig. 12



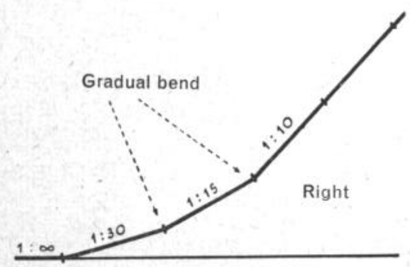


Fig. 13

When laying out track sections with gradients be careful to see that there is not too abrupt a bend between the horizontal and rising parts of the track, nor where the gradient increases (see figs. 12 and 13).

Satisfactory working will not be obtained unless the following rules are observed.

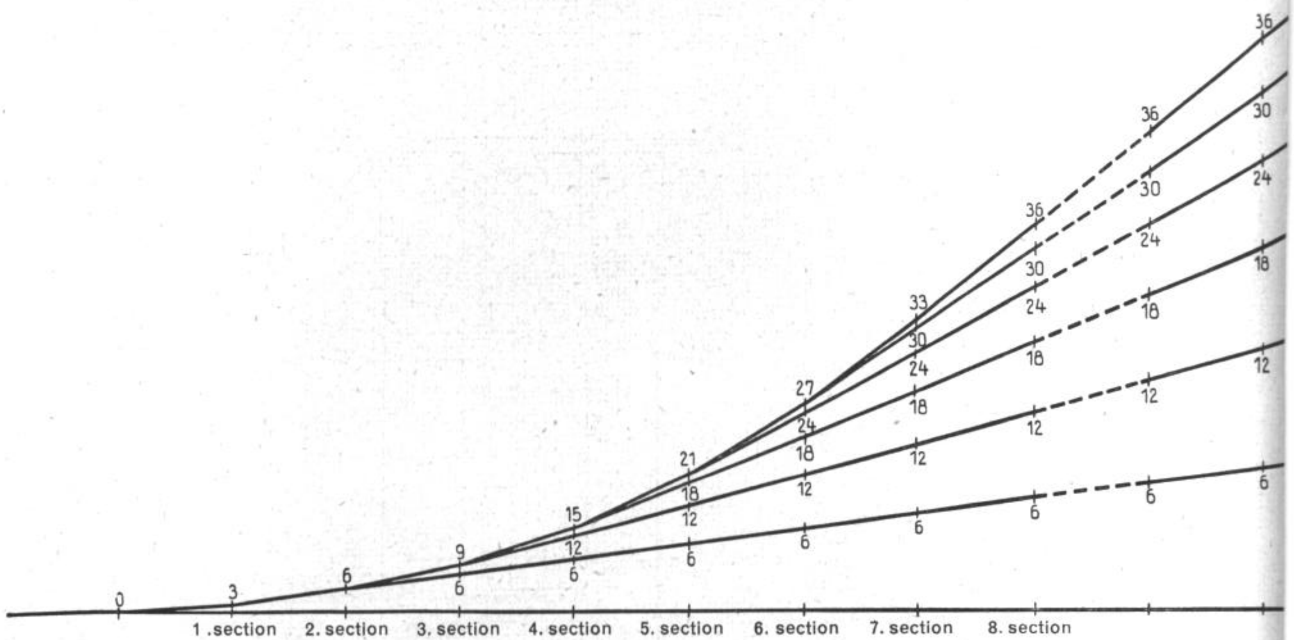
Fig. 14 gives the amount to raise each rail section for laying out stretches with various gradients. The horizontal lengths of the rail sections and their vertical rise are not to the same scale. The figures show how much higher or lower the end of a rail section must be than its beginning.

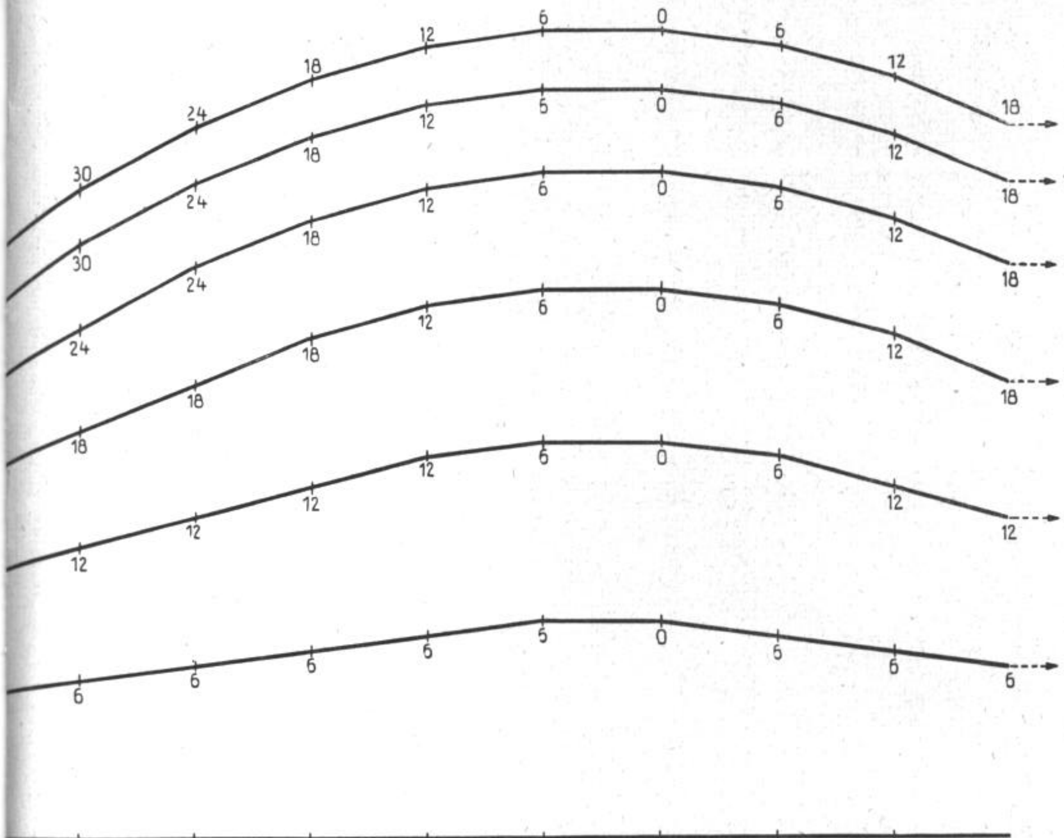
If an incline of 1 in 10, or 10 %, is to be built with standard track sections, for example, then, as the diagram shows, the end of the first inclined section will be lifted 3 millimetres, the second 6 millimetres more, the third 9 millimetres more, the fourth 15 millimetres more and the fifth 18 millimetres more, every further track section for a 10% gradient then being lifted another 18 millimetres.

The gradient must only be reduced gradually when coming out of a decline or incline on to the level, as can be seen by the further figures on fig. 14. The end of the first track section to start the return to the level must still be lifted to give a good transition, though only by 12 millimetres and not 18 millimetres as previously. The second track section thereafter will still have to be raised 6 millimetres and the third one is the first that can be laid level (0 millimetres rise).

Fig. 14

The rise to give MÄRKLIN track sections for most of the gradients in general use.





Standard track		Scale Model track	
1:5	=20%	1:6	=16,7%
1:6	=16,7%	1:7,5	=13,3%
1:7,5	=13,3%	1:9	=11,1%
1:10	=10%	1:12,5	=8%
1:15	=6,6%	1:19	=5,3%
1:30	=3,3%	1:37	=2,7%

6. Building up Inclines with MÄRKLIN Piers

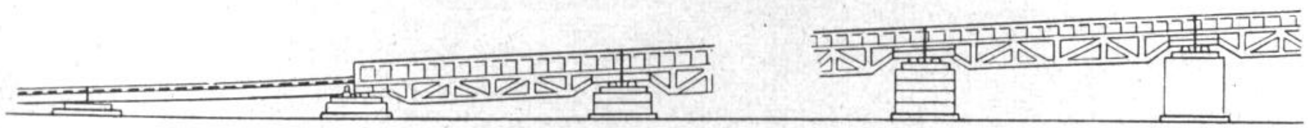


Fig. 15. Gradient 1 in 30

Building up an incline with MÄRKLIN bridge and approach ramp units is particularly easy, provided MÄRKLIN piers are used. Pier units are supplied in various heights; the foundation baseplate No. 467 P/3 is 3 millimetres high, pier No. 467 P/6, 6 millimetres and pier No. 467 P/30, 30 millimetres high. These parts fit together accurately and can therefore be built up into piers or pillars of any height desired. Fig. 15 shows a bridge built up with them.

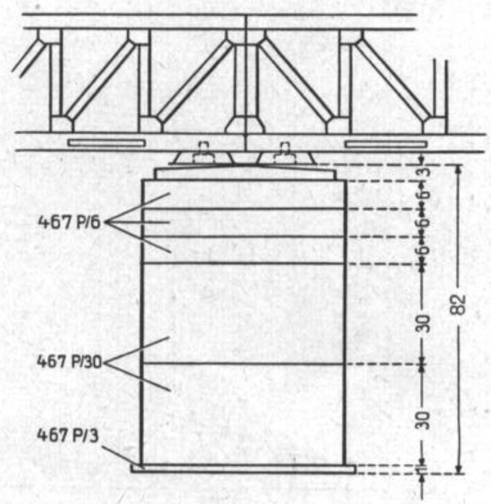
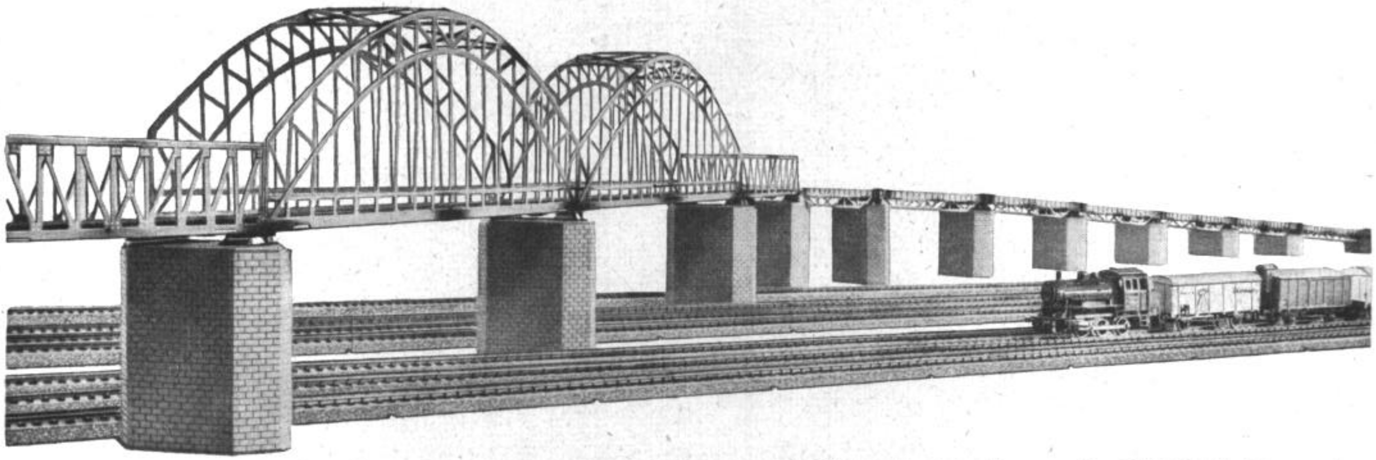


Fig. 16

Bridge Approach and Piers built up with MÄRKLIN Pier Units



A 10% gradient built up with MÄRKLIN Pier and Bridge Units.

Straight and curved approach ramp sections are easily joined to the piers as well as all MÄRKLIN bridges. Any of the heights given in fig. 14 can be made up by building up suitable pier sections.

As an example, building up a pier 82 millimetres high would require the following, as fig. 16 shows, viz:

One No.	467 P/3 unit.
Two No.	467 P/30 units.
Three No.	467 P/6 units.

II. Station Layouts

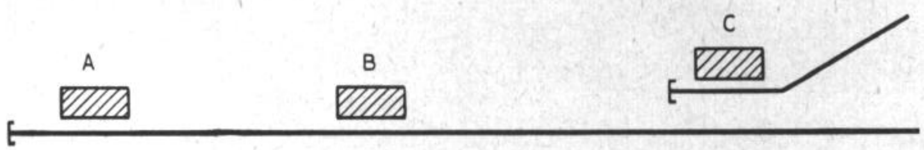


Fig. 18

1. General Remarks

Next in importance to the actual track itself on a model railway are the stations. The term "station" is used to mean a stopping place with at least one set of points and the signals required.

Sections of track where trains stop just for passengers to enter and alight are called "halts".

Stations of various kinds are shown diagrammatically in fig. 18, though only the most important tracks are marked. Stations are described as follows.

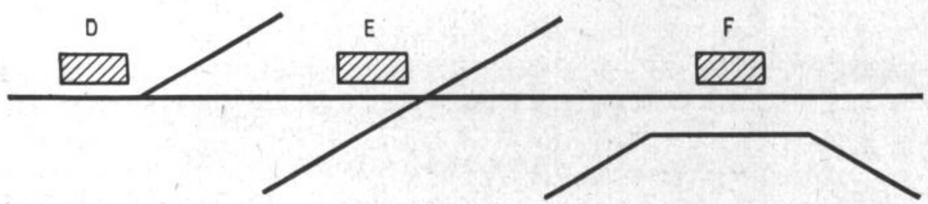


Fig. 19 (page 19). A Main City Terminal Station (aerial photo)

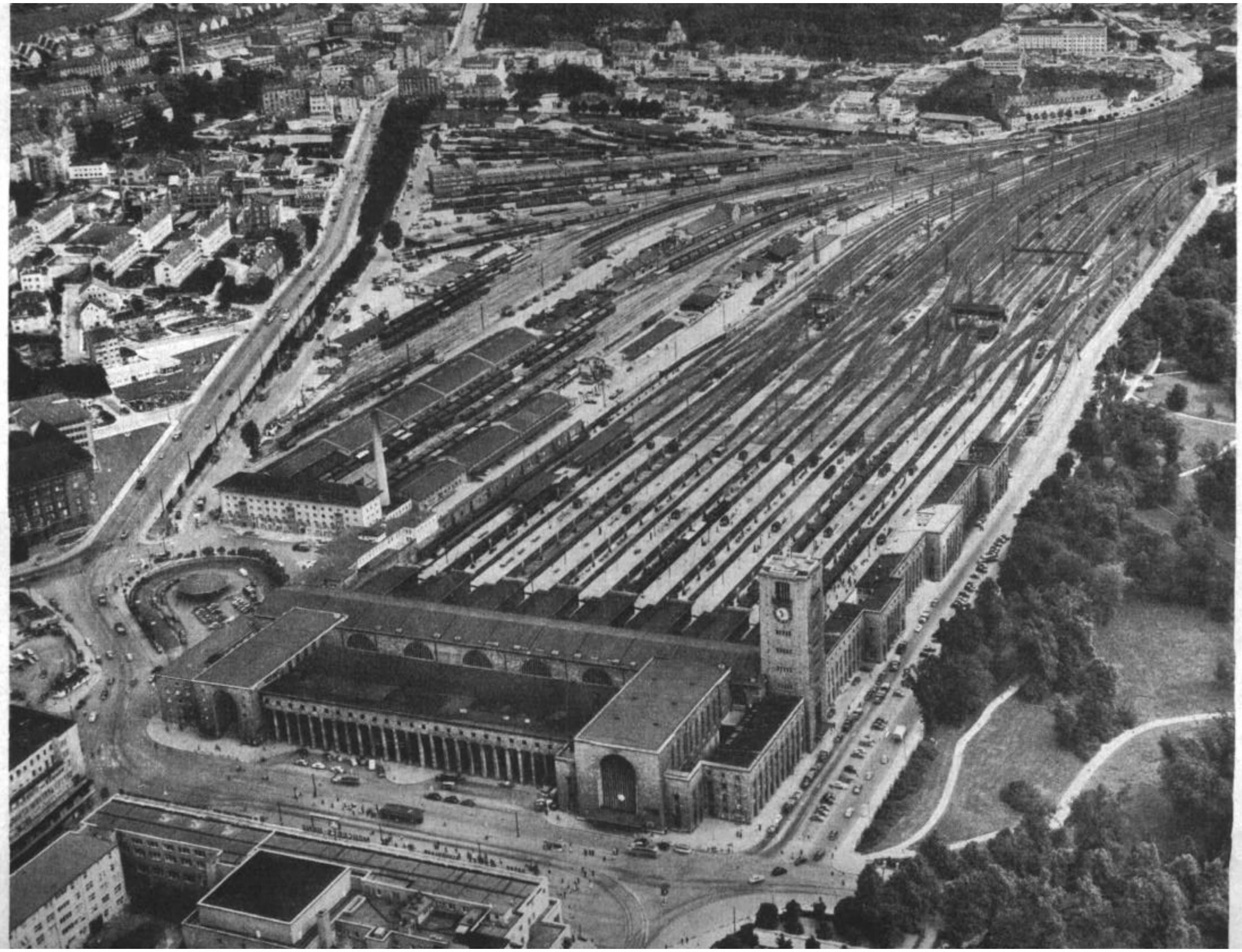


Fig. 19

"A" Station. Main or terminal station in a big town or city. Trains can only enter the station in one direction.

"B" Station. Main line station that trains can run through.

"C" Station. Main line junction. A combined main and main line station where passengers change to trains travelling in different directions.

"D" Station. Branch line junction with the same facilities as a "C" station.

"E" Station. Station where lines cross.

"F" Station. Interchange station.

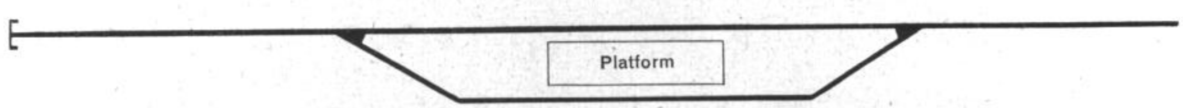
2. Station Diagrams

The following diagrams show only the main and more important side tracks and so the stations can be supplemented by other additional tracks as desired, according to the space available.

(a) Main Stations

Fig. 20 shows the layout of the simplest type of main station.

Fig. 20



The stretch of track between the two points must be longer than the longest train to be expected; if a train should stop on one of the points, the driver cannot shunt his engine along the loco track and consequently cannot make the return journey.

Fig. 21

Two trains can stop at the same time in the main station shown in fig. 22; it is the type of station for a small town.

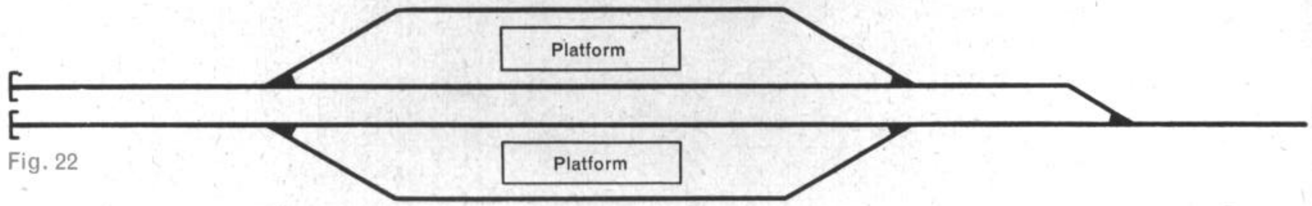


Fig. 22

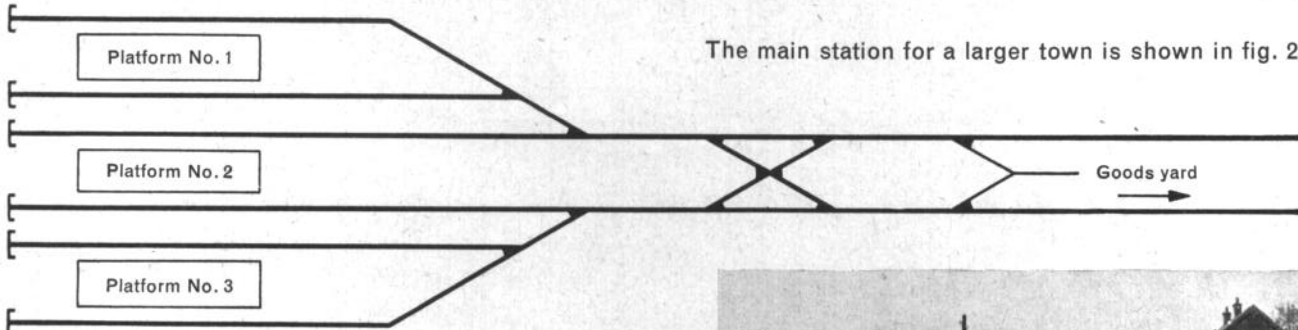


Fig. 23

The main station for a larger town is shown in fig. 23.

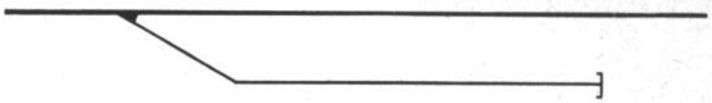
Fig. 24. The main station of a small town.

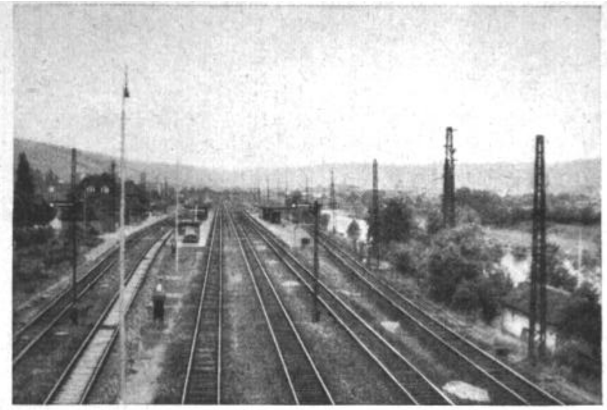
The aerial photograph on page 21 shows a Railway Works with its adjoining yard for passenger stock and also a carriage and wagon Works.

b) Main line stations for through traffic.

The main line station for through traffic shown in fig. 26 consists of one through road only with one siding for goods wagons, loading etc.

Fig. 26





A main line station for through traffic.

The station shown in fig. 27 consists of a main line through road (1), passing loop (2) and a siding (3). Trains can meet and overtake, the faster train taking track No. 1 and the slower one track No. 2.

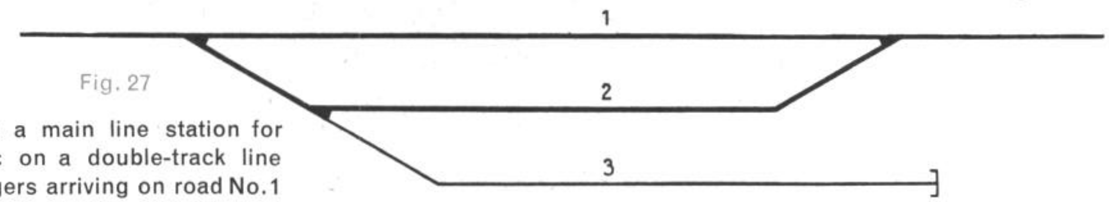


Fig. 27

Fig. 28 shows a main line station for through traffic on a double-track line where passengers arriving on road No. 1 by local train from neighbouring places have the advantage of being able to change to an express or fast train going in the same direction on track No. 2. The sidings or goods yard (details on page 30) should be arranged between the two through roads of the main line so that shunting operations do not interfere with through traffic.

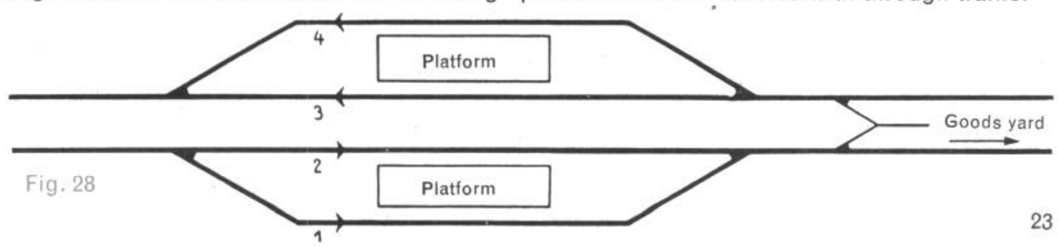
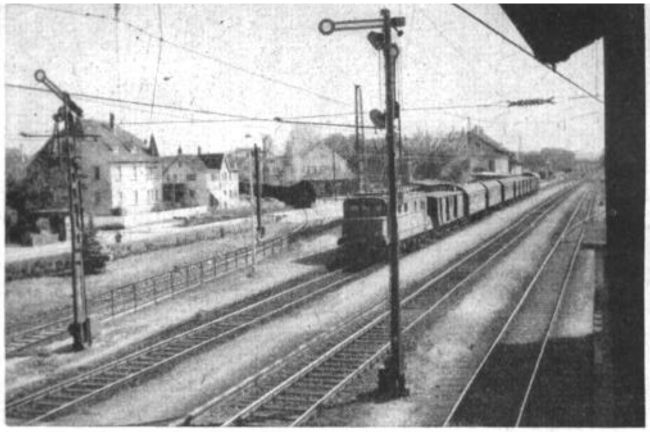


Fig. 28



Junction of a single-line track with a track having several lines.

If crossing one of the main through roads is unavoidable when the wagons travel into the yard, they should pass over the outgoing line, and not the incoming one.

c) **Junctions**

The junction of a single-line track with a double-line track is shown in fig. 30 with the tracks arranged so that trains can cross over from one to the other section without any great difficulty. The disadvantage of this layout is, however,

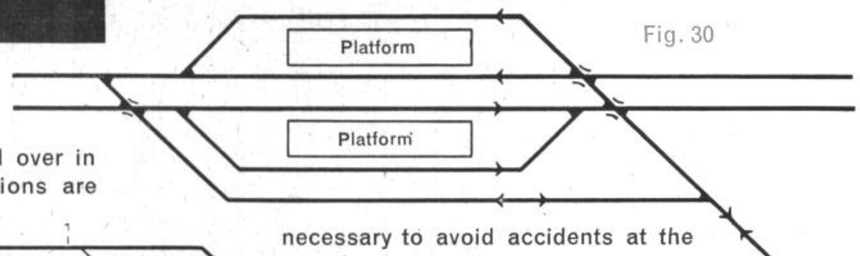


Fig. 30

that the double track has to be crossed over in certain cases and so adequate precautions are necessary to avoid accidents at the crossings.

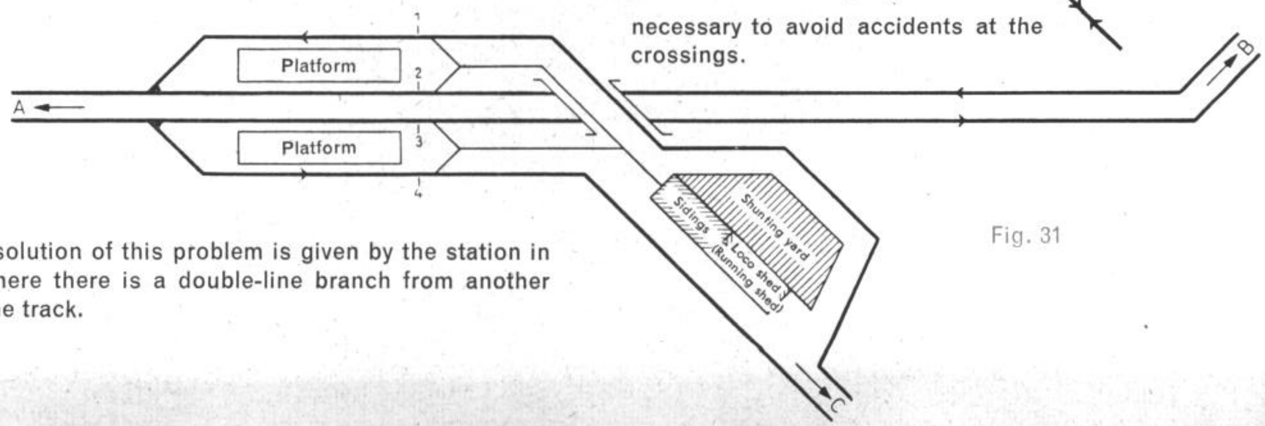


Fig. 31

A better solution of this problem is given by the station in fig. 31, where there is a double-line branch from another double-line track.

The danger of lines crossing on the same level has been avoided by means of a bridge, thus reducing both the likelihood of accidents and the cost of safety devices considerably. A noteworthy feature also is that the road to the sidings does not cross any of the lines and that passengers can change from trains going in the direction of C into those travelling in the direction of A, and vice-versa, at the same platform.

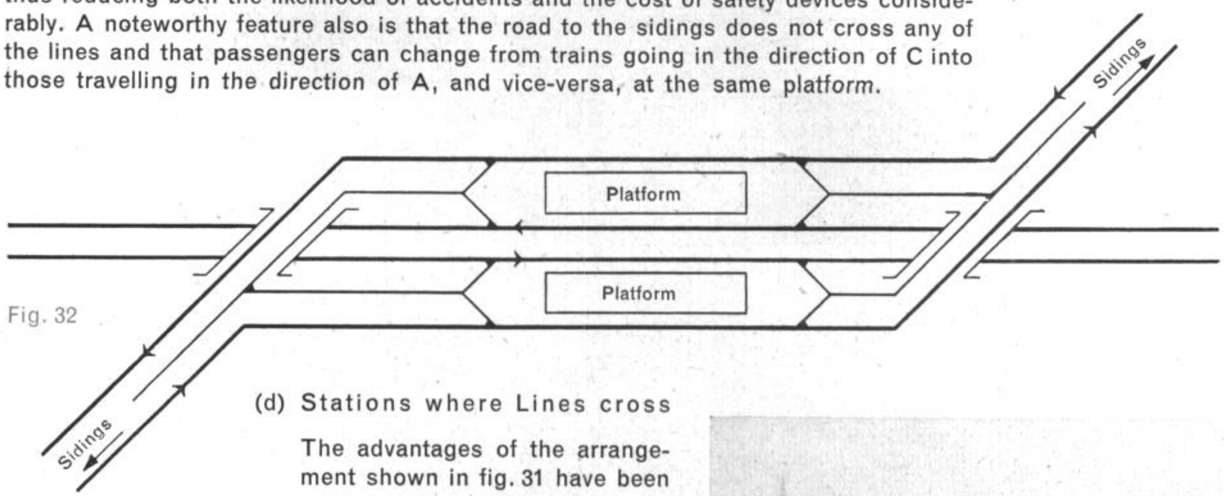
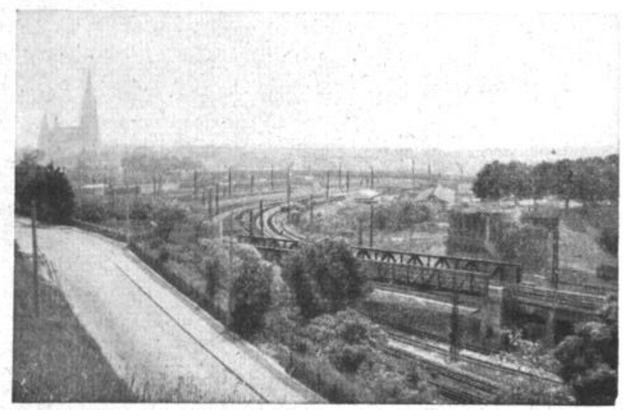


Fig. 32

(d) Stations where Lines cross

The advantages of the arrangement shown in fig. 31 have been put to good account in the crossing station shown in fig. 32; the safety of the layout and ease with which passengers can change from one train to another at the platforms will be obvious at the first glance.



A Station where the lines cross

3. The Four Parts of a Station

The remarks that have so far been made regarding stations have dealt only with their tracks for passenger traffic, but to maintain the service as a whole, it may be said generally that four parts or sections are necessary and these are separate from one another in big stations. In the smaller stations however the distinctions between the sections are in many cases no longer apparent.

These separate sections are as follows.

(a) The passenger and luggage departments:
Platform tracks – platforms – platform barriers – booking offices – luggage and baggage offices etc.

(b) Equipment for passenger train working:
Signalling buildings – tracks or roads for the storage and arranging of passenger trains – equipment for cleaning and carrying out minor repairs to passenger rolling stock-sheds for passenger train engines together with their installations for locomotive supplies.

(c) Goods traffic installations (local goods station):
Sidings for loading – ramps – goods sheds – loading equipment such as cranes and so on, also express goods equipment, though these will mostly be in conjunction with the passenger traffic arrangements (fig. 38, roads 4–a, 4–b and Z. 3).

The Public Hall in a modern City Station

(d) Goods train traffic equipment (grouping, shunting and marshalling yards):
Ground frames – roads for making up, regrouping and separating goods trains – engine sheds and supply depots for goods train engines.

The main Works where rolling stock is overhauled at prescribed intervals does not form part of a station layout.

4. The Roads or Tracks in Passenger Stations

In normal railway practice the distance between the centres of two parallel roads or tracks is generally 3½ metres. The equivalent distance for a miniature railway would therefore be 3½ : 87, *or 42 millimetres* between the metals. This distance cannot, however, be kept to on curves when using curved track sections of the usual radii. On the other hand, it is usual to space the tracks at least 4½ metres apart in stations on full-size railways and the equivalent spacing of 52 millimetres for a miniature railway is quite workable.

The following distinctions are made.

Main tracks or roads are lines over which trains pass on scheduled services; they are shown by thick lines on layout plans.

Sidings are for shunting purposes and are shown by thin lines on plans (see fig. 35).

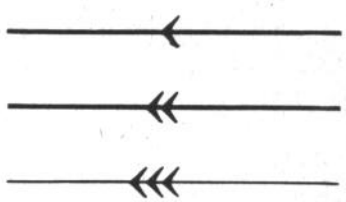


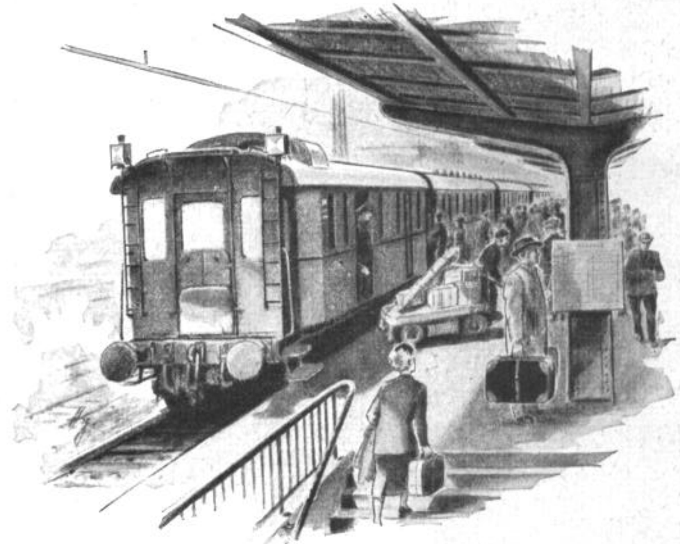
Fig. 35

Direction in which passenger trains travel over this main track.

Direction in which goods trains travel over this main track.

Direction in which locomotives travel along this siding.

The tracks or roads that are to be found in a passenger station will now be dealt with in conjunction with fig. 38, which shows the layout of a big station.



(a) Main Roads or Tracks for Through Traffic

Roads Nos. 4 and 5. These are understood as being the main tracks forming continuations in the station of the main tracks in the open.

(b) Other Main Roads

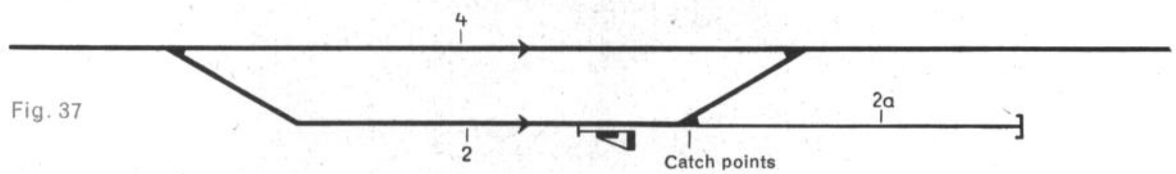
These are roads Nos. 1, 2 and 7, accessible from the platforms. The two main roads Nos. 2 and 7 can also be described as passing loops.

Main road No. 1 is used mostly as a passing loop for goods trains, in the same way as roads Nos. 8 or 9.

The section of main line between the two points must, in full-size practice, be long enough to take a train with at least 120 axles.

If a train should run in on road No. 2 on fig. 38 and fail to stop for some reason or other despite the starting signal being "On" or at "Danger", it will block traffic on road No. 4; it would therefore be better to provide catch points and a dead end or stop block 2-a on road No. 2, as fig. 37 shows. The catch points when correctly set would prevent any interruption in working on road No. 4.

Fig. 37



(c) The Engine Siding or Through Road

If the engine of a train is to be changed, a road must always be clear for the two engines so that the change-over can take place; the engine siding leading to the engine sheds can be used for these shunting operations (fig. 38, road No. 12).

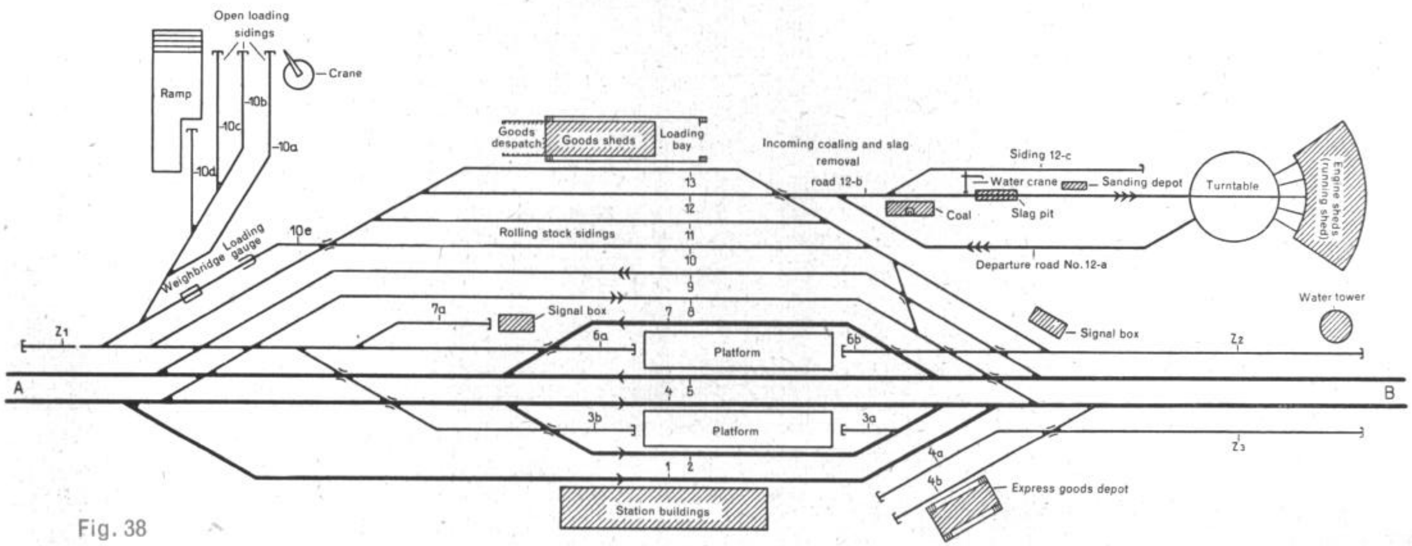


Fig. 38

(d) The Service Siding

Engines and also dining cars, sleepers and through coaches, if necessary, are placed ready on a service siding when engines or coaches have to be changed very quickly. These service sidings generally end at a stop block direct on the platform. (See fig. 38, roads 3–a and 3–b, and 6–a and 6–b.)

(e) Sidings

When a train has reached the end of its journey it must be shunted on to one of the sidings for cleaning. The road to the siding should, as far as possible, not have to cross any of the main lines, consequently the best place for it is between the two main tracks running through. As the station depicted in fig. 38 is not a terminal, no special sidings have been provided. Road 7–a and also roads Nos. 3–a, 3–b, 6–a and 6–b could be used for this purpose, providing the service and their lengths are suitable.

5. Tracks in Goods Stations

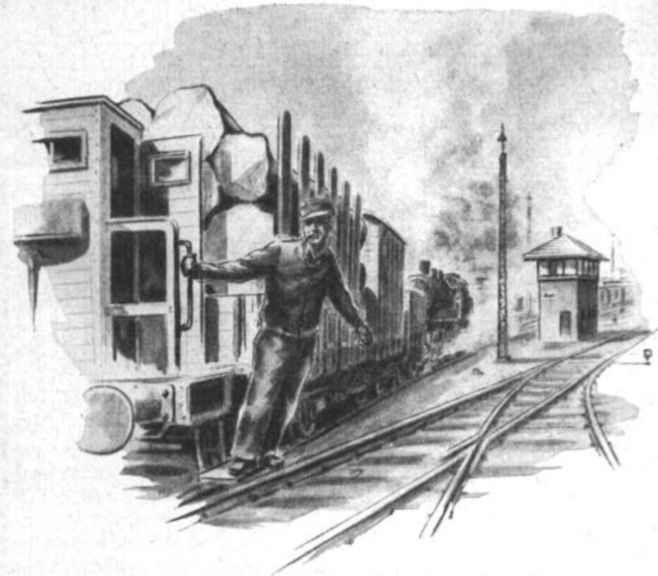
A goods train usually consists of wagons that are consigned to different destinations and if these are not all on the same section, the train is run into the regrouping, shunting or marshalling depot at some main traffic centre. The wagons are first of all registered (roads 1–a, 1–b, 15–a, 15–b, fig. 41) and the shunting arrangements are noted on the shunters' sheets.

After reaching its destination the train is run on to a siding for cleaning.

(a) The Sorting Track

The train is then run on to a sorting track where it is said to be "sorted out". Sorting tracks must be long enough to take any goods train but where space is limited, the work often has to be done on shorter tracks and the trains then have to be sorted out in two parts.

Two sorting-out roads Z 1 and Z 2 (extensions of road No. 8) are provided at the goods station shown in fig. 41. A goods train standing on the sidings 1–a or 1–b can be sorted out on road Z 2. After changing the points, it is shunted backwards up on to the marshalling hump and past the fly-shunting signal. The wagons, already uncoupled – on the MÄRKLIN miniature railway the wagons are uncoupled only on the downgrade of the hump – are usually fly-shunted singly, either slowly or at a moderate speed, as the flyshunting signal may indicate, and roll down the hump, running into the wagon sidings forming a gridiron yard – roads 1 to 15 in fig. 41.



Shunting signalling

(b) The Wagon Sidings

Before flyshunting the points are set for wagons with destinations on the same section to be marshalled on the same siding. There must therefore be a marshalling siding for each main line from this goods station and an additional siding may be required for the goods train baggage vans and wagons that are to remain at the station. The wagons standing on one and the same siding and together making up a new goods train can, if needs be, run over the hump again and be arranged in the order of their destinations.

The height of the marshalling hump (see fig. 124) depends on the distance the wagons have to cover; it can be found by trial before planning the model layout.

In smaller stations usually only two sidings for wagons are needed (such as roads 10 and 11 in fig. 38, for example). There are three tracks for sorting out provided in this station, goods trains being sorted out on one of the two roads Z 1 or Z 2. For remarshalling, the uncoupled wagons are shunted into either the sidings 10 and 11. the unloading road in the goods shed or, if there is a service in operation on Z 1, into the open loading sidings 10–a to d.

The goods wagons consigned to the station are run into the local goods station.

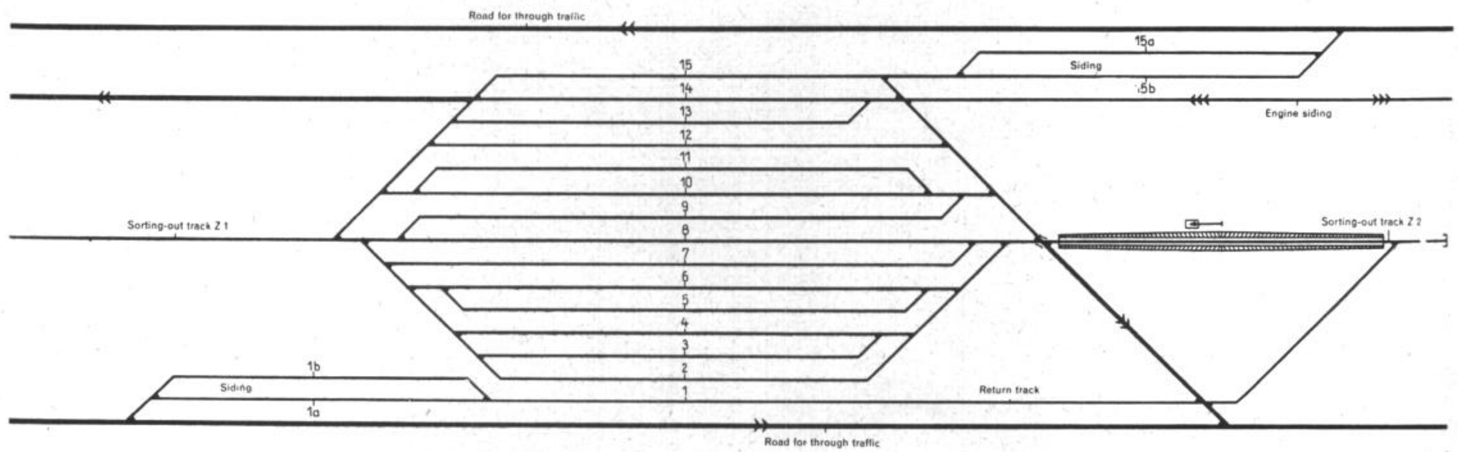


Fig. 41

Handling Piece Goods

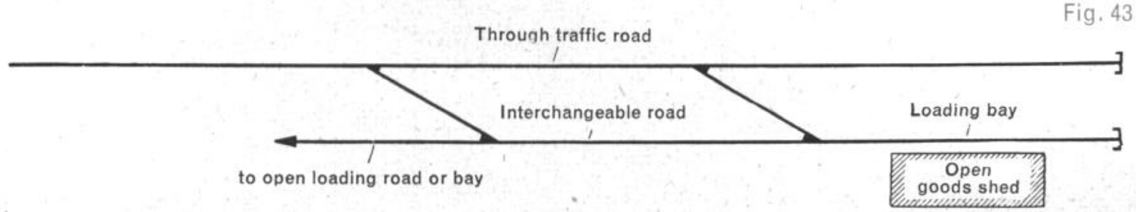
The Local Goods Station

The loading and unloading of goods wagons is carried out in various ways according to the kind of goods carried, and so local goods stations are provided with different kinds of loading tracks.
Closed goods wagons with piece goods, that is, single cases and so on, are shunted into the piece goods road of the station of their destination.

(c) The Piece Goods Road

Here they are unloaded by the railwaymen. Road No. 13 in fig. 38 is a road of this description. Another layout of a simpler kind is shown in fig. 43, the individual roads being laid out so that the wagons can be changed very quickly.

Fig. 43



In large towns and cities there are generally two separate goods sheds provided for outwards and inwards piece goods, a layout of this description being shown in fig. 44, roads Nos. 1, 3, 4 and 6 being interchangeable roads and sidings

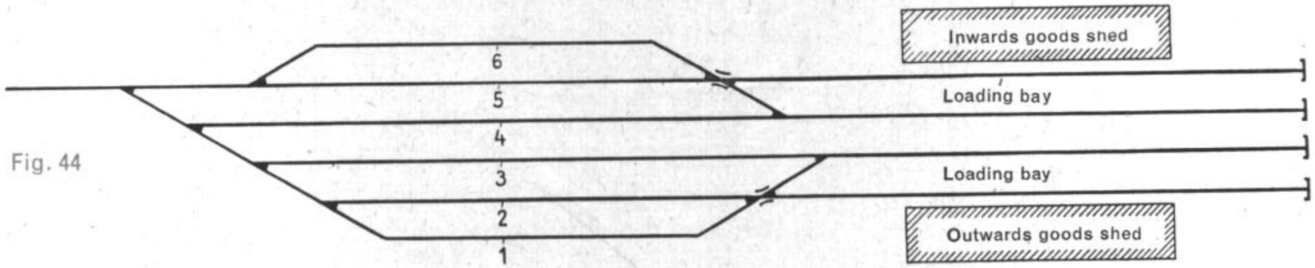


Fig. 44

Fig. 45 shows a staggered layout of a goods shed with its roads or tracks.
Road No. 1 is that connecting with the sorting road; roads No. 2 and 3 are interchangeable roads and sidings; roads Nos. 4, 5 and 6 are the loading roads leading to the bays in the goods shed.

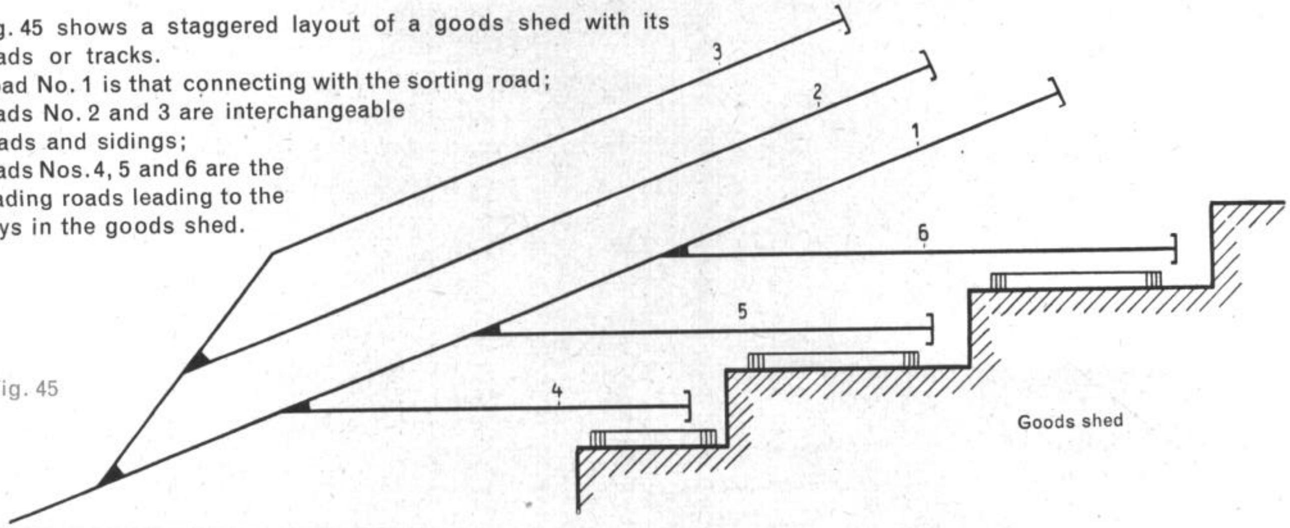


Fig. 45

(d) *The Open Loading Bay*

Goods in bulk, such as stone, coal, bar iron and similar goods are dealt with at the open loading bay where road transport vehicles can be run directly up to the goods wagons (fig. 38, roads 10–a and 10–b).

(e) Roads to the Loading Ramp

The loading ramp is built high enough to be on the same level as the floor of a goods wagon and is used for handling livestock, vehicles, fragile goods and the like (fig. 38, roads 10–c and 10–d).

The weighbridge for goods wagons and their loads – the so-called railway weighbridge – and also the loading gauge for limiting the size of the wagons – are both to be found close to the open loading bay and the ramp (fig. 46 and fig. 38, road No. 10–e).

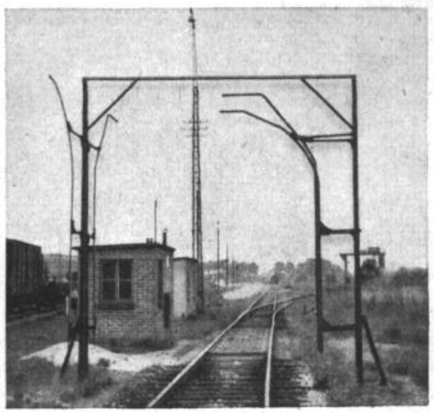


Fig. 46 A railway weighbridge and loading gauge (left, out of use, right, ready for use. The smaller loading gauge is that for foreign countries, the bigger one being for home use.

Fig. 48 is a separate diagram of the entry into a gridiron yard, similar to that in fig. 38.

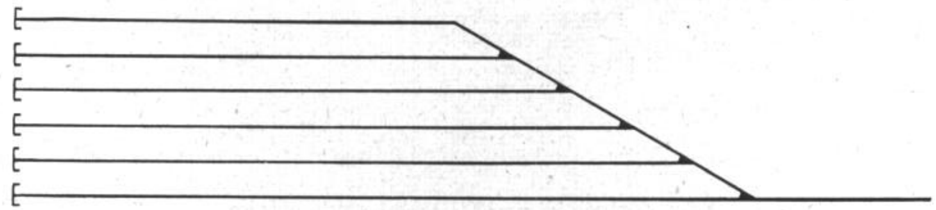


Fig. 48

The disadvantage of this arrangement is that only one engine can run in or out at a time.
Fig. 49 shows a gridiron yard with two tracks providing a free flow of traffic.

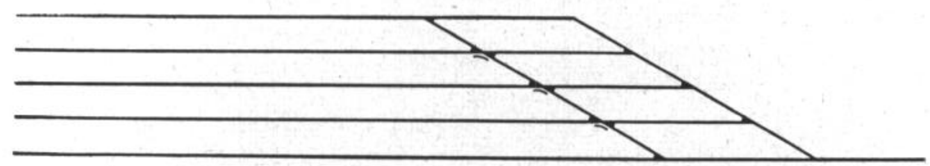


Fig. 49

6. The Layout of a Locomotive Running Shed

(a) The position of the running shed in relation to the station as a whole

Generally speaking, there is only one locomotive depot for both passenger and goods traffic at a station and this depot should be placed in a central position so that the roads leading from it to the various parts of the station may be as short as possible. Fig. 51 shows the layout of a station or depot. The engines run into there after finishing their sectional journey, running through from the passenger station via the sidings, where the coaches are uncoupled, to the running shed.

The points on this section are arranged so that the engines need not travel in a zigzag direction like that shown in fig. 52.

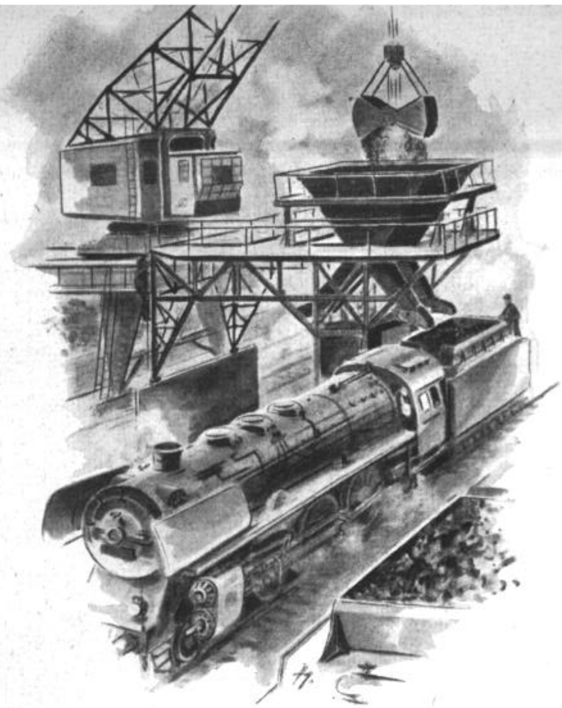


Fig. 50 Coaling at the Coal Dump.

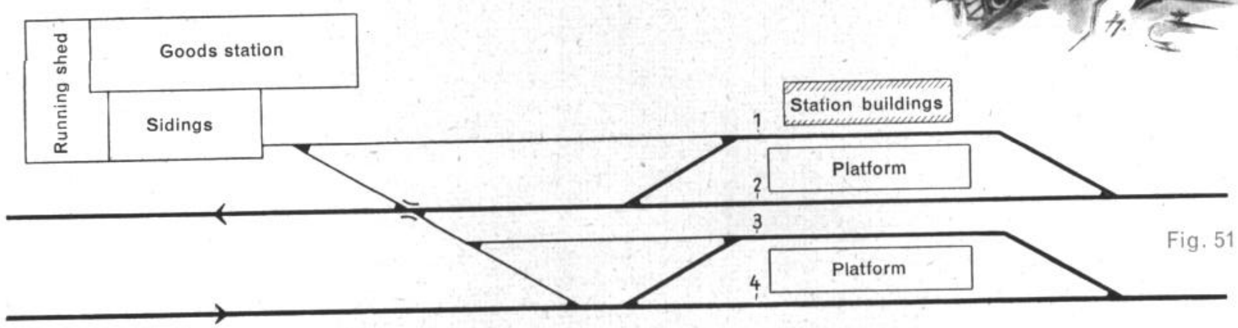


Fig. 51

Passenger trains pulling out from road No. 3 or 4 (fig. 51) to the sidings need only cross over the outgoing main line. Trains leaving a station generally travel slowly, so that this arrangement of the track enables working to be carried on without any great danger.

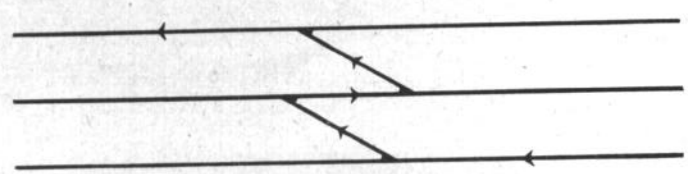


Fig. 52

The goods station directly adjoins the running shed and fig. 31 shows this combination at a large station. Despite the three double-track lines that come together here, none of the six main tracks is crossed by either passenger or goods trains when shunting.

(b) Supplies for the Engines

Anyone wishing to lay out a practical running shed must be acquainted with the sequence of operations to be carried out on the engines so that later on the various depots are arranged in proper order, and the engine runs through a circuit when being prepared for its fresh run. A steam engine coming out from the sidings or goods station will call at the following depots.

1. The coal depot or dump for coaling (fig. 50).
2. Removal of slag (fig. 54) and taking in water (fig. 53) at the slag pit.
3. The sand depot for taking in sand.

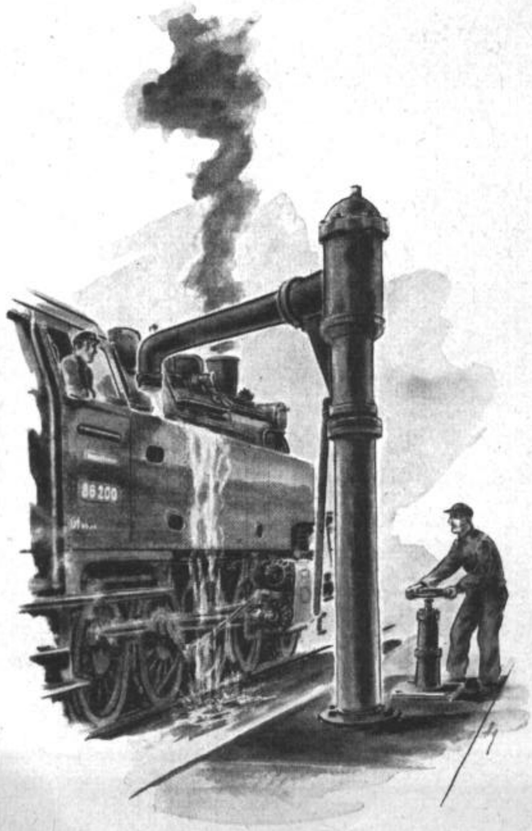


Fig. 53 Taking in water at the water crane

(c) The Roads or Tracks in a Running Shed

Referring to figs. 38, 55 and 56, we will now consider the roads or tracks that relate to the running shed.

The Outwards Road. Engines going into service leave the running shed by the outwards road which therefore always has to be kept clear for that purpose.

The Inwards Road. Before going into the sheds, an engine has to be made ready for its next service run. The inwards road runs past the coal depot, where coal is taken on. A few metres further on is the slag pit where the slag is dumped and water taken in at the same time from the water crane. Sand is next taken in and the engine prepared in the sheds for its next journey.

The Loop Road. Raking out and dumping the slag takes about twice as long (about 45 minutes) as taking on coal, and so at big stations or depots provision has to be made for passing engines that are dumping their slag; this is done by passing on a loop road (see fig. 56).

Inwards and Outwards Sidings. Used for standing engines, goods train baggage wagons and so on.

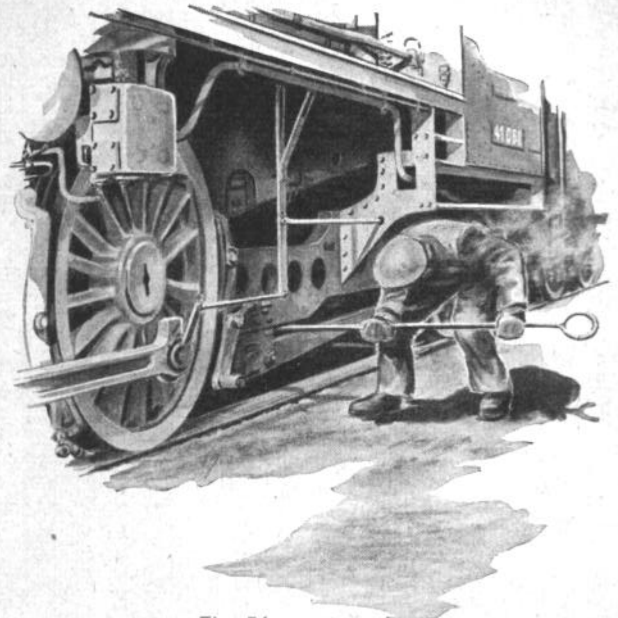


Fig. 54

Dumping Slag at the Slag pit

The Breakdown Train Road

The outlet for this must always be kept clear.

In the larger running sheds, depots and Works there are the following additional roads also, i. e., reversing road, coaling road, slagging road, engine shed roads, inspection road, servicing road, slag truck road, sanding road, workshops road, stores road, crane road and gridiron yard for goods train baggage wagons.

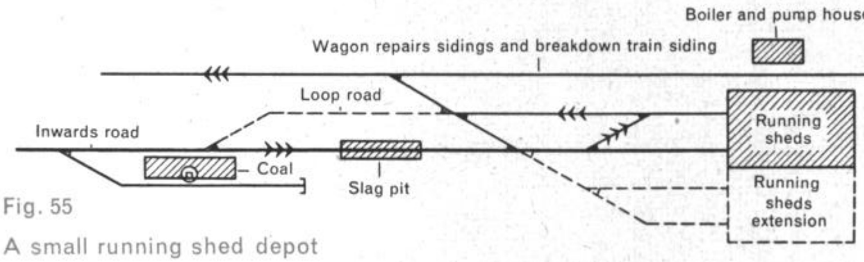


Fig. 55

A small running shed depot

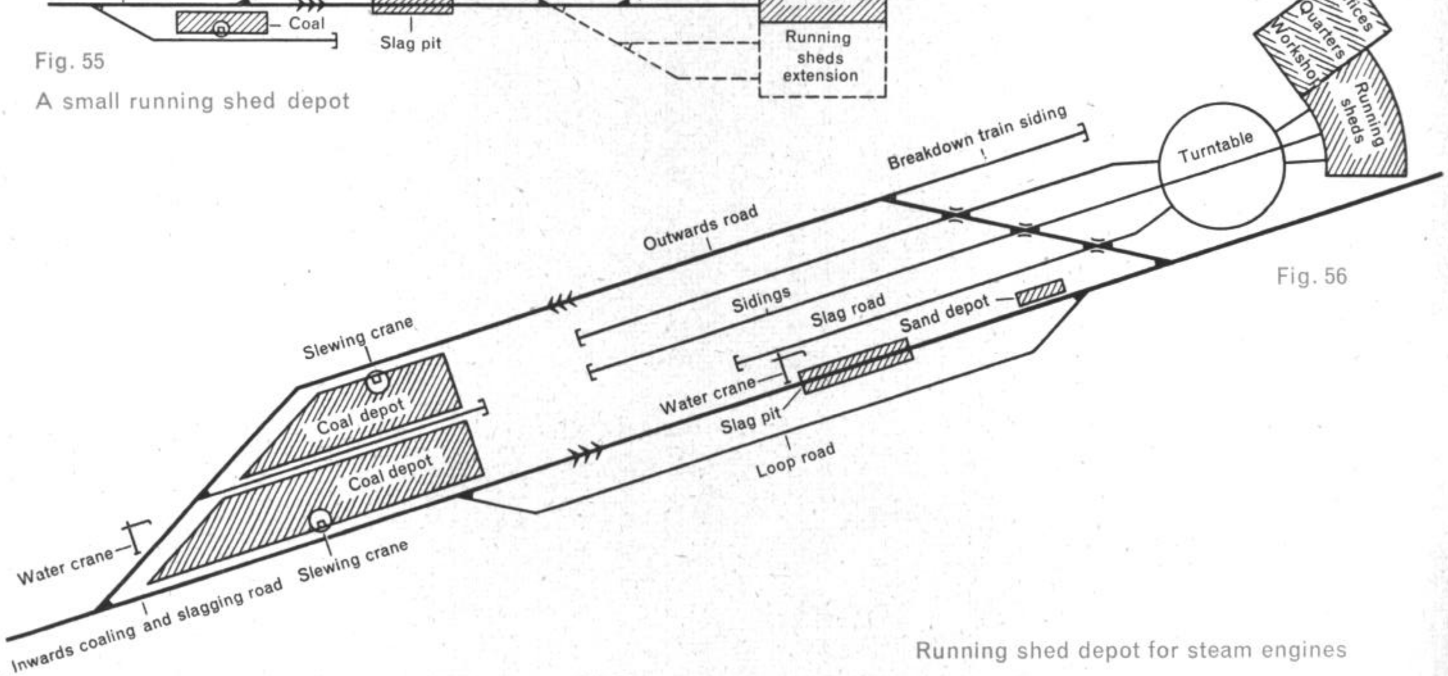


Fig. 56

Running shed depot for steam engines

(d) A Running Shed for Electric Locomotives

This running shed depot can be laid out as fig. 55 but in this case there is no need for a slag pit and coaling depot. Fig. 57 shows the general appearance of a running shed depot of this kind, fitted up with the MÄRKLIN overhead wire system. The true scale-model effect this overhead system gives can be clearly seen.

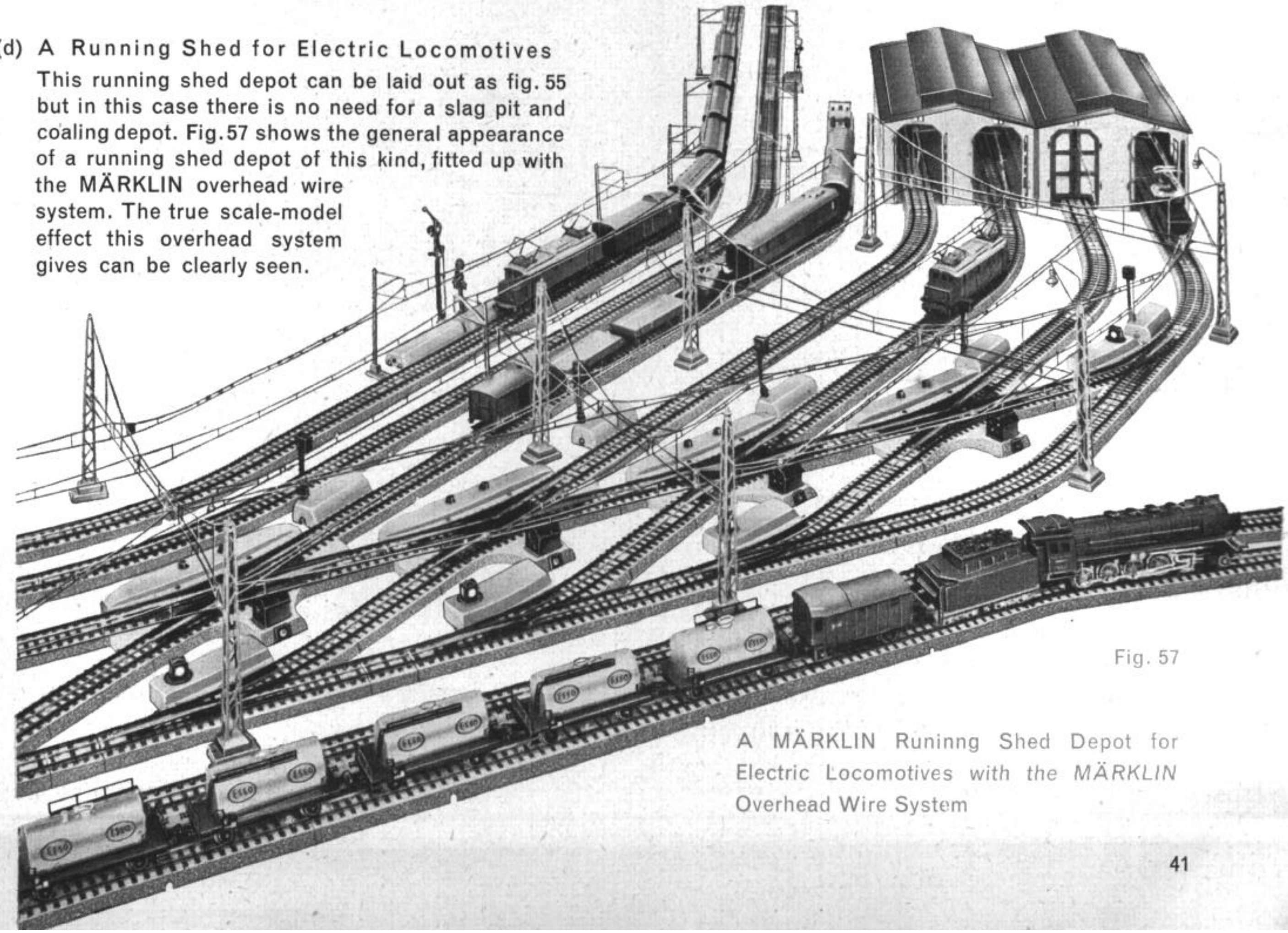


Fig. 57

A MÄRKLIN Runinng Shed Depot for Electric Locomotives *with the MÄRKLIN* Overhead Wire System

III. The Scenic Side

Every model railway should be, as far as possible, a section of its prototype and a true reproduction of the original. If the layout be built up with a definite idea in mind, it will appear as a harmonious whole to the onlooker, but for this to be so, the scenic surroundings with their buildings etc. should bear some relationship to the rolling stock. Therefore when building up a model railway it is best to start with the rolling stock available as a basis.

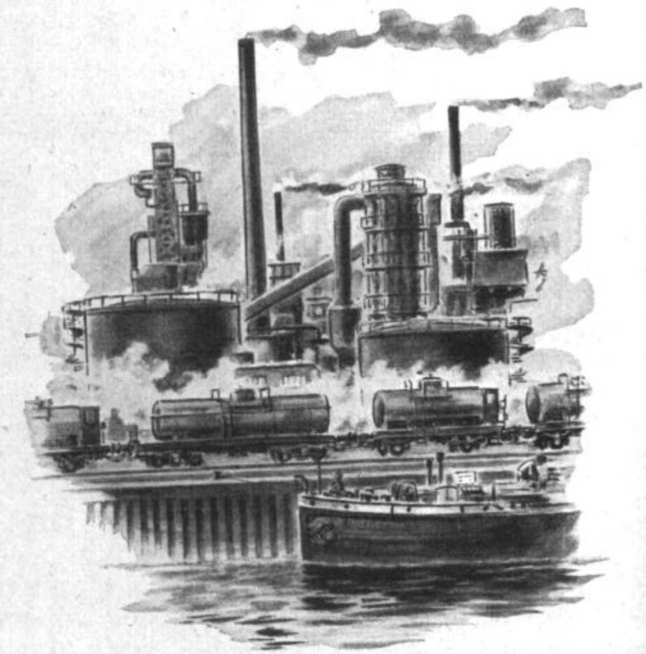
If there are several express train locomotives and a fair amount of track available, a long double-track layout can be made up passing, say, an industrial works of some kind. Smaller engines can then run local passenger trains over this section to sidings and branch lines.

A number of tank wagons included in the rolling stock would provide an opportunity for the industrial works to have the appearance of an oil refinery, and not only the tank wagons but open goods trucks laden with coal could then be run over the sidings to the oil works.

If there is not a great deal of track and rolling stock available, the landscape should be rather the scenic type, with villages, hamlets, mills and small streams interspersed among the surroundings of our local railway trains travelling at leisurely speed through an undulating countryside.

Once a definite idea has been formed with regard to the kind of scenery that best suits the rolling stock available, a very fine system can then be built up with the assistance of the remarks that now follow.

An Oil Refinery



1. The Foundation of the System

The first thing to do when planning your railway is to find out how big it is going to be, as its length and width will depend on the room available. There is no end to the ways of building up a model railway, and so only a few can be mentioned.

(a) The Table Railway

If there is no room to build up a permanent system, the railway material will have to be kept packed and taken out to be built up occasionally on a table. The advantage this has is that a new layout can always be designed and alterations can be made as you wish.

If the table is very small in size, boards or bridges can be used to extend the line to other furniture, the differing heights of the various "road beds" on which the track has to be laid themselves providing the gradients for our system.

Long straight stretches as in the original can be made up by laying the track along the walls of the room and extraordinarily interesting working can be had with a system of this kind.

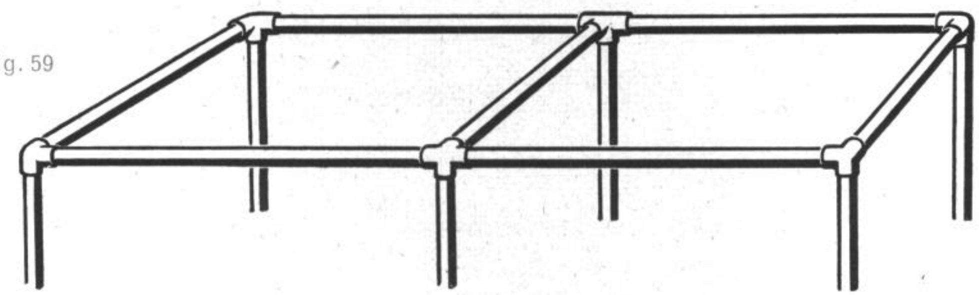
It is advisable to lay the part of the system with the largest station or shunting yard, as the case may be, on a sheet of three-ply not less than a ¼″ thick, and the rest of the track should also be laid on the same material, if possible, provided beforehand with strips of fabric or felt stuck on the underside.

Building up the railway will be a great deal easier, however, if the threeply sheets or strips are screwed on to a frame, as shown in figs. 60 and 61.

(b) The Foundation for a Railway System that can be enlarged

Where there is enough room available so that there is no need to use the furniture as the foundation for thesystem, it is advisable to build it up on fixed stands. A tubular framework like that shown in fig. 59 is, naturally, better still.

Fig. 59



The durability of the layout as a whole depends to a great extent on the strength of the material used and so the size of the material used for the foundation should not be skimped.

When deciding on the height of the framework, bear in mind that the railway will give an onlooker a particularly good impression when rather below the height of the eyes. Therefore, think beforehand whether the railway is to be looked at from a seated or standing position. When the height of the system has been finally decided, see whether, after opening the train service, every section of the track can be reached from the outside.

The plywood sheets or strips, fitted previously with a fixed framing as shown in fig. 60 or 61, must be firmly fastened to the stands or the tubular framing, as the case may be.

Fig. 60

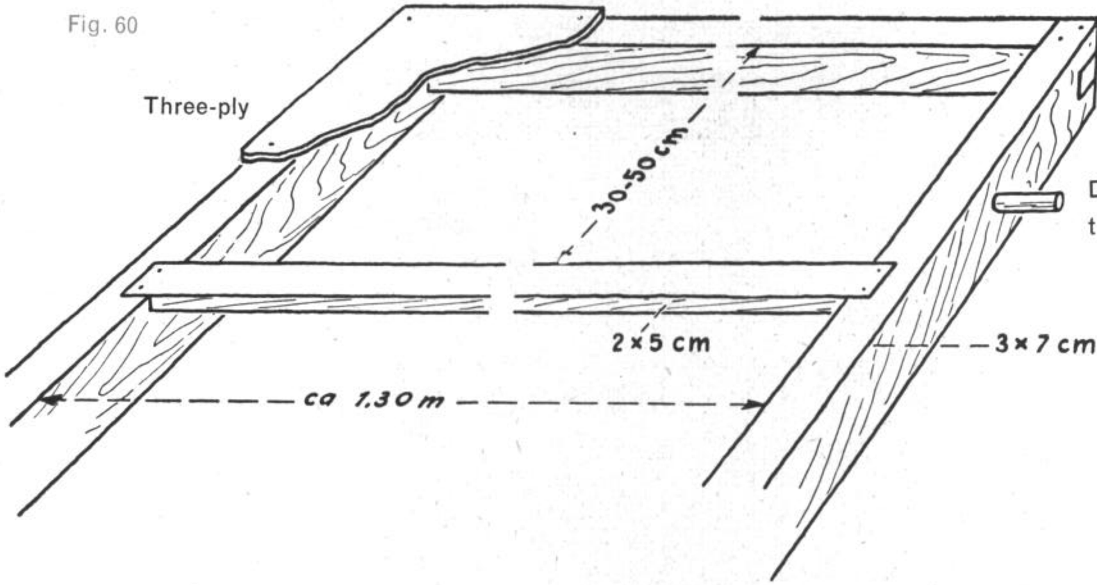
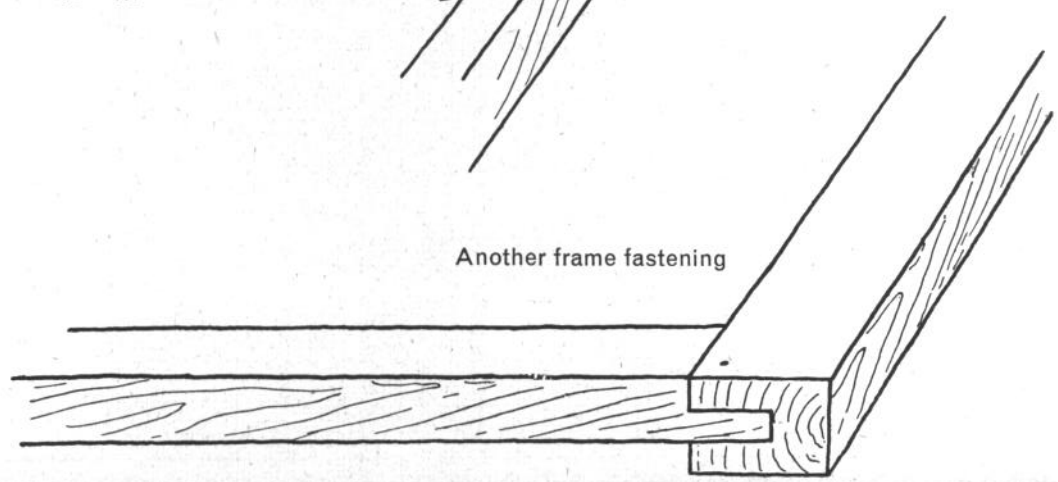
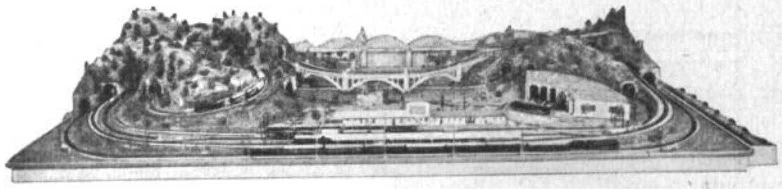

Three-ply
30-50 cm
Dowel pin for registering
the next frame
2×5 cm
3×7 cm
ca 1,30 m

Fig. 61


Another frame fastening



A MÄRKLIN Railway built up on the Frame Method

The crosspieces are glued and screwed to the frame and prevent the three-ply sheets bending; ¼″ three-ply can be used quite well with this method of construction.

Three-ply has the advantage of not warping. Track sections or scenery etc. can easily be screwed to the foundation, though it is advisable to drill the screw holes. The holes for the electric leads can then be drilled. All the leads are drawn through the sheets and passed along their underside where they connect with distributor plates screwed on.

First extension:

Second extension:

Third extension:

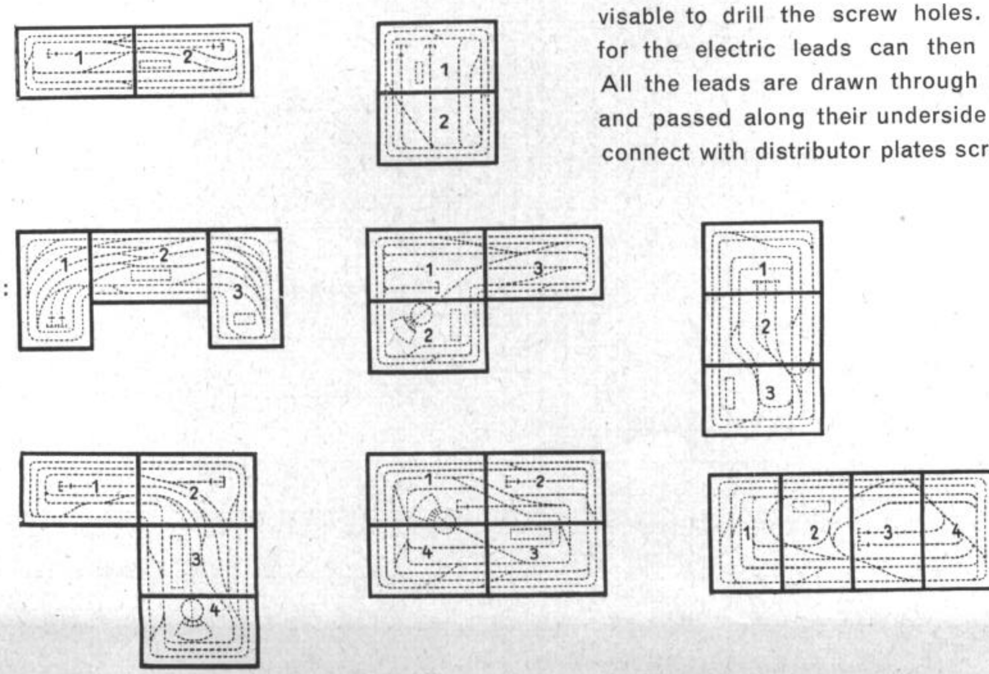


Fig. 63

A sheet 2 metres long and 1 ¼ metres wide, or even one rather larger, can be used for the first layout. Holes for dowel pins or screws are provided on three sides of the frame of this sheet (see fig. 60), where the second, third or fourth extension sheet can be firmly fixed later on. Fig. 63 shows a few of the combinations that can be made up with several three-ply sheets.

Other combinations will also be possible, according to the space available. Stands will be needed for the extra sheets, or provision can be made for an extension of the tubular framing.

If a layout of this kind is to be taken apart and put away, each three-ply sheet can be removed separately, provided the built-up parts are suitably arranged, but if there is no need for the system to be taken down in this way, then the built-up frame method can be adopted.

(c) The Built-up Frame Method

A strong frame can be built up of boards and laths, with boards inserted in it for laying the track on (see fig. 64). This frame can be made so that it either stands on the floor as it is, or rests on an under-frame. There is no particular resonance from the noise of the trains in motion with this method of construction and so the railway service can be run much more quietly than on a system built up on a three-ply sheet. (See page 55 also.) Building up the system in this way, the transformers and control panels should be arranged in the middle of the system and not at one side. This arrangement works particularly well with large layouts.

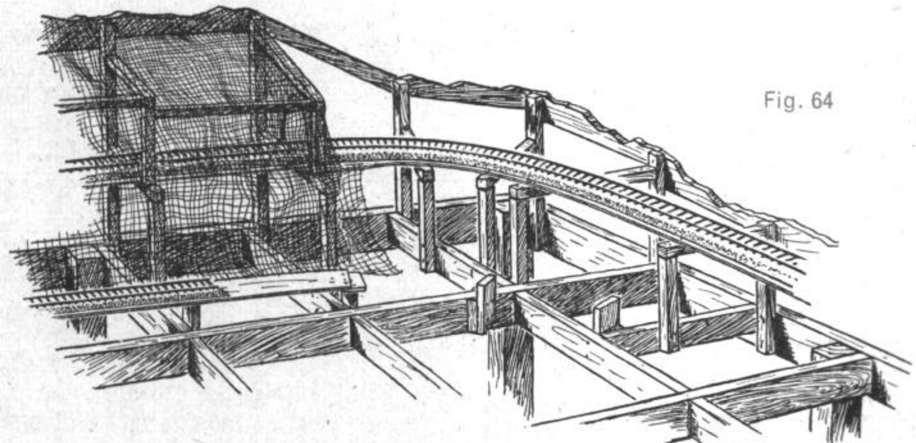


Fig. 64

An Example of a built-up Framework

2. The Formation of the Scenic Effects

(a) The Preliminary Work

There are different ways of going about building up a system.

1. To plan the scenic layout first and then decide on the course of the railway.
2. To lay the railway first and then set it in suitable natural surroundings.

Though the first way mentioned may promise better results, some necessity for seeking a compromise between the two methods may be unavoidable.

The scenic formation must provide the absolute necessity for building embankments, bridges, viaducts, road bridges or tunnels. An onlooker should not form the opinion that a tunnel has been made here or there simply because there would otherwise not have been one on the system. Only a high hill that the line cannot go round can justify the building of a tunnel, and similar consideration should be given before deciding on building embankments, bridges and so on.

It is advisable to proceed extremely cautiously with the formation of the scenery on curved sections. A clever model railway builder will see that hills, buildings etc. are well planned so that model railway curves which unfortunately are unavoidably not to scale do not bring a note of discord into the picture as a whole.

Fair-sized level spaces must be provided for stations. In smaller layouts the biggest station should, if possible, be placed at midway height, so that the lines from it will have an up grade on one side and a down grade on the other; both lines will then cross half way by a bridge.

Boards rising or falling on simple supports are fixed to the three-ply sheets for inclined sections and the track-sections are screwed on to them. If super-elevated curves are wanted, they can be arranged when doing this.

The whole railway can be built up after preparing the foundation or "road bed" for the track sections. Bases missing on inclined sections for signals can be provided. Holes can be drilled for the leads and the whole layout tested. If everything is found to be in order, take away the track sections for the time being to prevent their getting dirty.

The hills etc. in the scenery can now be modelled.

(b) Modelling Hills, etc.

Various methods of making these have been used by MÄRKLIN fans and those that are special favourites will now be described.

The basis for this method is a fine wire mesh or gauze (fly mesh), laid on laths built up to the maximum height desired. The gauze is only lightly fastened to the laths first of all and then bent so as to give it the scenic shape required. It is then covered with a thick paste, made up as follows.

For a medium-sized layout dissolve 500 grams of glue in about 2 litres of water and stir in some plaster of paris. It is best to give the mixture a brownish colour by mixing some dry colour with it. The entire surface of the wire gauze and the rest of the scenery is then painted with this plaster of paris and glue mixture and when it is fairly dry, the wire gauze can be shaped again to its final scenic form. If this latter shape is final, some more of the paste can be painted on and trees, bushes, hedges or fences, small notice boards, stones etc. can be fixed in it. If rocks and so on are to be represented by sand or small stones, they can be pressed on to the plaster while still wet. If they should not adhere, they can be fixed by glue or some other adhesive on to the surface of the plaster.

3. Nature and her Formations

The following remarks are intended to give railway designers some hints on other formations.

(a) Walls

such as are found where there are steep declivities or fencing on the line, are best made of three-ply, the wood being coated with glue and then given a coat of plaster of paris (made by adding plaster to water, and not the other way round). When the plaster is fairly dry, the grooves of the masonry can be cut in it.

(b) Tunnels

Tunnel entrances are made in the same way as walls. When deciding on the height, make sure there is enough room for fixing the overhead wire The hollow space inside the tunnel can be covered with an arched piece of tin to prevent dust and dirt inside the tunnel falling on the rails, or some supports can be sawn out, shaped like the tunnel entrance, from wood and covered with cardboard that has been moistened beforehand.

Fig. 66

A Tunnel Entrance with its typical Scenery

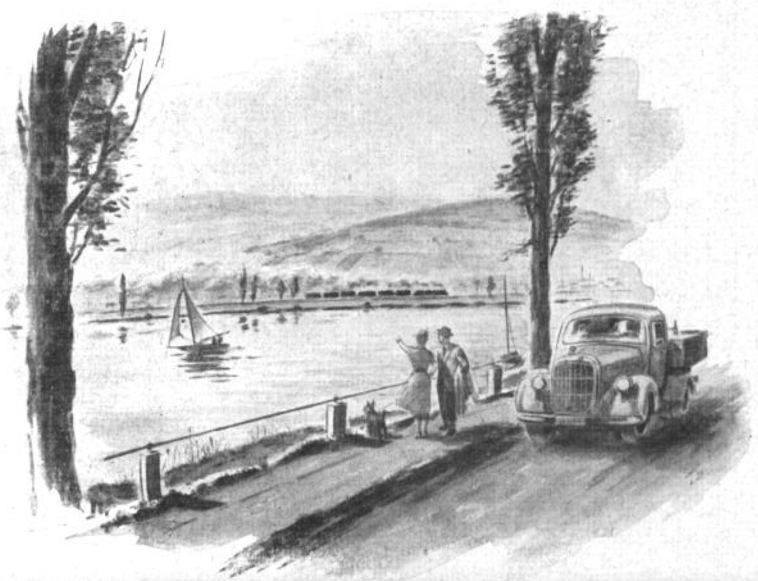

14
F

(c) Highways

Highways can be made up on a wooden board foundation in the same way as the railway track and treated like the parts for walls. The raised edges of the roads, with their water gutters, can be modelled on either side of the plywood strip if this has not already been done in the scenery. If the road is to be a first-class one or a motor road its surface must be made as smooth as possible and painted the colour required. The banks of the road should be treated in the same way as the meadowland described under (f).

(d) Ponds and Lakes

A sheet of green glass gives as close as possible a true reproduction of the surface of water.



Waves can be imitated by painting with transparent varnish, applied with a fairly stiff brush just before the varnish hardens.

Anyone who has once taken the trouble to lock closely at the colour of a lake will have seen that the bottom by the bank is light but appears dark towards the middle. This effect can be imitated by treating the surface under the glass plate with suitable paint.

Real water can be used in the model setout by using a basin made of wood with a rubber inlay, as in fig. 70. It can be emptied by means of a rubber tube used as a suction pipe. The banks of a lake like this must be modelled with particular care.

(e) Streams and Rivers

As the water in a small stream is not seen unless one stands right on its banks, it is generally sufficient to make a small channel in the model valley terrain and let the banks of the stream made in this way be overgrown with the bushes that grow there naturally. If, on the other hand, a large river is wanted in the set, it can be made up in the way mentioned in Section (d).

(f) Meadowland

Where there is to be a meadow, the surface should be painted with size, a dark meadow-green having already been made up with green and yellow dry colour, and this should be spread over the sized surface for the meadow by a sieve. If the season is to be Spring, we must also not forget to have some flowers in the meadow and this can likewise be done by spreading suitable colouring by means of the sieve. It is advisable to hold the sieve rather higher over the meadow surface to get the best spreading effect.

If the season is to be Summer, however, haystacks must be modelled in the plaster, unless it be desired to build these up in the way described in Section (h).

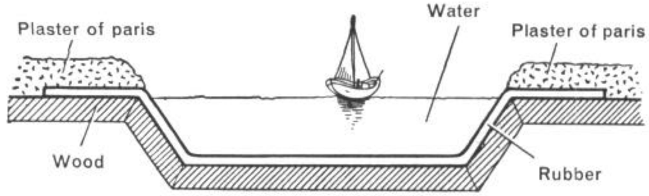


Fig. 70
If the basin be provided with a rubber inlay, it can be filled with water.

(g) Arable Land

As our plaster of paris countryside already has a brown colouring as it is, the colour will only need freshening somewhat to make it resemble ploughed land (Spring or late Autumn), in the same way as the meadow or pasture land. Furrows can also be modelled in it.

If, for example, a cornfield with standing corn as in high summer is wanted on the layout, it can be modelled later on. If the plaster of paris is set too hard so that it is difficult to scrape, moisten its surface with a brush to get the effect desired.

Supposing the corn to be standing 1½ metres high, for instance, the cornfield would then have to be 150 ÷ 87, or 1.7 centimetres higher than the rest of the ground to keep to the same scale. The yellow colouring – which should be mixed with some brown in this case – can be produced in the usual way. Bear in mind that in Nature cornfields are seldom met with on steep slopes, though vineyards and fruit orchards often are.

(h) Bushes, Shrubs, Vines, Trees and so on

Foliage can be represented by sticking dyed sponge or natural dried moss on to twigs for tree trunks. What has to be watched here is that the height of the trees and width of their foliage crowns are kept more or less to scale.

(i) Houses and Buildings

The best materials to use for buildings are plaster of paris, soft fibreboard or wood.

4. Subsequent Work

After the work of shaping and colouring the scenery is finished, all risk of dirtying the track sections is over and the railway itself can now be started on

(a) Building the Track

According to the plan now being followed, all signals, railway crossings, contact rails, circuit breakers, overhead wires etc. will be in place.

The dull noise that occurs when trains run over track laid on plywood is most disturbing and so, when modelling the scenery, do not forget to lay an insulating strip of felt, cardboard or corrugated cardboard at the places where the track sections will come.

The layout will already look quite good at this stage of construction, but its final finish will come with the detail work that now begins.

(b) The Detail Work

Telephone huts, gradient boards, fences and, where there are cuttings, protective lattice framework against snowdrifts, can be fixed along the track. Representations of safety strips for protecting forests and heath land, crossing keepers' cottages with their sheds and gardens, must likewise not be forgotten.

At stations the main building can be supplemented by smaller service buildings, such as baggage sheds and garages.

Signposts and traffic signs must be put up on the roads.

Small communities must be completed, the market place, fountain, monuments, churches, schools, the town hall and the village trees not being overlooked.

Anyone who does not wish to make these for himself should get whatever of them is missing from his layout from shops that specialise in them.

(c) Just a few more Hints

When building up a set it must never be forgotten that there is always an original to copy. Nature and the constructional elements of a full-sized railway are our great teachers, so that the railway builder who best knows how to see Nature in all her fineness of detail will succed in making the finest set. It is therefore advisable, in all cases of doubt – and not only those that are concerned with the immediate surroundings of the line – to go out to Nature and there see how similar things are done.

The colouring especially should be noticed, as the colours are never pure but shaded in some way or other; never forget to let the set show one season of the year only. Snow-covered mountains standing in a Spring landscape will have a delightful effect.

When the construction of the set is finished, it can be enlivened by people, vehicles and animals of all kinds. The passengers pouring into the station will then share with us in the great moment when our first scheduled train runs in.

The Great Example

B. The Electrical Equipment for Working MÄRKLIN Railways

A knowledge of the electrical units of measurement is essential for an understanding of the discussion of electrical equipment and the basic principles will therefore be explained in the following for those of our friends who do not yet know what these units are.

I. Electrical Units of Measurement

Electrical units are best explained with the aid of comparisons. The energy of a waterfall will be the greater the higher the fall and the greater the amount of water falling in a second.

Electricity is much the same. The electrical energy of a current – measured in volt-amperes or watts – is the greater the higher the electrical fall and the greater the amount of current flowing per second. Electrical engineers call the fall the tension or voltage and the quantity of electricity the current strength. The unit for electrical tension or voltage is the volt, denoted by V. In electrical engineers' formulae the tension is denoted by the letter U.

The unit for the strength of the electrical current is the ampère, denoted by A. In formulae the current strength is expressed by the letter I.

The unit for electrical power or output is the volt-ampère, abbreviated to VA. In formulae, the power or output appears as the letter N.

For calculating the energy *consumed* by our railway we can take 1 VA as approximately equal to 1 watt or 1 W.

(Continued on page 61)

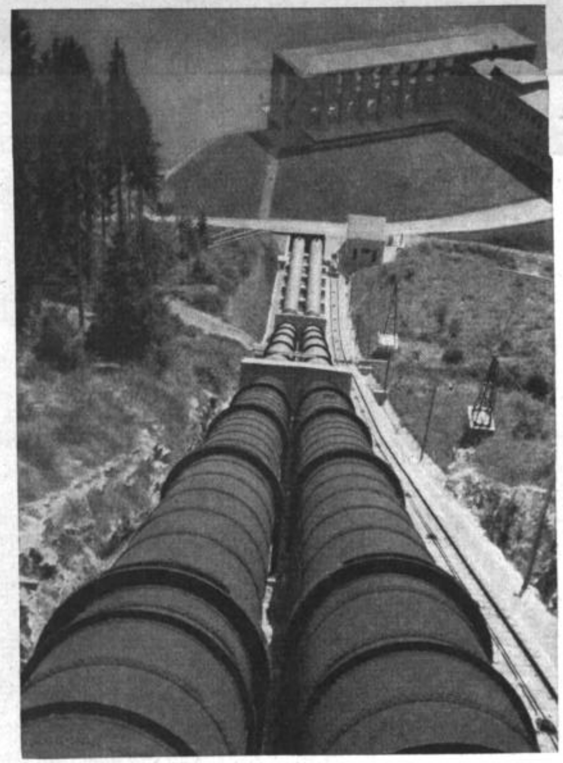
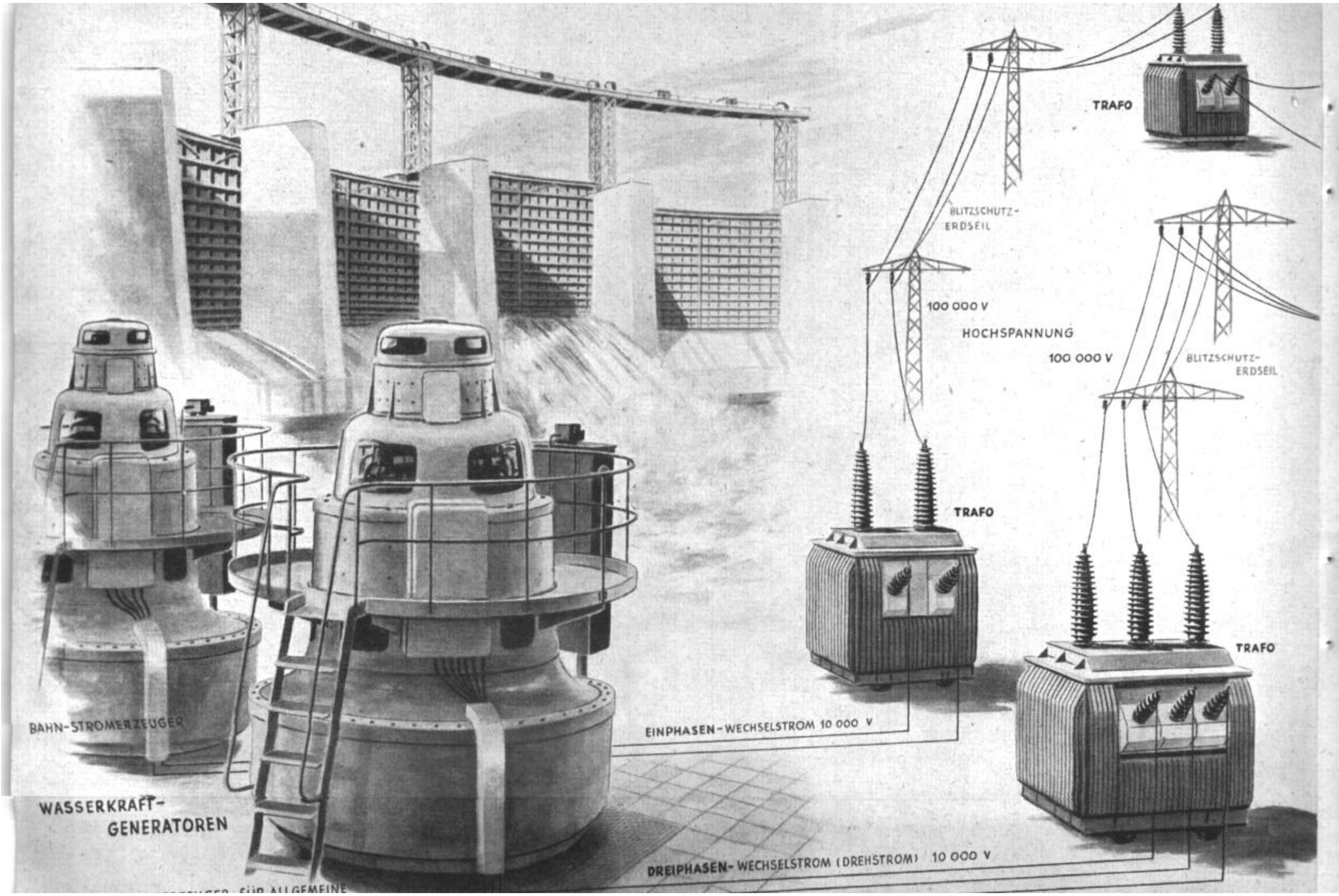
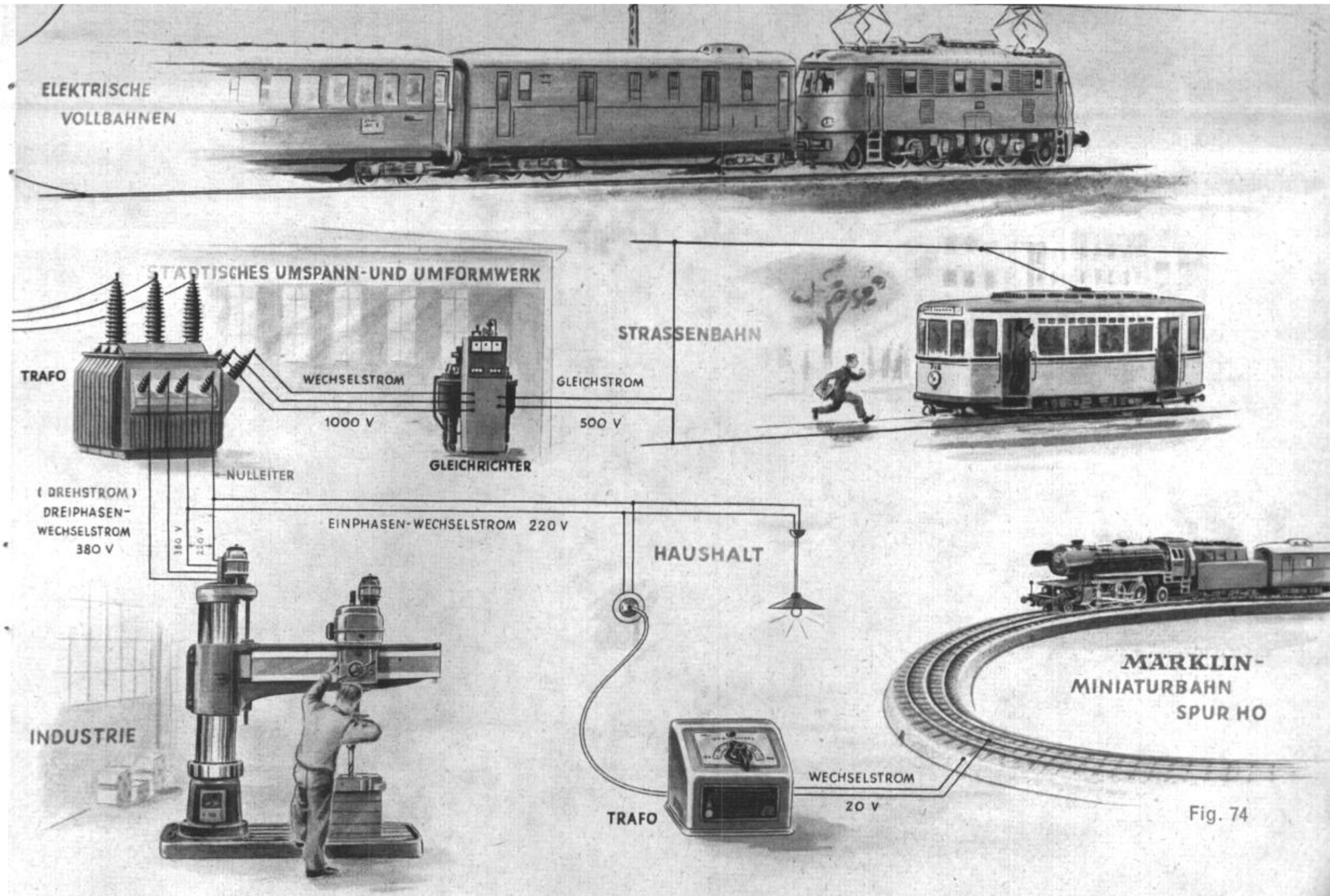


Fig. 73 The Penstocks and Turbine House of a Mountain Hydro-Electric Power Station

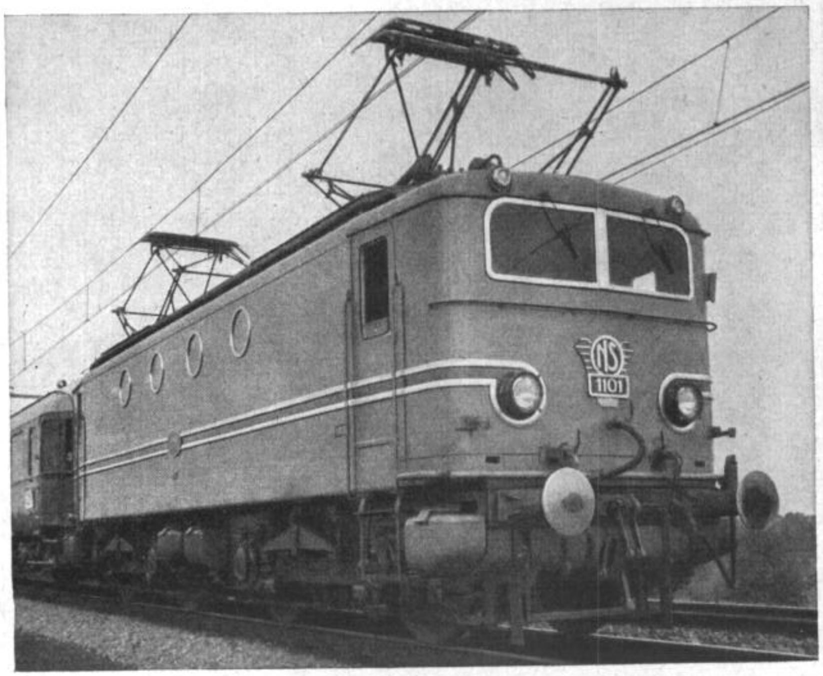

TRAFO
BLITZSCHUTZ-
ERDSEIL
100 000 V
HOCHSPANNUNG
100 000 V
BLITZSCHUTZ-
ERDSEIL
TRAFO
TRAFO
BAHN-STROMERZEUGER
EINPHASEN-WECHSELSTROM 10 000 V
WASSERKRAFT-
GENERATOREN
DREIPHASEN-WECHSELSTROM (DREHSTROM) 10 000 V


ELEKTRISCHE
VOLLBAHNEN
STÄDTISCHES UMSPANN-UND UMFORMWERK
TRAFO
WECHSELSTROM
1000 V
GLEICHSTROM
500 V
GLEICHRICHTER
STRASSENBAHN
NULLEITER
(DREHSTROM)
DREIPHASEN-
WECHSELSTROM
380 V
380 V
220 V
EINPHASEN-WECHSELSTROM 220 V
HAUSHALT
INDUSTRIE
MÄRKLIN-
MINIATURBAHN
SPUR HO
TRAFO
WECHSELSTROM
20 V
Fig. 74

An Explanation of fig. 74 on pages 58 and 59

From 100.000 volts to the 20-volt tension of our MÄRKLIN Model Railway

Electrical energy can be transmitted cheaply and easily over any distance and so the current is generated where the power required for it, such as the water power in the mountains, for instance, is available.



The water is stored up there in huge artificial lakes called basins and supplied to the water-driven turbines through big pipes. In the generating station the water does useful work by driving generators (or dynamos). The voltage of the current generated is stepped up to a high value by a transformer and transmitted over high-tension lines to wherever it is to be used, where transformers bring down the high voltage to the service voltage.

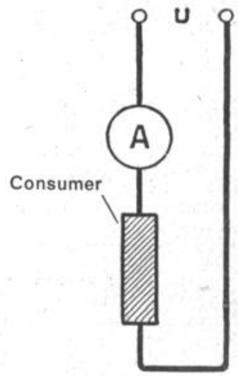
In the plains, too, and in the various coal areas, large generating stations are to be found, where there are brown coal, or lignite, and low-grade mineral coal, to be had as cheap fuel for steam-driven generating plants.

Fig. 75

A Netherlands Railways Series 100 express locomotive, 0-4-4-0 type, the prototype of the MÄRKLIN type SEW. 800 miniature locomotive.

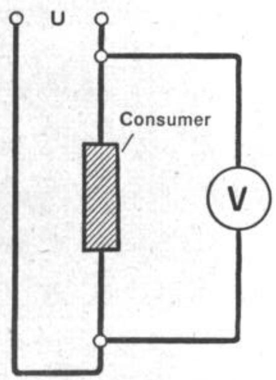
Fig. 76 shows how a meter – called an ammeter – is connected up to measure the strength of the current. The current consumer and meter are connected in series. In a closed circuit the strength of the current is the same everywhere and so the ammeter can be connected up at any point desired.

Fig. 77 shows how a voltmeter is connected up. This meter always measures the difference in tension or voltage and so has to be connected in parallel with the circuit. It is connected at the two points where the difference in voltage is to be measured.



Current strength measurement by an ammeter

Fig. 76



Voltage measurement by a voltmeter

Fig. 77

There is a very definite relationship between the three electrical magnitudes mentioned and this is expressed *in the* form of the following equation, i. e. : –

Volts × ampères = watts, or abbreviated:

$$U \times I = N$$

The power of 1.000 watts is called 1 kilowatt, or 1 kW.

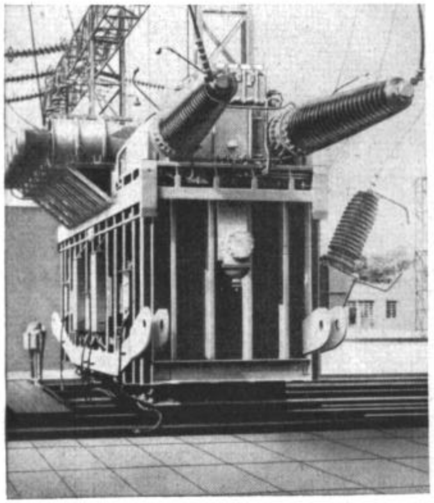


Fig. 78
A Step-down static Transformer (Open-air type), for three-phase 50-cycles current. Output 100,000 kVA with three windings for 230,000, 110,000 and 10,000 volts.

If an electrical appliance be connected to the mains supply the current flowing through it will perform a certain amount of work, and this will be the greater the longer the current flows through the appliance. It is measured in watthours (Wh) or kilowatt-hours (KWh), *and calculated* by the following formula:

Electrical energy = electrical output × time.

The "h" in Wh and KWh is an abbreviation for "hour".

An example of a calculation will serve to make the relationship more clear.

An electric lamp takes 0.3 ampère current on a 220–volt current supply; its consumption is:

$$N = U \times 1 = 220 \times 0.3 = 66 \text{ watts.}$$

If this lamp burns for ten hours, the work done is:

$$\text{consumption} \times \text{hours} = 66 \times 10 = 660 \text{ watt-hours.}$$
$$\text{equals } 0.66 \text{ KWh.}$$

Now that the more important units of electrical measurement have been explained the general representation on pages 58 and 59, fig. 74, will be understandable. It shows how electrical energy is generated, transmitted and made use of.

As the illustration shows, MÄRKLIN Miniature Railways are run on a 20-volt current that is absolutely safe and free from all risk.

II. MÄRKLIN Mains Connection Units

1. For Alternating Current (A. C.)

With *alternating* current the values of both voltage and current change extremely rapidly – a hundred times a second in most A. C. systems. As each two successive changes of the course of the current constitute one oscillation – or cycle or period, in technical terms – this A. C. has fifty cycles per second. A unit called the Hertz (1 Hz) is used for measuring these oscillations.

Meters for measuring A. C. current or voltage values have to be limited to showing mean values.

Owing to its characteristic properties mentioned, there are more opportunities for using A. C. in practice than D. C. A. C. that is available at a certain voltage can be transformed into other A. C. having a higher or lower voltage.

A transformer consists of two windings or coils with no conducting connection whatever between them, these windings being mounted on a core made up of sheet-iron laminations (see fig. 79). The winding connected to the supply mains is called the primary winding (or primary) and the other one the secondary winding (or secondary).

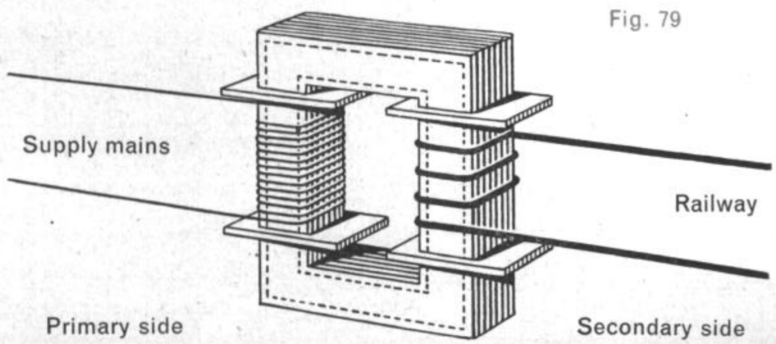


Fig. 79

Fig. 80

The MÄRKLIN 280-A Transformer-"Perfection in Switching" - for connecting to A. C. systems.

Alternating current flowing through the primary coil or winding sets up a magnetic field in the iron core, its polarity constantly changing with the oscillations of the current. This oscillating magnetic field sets up - or "induces", as the electrical engineer *says* - *another* alternating current and this induced current is known as the secondary current. The value of its voltage can be calculated accurately, being dependent mostly on the value of the primary voltage and the number of turns of wire on the two coils.

MÄRKLIN transformers also work on this principle. The primary winding, therefore, has no conducting connection with the secondary winding, and consequently the mains current cannot flow into the railway system.

When buying and using MÄRKLIN transformers the value of the mains supply voltage the transformers are to be connected to must always be found. Transformers must never be connected up to anything but an A. C. system with the same voltage as that shown for the primary on the transformer rating plate, though voltage differences of 10% may be disregarded.

The value of the mains supply voltage and the type of current can always be read from the electricity meter. Electrical engineers use a ~ sign for A. C. and a - sign for D. C.

2. Connecting a Railway to D. C.

With D. C. there is no change in the current value as with A. C. and consequently D. C. cannot be transformed. It must first of all be converted into A. C. by a mutator. If a railway is to be connected up to a D. C. supply, the current path will be as follows:

Mains supply - mutator - MÄRKLIN transformer - Railway.

A mutator is therefore essential if a railway is to be connected up to a D. C. supply, though under certain circumstances a rotary converter can be used in place of a mutator and transformer. Mutators and rotary converters are obtainable from electrical shops.

3. Constructional Details of MÄRKLIN Transformers

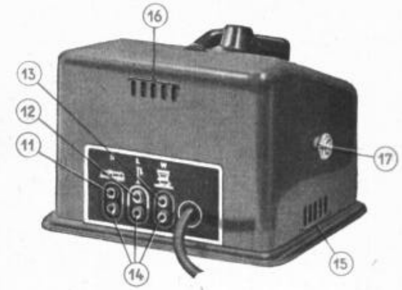
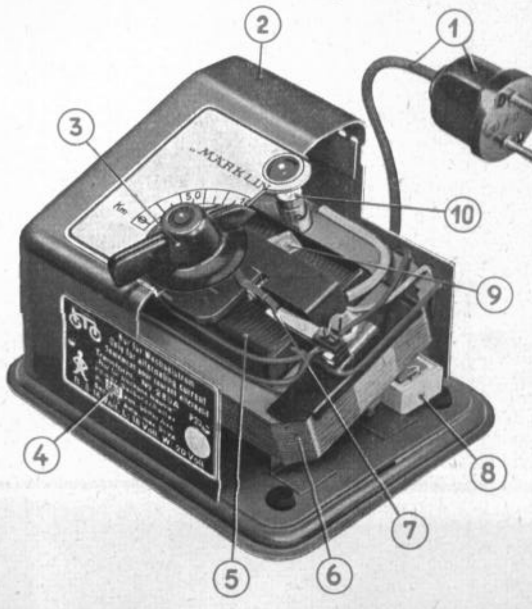


Fig. 81. Th[illegible]o. 280–A Trans-f[illegible] – rear view

As will have been gathered from the foregoing remarks, MÄRKLIN transformers are needed for operating the railway, whether it be connected up to a D. C. or A. C. mains supply system. They transform the high mains supply voltage into safe voltages of various strengths.

For the lighting system on the railway and for working the electro-magnetic points, signals etc., they provide current at 16 volts when loaded.

In the case of the connection for working the railway, the voltage mostly varies between 8 and 16 volts, according to the speed desired, so that no additional rheostat is needed for controlling the speed of a locomotive. If the transformer knob be pressed down, the ordinary railway working voltage is switched off and the 24–volt reversing voltage switched on to actuate the reversing switches of the locomotives (for further details see "Perfection in Switching", page 82.



The No. 280–A transformer (figs. 80, 81 and 82) has an additional 20-volt circuit that is used to supply current to single-coil magnetic accessories of the older type. Figs. 81 and 82 show the following principal parts of the transformer.

Figs. 81 and 82 show the following principal parts of the transformer.

1 Lead and plug for mains connection — 2 Deep-drawn sheet-steel housing — 3 Rotary controller switch for infinitely-variable speed regulation — 4 Rating plate showing the rated voltage — 5 Copper wire winding — 6 Core made of special iron laminations — 7 Switch lever with contact springs — 8 Thermal cut-out — 9 Slider spring to pick up current from the winding — 10 Warning light — 11 Connecting socket (red) — 12 Connecting socket (yellow) — 13 Connecting socket (green) — 14 Three connecting sockets (brown), used for earth connections — 15 Openings to admit fresh air (to cool the winding) — 16 Outlets for warm air — 17 Earthing screw.

All MÄRKLIN transformers are fitted with an automatic short-circuit cut-out or circuit-breaker that protects both the railway system and the transformer windings as well against all danger. If the transformer should be connected up to too high a voltage by mistake, the circuit-breaker will automatically cut off the current. Its action is not, however, confined to the mains or primary side only, as it also looks after the railway system or secondary side. Should a derailment occur or a short-circuit be caused on the railway from any other reason whatsoever, the circuit-breaker will switch off the transformer after a brief period, the current to the transformer being switched on again after about a minute. The operation of the circuit-breaker can be seen by the red warning light which goes out when the circuit-breaker switches off.

A flickering lamp shows that the current is about to be switched off. That is the time to stop operations and rectify the short-circuit. If there is no warning light fitted to the transformer, a bulb can easily be inserted in the secondary circuit in any position desired.

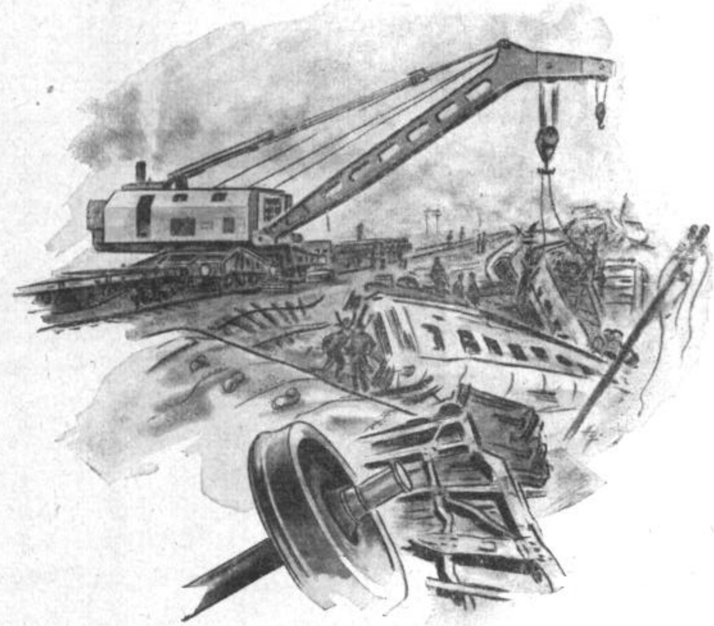


Fig. 83 The breakdown train crane clearing the wreckage from the scene of an accident

MÄRKLIN transformers should be used for working a MÄRKLIN Railway not only because they supply the voltages required for proper working but also because they can be handled with perfect safety.

4. How many Transformers are needed for small and large Layouts?

To answer this question the output of MÄRKLIN transformers must be known on the one hand, and the current taken by the various locomotives and other current-consumers on the other.
The values are accordingly summarised in the following.

Output:

No. 280–A transformer:	30 VA
No. 278–A transformer:	16 VA

Current taken:

Locomotives CM and CE–800:	9–10 VA
Locomotive DA–800:	10–11 VA
Locomotives TM, TT, SET, SEW, SEWH, RET, SK, G, F–800 and most locomotives of the older types:	10–15 VA
Rolling stock DL, CCS and ST 800:	15–20 VA.

If there are only a few wagons coupled to the locomotive, the current taken is about the lower of the two values given, the higher of the two values being with a large number of wagons behind the locomotive. The figures given include the current consumed by the locomotive lamps, but lighting in the coaches etc. is additional.

The current taken by other current-consumers:

Bulb No. 485 with push-in fitting:	0,9 VA
Bulb No. 495 with screw fitting:	1,25 VA
Bulb No. 499 with screw fitting:	1,25 VA
Turntable No. 410–NG:	9 VA
Slewing crane No. 451–G:	10–20 VA
Coils for signals and points:	4–6 VA

Separate transformers should be provided from the outset for each locomotive running at the same time as others. A simple calculation will show whether these transformers can supply all other current-consumers also. The current taken by turntable and slewing crane should not be included in the calculation at its full value, as one of the locomotives is generally at a standstill while these accessories are working. Nor need any account be taken of the current consumed by the coils for signal and points operation, as such consumption is only momentary and all MÄRKLIN transformers will stand overloading.

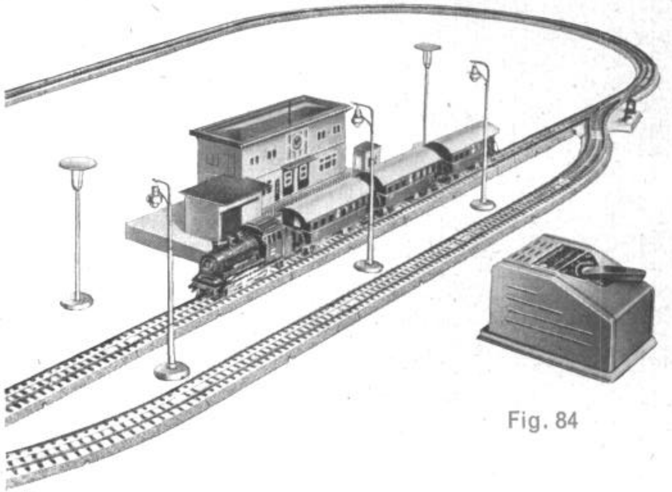


Fig. 84

The following example will show how the current consumption of a railway system can be calculated.

Example No. 1

The CM–800 locomotive is operated by a No. 278–A transformer.

Query: Can five arc lamps with No. 495 bulbs also be included? (Fig. 84.)

Calculation:

Locomotive with its load:	10 VA
5 bulbs, each 1,25 VA:	6,25 VA
Total:	16,25 VA.

There is therefore no objection to connecting the lamps to the transformer.

Example No. 2

A railway system consists of a goods train and six wagons, drwan by a TM–800 locomotive.

Query: Will the output of a No. 278–A transformer be sufficient if three signals (with bulbs No. 485) are set up on the track?

Calculation:

Locomotive with average load:	13 VA
3 bulbs No. 485, each 0,9 VA:	2,7 VA
Total:	15,7 VA.

The signals can therefore be installed and operated.

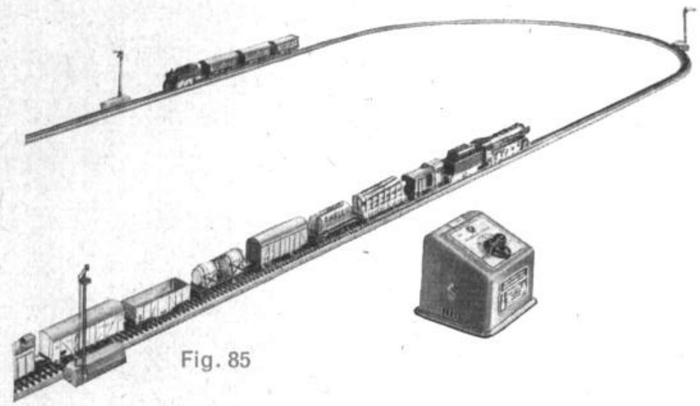


Fig. 85

Example No. 3.

Two trains are to run on a system with 3 block signals each taking 0,9 VA (fig. 85).
Train No. 1: Locomotive TM–8000 with three coaches.
Train No. 2: Locomotive G–800 with ten goods wagons.

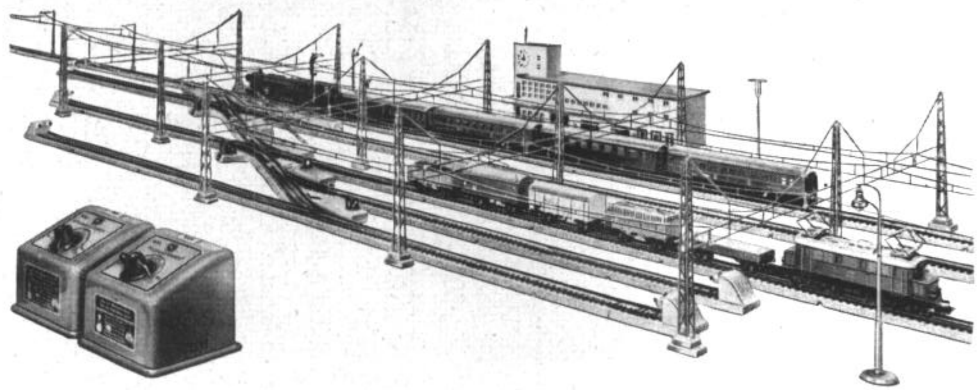
Query: Can the system be run with one No. 280–A transformer?

Calculation:

Train with G–800 engine and ten goods wagons:	15 VA
Train with TM–800 engine and three coaches:	10 VA
Lighting for three block signals:	2,7 VA
Total:	27,7 VA

As the No. 280–A transformer has a 30 VA output, the system in question can be run without difficulty, though operation with two trains is far more interesting if a separate transformer is used for each individual train.

Fig. 86



Example No. 4.

A large system has the following current-consumers.

Locomotive F–800 with four express coaches with interior lighting; locomotive SET–800 with five 4-wheeled wagons. The system also includes five signals, 5 points and two lamps with No. 495 bulbs. Two No. 481 lighting fittings are used for lighting buildings.

Query: How many VA must be provided?

Calculation:

F–800 with 4 express coaches, approx.:	14 VA
Interior lighting with 4×3 bulbs No. 485, each 0,9 VA, altogether:	10,8 VA
SET–800 with 5 wagons:	13 VA
5 signals with 6 bulbs No. 485, each 0,9 VA, altogether	5,4 VA
5 points with No. 495 bulbs, each 1,25 VA, altogether	6,25 VA
2 lamps with No. 495 bulbs, each 1,25 VA:	2,5 VA
2 No. 481 lighting fittings with No. 499 bulbs, each 1,25 VA:	2,5 VA
Total:	54,5 VA.

The output of a No. 280–A transformer is 30 VA and so two such transformers must be provided. (Fig. 86.)

III. MÄRKLIN Locomotives

1. The Way Energy is supplied

(a) The possibilities for this generally are as follows.

In standard railway practice there are several forms of energy used for driving the locomotives; at the present time steam and electricity are mostly used.

Energy from steam is generated in the steam locomotive itself but electrical energy has to be supplied through conductors. The path followed by the current through an electrically-driven locomotive is shown in fig. 87.

Steam and electricity can also be used to provide the power on miniature railways as well, though locomotives of the HO gauge size are too small for steam traction. In order that steam-prototype locomotives can be operated by electricity on a miniature railway system a practical means of supplying the energy had to be found, and various possibilities have been tried in the course of time.

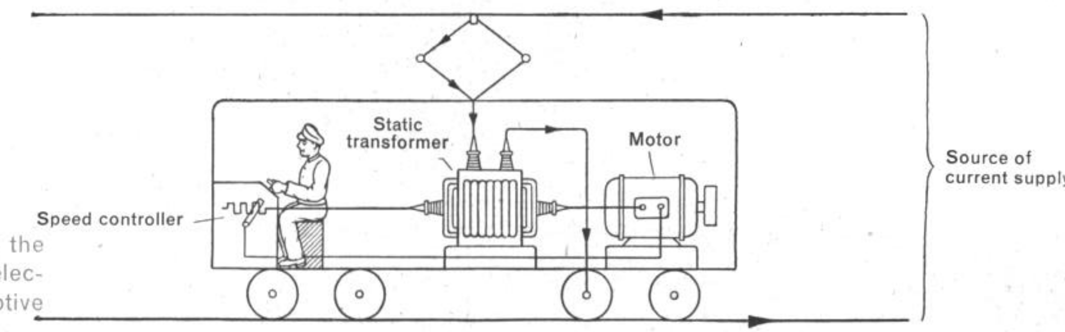


Fig. 87

The path followed by the current through an elec- (trically driven) locomotive

The Two-Rail System

All wheels on one side of the rolling stock are insulated electrically from the wheels on the other side. This provides the opportunity for picking up the current from the source of supply through one rail and taking it back through the motor to the source through the other rail.

The Third-Rail System

The electric current is supplied to locomotives of the steam type through a central conductor in between the track rails. The path of the current in locomotives supplied from the overhead wire is through exactly the same arrangement as on the full-size prototype with this system. The third-rail system furthermore has the advantage of not requiring the wheels to be insulated, as well as simplifying the construction of track formations such as occur with points, crossings etc.

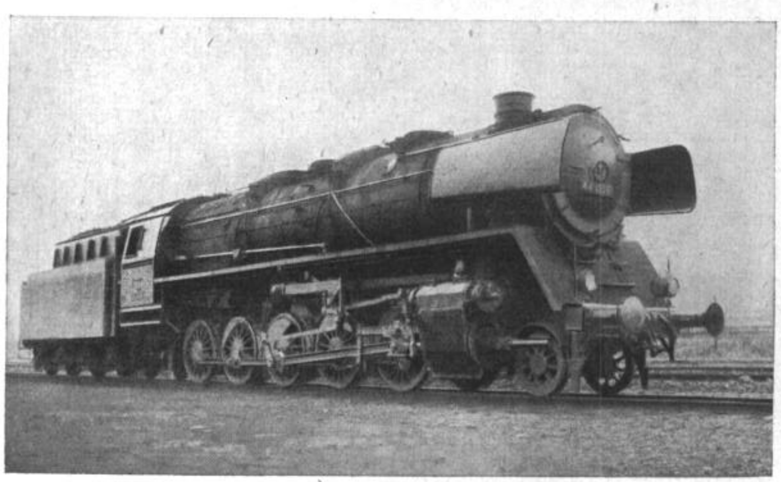


Fig. 88

Series 44 2–10–0 type goods locomotive of the German Federal Railways. The prototype of the MÄRKLIN miniature locomotive No. G–800.

(b) The MÄRKLIN Current Supply through Ground-level Conductors

Steam-type locomotives pick up their current from the third (centre) rail in the middle of the track (fig. 89).

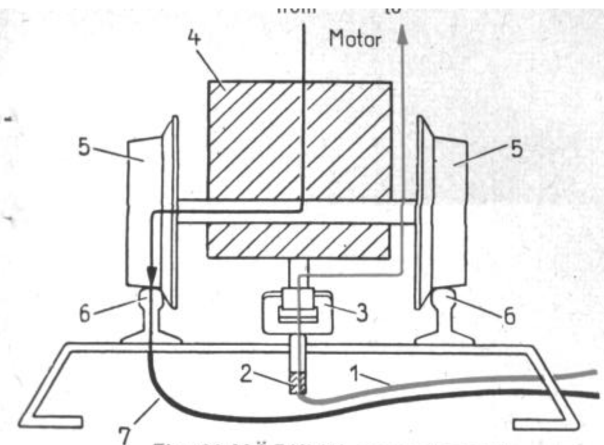


Fig. 89 MÄRKLIN current supply through the third rail

The Current Supply

The current comes from the mains unit (transformer) through the red lead 1 of the track contact section to the third or centre rail, is picked up from there by a collector shoe 3 underneath the locomotive and passes to the motor.

The Current Return

After the current has done work in the motor, reversing gear and lighting, it returns through the body of the locomotive 4 through the wheels 5 to the rails 6 and is taken from there through a brown lead 7 back to the mains unit or transformer.

A special point that may be mentioned is that MÄRKLIN locomotives with a pantograph collector on the roof can also be run from the centre rail between the track as well.

(c) The MÄRKLIN Current Supply from the Overhead Wire

Just as in full-sized railway practice, an insulated overhead wire suspended above the track conducts the current which is picked up by an insulated collector on the roof of the locomotive and taken to the motor, where it does its work. From the motor the current returns through the wheels and rails back to the power supply unit.

The path of the current with the MÄRKLIN overhead wire system is shown in fig. 91.

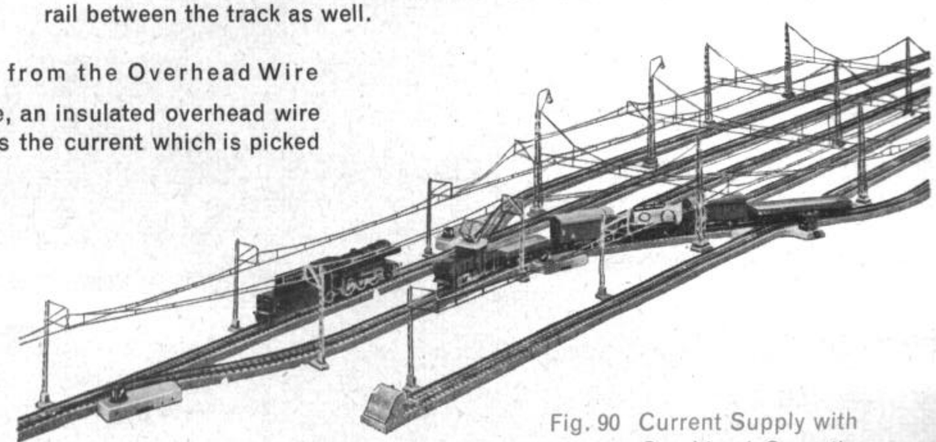


Fig. 90 Current Supply with Combined Operation

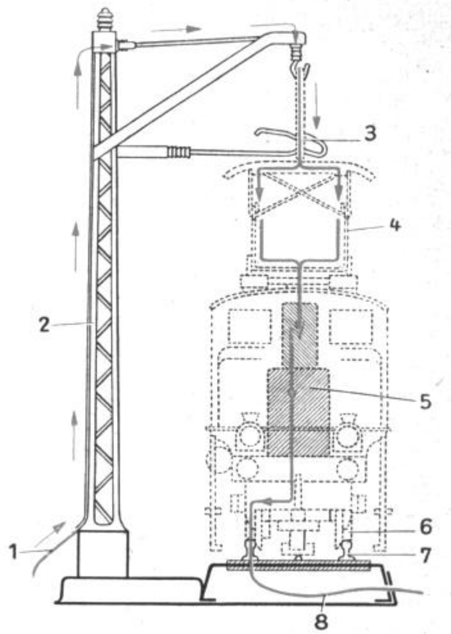


Fig. 91 The path of the current in the MÄRKLIN Overhead Wire System

Current Supply

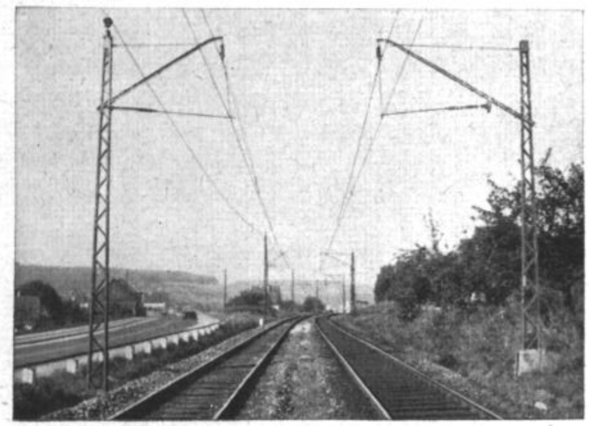
Mains unit (transformer) – red lead (1) – contact mast (2) – overhead (or trolley) wire (3) – current collector on the roof of the locomotive – the locomotive motor – reversing gear and locomotive lighting system. After the current has done its work in the locomotive motor and the reversing gear it flows back to the mains unit (transformer).

Current Return

Locomotive motor, reversing gear and lighting system – the body of the locomotive (5) – wheels (6) – rails (7) – brown lead (8) – transformer (mains unit).

(d) The Current Supply with Combined Operation

The speeds of two trains running over one and the same section of track can be regulated independently of each other if one picks up its current from the third rail and the other from the overhead wire, though each conductor must be supplied from its own separate transformer. The train service can ce run with either two electric-type locomotives on different bircuits, or with one steam-type locomotive and one electric type.



The overhead wire with lattice masts on a double-line track section

2. Running as many trains as you like

(a) With the third rail

Large systems can be split up into several sections of track insulated from one another by inserting a third rail insulating section No. 3600–Z, each of the sections being then fed with current by its own separate transformer (see figs. 94 and 95). Care must be taken with this, however, to make sure that the polarity of the current of all the transformers is the same.

To find out whether the polarity of all the transformers is the same, proced as follows.

1. Connect up transformer No. 1.
2. Connect up transformer No. 2 and see that its mains connection plug is in its right position. This is done as follows.
3. Set the two transformers for track sections 1 and 2 to give half the railway operating current.
4. A bulb (arc lamp or the like) is connected across the centre rail of section 1 and the centre rail of section 2 (fig. 93). If the bulb burns very brightly, the second transformer has the wrong polarity and its mains connection plug must be turned round through 180 degrees, i. e., reversed. If the bulb does not light up at all, both transformers are connected up correctly.

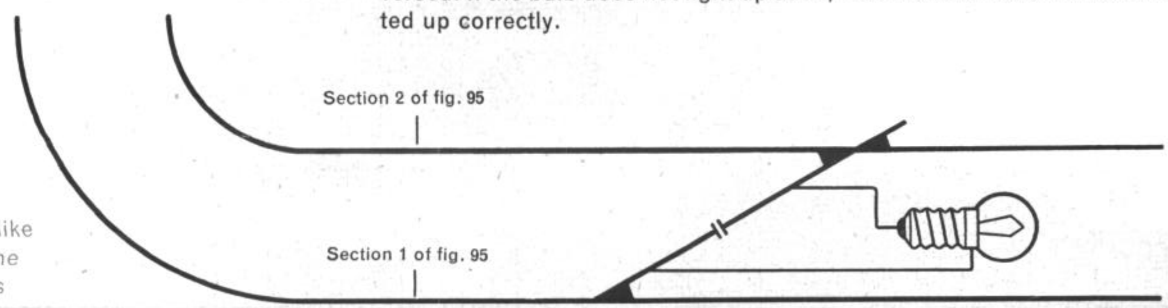


Fig. 93
Testing for like *polarity of the* transformers

5. Connect up transformer No. 3 and check its polarity in the way described on the previous page. The bulb should then be connected across the centre rails of track sections No. 2 and 3.

6. Every additional transformer placed along the track system must be tested for polarity as soon as it is connected up.

Note specially that two transformers must never be connected up to the same track section.

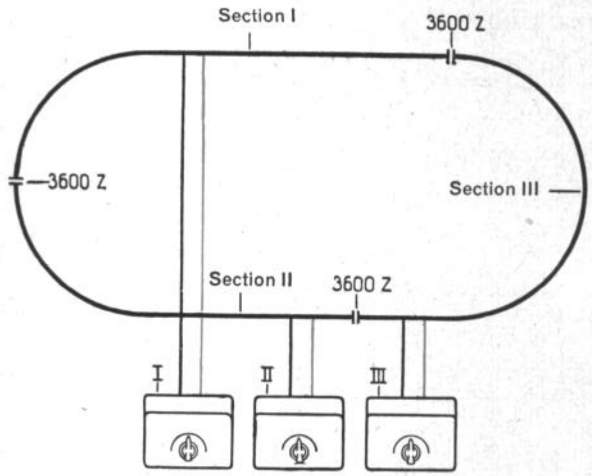


Fig. 94

A system can be split up into several sections separate from one another by inserting centre rail insulating or isolating track sections No. 3600–Z.

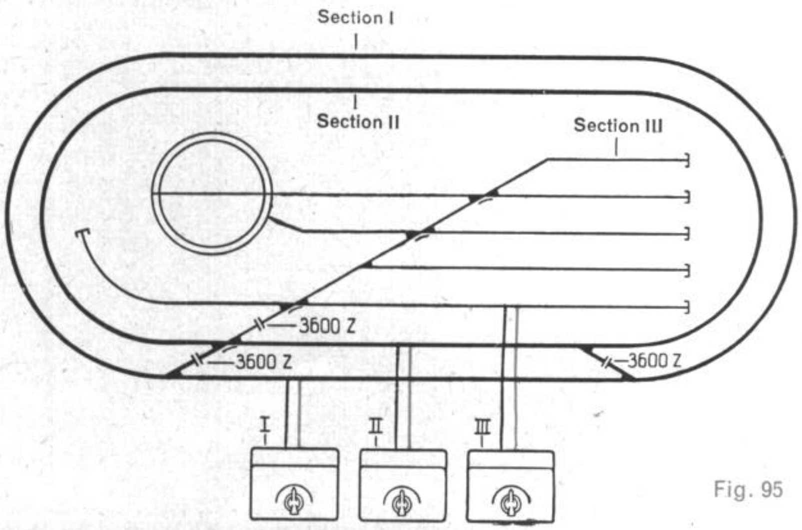
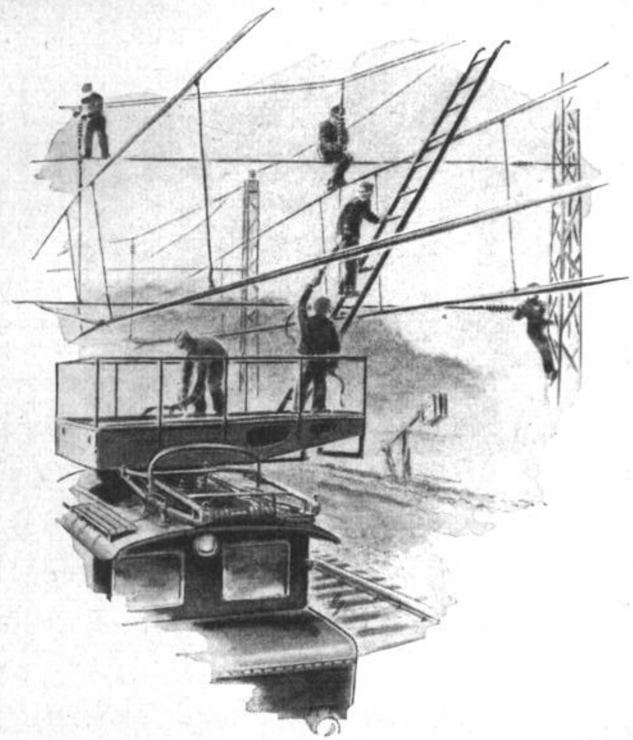


Fig. 95

(b) The Overhead Wire


Overhead wire erection with a tower car

Where there are breaks in the third rail the overhead wire circuits are also isolated from one another by inserting an interrupter section No. 409–U. Current is supplied to each overhead wire circuit from the rail current socket of a transformer. The two transformers (for the third rail and overhead wire), must be connected to each other by an earth lead. When the overhead wire transformer has been connected up its polarity must set to that of the third rail. Test in the way given for the third rail; in this case the bulb must be connected across the overhead wire and the middle third rail. The polarity of transformers for additional overhead wire sections must be checked in the same way.

(c) General Remarks regarding Working with several Locomotives

The speed of each locomotive running on an large system can be regulated from the transformer for the section the engine is running over. Where are there two locomotives on one and the same section, both will run at the same speed, provided they both have the same transmission ratio and both take the same amount of current.

This kind of running is undesirable and so a home or track lock signal should be placed at the commencement of each section to stop a second locomotive running in.

Fitting the signals and automatic block working are fully described in the MÄRKLIN Signal Book No. 446/99.

(d) Stopping one or more locomotives in a Section

If the supply of current to a locomotive is to be cut off for the time being by the transformer, a track block or home signal must be placed at the desired position on the track. If a signal is not wanted there, however, the track section can be isolated and the current switched on and off by the No. 475/4 control panel (see fig. 97). The four tracks or roads in this figure can be selectively supplied with current by pressing the appropriate switch.

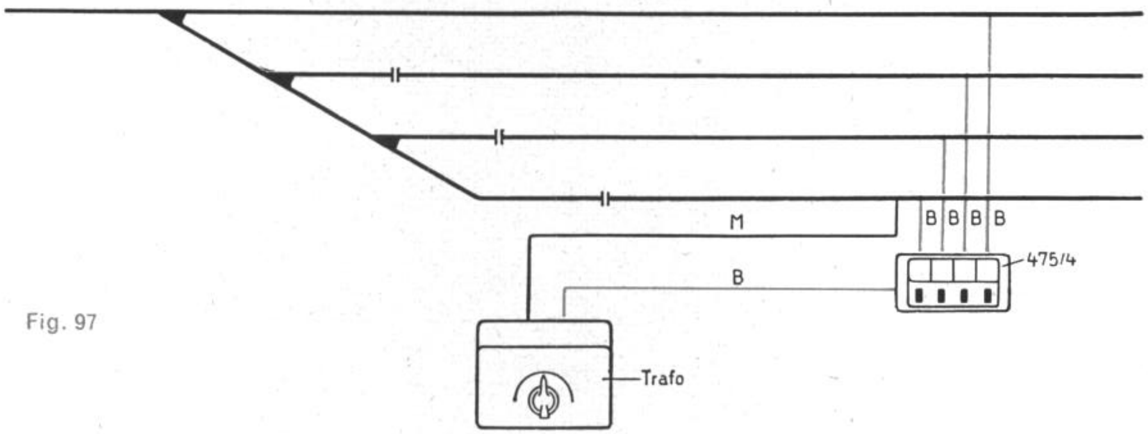


Fig. 97

3. The Electrical Equipment on MÄRKLIN Locomotives

All MÄRKLIN fans should get to know all about the constructional details of the locomotives, as a knowledge of these things will enable them to put any small defects right. Before describing the individual parts, however, a general idea of the electrical circuit on the locomotives can be given.

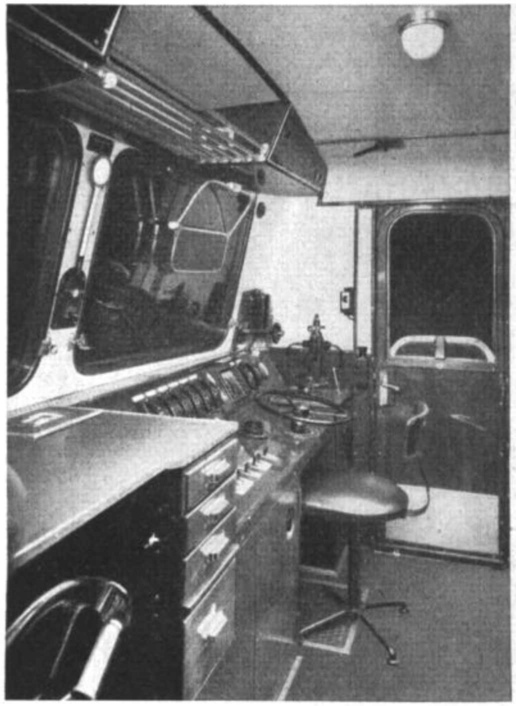


Fig. 98

The Driver's Cab of Electric Locomotive No. E 10001 (0-4-4-0 type) of the German Federal Railways, built by the A.E.G., Berlin

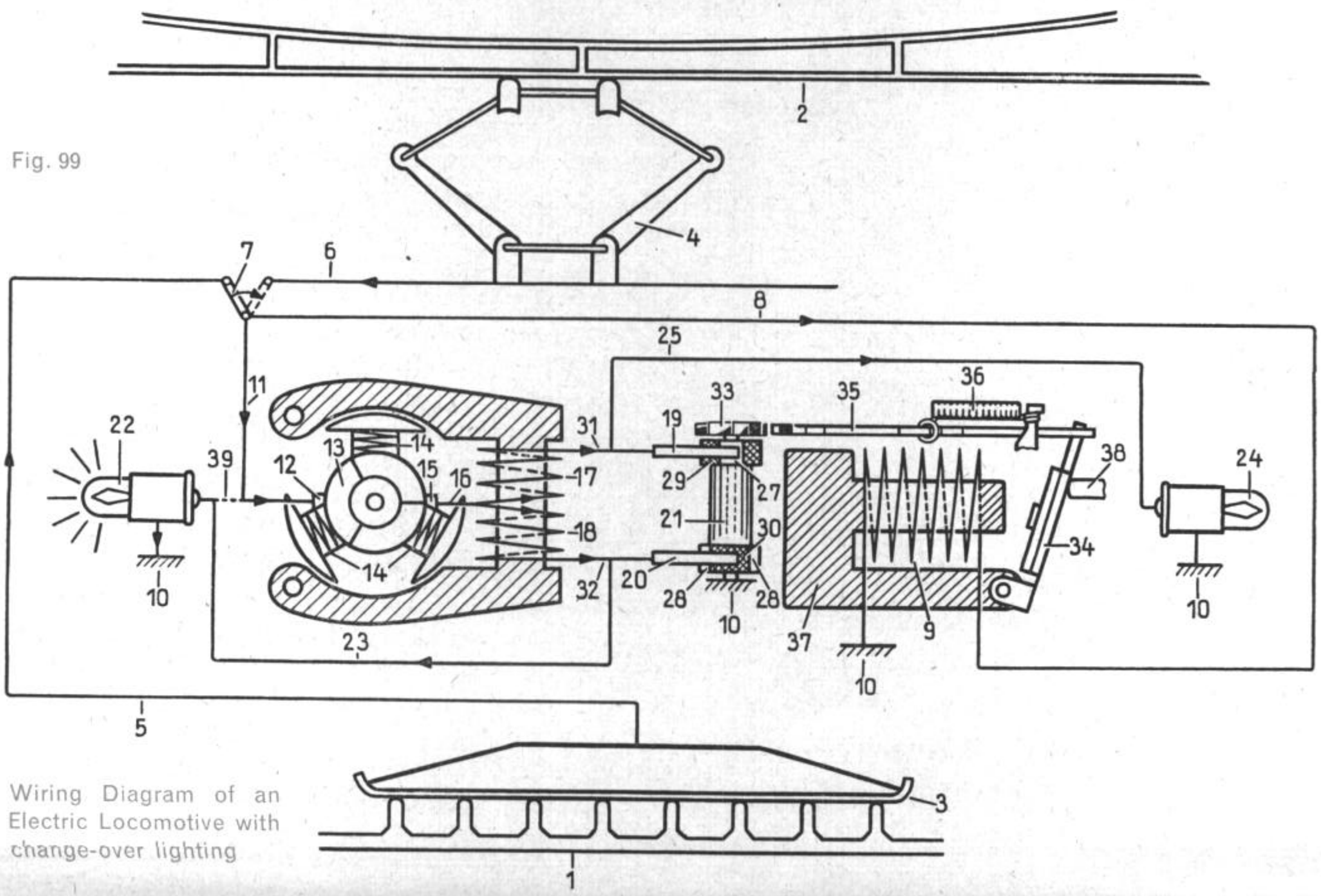
(a) A General Idea of the Electrical Circuit of the Locomotives.

The wiring diagram of an electric-type locomotive with change-over lighting is given in fig. 99 (see fig. 101 also). The voltage from the centre rail 1 or overhead wire 2 passes through either the collector shoe 3 or the current collector on the roof 4 via the leads 5 and 6 to the switch 7.

The current required for working the locomotive is taken either from the third rail or the overhead wire, according to the position of this switch. In the position shown in the drawing the connection is made with the third rail. The position of the switch shown in dotted lines is the circuit for all the locomotive's equipment with the overhead wire. The current splits up at switch 7, flowing on the one side through a lead 8 and winding 9 of the reversing switch to the body of the locomotive 10 and so through the wheels of the locomotive to earth. On the other side, current flows through a lead 11 to the locomotive motor, passing to the armature windings 14 through brushes 12 and a three-part commutator 13 (see fig. 100 also). Through brush 15 and lead 16 it goes to one of the two field windings 17 or 18, then passing back to earth 10 through one of the two contact springs 19 and 20 on the switch cylinder or drum 21. The current for the two front lamps 22 (lead 23) and the two tail lamps 24 (lead 25) is taken from the contact springs.

Parts Nos. 4 and 7 of this equipment are not provided on steam-type locomotives.

Fig. 99



Wiring Diagram of an Electric Locomotive with change-over lighting

(b) The Locomotive Motor

All electric motors have an armature and an electromagnetic field (the field laminations 26, figs. 100 and 101), connected in either parallel or series. MÄRKLIN motors have the armature and field connected in series, the current flowing from the armature 14 (fig. 99) to the field 17 or 18. The motor is series wound and therefore develops great tractive effort with a high starting torque. All series wound motors can be run off both kinds of current, i. e., alternating (A. C.) or direct (D. C.).

For the armature to change its direction of rotation the direction of current must be changed in either the field or armature. Changing the direction of current in both field and armature does not alter the direction of running.

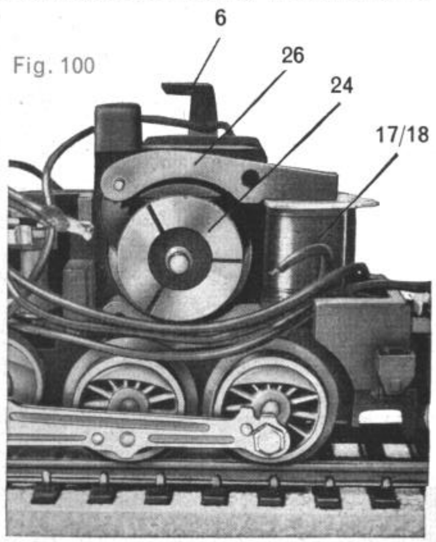
MÄRKLIN motors reverse by means of two opposing field windings 17 and 18 (see fig. 99), the current passing through only one of these two field coils or windings at a time. The motor runs forward on winding 17 and reverses on winding 18.

The current path through the two field coils is controlled by the switch drum 21 in the reversing switch.

(c) The Reversing Switch

The metallic parts of this switch, and the contact discs or segments 27 and 28 particularly, are conductively connected to the body of the locomotive 10 and therefore to earth also. The two spring contacts 19 and 20 can bear both on the contact segments as well as the isolated segments 29 and 30. When a spring contact is on a contact segment the circuit of the field coil it is connected to is closed. Thus, if spring contact 19 is on contact segment 27, current will flow through field winding 17 passing through lead 31, and the motor will then run forward. If both spring contacts are on isolated segments, the current will be interrupted and the armature cannot move at all, so that the locomotive then remains stationary.

Fig. 100



The Locomotive Motor with the motor casing removed.

The switch drum 21 is turned by a ratchet wheel 33 actuated by a switch armature 34 and switch plunger 35, the plunger being returned to its original position by a return spring (36). In addition to the parts mentioned, the magnet laminations (37) and coil or winding (9) also form part of the reversing switch.

(d) "Perfection in Switching"

The parts just mentioned combine to make up this ideal switching system. The switch drum 21 is made so that each movement of the switch plunger 35 causes a fresh movement to take place in the engine. The sequence of these movements is as follows.

1. Forward running.
2. Stop with engine lights on.
3. Running in reverse.
4. Stop with engine lights on.

The current path in these various stages of movement can be followed by means of the remarks under (c) page 81 and fig. 99.

Reversing can be effected:

1. By the manual reversing lever 38 on the locomotive that presses the switch armature 34 against the laminated magnet 37, or
2. By the operation of the electro-magnet 9 that moves the switch armature in the same direction.

The railway working current flows continuously through the coil 9, but the magnetic force developed in the magnet laminations is too weak in comparison with the tension of the return spring 36 to move the switch armature. Not until the railway working current has been replaced by the stronger switching current by pressing the knob on the transformer will the magnetic force in the reversing switch be sufficient to attract the switching armature so as to turn the switch drum into its next position.

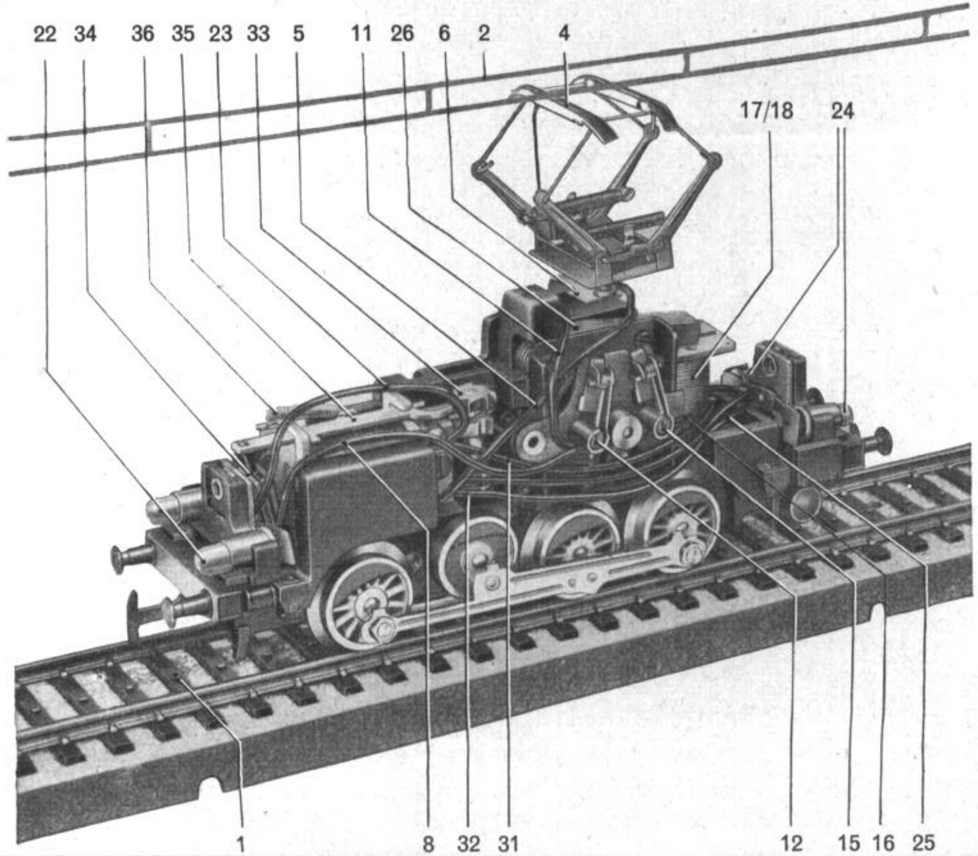


Fig. 101

All our fans who are thoroughly well acquainted with our reversing switch (the locomotive auto-switch) and the "Perfection in Switching" that it provides, esteem it very highly indeed, as its switching operations ensure the locomotive working *satisfactorily and without* any trouble whatever.

There are two things to bear in mind, however.

1. The return spring 36 of the reversing switch is set while the locomotive is being put together so that the switching operation takes place when the transformer knob is pressed if the transformer is supplied with current at the rated mains voltage. Unfortunately it sometimes happens that considerable voltage fluctuations take place up or down in lighting circuits.

   If the voltage is low in the mains, the switch armature 34 will not be attracted, so that in such case the return spring must be eased somewhat.

   With a high voltage in the mains the switching operation will sometimes be completed when the locomotive is set to run at high speed, so that the reversing switch "buzzes". The return spring 36 should then be tightened somewhat.

2. If the higher current is fed to the track for too long a period, the locomotive may jump when the switch changes from the "Stop" to "Run" position, and this is called "buck-jumping". This can be lessened very considerably by pressing the transformer knob only very briefly when reversing.

(e) Locomotive Lighting

The bulbs for locomotive lighting are run off the railway working current the same as the motor of the locomotive. The wiring diagram of the bulbs for a locomotive with change-over lighting is given in fig. 99.

A Shunting Engine at work at night in a goods yard

In the position shown, the engine is set for forward running. The small amount of current for the bulbs 22 flows through the armature 14, field winding 18 and lead 23, the motor field being excited at this moment by the field winding 17. The bulbs 24 do not receive any current with this as, finding no resistance, current passes through the switch cylinder direct back to earth. If, when running reversed, the motor current passes over the spring contact 20 to earth 10, then spring contact 19 is isolated. In this case, therefore, the bulbs 24 will be fed with current, but the bulbs 22 not.

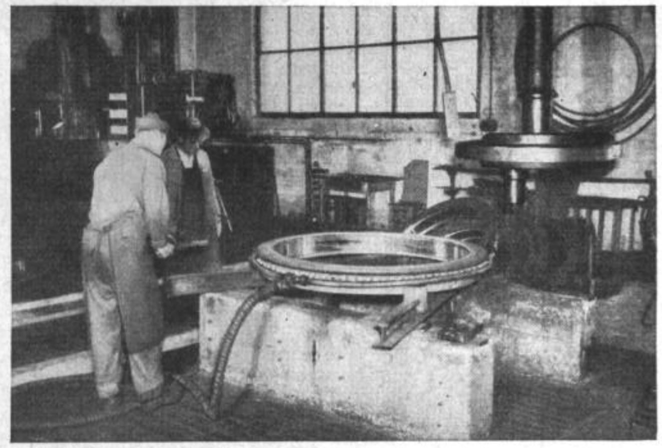
If both springs 19 and 20 are isolated – the "Stop" position on the switch – all four lamps on the locomotive will light up.

On some MÄRKLIN locomotives the lighting current for the change-over lamps is distributed by a drag switch that answers to the change of direction of rotation of an axle, and in that case only one pair of lamps will light up with the switch cylinder in the "Stop" position.

The lighting of locomotives without the change-over lighting is connected directly to the railway working current and then the two connections behind the field coils are omitted, there being the connection 39 shown dotted for the front lamps in fig. 99 in their place.

C. Rolling Stock

All MÄRKLIN Railway fans are very well aware of the excellent design and construction of MÄRKLIN rolling stock, but not everyone owning these miniature railways has had sufficient opportunity of learning the details of their full-sized prototypes. For that reason a description of the constructional features of the locomotives and carriage and wagon stock of a full-sized railway has been given pride of place in the following remarks.



Shrinking a Tyre on to a Wheel

I. Classification and Description of Locomotives and other Motive-power Stock

The tractive effort exerted by locomotives and other motive-power stock is used to pull railway rolling stock. The energy this requires is generated either by steam engines or electric motors, and sometimes by petrol, diesel and compressed-air engines as well, and transmitted to driving wheels. The purpose for which an engine or motive power unit is to be used can be gathered from the size of the driving wheels, which are therefore generally characteristic features of locomotives.

1. Generally Characteristic Features of Locomotives

Express locomotives have large wheels, being required to cover as great a distance as possible with one revolution of the wheels. Slower passenger train locomotives have medium-sized driving wheels, as they are not expected to run at any specially high speeds. Goods engines, on the other hand, have small driving wheels, as they have to exert very high tractive efforts at low speeds.

High-speed locomotives not only have large driving wheels but are also carried on smaller wheels as well, usually in separate frames, so as to keep safely on the rails. A distinction is made between two-wheeled trucks and multi-wheeled bogies.

The number and arrangement of carrying and driving wheels is given very simply, the carrying wheels being denoted by Arabic numerals and the driving wheels by Roman capital letters. Thus, for example (see fig. 105):

A denotes a locomotive with single driving wheels;

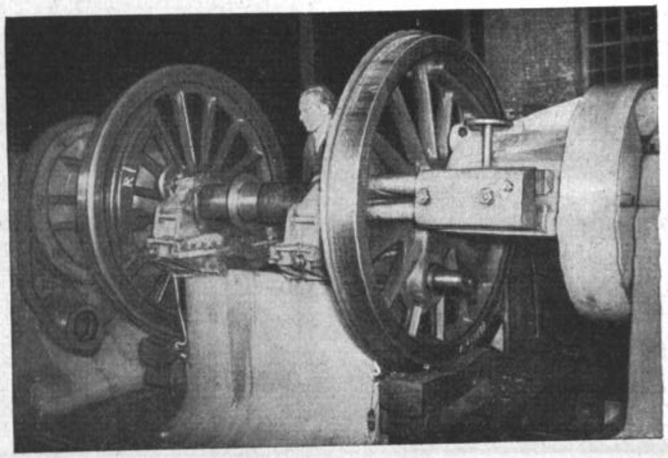
B denotes a locomotive with four-coupled wheels;

C denotes a locomotive with six-coupled wheels, and so on.

The number of carrying axles is given by Arabic numerals either in front of or behind these letters, according to their arrangement. A locomotive with six driving wheels coupled together by coupling rods is therefore denoted by C (fig. 105–a), and a locomotive with four-coupled driving wheels and two nonpivoting wheels in the frame by 1 B (see fig. 105–b and similarly 105–c also).

If the carrying axles do not have their bearings in the main frame of the locomotive but in their own truck or bogie, this is shown by a stroke at the top right of the number. A locomotive with four-coupled driving wheels and one carrying axle in a truck would be denoted by I'B (fig 105–d). Further examples of this kind are given in fig. 105 under e and f.

In some types of locomotives the driving wheels also are carried in two or more separate frames arranged so as to pivot in the main frame of the locomotive.

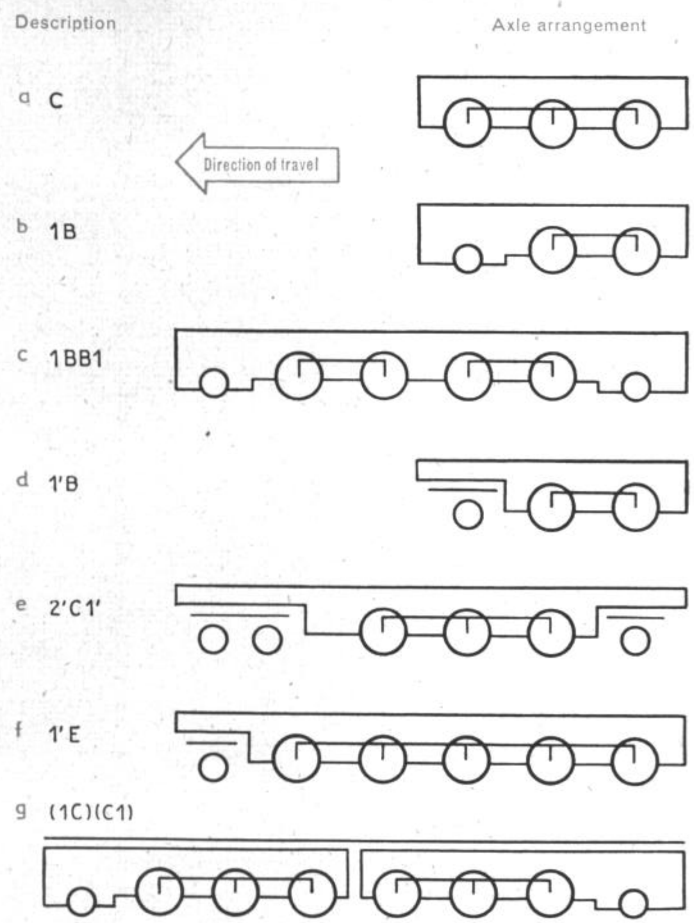


A Roller-burnishing Lathe in a Repair Works

The characteristic signs for such axles are shown in parentheses. If a locomotive has two bogies each with sixcoupled driving wheels and one carrying axle in the frame, the arrangement is denoted by (1 C) (C 1) (fig. 105–g). If the two carrying axles can pivot about a vertical pin in these bogies, the axle sequence is then expressed by (1′ C) (C 1′).

Electric-type locomotives are often fitted with individual axle drive, the driving wheels not being coupled by coupling rods, each axle being driven by its own motor. In such case the distinguishing letter has a small "o" added to it. Thus, l'Do denotes a locomotive with four motors, each driving an axle and with a carrying axle in a truck (fig. 105–h). Driving axles with single-axle drive carried in two separate bogies make up the Bo′ Bo′ axle arrangement, i. e., the locomotive has two four-wheeled bogies (fig. 105–i). Tenders and railcars (fig. 105 k and l, and m and n) have also been included in this system. The figure with the tender designation gives the capacity of the water tank in cubic metres.

In addition to these descriptions there are various others in use in different countries. A C locomotive, for instance, is termed a 3/3 in Switzerland, a 0–3–0



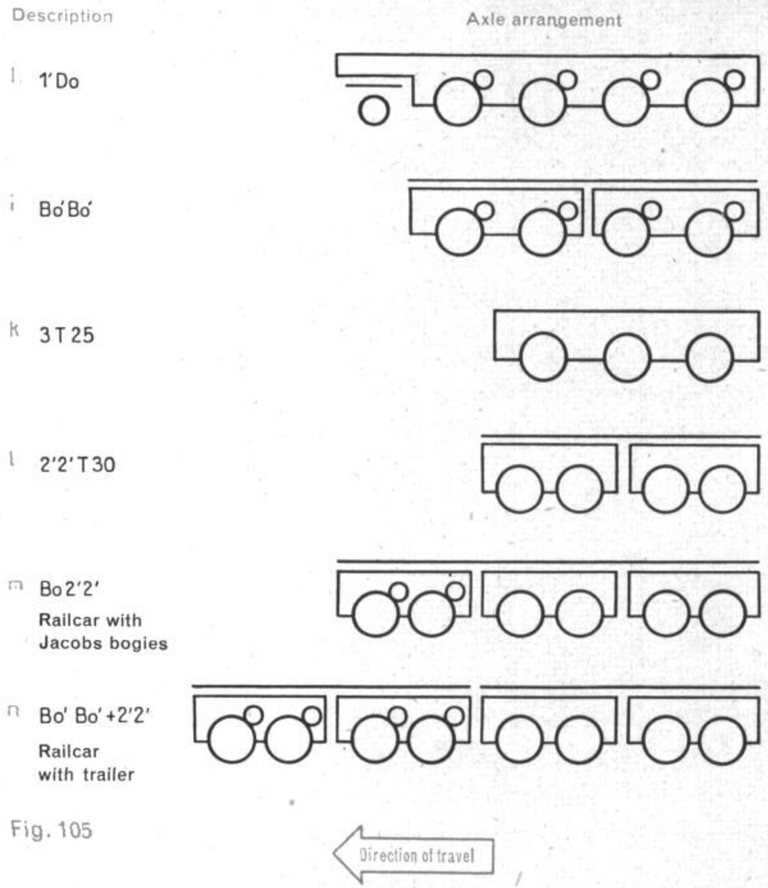


Fig. 105

in France and an 0-6-0 in America. A (1' C) (C 1') is also a $^6/_8$ in Switzerland (6 being the number of driving axles and 8 the total number of axles); in France, a 1-6-1 (number of axles) and in America a 2-12-2 (number of wheels).

2. Designation of Steam Locomotives

Steam locomotives travelling over long distances need large quantities of coal and water which are carried in a special truck called a tender.

Locomotives for short-distance journeys and shunting, on the other hand, do not need such large quantities, so that their needs can be met by water tanks and coal bunkers on the engine itself. They thus combine locomotive and tender in one. Such engines are known as tank engines in contrast to locomotives with separate tenders.

Locomotives are classified in a simple way by letters, the designations being as follows.

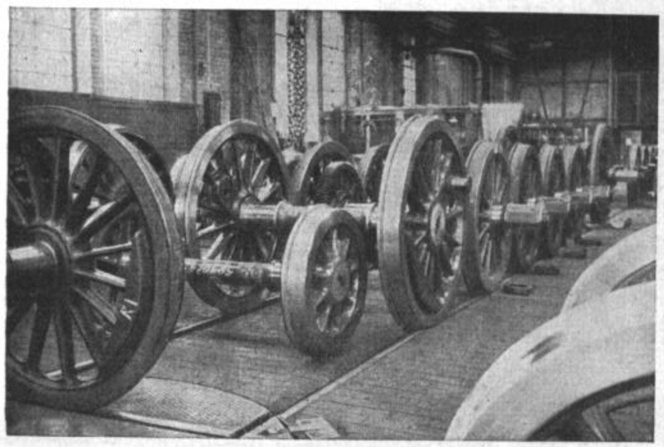
Express train locomotives with tender:	S
Passenger train engines with tender:	P
Goods locomotives with tender:	G
Rack railway locomotives:	Z
Local service engines:	L

A small "t" is added to these main classification letters to denote tank engines, viz:

Express train tank engines:	St
Passenger train tank engines:	Pt
Goods tank engines:	Gt

The service numbers on locomotives of the steam type also denote their type and service they are engaged on. The first two figures of the service number form what is called the basic number, denoting the type or series of the engine. Steam locomotives in Germany have the following basic numbers.

Express train locomotives:	01 to 19
Passenger train engines:	20 to 39
Goods engines:	40 to 59
Express and passenger train tank engines:	61 to 79
Goods tank engines:	80 to 96
Rack railway locomotives:	97
Local service engines:	98
Narrow-gauge locomotives:	99



Sets of Wheels waiting to be fitted

The locomotive with the number 01 039 (see fig. 107) is therefore an express train engine with separate tender, of the 01 series with the consecutive number 39.

Service type symbols were also inscribed on steam locomotives. Thus, for instance, S 36.20 denoted an express locomotive with three driving axles (six-coupled) or with six axles (three being carrying axles) altogether. The figure 20 is the axle load in tons per driving axle.

From this service type symbol the maximum tractive effort could be calculated approximately. In the ordinary way it is one-fifth the frictional weight:

Tractive effort = Number of driving axles multiplied by the axle load multiplied by one-fifth.

The tractive effort of the express engine mentioned above, S 36.20, can therefore be calculated as:

$$3 \times 20 \times {}^{1}/_{5} = 12 \text{ tons.}$$

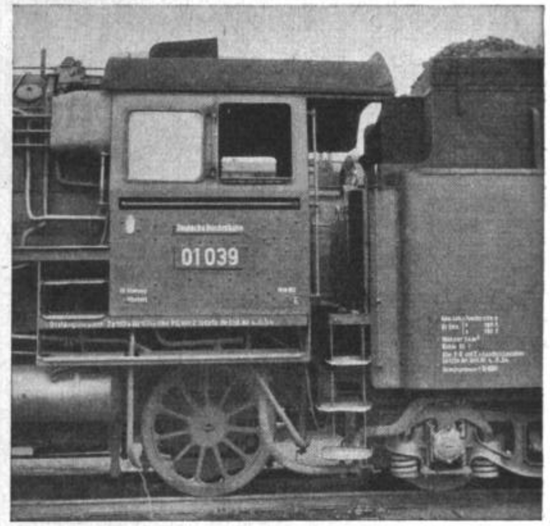


Fig. 107
Inscriptions on a Steam Locomotive without a Service Type symbol

There is also a still greater number of service descriptions and numbers that cannot be gone into here. The number of locomotives differing considerably from one another even outwardly is great, and, in addition, they also need various kinds of descriptions with regard to their date of manufacture and the firms that built them.

3. Description of Electric Locomotives

Electric locomotives have the letter E in front of their type number, the latter being apportioned as follows in Germany.

Express locomotives	E 01 to E 29
Passenger train locomotives	E 30 to E 59
Goods locomotives	E 60 to E 100

The service number of an express train locomotive, made up of its type number and consecutive number, could therefore be E 1835 (fig. 108).

Fig. 108

The description of an electric express locomotive

4. Description of Diesel Locomotives

All diesel locomotives carry a "V" in front of their type number to show their power unit is an internal-combustion engine (V for Verbrennungsmotor, the German word for an internal-combustion engine). As in the case of the locomotives already mentioned, the service number consists of a two or three-figure type number and a three-figure consecutive number. Multiplying the type number by ten gives the horse-power of a diesel locomotive.

Fig. 109 The description of a Diesel Locomotive

The diesel locomotive No. V 200001 in fig. 109 is the first of its kind and has 2000 H.P. (200 × 10).

Diesel locomotives and other locomotives of lesser power with a maximum speed not exceeding 30 kilometres (approximately 20 miles) per hour and less than 150 H.P. carry the letter K (for Kleinlokomotive, or small locomotive) with small letters after it denoting how the locomotive is driven, as follows.

b (Benzole)	Driven by a petrol or benzole engine
ö (Oel – oil)	do. diesel engine.
d (Dampf – steam)	Driven by a steam engine.
s (Speicher – accumulator)	Driven by an electric motor deriving its current from an accumulator.
e (Elektromotor – electric motor)	Driven by an electric motor.
f (Flüssigkeitsgetriebe – hydraulic transmission),	locomotive with hydraulic power transmission.

Köe, for example, would denote a small locomotive with a diesel engine and electric motor, working on the diesel-electric principle (see page 101).

The designation letters of these locomotives are followed by a four-figure number.

5. Description of Railcars

Railcars have various letters prefixed to their service numbers according to their method of propulsion namely:

VT Railcar or railbus driven by an internal-combustion engine (fig. 110).
VS Railcar trailer car with control gear.
ET Electric railcar.

The trailer cars of all railcars driven by internal-combustion engines are denoted by the letters VB.

Railcar service numbers are made up in the same may as locomotive service numbers, with the type number giving the maximum speed of the railcar.

Fig. 110
The Description on a Railbus

VT 01–19	Bogie railcar with a maximum speed of 120 kilometres (74 miles) per hour and over.
VT 20–39	Bogie railcars with a maximum speed of 100 to 119 kilometres (63 to 74 miles) per hour.
VT 40–59	Bogie railcars with a maximum speed of 85 to 99 kilometres (53 to 62 miles) per hour.
VT 60–69	Bogie railcars with a maximum speed of 65 to 84 kilometres (40 to 52 miles) per hour.
VT 70–79	Railcars with radial axles and a maximum speed of 65 to 85 kilometres (40 to 52½ miles) per hour.
VT 80–89	Railcars with radial axles and a maximum speed of 64 kilometres (40 miles) per hour.
VT 90–99	Narrow-gauge and special railcar types (such as railbuses, sightseeing cars, railcars for steep inclines etc.).

The consecutive number following the type number has either three or four figures. The first figures of the consecutive number denote the type of propulsion of the railcar, the figures 0 to 4 being for electrical transmission, 5 to 8 for hydraulic transmission and 9 for mechanical transmission.

As an example, the number VT 959189 shows that it is a railbus (type number 95) with mechanical power transmission (the first figure of the consecutive number being 9).

II. Types of Locomotives

1. Steam Locomotives

Steam locomotives derive their tractive effort from high-pressure steam. Valves operated by what is known as the Heusinger valve gear control the steam in such a way as to cause the pistons to move backwards and forwards, setting the driving wheels of the engine in motion by means of the connecting rods.

In the remarks that follow, special consideration will be given to locomotives that are the prototypes of the miniature engines now being made by the MÄRKLIN concern.

(a) Express Engines

The 01 and 03 Series are the locomotives that have become the best known ones, these long and massive engines being found on all the trunk line routes of the German Federal Railways. The two-cylinder Series 01 4-6-2 express engine (fig. 111) was the prototype for the **F 800** express tender locomotive. The original has a great tractive effort and its maximum speed is 130 kilometres (just over 81 miles) an hour. Its length, measured over the buffers, is 23.94 metres, or approximately 78 feet.

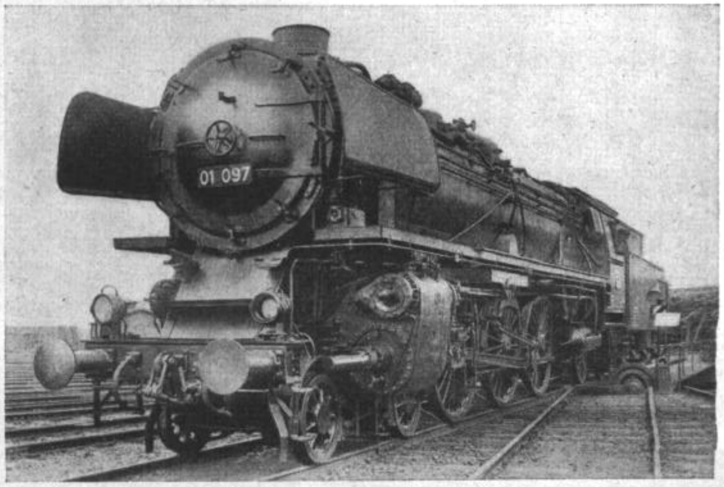


Fig. 111

The Series 01 Express Locomotive of the German Federal Railways. Prototype of the F 800 miniature locomotive

The **SK 800** MÄRKLIN Locomotive is a replica of the streamlined Series 06 of the German Federal Railways (fig. 112), though its design has been simplified somewhat for economic reasons. The wheel arrangement of the original is 4-8-4, whereas the replica has a 4-6-4 arrangement.

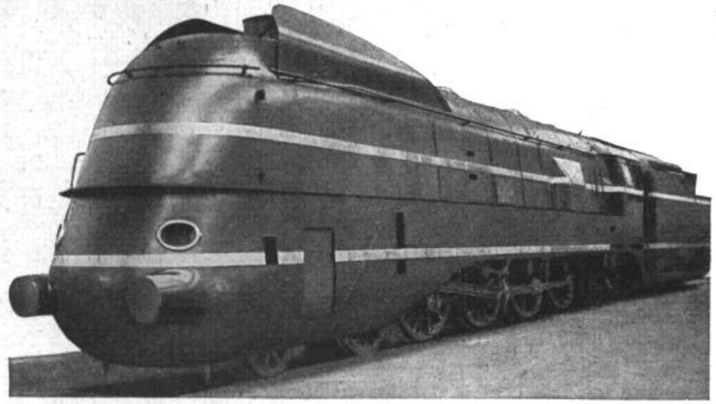


Fig. 112
The Series 06 Streamlined Locomotive, prototype of the SK 800 MÄRKLIN miniature Locomotive

(b) Passenger Train Engines

Among the tender locomotives of the Series 23 are the latest passenger train engines of the German Federal Railways. 21.30 metres (approximately 70 feet) long over the buffers; they can reach a maximum speed of 110 kilometres (nearly 70 miles) per hour and they are allowed to run at a speed of 85 kilometres (approximately 54 miles) per hour in reverse. They are designed for passenger train services of medium weight and are also used for light expresses. Fig. 113 shows one of these locomotives full size in comparison with its MÄRKLIN No. **DA 800** replica.

The tender locomotives mentioned under goods locomotives are also frequently used in ordinary railway practive for local passenger train services.

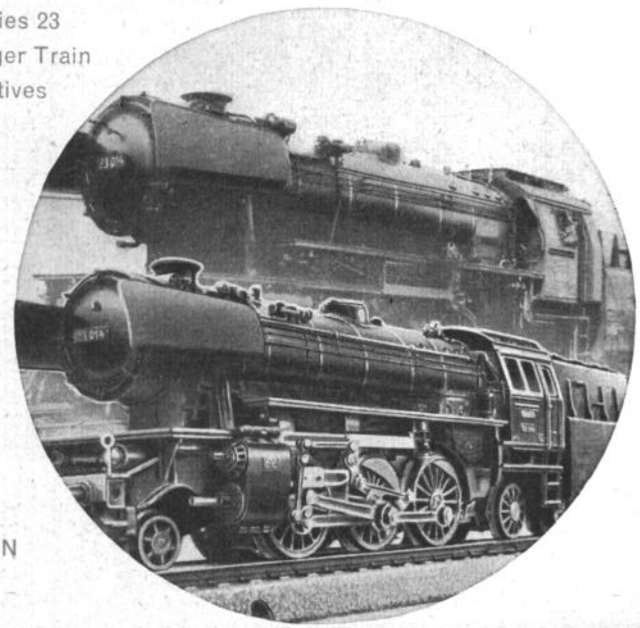
(c) Goods Engines

The MÄRKLIN No. **G 800** is certainly the best-known goods engine, the German Federal Railways' Series 44 goods locomotive being taken as the prototype. In designing the G 800 the 2–10–0 wheel arrangement of the original (see fig. 88) could not be copied owing to the small radius of the curves on the miniature railway track, and the framing was therefore made articulated to make the model safe from derailment, giving a 2–6–4 wheel arrangement. Like their prototypes, these G 800 locomotives have great pulling power.

Goods tank engines are used in many cases for local traffic, both goods and passenger, and three replicas of this type of engine deserve special mention among the MÄRKLIN tank engines.

The **TT 800,** a model of the Series 86 2–8–2 tank engine (fig. 114) is an exact replica of the original, even down to the wheel arrangement. The second of the goods tank engines is the MÄRKLIN No. TM 800.

Fig. 113
The Series 23 Passenger Train Locomotives and the



DA 800 MÄRKLIN replica

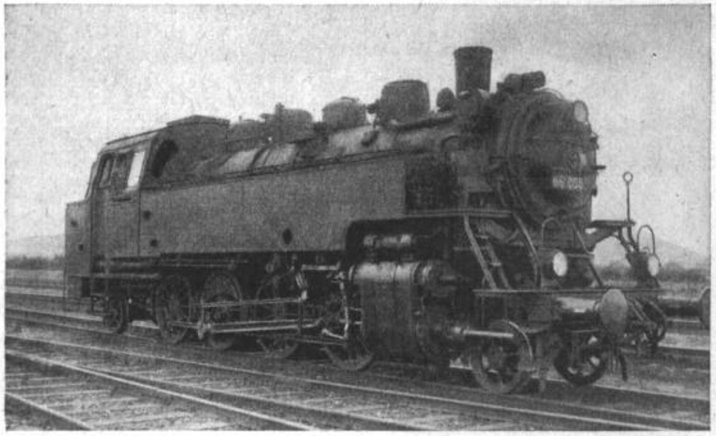


Fig. 114

The Series 86 Tank Engine, prototype of the MÄRKLIN TT 800 Tank Engine

The **TM 800** tank engine with the 0–6–0 wheel arrangement is a replica of the Series 80. With the exception of a simplification to the valve gear, rendered necessary for economic reasons, the original has been copied very faithfully to scale.

The **CM 800** tank engine has very quickly become known as a favourite among model railway fans, and despite the small size of its prototype (Series 89, length over buffers 9,6 metres, or approximately 30 ft.) its replica has turned out very successfully. In normal railway practice this little engine is designed for shunting work, in which it can reach a speed of 45 kilometres (approximately 28 miles) an hour. For this reason the CM 800 has a low reduction gear so that it can run very slowly. Its prototype is shown in fig. 115.

2. Electric Locomotives

The overhead or trolley wire used to feed the electric current to the locomotives on full-size railways generally carries current at 15,000 colts (see fig. 74). The current is A.C. with a periodicity of $16^2/_3$ cycles. The voltage is brought down to about 650 volts in the transformers on the locomotive.

(a) Express Locomotives

Most of the expresses on the German Federal Railways are drawn by the Series E 18 2-4-4-2 engines (fig. 118). The maximum speed they are permitted to run at is 150 kilometres (approximately 94 miles) per hour. The MÄRKLIN **MS 800** engine is copied from them and has the same wheel arrangement; like its full-size prototype, it has a surprisingly high tractive effort.

Other MÄRKLIN express locomotives of the electric type are copies of very well-known engines running in countries outside Germany. The **RET 800** MÄRKLIN engine with the 2-4-2 wheel arrangement is specially mentioned in this connection, copied from the well-known Re 4/4 Swiss express engine (see fig. 165). The Re 4/4 with the 0-4-4-0 wheel arrangement develops a maximum speed of 125 kilometres (approximately 78 miles) per hour and is used on the light express train services on the Swiss Federal Railways. The Serie 1100 express engines (fig. 75) are also very well known; in two different types they are used on services in Holland and France.

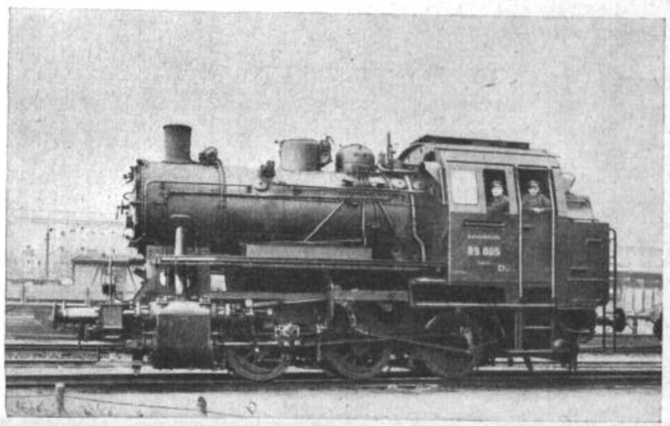


Fig. 115 The Series 89 Tank Engine, prototype of the MÄRKLIN CM 800 Locomotive.

They served as the prototype for the two MÄRKLIN engines **SEW 800** and **SEWH 800** with the 2–4–2 wheel arrangement. These locomotives (and also the RET 800 and SET 800) are designed so that outwardly the impression of the 0–4–4–0 arrangement of the prototype is retained.

(b) Passenger Train Locomotives

The 0–4–4–0 Series E 44 (fig. 117) is the type of engine mostly used for passenger traffic on the electrified sections of the German Federal Railways, and they were used as a basis for the design of the MÄRKLIN **SET 800** locomotive. This locomotive is used in actual railway practice not only for passenger traffic but also for light express and goods services. Its maximum speed is 90 kilometres (56 miles) per hour.

(c) Goods Locomotives

The **CE 800** MÄRKLIN locomotive has become a great favourite in a short time. Its pulling power and suitability for shunting enable it to be used for all sorts of purposes on a model railway. It is a replica of the Series E 63 of the German Federal Railways (see fig. 116), the engines of this series being very similar to the Series Ee 3/3 of the Swiss Federal Railways. In actual railway practice the engines of the Series E 63 and Ee 3/3 have a maximum speed of 45 to 50 kilometres (about 20 to 32 miles) per hour. They are used chiefly for shunting, though also for light goods traffic, where the trains are not heavy and the sections travelled over are not too steep.

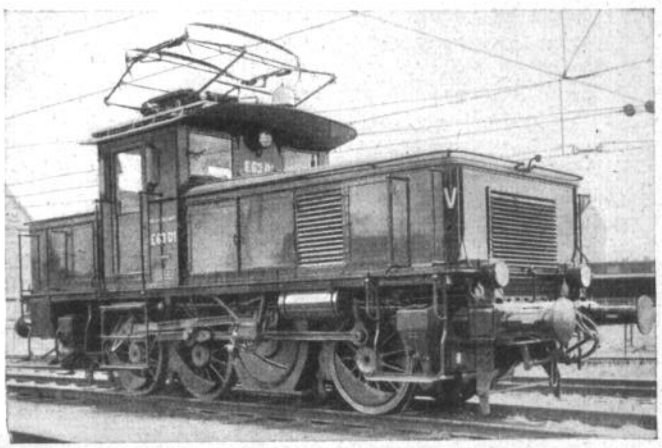


Fig. 116

The Series E 63 Shunting Engine, prototype of the MÄRKLIN CE 800 locomotive.

The MÄRKLIN **CCS 800** locomotive has become very well known by its 2-6-6-2 wheel arrangement and its distinctive appearance, like its big prototype, the Series Ce 6/8 of the Swiss Federal Railways (fig. 160). Engines of this type run over the lines in the mountainous districts in Switzerland and are used in particular for hauling heavy goods trains over the St. Gotthard line with its long and steep gradients.

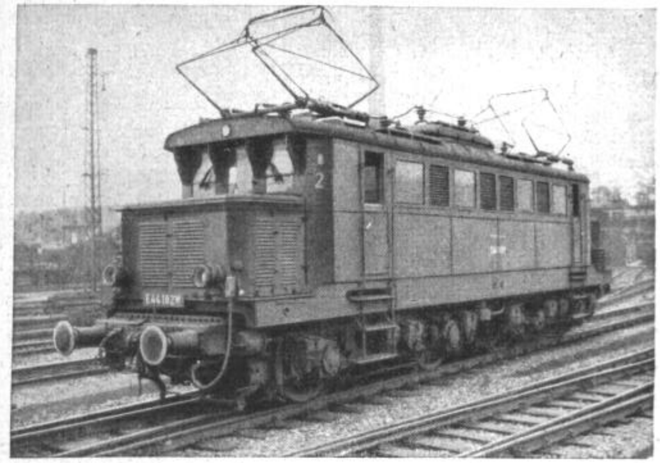


Fig. 117
The Series E 44 Electric Locomotive, prototype of the SET 800 MÄRKLIN Locomotive

3. Diesel Locomotives

Diesel locomotives develop their tractive effort by means of one more reciprocating or piston engines in which oil injected into the cylinders is subjected to such high pressure as to reach its combustion temperature. The energy released by combustion is transmitted to the driving wheels of the locomotive through the pistons of the engine and some form of gear that provides fast and slow running. The gear has been done away with on many locomotives, its place being taken by a generator that generates electric current to drive electric motors, and the speed of these motors can also be controlled very easily without gears. On the other hand, with this arrangement the speed of the diesel engine remains constant and is set so that the whole system, called "diesel-electric" runs very economically. This type of locomotive is only rarely met with on the German railways, although the German Federal Railways have placed some new diesel locomotives in service during the last few years. In the U.S.A. conditions are different, and there considerable numbers of diesel locomotives are running on the long stretches of railway in that extensive country. The diesel locomotives in use there have become very well known on account of their great efficiency. The MÄRKLIN **DL 800** twin locomotive with its 0-4-4-4-0 wheel arrangement has been copied from an engine of that type.

It is notable for its outstanding rail position and its cleancut appearance. Its extraordinary pulling power is due in particular to the fact of all its twelve wheels being driven by a very powerful motor. Those who are partial to overhead wire working have the opportunity of fitting this locomotive with pantograph current collectors by hand.

Fig. 118
The Series E 18 Express Locomotive, prototype of the MS 800 MÄRKLIN Locomotive.

4. Railcars

In full-size railway practice railcars can be fitted with either electric motors or internal-cimbustion engines. They are used more especially on sections where there is a demand for short time intervals between the trains. There are railcars for both passenger traffic as well as fast and expre ss servives.

The **ST 800** MÄRKLIN Railcar Unit is especially suitable for long-distance railcar traffic on a model railway, as it has excellent running characteristics with its unusually powerful motor and its excellent placing on the track, these being not least due to the use of Jacobs bogies that also enable the unit to be lengthened by means of the supplementary centre units ST 800 MT. The MÄRKLIN ST 800 railcar unit can be used with or without pantograph collectors on the roof; it has been designed from an American prototype.

III. Passenger Coaches

Passenger rolling stock also carries various markings, just as the locomotives do. In the case of passenger and express coaching stock the following are used.

A denotes coaches with compartments, 1st class
B denotes coaches with compartments, 2nd class
C denotes coaches with compartments, 3rd class
MC denotes coaches with makeshift seating, 3rd class built during the years 1943 to 1945
WR denotes restaurant cars
WL denotes sleeping cars
WG denotes saloon cars
Salon denotes lounge cars
Z coaches with cells (for convicts)
L coaches for local services
D denotes double-decker coaches
K denotes narrow-gauge coaches

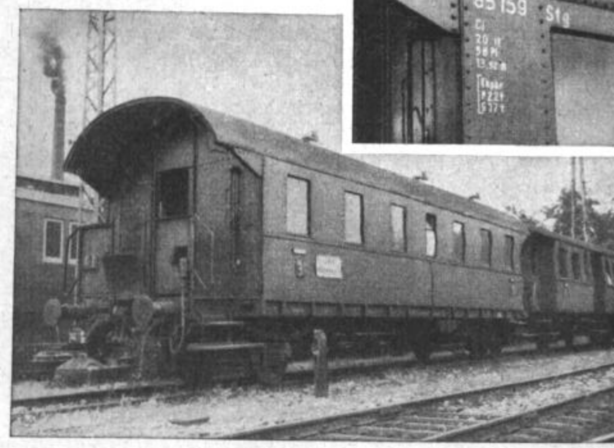
Hence the following descriptions:

AB	1st and 2nd class (composite) coaches
ABC	1st, 2nd and 3rd class (tri-çompositz) coaches
BC	2nd and 3rd Class (composite) coaches
WLAB	Sleeping car, 1st and 2nd class
DBC	Double-decker coach, 2nd and 2rd class
KC	Narrow-gauge coach, 3rd class

Fig. 119 A Ci passenger coach, prototype of the MÄRKLIN No. 329/1 passenger coach.

Additional markings are added to the letters – socalled extra type markings. A figure gives the number of axles the coach has. These extra type markings are:

d Coach with bench seats
e Coach with electric heating
g Coach with enclosed vestibule with rubber screens instead of concertina vestibules
oach with open connecting gangways and central corridor



k Coach with kitchen compartement.

kr Coach with sick bay.

l Light 8-wheeled coach, standard type, with less than 28 tons unladen weight.

m Coach more than 24 metres (approximately 78 ft.) long, with upholstery in the third class and electrical heating.

s Coach with central corridor in the 3rd class and closed side corridor in the 2nd class.

tr Coach with baggage compartment.

ü Coach with concertina vestibule and closed side corridor.

w Coach with upholstered seats in the 3rd class.

y Express and passenger train coaches with closed vestibules and central or open side corridor.

The full marking on any one coach could therefore be as follows, for example.

BC 4 ü An eight-wheeled express coach with 2nd and 3rd Classes.

Ci 3 tr A six-wheeled 3rd class passenger coach for passengers with luggage with an open intercommunicating gangway. The marking for the same coach with only four wheels is Citr. The marking

BC 4 ymg is carried by eight-wheeled fast and passenger train coaches, 2nd and 3rd class, with a length of more than 24 metres (approximately 78 ft.), upholstery in the 3rd class, electrical heating and enclosed vestibules with rubber screens.

Other examples: AB 4 üe, C 4 kr, C 4 ük, Cid, BC 4 üwe, BC 4 ysl, BC i.

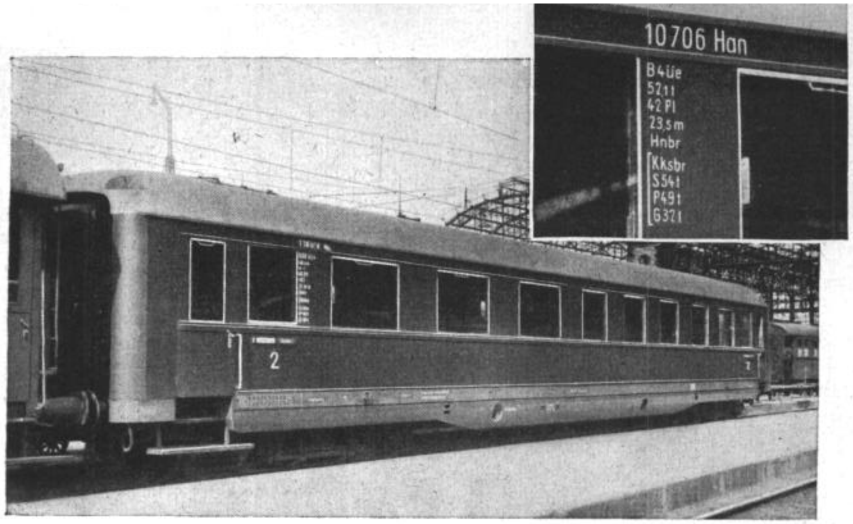


Fig. 120 Prototype of the MÄRKLIN Express Coach No. 346/1

The other markings on passenger coaches refer to the Divisional Office of the Federal Railways by whom the coach was placed in service, its home station, the type symbol, number of seats, the tare, wheelbase, axlebox lubrication, buffers, type of brakes, heating, lighting, number of the coach (from 1 to 99 999) and much more. Coaches with the RIC marking can run over the systems of European countries that are party to the Agreement of the Union for the Use of Passenger and Baggage Cars in International Traffic (**R**egolamento **I**nternationale **C**arozza).

(a) Coaches for Corridor Trains

As the name indicates, corridor train coaches are made so that passengers can pass from one coach to another without difficulty. By being mounted on two bogies each with four wheels and spring suspension to suit, these coaches run almost without shock or vibration.

To match their big prototypes, express trains can also be made up with the MÄRKLIN miniature express coaches, consisting of passenger coaches, dining cars, sleepers, baggage cars and mail vans. The coaches for this are numbered 346 in the MÄRKLIN Catalogue. (The prototype of coach No. 346/1 is given in fig. 120). If the red dining cars and sleepers are used, the train will have the appearance of a German one; an international impression will be given if blue dining cars and sleepers are included in it.

All German long-distance express coaching stock is now to be painted blue, and trains to match can be made up on a MÄRKLIN model railway system by using coaches with the catalogue number 346/6.

MÄRKLIN coaches bearing catalogue No. 348 are replicas of the lightweight express coaching stock, restaurant cars with an overhead bow collector and baggage wagons. They enable typical lightweight express trains of the Swiss Federal Railways to be made up on a model system (fig. 121).

(b) Coaches for Fast Trains

According to the German Federal Railways' plans, no more fast train coaching stock is to be built, express stock being used for trains of this kind in future, so that coaches can be changed (through coaches) as between fast and express trains without any difficulty.

(c) Coaches for Passenger Trains

In passenger trains with the simpler kinds of coach the gangway between coaches is reserved primarily for the use of the train staff. Passenger train coaches of the newer type are practically always four-wheeled and shorter than express coaches. The four-wheeled standard passenger coach is used extensively on the German Federal Railways (fig. 119), its replicas bearing the numbers *329/1, 327/1 and 327/2 in the* MÄRKLIN coach range.

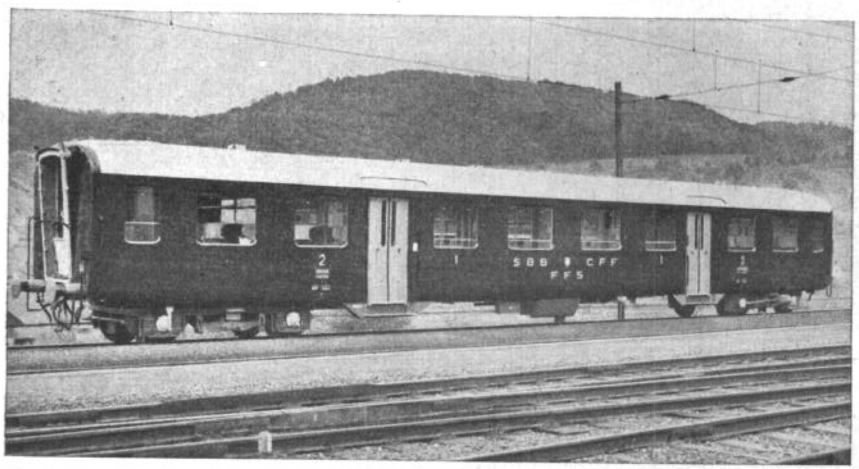


Fig. 121 A Swiss Federal Railways Lightweight Express Coach, the *prototype of* MÄRKLIN Coach No. 348/1.

The six-wheeled coaches known as compartment stock that are still used to a considerable extent even now, date from earlier times (see fig. 122), and coaches of this kind are also included in the MÄRKLIN coaching range under catalogue Nos. 330/1 and 330/2. They are great favourites with model railway fans who have a preference for a railway of the local type, with its rather less pretentious facilities, instead of a main line layout.

MÄRKLIN passenger coaches can easily be fitted with interior lighting afterwards; the coaches, when lit up, give a particularly attractive impression of the original when running after dark.

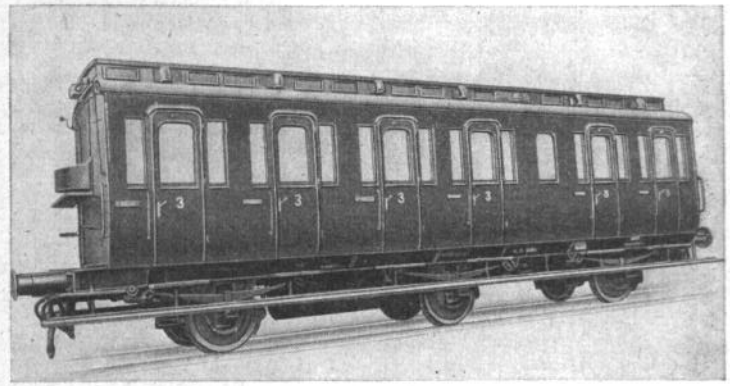


Fig. 122 A six-wheeled Compartment Coach, prototype of the MÄRKLIN No. 330/1 Coach.

IV. Luggage or Baggage Vans

A luggage van with four or more wheels is always included in every passenger train to take passengers' luggage as well as any fast or express goods there are to be sent. Luggage vans are particularly typical by reason of their roof construction (see fig. 123). The guard has a high seat under the raised roof and so can see out over the whole length of the train.

Main type symbols are used for luggage vans also, viz:

Pw Passenger train luggage vans.

Pwg Goods train luggage vans.

Pwgs Goods train luggage vans for fast goods trains.

Appropriate supplementary symbols are placed after these main type symbols. Thus, for example, the descritpion Pw4ü would mean an eight-wheeled (express train) luggage van with a concertina vestibule connection. The weight that can be carried is also shown, in addition to the otherwise usual inscriptions (similar to those on passenger coaches). There are also passenger train luggage vans with a compartment for the mails, though they are not a great deal in use. The description of such a van, for example, would be PwPost 4ü.

V. Postal or Mail Vans

Mail vans with four or more wheels are the property of the German Federal Post Office and have only a few guarded windows. The side walls of the van are taken up chiefly by shelves for the mail and therefore the small windows cannot supply sufficient light for the interior of the van during the daytime. For that reason most mail vans have roof lights or windows, and so as to use the room to better advantange, wells are built into the floor of the van into which parcels and newspaper post can be dropped. These wells are visible outwardly as metal boxes between the axles of the van.

The post Office is now carrying out tests with new types of van, mostly for running at night, made up into so-called "mail trains".

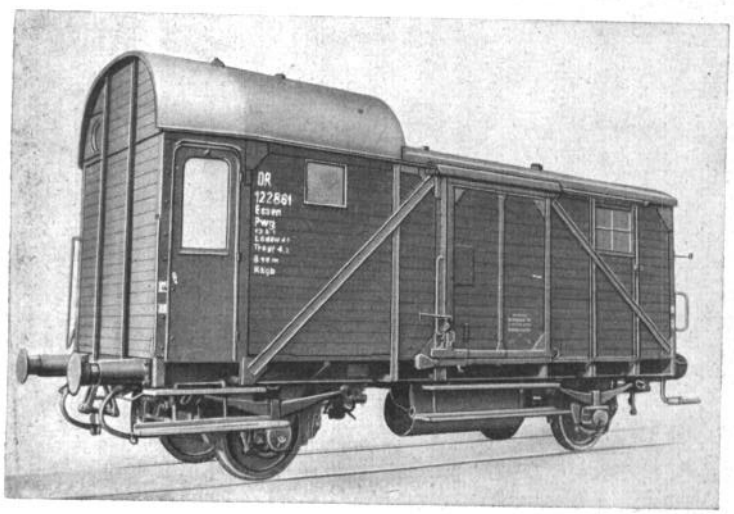


Fig. 123 Four-wheeled Luggage Van, prototype of the MÄRKLIN No. 310 Van.

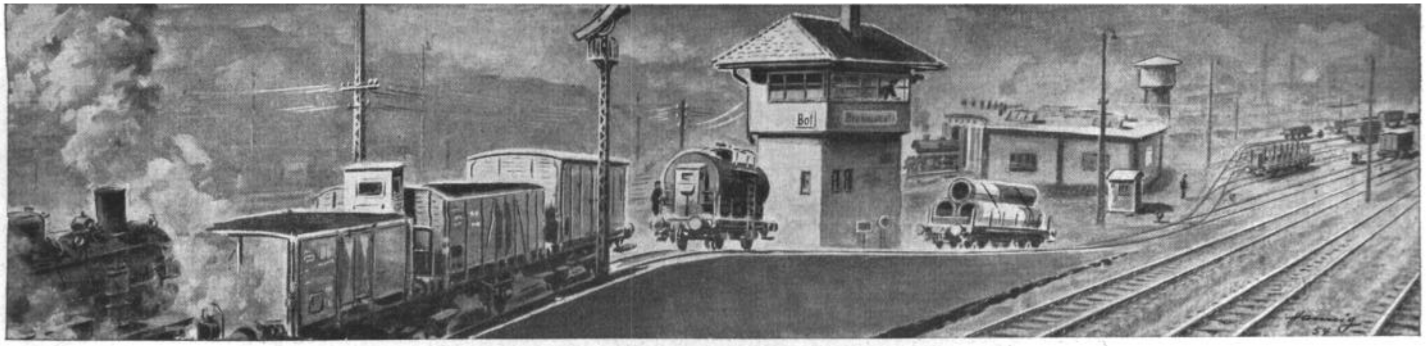


Fig. 124 The Marshalling Hump

VI. Goods Wagons

Goods wagons are built in a variety of types to suit the purposes they are to be used for, this being necessary on account of the great variety of goods to be carried (solid goods, bulk goods, liquids, goods in the form of gas etc.). Their type and therefore the purpose they are used for is denoted by type symbols.

1. Type Symbols

These consist of the main type marks and supplementary symbols, as well as the series number. The following gives the meanings of the supplementary symbols and then those of the main type symbols.

(a) Supplementary Symbols

- a Open brakesman's platform with stanchions to fold down (see fig. 125).
- c Open truck with wooden sides approximately 4½ to 6 ft. high.
- d Powder container truck with pneumatic emptier.
- e Truck with conductor for electric heating.
- g In conjunction with the main type symbol G: Collapsible bottom for discharging bulk goods.
  In conjunction with the main type symbol T: For refrigerated goods only.
  In conjunction with the main type symbol V: Wagon with four floors.
- h Wagon with steam heating pipe.
- k In conjunction with the main type symbol K: Wagon for unloading by crane (with sliding roof, for example).
  In conjunction with the main type symbol O: Hopper-type truck.

- k In conjunction with the main type symbol S: Loading length under 42 ft.
  In conjunction with the main type symbol SS: Loading length under 50 ft.
- kk Refrigerated van (with refrigerating machinery)
- l In conjunction with the main type symbol G: Minimum loading space, 26 square metres
  In conjunction with the main type symbol O: Loading length at least 32 ft. 6 ins.
  In conjunction with the main type symbol SS: Loading length at least 58½ ft.
- ll Two covered vans coupled together to form a "Leig" unit (Leig means light goods van) for express piece goods traffic.
- m Wagon to take 20 tons load.
- mm Wagon to take over 20 tons load.
- p Open truck to take not less than 15 tons load and with walls not less than 6 ft. high; non-tipping type.
- r Transfer wagon for transfer to broad gauge.
- s Wagon for fast trains.
- t Wagon with doors at front, or with hoppers, also well wagon.
- v Cattle truck
- w Wagons with a loading weight less than 15 tons (Gw, Vw and Xw, for instance), or eight-wheeled wagons to carry loads under 30 tons (such as GGw, OOw, SSw, for instance)
- z Mineral truck

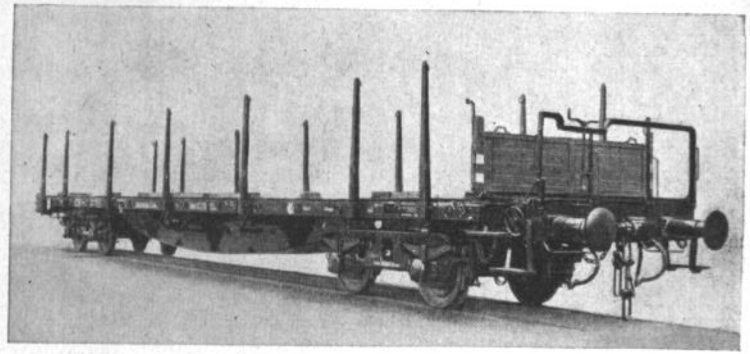


Fig. 125 The SSla flat truck with stanchions; prototype of the 392-C MÄRKLIN wagon.

(b) Main Type Symbols

In their day the German State Railways gave the type area or region together with the type symbol, consisting of the main type symbol and supplementary markings, on goods wagons. One or more type symbols were equivalent to a type region. The name of the type region had no connection with the German State Railways' Divisional Office or with the towns whose names it bore.

The names of the former type regions are given in parentheses behind the main type symbols. When renewing the inscription on a wagon the type region is no longer given, but the new type numbers that are dealt with on page 122. A distinction is made between open and covered wagons.

Open Goods Wagons (trucks)

- BT Four-wheeled wagons for carrying large containers.
- H Bogie trucks (formerly timber trucks; example: H – Regensburg.
- O Four-wheeled 15-ton-trucks with side walls. Example: O – (Frankfurt, Halle, Schwerin or Nuremberg, according to wall construction); Oc and Ocp (Muenster); Ommru – Villach and Otmm (Mainz).
- OO Open goods trucks to take at least 30 tons load; example: OOt – Saarbruecken.
- R Open 4-wheeled 15-ton-trucks with wooden stanchions and boarded sides; examples: R, Rr, Rm and Rs (all Stuttgart).
- S Open 4-wheeled 15-ton-trucks with iron stanchions (the main type symbol "S" originated from the former designation "Schienenwagen", or stanchion truck. Examples: S, Sk, Sm (all Augsburg).
- SS Open trucks with eight or more wheels, with iron stanchions (see fig. 125); examples: SS, SSk, SSw, SSl, SSla and SSt (all Cologne).
- X Four-wheeled 15-ton-service truck for railway material; examples: X, Xt, Xw, Xo and Xow (all Erfurt).

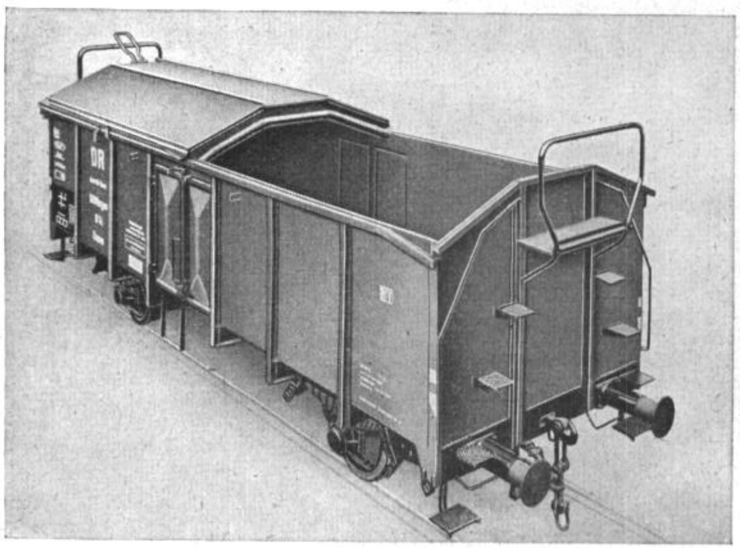
Closed Goods Wagons (vans)

- G Covered 15-ton vans with four or more wheels; examples: G (Hannover, Stettin, Karlsruhe, according to number of axles and carrying capacity); Geh (Munich); Gl, Gll, Glehs, Glrvhs (all Dresden); Gk, Gkeh (Berlin); Gfkhs (Saarbruecken).
- GG Covered vans with eight or more wheels; examples: GGhs, GGvwehs (all Dresden).
- K Vans with lift-up tops or sliding roofs: examples: K (Wuppertal); Kmmks (see fig. 126).
- KK Vans with lift-up top, with eight or more wheels, to carry at least 30 tons; example: KKt (Saarbruecken).
- T Refrigerator (Thermos) vans, four or six-wheeled, 15 tons.
- TT Refrigerator (Thermos) vans, 8-wheeled, to carry at least 30 tons.
- V Lattice wagon, four-wheeled, to carry 15 tons, with lattice sides and two floors; examples: Vh, Vr, Vwh and Vg (all Hamburg).

From the foregoing Schedule it will be seen that doubling the letter denotes wagons with eight or more wheels.

(c) The Series Numbers

In the latest method of denoting the series or type the type region is done away with. The series descriptions consist of the main type symbols, supplementary symbols and series number. The approximate year of construction of the wagon can be obtained from the series number. As an example, the series description of the covered 15-ton-wagon of the interchangeable type is now "Gr 20" instead of the former description Gr (Kassel). From this new description it may be gathered that this wagon was built about 1920.The open goods trucks not boarded built about 1933 to carry more than 20 tons now bear the type symbol "Ommru 33" (fig. 128), instead of the description "Ommru" (Villach), (fig. 127).



2. Wagon Numbers

According to the latest plans of the Federal Railways Management, all goods wagons for public traffic are to have six-figure numbers made up of the single-figure group numbers and an ordinary number. Group numbers are to be allotted as follows.

1 for G group wagons to carry up to 15 tons
2 for G group wagons to carry 20 tons and over
3 for T, V and K group wagons
4 for R and X group wagons
5 for private wagons in service on the German Federal Railwyas (international arrangement).

Fig. 126 Goods wagon with sliding roof.

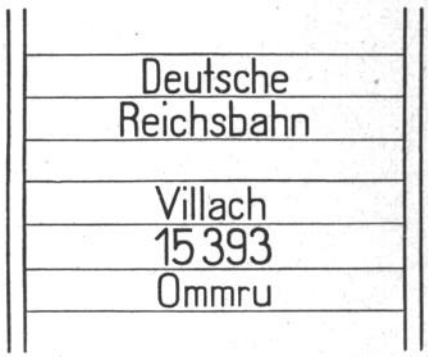


Fig. 127

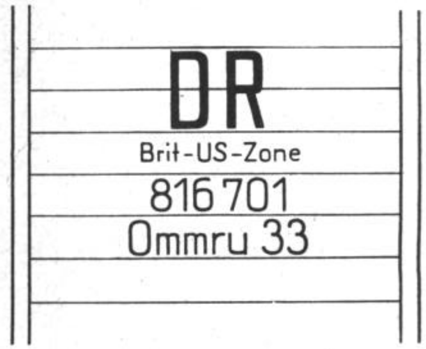


Fig. 128

6 for all special wagons of the O-group and for O-wagons to carry 15 tons,
7 for all wagons of the O-group to carry 20 tons,
8 for all wagons of the O-group to carry over 20 tons,
9 for all wagons of the S- and H-groups,
0 for all wagons of the BT-group.

Accordingly, as an example, wagons of the O-group to carry up to 15 tons have the numbers 100,000 to 199,999, or wagons of the S- and H-groups the numbers 900,000 to 999,999 and so on. The Railways' own tank wagons are included in the BT-group, but other railway service wagons that are excluded from public traffic have only four-figures numbers.

3. Other Goods Wagon Inscriptions

All goods wagons carry other additional inscriptions besides the type description and wagon number, these referring to the size of the floor area, loading length, load, carrying capacity, tare, home station or depot, length of the wagon over buffers (abbreviated to L ü P – the initials of the German wording), last inspection, last time painted, and so on.

Fig. 129 shows the special markings for the various loads carried, the figures giving the permissible loading weight in tons.

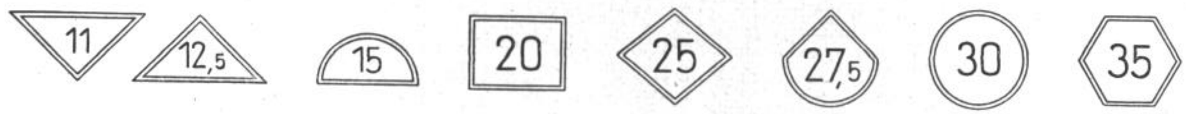


Fig. 129

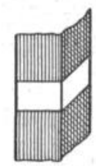
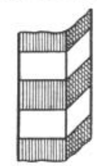
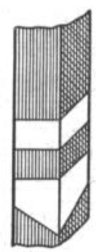
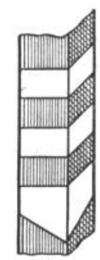
Type of Brake	Corner Band Arrangement	Type of Brake	Corner Band Arrangement
(a) Air brake pipeline		(c) Kunze-Knorr	
(b) Kunze-Knorr G.P.		(d) Kunze-Knorr or Westinghouse, with G.P. interchange	

Fig. 130 a–d

Unfortunately it is not possible to explain the different braking systems here. The differences refer to the method of operation and the special constructional features of the brakes. The abbreviations P and G under the "Type of Brake" stand for Passenger Train and Goods Train respectively.

The sign in fig. 131 a means that the wagon, when being shunted, must not be pushed over a hump with a rounding-off curve diameter less than 350 metres.

The sign in fig. 131 b means that the wagon is not to be allowed to roll over a hump at all.

Fig. 131 a

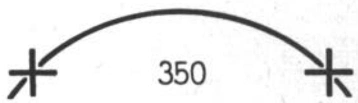


Fig. 131 b

The sign P means that the wagon is privately-owned and does not belong to the German Federal Railways.

4. International Markings

Goods wagons bearing the sign T are permitted to travel through other countries (in transit traffic) for international traffic purposes.

Goods wagons that, by reason of their design and under the Convention regarding the mutual use of goods wagons in international traffic, may run over the railways of European coutnries as well, carry the inscription "RIV" ("Regolamento Internationale Veicoli"). Under this arrangement, after reaching their destination in a foreign country they must be returned without delay to their home administration – immediately and with a load, if possible.

Since the formation of the "European Wagon Pool" the rolling stock has been used considerably more economically. Some ten European countires have contributed some of their rolling stock to this Pool, and at the present time there are about 160,000 wagons in service altogether. Wagons bearing the markings shown in fig. 132–a oder 132–b can circulate freely in all countries that are party to the Pool. If, for instance, goods are conveyed from Germany to Italy in one of these wagons, *it need not be returned* to Germany immediately but can be used for traffic in Italy or for transport from Italy to one of the countries party to the Pool. Only the main inspection of these wagons takes place at their home station.

Instead of the DB sign shown in fig. 132-a the wagons of other States forming the Pool carry the abbreviation of the name of the railway concerned (such as SNCF for French wagons, for instance — fig. 132–b).

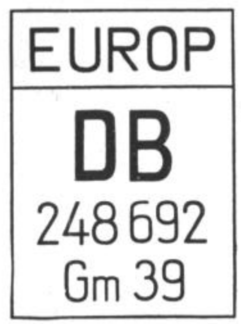


Fig. 132–a

Fig. 132–b

5. Goods Wagons of the MÄRKLIN Wagon Pool

MÄRKLIN goods wagons are noted for their scale-model design, and it is worth while examining their technical details through a magnifying glass. The MÄRKLIN pool contains open as well as covered wagons, both four and eight-wheeled. The MÄRKLIN catalogue includes goods wagons that have already proved to be successful models for many years, side by side with the latest productions.

D. Signalling, Safety and Communications Equipment

Measures of all kinds for the safety of the traffic have been taken in normal railway practice, so that trains may run as far as possible without accident. Many of the appliances for these purposes are so prominent on the railways as to attract the special interest of every model railway fan.

I. Signals on a Full-size Railway

Railway lines are divided up into sections known as block sections. At the beginning of each such section there is a home signal that stands at "Danger" when there is anything on the line in the following block section. When signals are seen to the right of the line from a train in motion, traffic is said to be right-handed, and that is the case when the right-hand track is used normally on double-track lines. If the signals are on the left of the line, then the signal arrangements on that line are said to be for left-hand traffic.

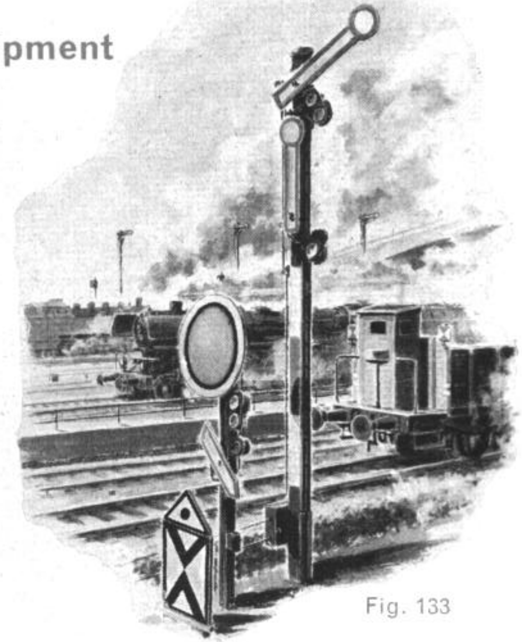


Fig. 133

Right-hand traffic is the rule in the following countries, namely:

Austria, Bulgaria, Canada, Czecho-Slovakia, Denmark, Finland, Germany, Greece, Holland, Hungary, Luxemburg, Norway, Poland, Rumania, Syria, Turkey and the U.S.A.

Trains travel on the left in:

Belgium, England, France, India, Italy, Portugal, South Africa, Spain, Sweden and Switzerland.

In some of the countries mentioned, both kinds of traffic are to be found.

1. General Information about Home and Distant Signals

The signal layout must be such as to enable a train to come to standstill before reaching a home signal standing at "Danger". With the very considerable braking distances that heavy trains need, the engine driver must know about the home signal well in advance, and this is particularly important when visibility is bad – at night, or in fog, rain or snow. For this reason an advance or "distant" signal is placed anything from 700 to 1 000 metres before the home signal, according to the braking distances of the locomotives and trains travelling over the line, this distant signal telling the driver what to expect at the home signal he is approaching. Notice of an approaching distant signal is given by three, or more rarely by five, warning boards, so as to prevent the driver overlooking the distant signal. Furthermore, there is also the so-called distant signal sign on the signal itself. Fig. 134 shows how the distant signal warning boards are placed.

The home signal is not only to let the driver know that he can enter the section but it also tells him the speed he is to run at. This is done by the home signal having two semaphore arms. If the signal is at "Line clear", the train can continue to run at its normal speed; if both arms are in a sloping position, however, it shows that the train is to be diverted over some points and therefore speed must be reduced to 40 kilometres (approximately 25 miles) per hour.

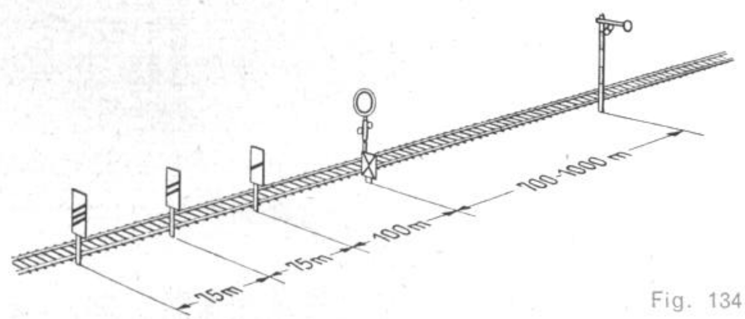


Fig. 134

The speed limit may be shown on the signal; for instance, the figure 3 denotes a speed limit of 30 kilometres (approximately 20 miles) per hour; the figure 7 a speed limit of 70 kilometres (approximately 45 miles) per hour, and so on (see fig. 135).

Home signals are for traffic on open sections and not for shunting inside stations, where track block signals are used.

Fig. 135

The various signal positions and the abbreviations used for them on the German Federal Railways will be explained in the following pages.

2. Home Signals (Hp)

Figs. 136–a to c show the three different positions of the home signals, giving the positions of both semaphore signals as well as colour-light signals.

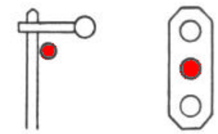


Fig. 136–a shows the Hp O signal position for "Stop", with a red light showing.

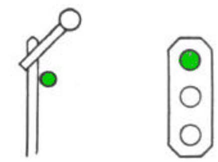


Fig. 136–b shows the Hp 1 signal position for "Line clear", with a green light showing.

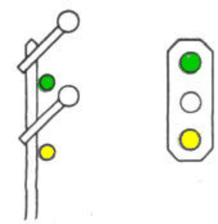


Fig. 136–c shows the Hp 2 signal position for "Line clear but with speed limit" to 40 kilometres (approximately 25 miles) per hour, or whatever other figure is shown.

3. Distant Signals without an Extra Board (Vo)

These consist of a round disc that can be laid flat. Figs. 137–a and b show the two possible positions of these distant signals with the equivalent colour-light signals.

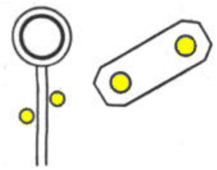


Fig. 137–a shows the Vo 1 signal position; it means "Expect stop" at the home signal (Hp 0); two amber lights are shown, rising obliquely upwards.

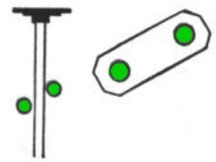


Fig. 137–b shows the Vo 2 signal position; it means "Expect line clear" Hp 1 or Hp 2 at the home signal; two green lights are shown, rising obliquely upwards.

4. Distant Signals with an Extra Board (Vz)

A distant signal with extra board is usually arranged with a home signal with two semaphore arms. Its positions are explained in figs. 138–a to c.

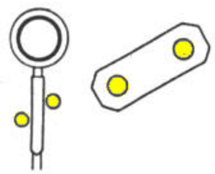


Fig. 138–a shows the Vz 1 signal position; it means "Expect stop" at the home signal (Hp 0). Two amber lights are shown, rising obliquely upwards.

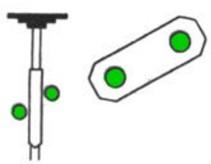


Fig. 138–b shows the Vz 2 signal position; it means "Expect line clear" (Hp 1) at the home signal. Two green lights are shown, rising obliquely upwards.

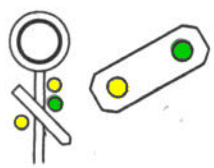


Fig. 138–c shows the Vz 3 signal position; it means "Expect run with speed limit" at the home signal (Hp 2). Two amber lights rising obliquely upwards and a green light are shown, or an amber and a green light rising obliquely upwards.

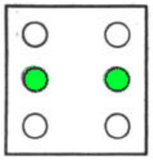


Fig. 139–a shows Sv 1; it means "Line clear" and "Expect line clear" at the next home signal (Sv 1, Sv 2 or Sv 5).

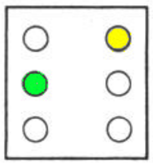


Fig. 139–b shows Sv 2; it means "Line clear" and "Expect stop" at the next home signal (Sv 3 or Sv 4).

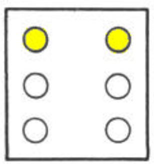


Fig. 139–c shows Sv 3; it means "Stop", and after verbal order "Continue, but look out".

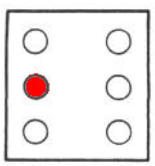


Fig. 139–d shows Sv 4; it means "Stop".

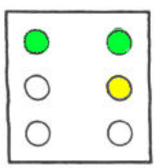


Fig. 139–e shows Sv 5; it means "Line clear" and "Expect line clear with speed limit" at the next home signal (Sv 6, Sv 7 or Sv 8).

5. Combined Home and Distant Signals (Sv)

It frequently happens that a home signal has the distant signal for the next home signal in front of it. A home signal is placed at the entry into a station to control traffic entering the station. Immediately in front of this home signal there is a distant signal (fig. 133) that gives the position to be expected at the signal for leaving the station, i. e., it shows the driver whether he has to stop in the station or can run through it. These two signals – the distant and the home signal – can be combined in one signal that then becomes a colour-light signal. On the left-hand side it shows the position of the home signal and on the right-hand side the distant signal, and therefore the position to expect at the following home signal. The basic position of a combined signal is "Line clear", contrary to semaphore signals.

Figs. 139–a to h explain the positions of these combined home and distant signals.

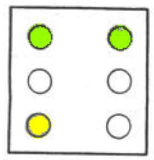


Fig. 139–f shows Sv 6; it means "Continue with speed limit" and "Expect line clear at next home signal" (Sv 1, Sv 2 or Sv 5).

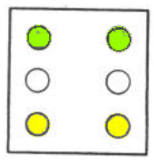


Fig. 139–g shows Sv 7; it means "Continue with speed limit" and "Expect continue with speed limit" at the next home signal (Sv 6, Sv 7 or Sv 8).

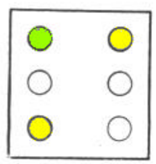


Fig. 139–h shows Sv 8; it means "Continue with speed limit" and "Expect stop" at next home signal (Sv 3 or Sv 4).

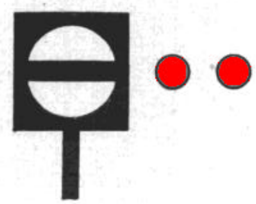


Fig. 140–a shows the Ve3 signal position; it means that running past the signal is forbidden. The equivalent colour-light signal shows two red lights in a horizontal line.

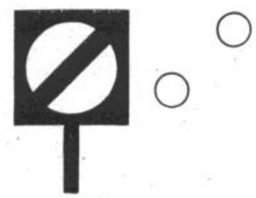


Fig. 140–b shows the Ve4 signal position; it means that the signal can be passed if an order to do so has been given either verbally or by a sign. Colour-light signals show two white lights rising obliquely upwards.

6. Track Block Signals (Ve)

Track block signals (figs. 140–a and b) are stop-and-go-signals used to safeguard the tracks inside stations. There are some track block signals that can be set directly by hand where they are by the foreman shunter.

7. Shunting Signals (Ra)

Shunting signals are given by the foreman shunter both audibly (by a whistle or horn) and visibly (by movements of the arms). There are also semaphore and colour-light signals as well to control shunting at the marshalling hump.

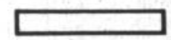
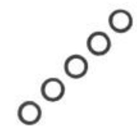
(a) The audible and visual shunting signals are summarised in the following Table.

Signal	Whistle or horn	Hand Signals-Day	Hand Signals-Night	Meaning
Ra 1	Long blast —	Vertical movement of the arm from above downwards	As by day, but with hand lamp	"Go"
Ra 2	Two moderately long blasts — —	Slow horizontal movement of the arm backwards and forwards	As by day, but with hand lamp	"Come back"
Ra 3	Two short blasts, quickly one after the other ◡ ◡	Lift both arms shoulder high to the front and close flat outstretched hands towards one another repeatedly	As by day, but with hand lamp	"Push up" (To uncouple or couple up)
Ra 4	Two long blasts and one short one — — ◡	Horizontal movement of the arms from the body outwards twice and a quick vertical movement downwards	As by day, but with hand lamp	"Push off" (fly-shunting)
Ra 5	Three short blasts in rapid succession ◡ ◡ ◡	Circular motion of the arm	As by day, but with hand lamp	"Stop"

Holding up the arm or lamp during shunting and a long blast at the same time means "reduce speed" ("slow up").

(b) Fly-shunting Signal

Fly-shunting signals are placed on the marshalling hump, the shunting operations being described on page 31. The signals are shown in figs. 141–a to c.

Signal Type	Semaphore Signal	Colour-light Signal	Meaning
Ra 6			Fig. 141–a Stop! Do not fly shunt
Ra 7			Fig. 141–b Fly shunt slowly
Ra 8			Abb. 141–c Fly shunt moderately fast

8. Ground Signals (for points)

In standard railway practice there are single points (see fig. 142–a), double curve points (see fig. 142–b), single slip points (see fig. 142–c), double slip points (see fig. 142–e) and combinations of these types of points.

142–a 142–b 142–c 142–d 142–e

Ground signals are for showing the driver the position of the tongues of the points.

(a) Ground Signals at Single Points

The signal indications are fixed to the lamps at the points. When the points are changed, the lamp turns round through 90 degrees and shows signal indications both back and front, according to the way the points are set. Looking at the lamp from the top and imagining the signal indications opened out sideways, they would look as shown in fig. 143.

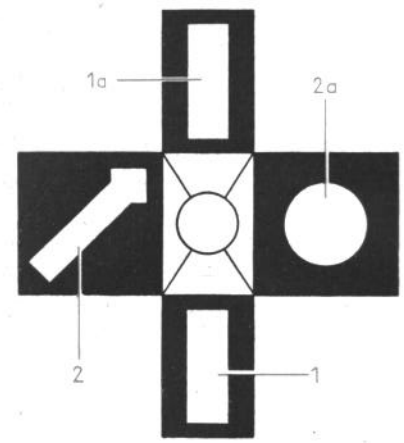


Fig. 143

If the points are set as shown in fig. 144–a, the signal lamp will show the indication marked "1" in fig. 143 where traffic passes through the points in the direction of the arrow, i. e., when they are "facing" points. With traffic passing in the opposite direction, i. e., through "trailing" points the indication shown will be 1–a, the same as 1. With the points set as shown in fig. 144–b, the "facing" side of the lamp will show the No. 2 indication in fig. 143 and No. 2–a in the opposite direction.


Fig. 144–a


Fig. 144–b

(b) Ground Signals at Double-Curve Points

With the points in the position shown in fig. 145–a the signal indications given will be No. 1 at the front and 1–a at the back (see fig. 146). The indications given with the points set as in fig. 145–b will be Nos. 2 and 2–a in fig. 146.

Fig. 145a

Fig. 145b

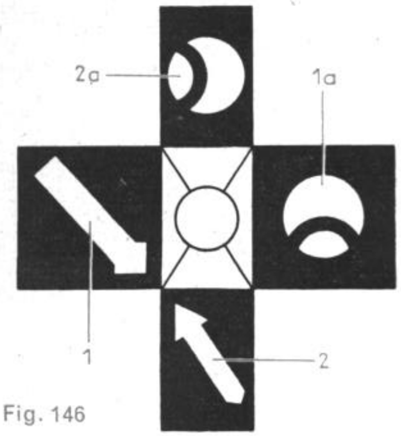


Fig. 146

(c) Ground Signals at Double-Slip Points

The lamps at double-slip points are fixed and do not turn round, the indications, being given on both sides of the lamps by moving parts inside. Fig. 147 shows the indications for the various settings of these points.

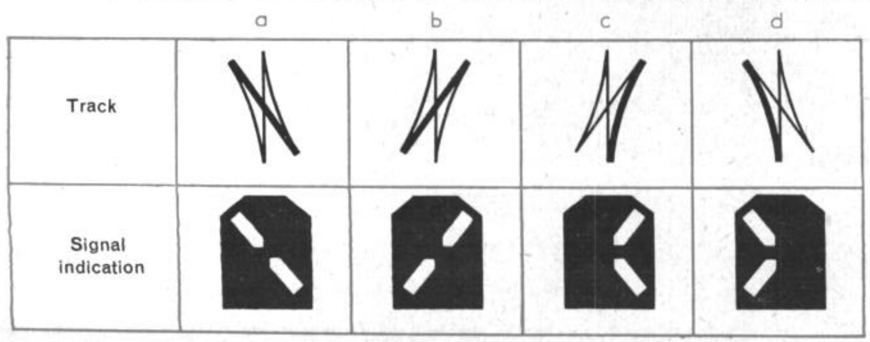


Fig. 147

II. The Inductive Train Warning System

The signals on a full-sized railway system can only provide absolute safety for traffic when they ars duly observed by the engine drivers. As mechanised safety devices have no parts that "get tired", an inductive, or electro-magnetic train warning system has been installed on the main lines. It will bring a train to a standstill quite independently of the watchfulness of the footplate crew when a signal is against the train. The layout of this inductive train warning system consists of parts that are fixed on the track and another part fixed to the engine, the latter being fitted on the side of express locomotives (see fig. 148); in this part there are three active oscillating circuits (locomotive magnets) separate from one another.

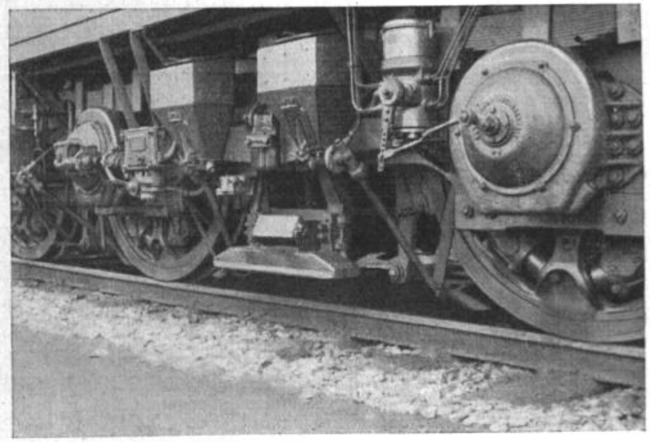


Fig. 148 The Locomotive Magnet

The stationary part of the system consists of a unit placed at three different points to the right of the rails, each unit having an oscillating circuit (track magnet) with its frequency tuned to one of the circuits on *the unit on the engine*. These oscillating circuits mutually affect, or "induce" one another, if the driver should fail to stop at a signal against him, and so actuate the automatic control on the engine.

Type of Magnet	Location of Track Magnet	Oscillation frequency
Distant signal	At distant signal	1,000 cycles
Speed	150 metres before the home signal	500 cycles
Home signal	At home signal	2,000 cycles

When the magnet on the engine runs over the distant signal magnet a contact is actuated that shows an amber light in the cab of the engine for five seconds, if the distant signal shows the indication Vo 1 or Vz 1. In this period the engine driver presses the "Alert" key. If this is not done, the brakes are automatically applied if the train is running at more than 90 kilometres (about 56 miles) an hour. If, after pressing the "Alert" key, the driver fails to reduce the speed to at least 90 kilometres per hour within 22 seconds, the brakes are also applied. Automatic braking likewise occurs if, after passing the speed magnet, speed has not been reduced to 65 kilometres (about 40 miles) per hour 150 metres in front of the home signal. If the engine passes a home signal against it, the home signal magnet likewise applies the brakes.

In this way every engine is brought to a standstill at least after travelling 200 metres past a signal against it (the danger point). Under the regulations, points must not be placed nearer to a home signal than 200 metres behind it, so that this inductive train warning system ensures absolute safety on the track section.

This system is similar in principle to the train control system on a miniature railway by means of MÄRKLIN signals.

III. The MÄRKLIN Signals

Most of the signals used for the safety of traffic on full-sized railways are available in scale-model form as acessories for MÄRKLIN miniature railways. The MÄRKLIN No. 446/99 Book of Signals gives full information as to how they are installed, connected up and used.

The book also explains how automatic block working can be fitted up with these signals, also how they can be inter-

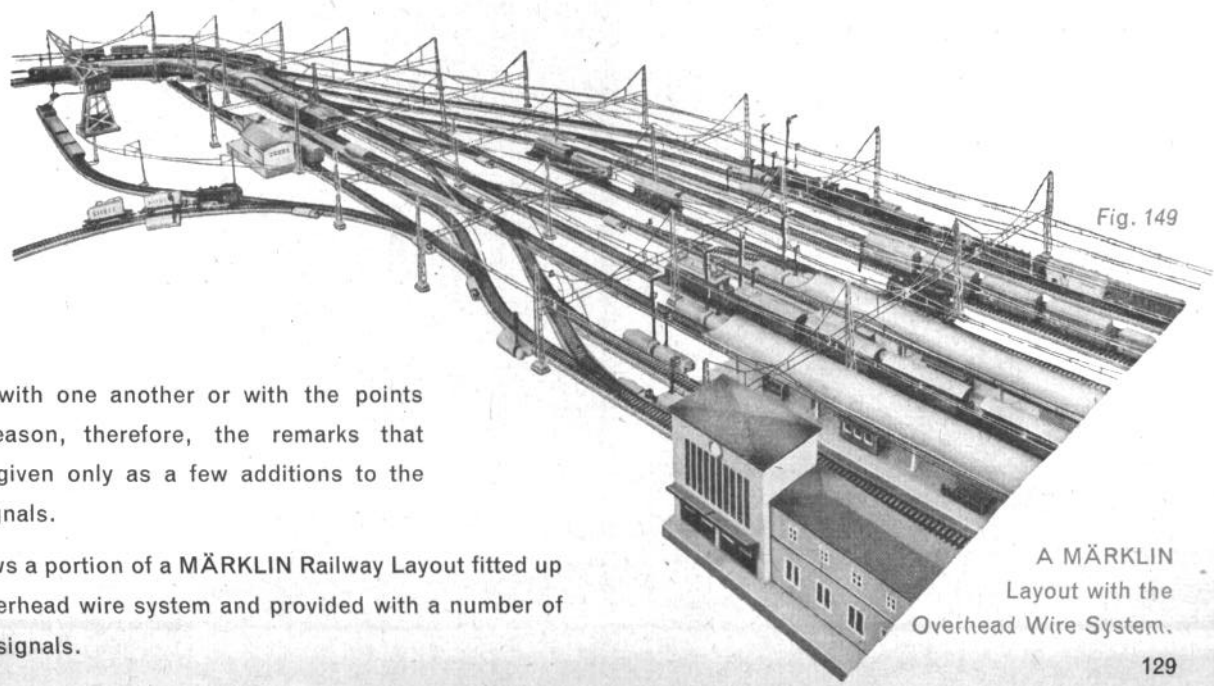


Fig. 149

connected with one another or with the points For this reason, therefore, the remarks that follow are given only as a few additions to the Book of Signals.

A MÄRKLIN Layout with the Overhead Wire System.

Fig. 149 hows a portion of a MÄRKLIN Railway Layout fitted up with the overhead wire system and provided with a number of MÄRKLIN signals.

1. Distant Signals

Distant signals have their warning boards in model railway practice also; these boards are listed in the MÄRKLIN Catalogue under No. 431. Just as in full-size practice, three such boards are used, erected at definite intervals from one another (see fig. 134). For MÄRKLIN layouts the spacing would be 75 metres divided by 87, or 0.86 metre, equal to 86 centimetres (about 31 inches). Generally speaking, considerably smaller spacing will have to be used, as most model railway fans have not the opportunity to lay out their tracks true to scale. Many other sections are also affected by this limitation, so that – unfortunately unavoidably – signals, points, stations etc. have to follow one another at too short intervals.

MÄRKLIN fans have a choice of three different distant signals, their numbers and the indications they can show being as follows.

Type of Signal	Indications		
Distant, No. 446/1	Vo 1	Vo 2	
Distant, No. 446/2	Vz 1		Vz 3
Distant, No. 446/3	Vz 1	Vz 2	Vz 3

2. Train Control Signals

These signals have two switches for the track current that switch the current on and off automatically both on the overhead wire as well as the third rail, according to the signal indication. This arrangement, together with the contact rail sections, enables automatic block working to be carried out very simply. The MÄRKLIN train control signals allow the following signal indications to be shown (see figs. 136 and 140).

Type of Signal	Indications		
Home, No. 446/11	Hp 0	Hp 1	
Home, No. 446/12	*Hp 0*		*Hp 2*
Home, No. 446/13	Hp 0	Hp 1	Hp 2
Home, No. 446/41	Hp 0	Hp 1	
Track block, No. 446/21	Ve 3	Ve 4	

3. Ground Signals

The MÄRKLIN points Nos. 3600 W, 3600 MWS and 3900 MW, also the double slip points No. 3600 DKWS, are fitted with ground signals in the same way as those in normal railway practice. The points and double-slip points worked electro-magnetically have signals that are illuminated exactly as their prototypes.

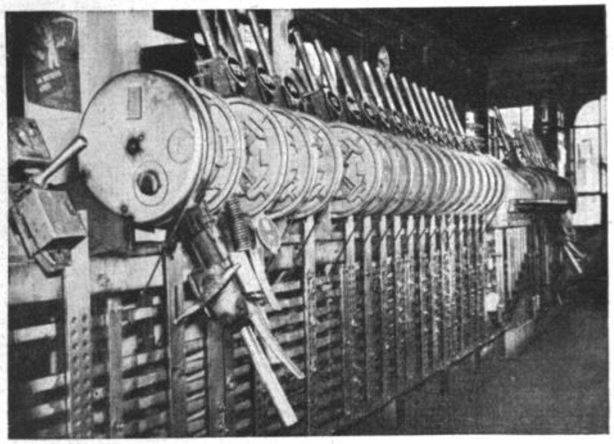


Fig. 150 A Signal Box with Lever Operation (Manual)

IV. Signal Boxes

In the early years of railways the few points that were used could be set by hand, but as the demands on railway service increased, means had to be found for points and signals to be worked from some central place. Such places were then called "signal boxes" and their use enabled the points and signals to be worked much more quickly.

1. Lever-operated or Manual Signal Boxes (Fig. 150)

Working the semaphore arms of the signals and the tongues of the points requires a certain amount of work, and this is done by the signalman expending a certain amount of energy when working the levers in the signal box.

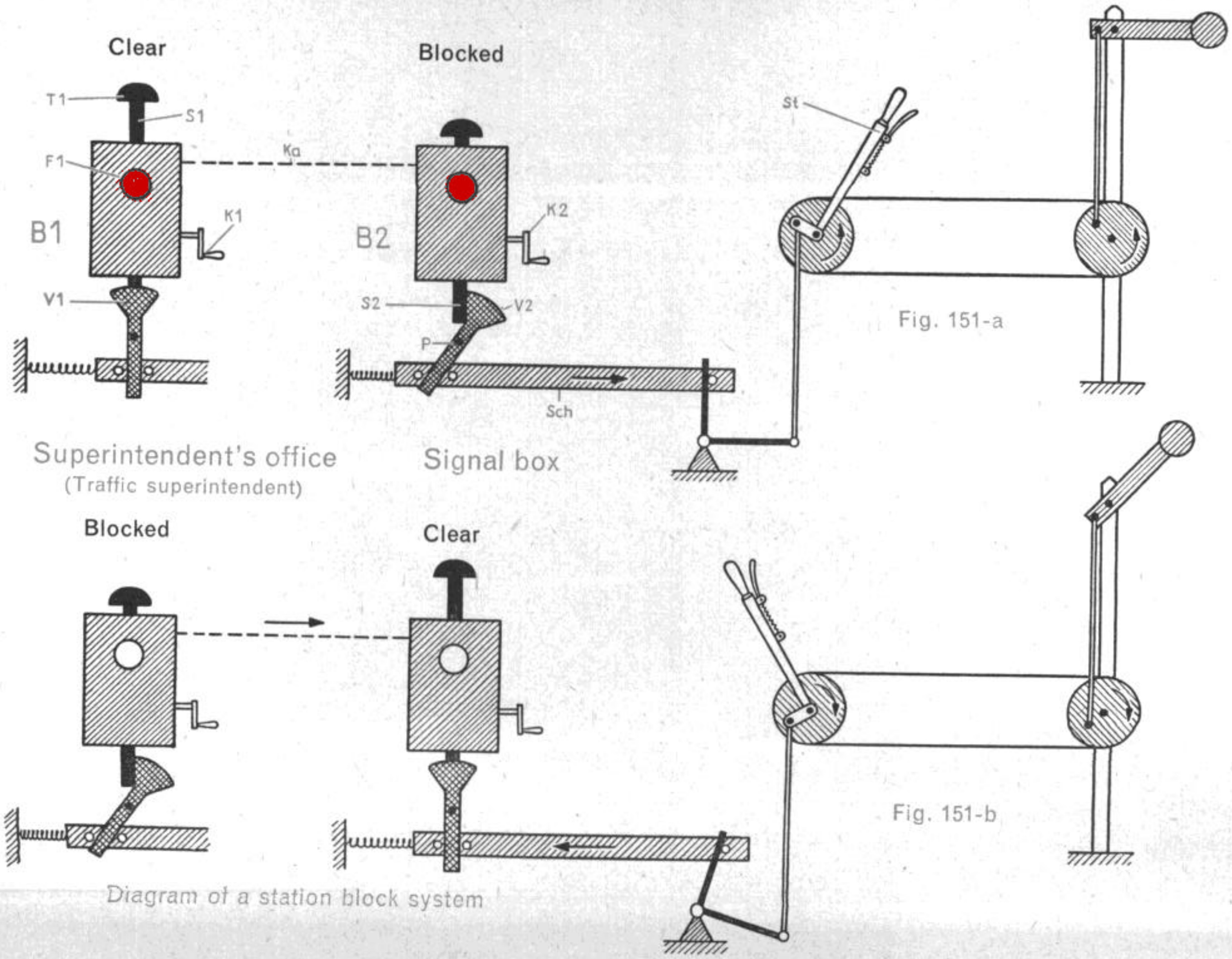


Fig. 151-a

Fig. 151-b

Diagram of a station block system

This energy is then transmitted by wires, kept taut by a tensioning device, to the points and signals, though in some countries it is transmitted either through pipes by compressed air, or by rods made up of gaspipe, instead of wires.

Block-working equipment is closely connected with the signal boxes. It provides additional safety by blocking signals or points in such a way that trains cannot run over the wrong lines or collide. The relation between signal boxes and block equipment is shown by the simple diagram in fig. 151, using a station block layout as an illustration.

Equipment such as that shown in fig. 151 is provided at stations where the points and signals are worked from several signal boxes. The various block instruments prevent the signals or points being worked wrongly.

The traffic superintendent or controller is responsible for the safety of traffic within the station area and from his block control office he can, by means of the block instruments, supervise the signalmen in their boxes under him. The traffic superintendent's block instrument B 1 (as in fig. 151–a) is shown in its "Clear" position, denoted by the block window showing red and the rod S 1 being out. The block instrument B 2 in the signal box is blocked, as the red in the window shows, and its rod S 2 is in. When the block instrument B 1 is blocked, the signalman in his box cannot set the signal at "Line clear"; if he tries to pull the signal lever over, he cannot do so, as the push rod Sch or the locking bar V 2, as the case may be, prevents him, the locking bar being up against the rod S 2.

The signalman cannot set his signal at "Line clear" until his instrument is cleared, this being done by the traffic superintendent in his control office pressing the knob T 1 of rod S 1 in the block instrument box, thus pressing the rod in, and at the same time turning the handle K1 which generates a current to clear the signal box *instrument electro-mechani*cally via the cable Ka. Rod S 2 then comes up and not longer bars the movement of the locking bar V 2. The signalman's instrument is now clear, but the traffic superintendent's is blocked. The signalman can therefore set his signal at "Line clear" but, on the other hand, the traffic superintendent can no longer change the positions of the signals and points for the route set (see fig. 151–b), on account of the position of the locking bar V 1.

The new state of the block equipment is shown not only by the rods S 1 and S 2, but also by the white colour shown in the two block windows.

So long as the signal remains set at "Line Clear" the signalman cannot return to the initial position of the block instruments, as to block his own instrument or clear the traffic superintendent's, he would have to press rod S 2 down, but cannot do so owing to the position of the locking bar V 2. Not until the signal has been reset at "Danger" can the signalman press in rod S 2 and, by turning the crank handle K 2, clear the superintendent's instrument again, that in the signal box again being blocked (see fig. 151–a).

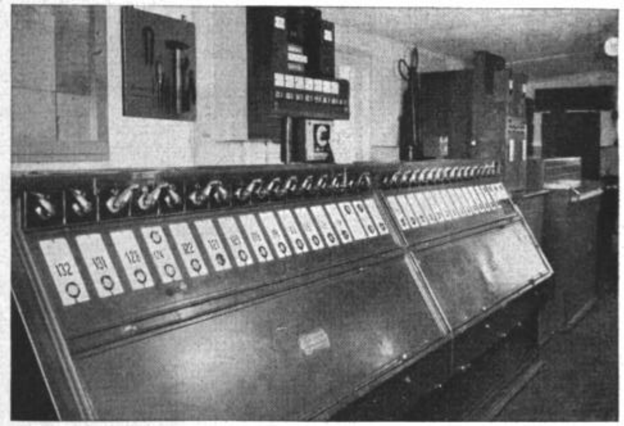


Fig. 152 Power-operated Signal Box

The following work has to be carried out in a mechanical signal box before a train can enter a station. After clearing, the signalman then moves over the levers for the road or track the train is to follow; then he can move the points for the train. Not until all this work has been done and also the so-called "catch points" have been properly set, can he set the inwards signal to "Line clear". That then locks all levers, so that points in the vicinity of the road for the train cannot be moved again. When the train has completed its journey along the road set, all these activities are repeated in the reverse order. Block working on open sections of the line is carried out in a similar way to the station block working just described.

As a mechanical or manual signal box with its levers makes heavy demands on the signalman's strength, and because, *in addition*, the part of a system that can be controlled by a manual box is not very large, operation of the points and signals has been changed over to electrical energy.

2. The Power-operated Signal Box (fig. 152)

In a signal box of this kind the signals and points are worked by electric motors that are set in motion by remote control from the signal box. In place of levers there are rotary knobs that have to be turned to operate the signals and points, and by this means, all working operations can be carried out more quickly over a greater area for the signal box.

These modern signal boxes have, just recently, been replaced by what are called track diagram signalling systems at stations of various sizes.

3. Track Diagram Signal Boxes

In signal boxes of this kind there are no mechanical moving parts, but only electrical relays and groups of relays that carry out the operations required. The entire "signal box" consists of a signal table or desk on which there is a diagram of the track layout (fig. 154).

Operating buttons are placed at all points, tracks and signals on this track diagram, and two of these buttons must always be pressed together, so as to avoid mistakes in operating the signalling table. Thus, when a certain road or track is to be set, the track or section button must be pressed together with the appropriate signal button. If a single point is to be moved over, then the point button must be operated together with the point group button, as it is called.

A lamp placed under each signalling point is always alight to show up the position of the point on the signalling diagram.

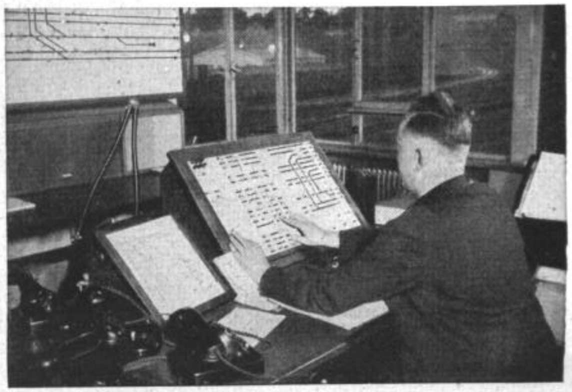


Fig. 153 The Traffic Superintendent sitting at the Train Schedule Recorder and the Section Signal Table or Panel.

On the other hand, the marking of the sections on the signalling table is dark, in the ordinary way, but if a train is announced and its road set, it will be shown by a steady amber light. An amber winking light is a sign to show the official that an acceptance or order of some kind has been received and that a definite road is to be cleared. Signal indications are shown on the track diagram by red, green or amber lights. The course of the train can be accurately followed on the signalling table. A red stripe appears at the places on the track the train is running over on the diagram on the signalling table, and when a train passes out of its section, the red illumination goes out automatically.

The correct illumination of the signalling diagram is obtained by the rails of one side of a track being electrically isolated from those of the other side. A steady current flows through each line of rail and passes through the wheels of the oncoming train. Any interruption of this steady current causes the red lamps on the signalling table to light up. This procedure can be copied in an almost scale-model way by using the contact track sections Nos. 3600–BSA, 3600–BSD, 3900–BSA, 3900–BSD and 3800–BSA on MÄRKLIN model railway systems.

These track diagram signalling systems allow the train service to be controlled both in a large station not under visual supervision, as well as along an open section between several stations.

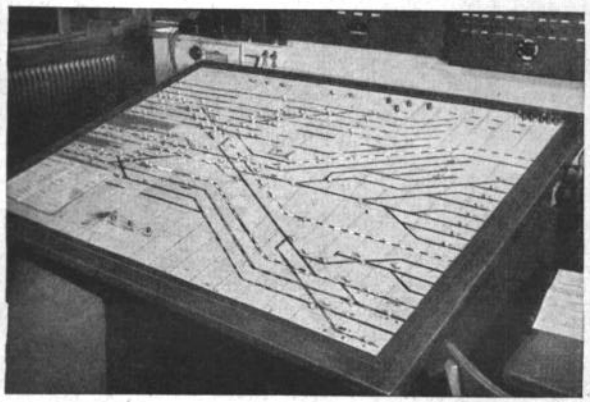


Fig. 154
The Signalling Panel of a Track Diagram "Signal Box".

4. The Track Diagram Section "Signal Box" (fig.155)

The train service on the section of line between Nuremberg and Regensburg is controlled by a signalling system of this kind. The section of the line is reproduced on a section signalling panel. The traffic controller can supervise the whole of the traffic and see at a glance all the trains that are running through the section. When a train enters the area of this signalling system, its number appears on the incoming side and moves across the panel with the sign showing the train. Owing to the good general idea he can obtain from the panel (fig. 153) the traffic controller can make arrangements that will reduce to a minimum any trouble caused by trains being delayed, or other irregularities in traffic.

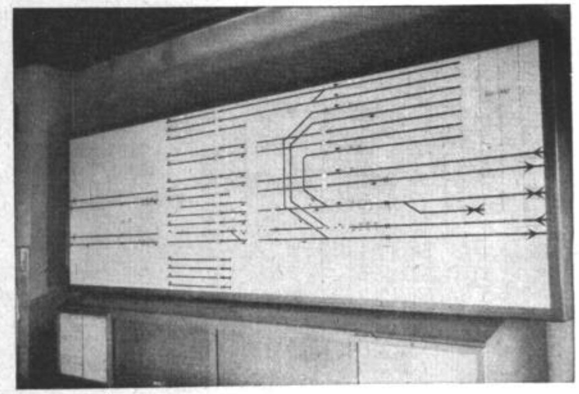


Fig. 155 A Section of a Track Diagram Section Signalling System Panel.

There is also a train schedule recorder placed in front of the signalling panel in the duty room of this section track diagram signalling system, its purpose being to keep a graphic record of the train's progress and its times.

V. Signal Boxes in Miniature Railway Working

Anyone who has once seen a relay frame in a track diagram signalling system, with its multitude of coils and other components, will be convinced that working the points and signals on a miniature railway in such a way would be too costly altogether. All that can be done, therefore, is to copy the prototype as closely as possible.

The various kinds of signalling and switching operations carried out on a full-sized railway can, however, be copied to a great extent on model railways as well. Naturally, there are not only the **MÄRKLIN** points with electro-magnetic remote control but there are also **MÄRKLIN** points that can be set directly by hand purely mechanically, just like their big prototypes. Formerly, there were even **MÄRKLIN** points to be had that were remotely controlled either by suction or compressed air.

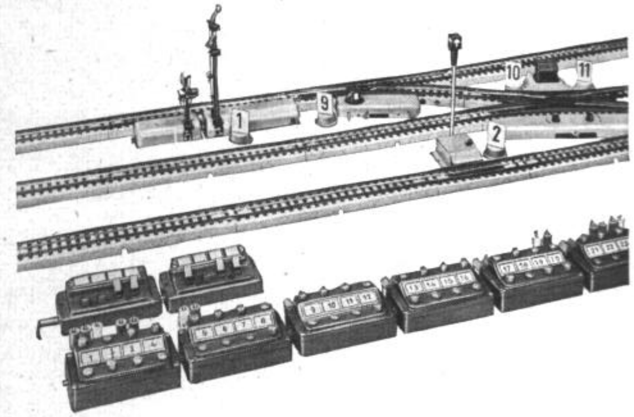


Fig. 156 A MÄRKLIN Signalling Installation

MÄRKLIN signalling installations on a large scale can be made up by placing several signalling control panels together, one after the other (fig. 156). Such a signalling system is like a power-operated signal box on a full-sized railway. Each control panel has red and green buttons to show the positions of signals or points, as the case may be. If a red button is higher than the green one working with it, the signal will be at "Danger" and the points open for the branch line. If the green button is higher than the red one, the signal will show "Line clear" and the points will be open for the main line. The settings of the points and signals can therefore be seen from the control panels alone, even though they may be out of sight from the signal control point, owing to being hidden by a hill or a building.

For reasons given in the beginning, a scale model replica of a track diagram signalling system can only be made up in exceptional cases, though ways and means can probably be found for building up a track diagram signalling system on a model scale that is at least something like the real thing.

VI. Train Advices

Among the many precautions taken to ensure the safety of trains, brief mention may be made here of the system of advising trains from one station to another.

Supposing a train is to travel from the town of A to the village of B, it cannot start away from A until the village of B has given permission for it to do so. The train is "offered" by A to the station in B. B will either "accept" it, or advise A to wait awhile before sending the train. Arrangements between the two stations can be made over the telephone in exceptional cases, though as a rule the telewriter or Morse apparatus (fig. 157) is used for the purpose. With the Morse apparatus, the letters of the Morse alphabet are used as characters. The departure of long-distance express train No. F 8 from the city of A would therefore take place something like the following.

A calls B: —.—.—. (call sign)
B replies: Hr B — B here: . . . . .—. —. . .
A offers F 8: Hr A F 8 ag? (ag — accepted): . . . . .—. .— . .—. ——. . .———.
. .——. .
B accepts the long-distance train: F 8 yes: . .—. ———. . .——— .—
A finishes the advice message with "Arrr" ("Finish" sign): .— .—. .—. .—.

The arrival of the train at B is then advised to A over the telewriter in a similar way. For "arrived" (the German word "angekommen") the abbreviation ak (.— —.—) is used. If the train cannot be accepted by a station, the answer "No – wait" (nein – warten) is given, instead of "yes" (ja). If there are block stations in between the two train advice points, the officials in charge of such block stations also read the various advices on their telewriters.

At about the same time as the train is advised, in the ordinary way it will also be rung off by the traffic superintendent and by this means, all crossing-keepers on the section are advised of the departure of the train, so that they can close the gates or barriers in good time and protect the train and road accordingly.

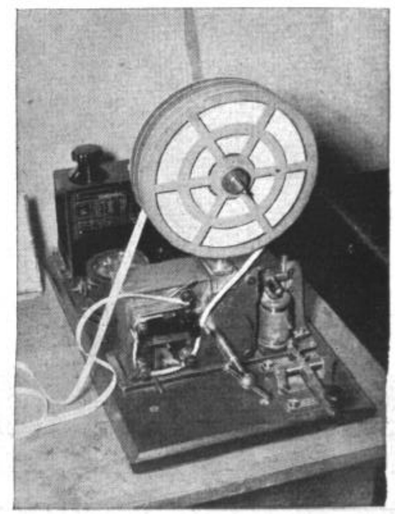


Fig. 157 The Morse Apparatus

E .Railway Operation

Track, platforms and all other parts of a railway system are almost always eminently practical and therefore straightforward in design, though animated in their own attractive way both by day and night by the pulsating activities of railway operation. This liveliness excites the interest of many people who find pleasure in watching the traffic and those taking part in it, and who follow with interest the duties carried out by railwaymen as the trains arrive and depart.

I. Operations in a Passenger Station

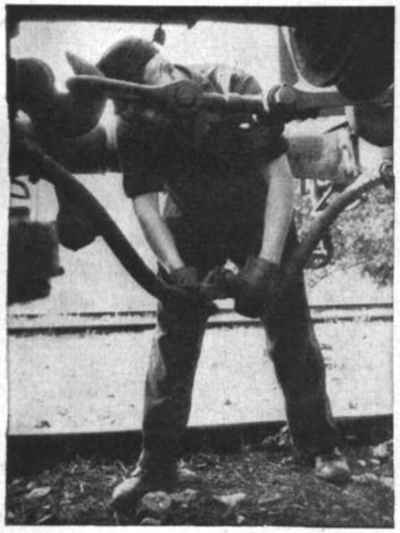
Many officials and staff are engaged in carrying out railway operations at passenger stations. First of all a description of the activities of the train service officials will be given.

1. The Activities of the Train Service Officials

The traffic superintendent has sole responsibility for the movement of all trains and locomotives. In the larger stations, his duty post is in the duty room, from where he supervises and directs all movements over the system of tracks in his duty area. In a station such as that in a capital city, railway traffic often requires the services of two traffic superintendents whose responsibility is split up between the station area and the open sections. These officials are known as the station traffic superintendent and the main line traffic controller. Where the traffic superintendent or controller carries out his duties in a track diagram section signalling system, he is known in the service as the superintendent of the line.

The best-known railway official is certainly the stationmaster, known by the red service cap he wears (in Germany and other countries). He is responsible for the safety of passengers, the departure of trains at the right times from their platforms, and for the proper order and condition of the coaching stock.

Fig. 158 The Guard filling out his Journey Sheet



Connecting the Air Brake Pipe when coupling coaches

He gives the guard or engine driver, as the case may be, the signal to start by means of his departure sign, though he may not do this without consent of the traffic superintendent, i. e., only when the departure signal is "off", or shows "Line clear". At the smaller stations the duties of traffic superintendent and stationmaster are carried out by one and the same person.

2. The Make-up of Passenger Trains

It is the custom to arrange the individual coaches of a train in a very definite order. The luggage van is generally coupled directly to the engine, and in most cases the mail van follows next, though where trains *run on a shuttle service*, these two coaches are frequently at the ends of the train also.

When making up long-distance express trains care is taken to place the sleeping cars at the beginning or end of the train, the idea being to avoid persons passing to and fro through these coaches. The restaurant or dining car should be in the middle of the train as far as possible, so that passengers do not have far to go to get to it. Nevertheless, this sequence cannot always be followed, especially if the train has through coaches or has to pick them up en route. Through coaches are carriages that travel *only part of the* way with the train and are transferred to another train travelling in a different direction at a certain junction. In this way, certain passengers are saved the trouble of changing. The transfer of through coaches can be carried out by tank engines in scale-model fashion on a miniature railway, if the MÄRKLIN uncoupling track section No. 3600 EKS required is arranged in the main line track running through.

A train therefore consists of the set coaches, i. e., those that always run with the train, the through coaches and, when necessary, extra coaches that have to be added when there are large numbers of passengers to be taken.

Passenger trains travelling at over 90 kilometres (about 56 miles) per hour are made up of bogie stock only, as a rule and if, as exceptions, wagons with six or even four wheels have to be made up into express trains, they are placed at the end.

Goods wagons for fast and express goods can run with passenger trains, but only if they have the [SS], [S] or the supplementary s markings. The regulations lay down that these wagons also are to form the end of the train, as far as possible.

When making up trains on full-size railways care must be taken to see that the brakes on all stock will ensure proper braking of the train, and that the weight of the train, or the axle loading, as the case may be, does not exceed the carrying capacity of the permanent way and bridges on the route to be taken. This was the consideration on which was based the regulation that a passenger train may have up to 60 axles, or 80 axles in exceptional cases. The tractive effort of a locomotive also often sets a limit to the length of the train.

In miniature railway working with MÄRKLIN engines the number of axles a train may have is limited not by the tractive effort of the locomotives but by the station layouts that are, generally, too short.

The order in which the coaches etc. are to be arranged in a passenger train is set out in the train composition plan, which gives the number of the train, the type and sequence of coaches, etc., the number of the train from which the rolling stock was taken over, and the number of the train to which it is to be transferred later on, as well as the more important stations each coach will pass through.

In the German and European Rolling Stock Pool the movements of all passenger coaches and sleeping and restaurant or dining cars are recorded.

3. Preparing for a Journey

The guard is responsible for the correct composition of the train, the proper functioning of its brakes, the regular lubrication of its axle bearings and for the coaches etc. being coupled up properly. In Germany he wears a red identification band so that he may be recognised easily. He fills out his journey sheet before the train leaves, showing the number of the train, its destination, and its individual coaches etc. in the order of their make-up. Fast, express and long-distance express trains carry a number with one, two or three figures. Passenger or slow trains have a three or four-figure train number.

Goods trains are numbered between 5,000 and 100,000. On a miniature railway system also the rolling stock should be examined as to its fitness for service, especially with regard to the couplings being in order. Losing part of the train may be great fun, but it is certainly not "scale model". The coupling gauge provided with railway service tool No. 397/1 will be found very useful for inspection purposes. Oiling the engine also forms part of the duties of a model railway engine driver.

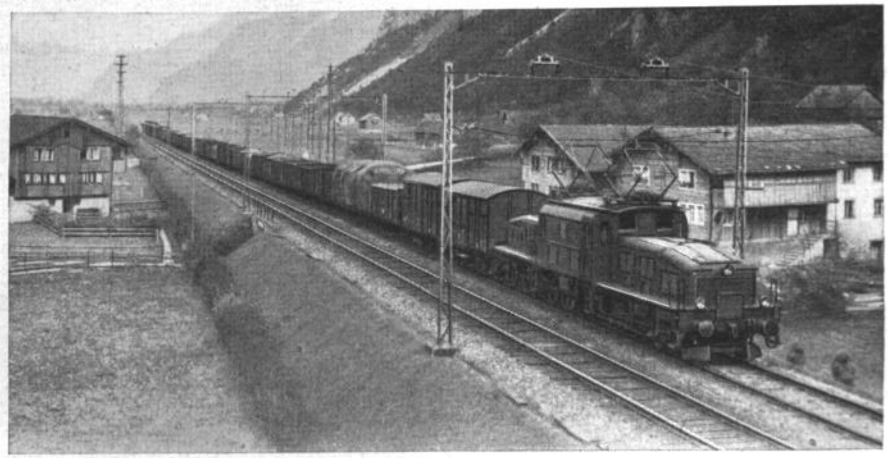


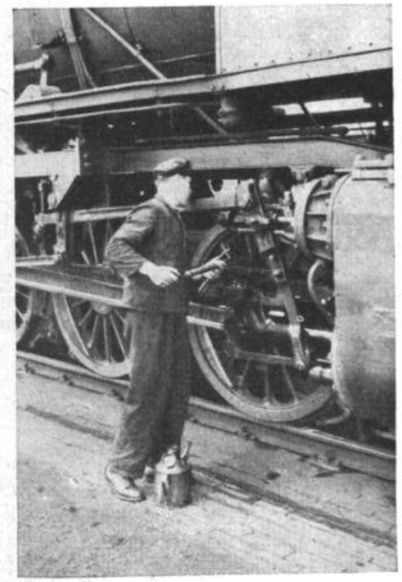
Fig. 160 A Ce 6/8 type Locomotive of the Swiss Federal Railways, prototype of the MÄRKLIN CCS-800 Locomotive.

II. Operations in a Goods Station

So far as passenger traffic is concerned, the number of persons carried is approximately the same in both directions, on an average, as most passengers travel back again to the station they started from. That is why trains are able to run over their routes in both directions without any alteration to the set number of coaches ("set trains"). Every passenger coach therefore runs backwards and forwards between two definite stations only, though there are, naturally, practically always other stations in between these two. That is not the case with goods trains, however, as the wagons may have to be transferred to other trains several times in order that their loads may reach their destinations. Therefore, in goods trains with definite service numbers, though the engine and luggage vans or guard's van may be the same all the way, the actual goods wagons or trucks will not be the same. Goods stock travels freely over the entire railway system and is used in marshalling yards so that, as far as possible, it always carries a load of some sort on its journeys.
Passenger trains are made up mostly on passenger stock sidings, but goods trains are made up on the marshalling hump of a marshalling yard, as described on page 31.

1. The Composition of Goods Trains

The composition of goods trains is governed by regulations that are so extensive that they cannot all be recapitulated within the scope of this handbook. The foreman shunter is responsible for making up the trains, and can be identified by the red band he wears on his cap (in Germany). He arranges the movements of the individual wagons under the supervision of the traffic superintendent. No general plan can be followed for these operations, owing to the great variety of wagon movements during shunting. The foreman shunter has to see that certain wagons do not run over the hump. Wagons carrying a yellow flag (gunpowder or poison); those marked "Not to be fly shunted" or "Not to be run over hump"; wagons carrying the inscription shown in fig. 131–b, and also wagons with long loads (rails or the like), carried on two or more trucks, are all not allowed to run over a hump. In making up trains, the chief things to watch are that the braking weight, the axle loading and the brakes on the rolling stock are in the stipulated ratio to the carrying capacity of the permanent way and bridges of the route to be taken. The speed of the goods train and the tractive effort of the engines also play no small part in this. In the ordinary way, a goods train is allowed to have anything from 60 to 150 axles.



Oiling the Engine

In laying down the order in which the stock is to be arranged, on full-sized railways, for reasons of safety, it is the practice to see that heavy stock is placed next behind the locomotive and the lighter stock at the *end of the train, not only* on passenger trains but even more so on goods trains. This practice should also be followed in miniature railway working as it prevents derailment to a considerable extent.

For economic reasons it is most important to see that:

2. The Unloading of Goods Wagons

takes place as quickly as possible. In the goods shed or sheds of local goods stations there is usually a crane available for loading and unloading heavy goods. The most varied kinds of transport appliances are very frequently to be seen in the vicinity of the open loading bays or roads where goods in bulk are dealt with, such as slewing cranes, diggers, bucket excavators, conveyor belts, wagon tipping gear and so on, all for loading and unloading goods wagons mechanically in the shortest possible time.

The MÄRKLIN slewing crane, catalogue No. 451–G, with remote control, can be used both in the vicinity of the goods shed as well as on the open loading bay, to turn, lift and lower the load again.

III. Locomotive Service

1. The Turntable

Turntables are provided more particularly in the track layout at stations where trains commence or finish their runs. They should be placed where they are easy of access from the main through lines, though they must not form part of such through lines. If a train, drawn by a tender locomotive, is to continue its journey in the opposite direction, the engine would normally

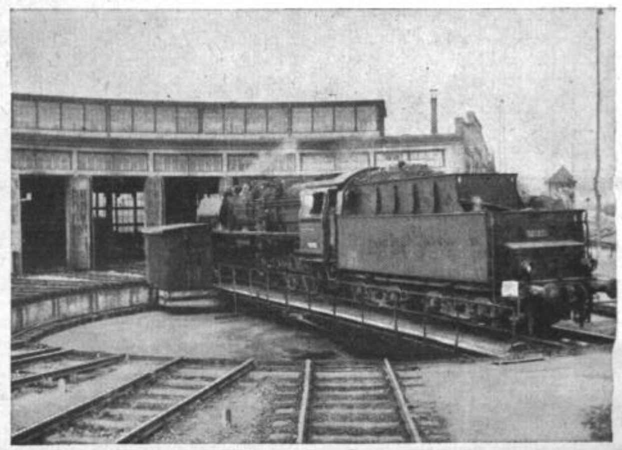


Fig. 162 An Engine on the Turntable

come on to the other end of the train, and so would have to run tender first, but then the regulations limit its speed to 50 kilometres (about 30 miles) an hour, and so it is turned round on a turntable (fig. 162). It can then be coupled on to the train to run the right way. The inward road to a turntable is guarded by a track block signal.

All turntable operations on a full-sized railway can be copied on a miniature railway with the MÄRKLIN turntable (Catalogue No. 419–NG). It has several roads into the engine sheds.

2. The Engine Sheds

These sheds are provided on full-sized railways for the protection of the engines from the weather. The loco staff can attend to cleaning and oiling the engines and getting them ready for service without being exposed to inclement weather. The boiler and its tubes can also be attended to in the sheds and minor repairs carried out. With the rectangular type of shed like that under No. 412 in the MÄRKLIN catalogue, engines can run into them either over points or through turntables and traversers. Entry by points gives a better flow of traffic, and in such case the engines can be turned round either on a turntable arranged close to the points, or else round a triangle or loop. When the engine sheds are the circular type ("round house"), the turntable is in the centre of the circle. At medium-sized stations where there is no great number of engines in service, the engine shed is often the sector type. The MÄRKLIN engine shed under Catalogue No. 411–B is a copy of a shed of this type. The layout with a turntable in front of the sheds has the advantage of saving space, compared with a points layout.

3. The Coaling Depot

The coaling depot is placed close to the engine sheds. At smaller stations, coal is brought to the engines in baskets by hand, but at medium-sized and larger stations there are special depots equipped with a grab crane and the track layout is then mostly like that shown in fig. 163.

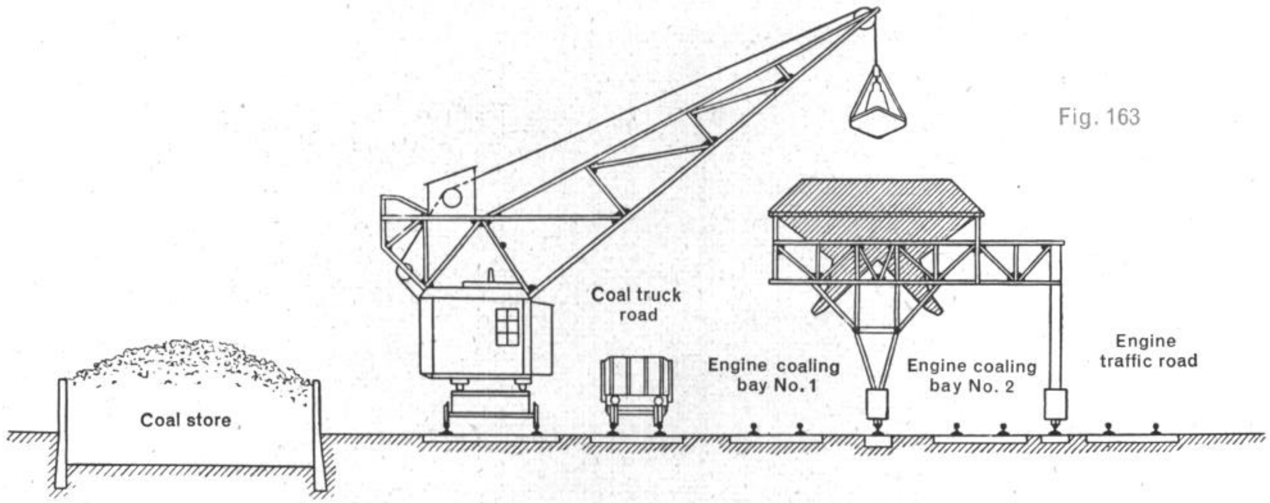


Fig. 163

A grab crane, running on a broad-gauge track, is next to the coal store, then a track for the coal trucks follows, two coaling bays. Nos. 1 and 2, for the engines, and the road over which the engines pass to and fro. Close to the grab crane is the slag pit.

4. The Slag Pit

The slag falls into the pit when the grate of a steam locomotive is tipped up. It is removed from the pit later on by slag trucks. A crane is also frequently used for lifting the slag trucks.

5. The Sanding Depot

Sand is applied to the rails to increase adhesion between the wheels of the engine and the face of the rail when starting, in wet weather, when running up steep inclines and when braking, as required. The best results are obtained with dry, coarse quartz sand. The sand is dried in the sanding depot and supplied by a sand delivery arrangement to sandboxes on the engines.

In the case of miniature engines the sanding effect is obtained by rubber or plastic tyres on the driving wheels.

6. The Water Crane

Water cranes to supply the engines with water are provided on main line sections, shunting yards and particularly in engine depots, being found more especially in the vicinity of engine sheds, coaling and sanding depots. The water, taken mostly from lakes and rivers, is supplied to the water cranes by a gravity tank or from an underground reservoir under pressure.

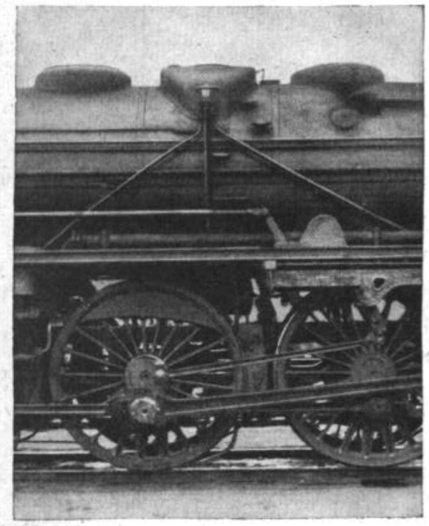


Fig. 164
Part of a locomotive, showing the sandbox and three sanding pipes, two slanting.

IV. Operations on Main Line Sections

1. Train Speeds

Speed is understood to mean the distance covered in an hour, measured in kilometres; it can be calculated by the following formula, viz:

$$\text{Speed} = \frac{\text{Distance}}{\text{time}} \text{ kilometres per hour,}$$

or, expressed in the brief technical fashion:

$$V = \frac{S}{T} \text{ (km/h)}$$

In this, the speed V is given in kilometres per hour, the distance S in kilometres and the time T in hours. The following is an example.

The Orient Express covers the 1,405 kilometres between Vienna and Paris in 21 hours, 15 minutes; its average travelling speed is therefore:

$$V = \frac{S}{T} = \frac{1405}{21^1/_4} = \frac{1405}{21.25} = 67 \text{ (km/h)}$$

or about 42 miles an hour.

The speed of this famous train may appear to be rather low, but on looking into the matter, it must be realised that this is not the maximum speed of the train, as it includes stops in stations, picking up and setting down through coaches, and so on. Looking at its speed between Munich and Augsburg – it covers the distance of 62 kilometres in 44 minutes, i. e., 44/60, or 0,73 hour non-stop – it runs between these two places at:

$$V = \frac{62}{0{,}73} = 85 \text{ (km/h),}$$

or about 53 miles an hour.

The maximum speed a main line express train is allowed to run on a line provided with the inductive train warning system is 130 kilometres (about 80 miles) an hour, in exceptional cases.

Generally speaking, speeds will depend on the quality of the permanent way, i. e., the radius of its curves, the loads the bridges are allowed to carry, the stability of the track and the extent of the gradients to be negotiated, as well as on the type of train and its braking system. Main line expresses are not allowed to travel more than 110 kilometres (about 70 miles) an hour over sections that are not fitted with the inductive train-warning system.

The following maximum speeds are allowed at the present time by the German Federal Railways, provided there are no special regulations governing the sections concerned.

Express trains	120 kilometres (75 miles) an hour
Fast trains	110 kilometres (70 miles) an hour
Passenger (slow) trains	85 kilometres (53 miles) an hour
Express goods trains	100 kilometres (62 miles) an hour
Fast goods trains	75 kilometres (47 miles) an hour
Through goods trains	65 kilometres (40 miles) an hour
Freight goods trains	55 kilometres (34 miles) an hour

In engineering practice the speed is measured in metres per second as well, and not only in kilometres per hour. As 1 kilometre is 1,000 metres and the hour has 3,600 seconds, a speed given in kilometres per hour (V) can easily be converted into metres per second (v), as follows:

$$v = \frac{V \times 1000}{60 \times 60} = \frac{V \times 1000}{3600} = \frac{V\ (km/h)}{3{,}6}\ (m/sec)$$

$$V = 85\ (km/h) \text{ is thus: } v = 85 : 3.6 = 23.6\ (m/sec.).$$

To convert the other way round, i.e., m/sec. to km/h, the following formula is used:

$$V = \frac{v \times 3600}{1000} = 3{,}6 \times v\ (km/h).$$

v in this formula is the speed in metres per second.

The following Table shows the maximum speeds of the best-known types of the German Federal Railways that have been used as prototypes for MÄRKLIN engines. If the speed of an engine on a model railway is to be fixed, the length of the section over which the speed is to be measured must be settled beforehand. As the length of the track sections is given in the MÄRKLIN Catalogue there will be no difficulty in deciding on the length for measurement.

Type	Maximum Speed	MÄRKLIN-Locomotive
01	130	F 800
23	110	DA 800
44	80	G 800
89	45	CM 800
E 44	90	SET 800
E 63	50	CE 800

As an example: A MÄRKLIN F 800 locomotive travels round an oval 10½ metres long in 12,7 seconds; its speed can therefore be calculated as

$$v = \frac{10,5}{12,7} = 0,83 \text{ (m/sec.)}$$

From this:

$$V = 0,83 \times 3,6 = 3 \text{ (km/h)}.$$

The transformer was in its maximum position for this. As the HO gauge miniature railway represents a reduction of 1/87th full size, in converting the length the speed must also be multiplied by 87 to find the equivalent for full-size practice. 3 km/h on the miniature railway is therefore equivalent to:

$$V = 3 \times 87 = 261 \text{ (km/h)},$$

on a full-size railway. From this very high speed it may be concluded that:

The speed of the F 800 was not true to scale. The scale model speed is obtained when the track voltage is regulated by the transformer control knob so that it does not exceed about half the possible high tension.

For calculating the speed at which the wheels revolve, the circumference is given by the formula:

$$\text{Circumference} = \text{diameter} \times 3,14.$$

The MÄRKLIN F 800 locomotive has wheels 22 millimetres in diameter and so the circumference of such a wheel will measure 22×3.14, or 69 millimetres. If, according to the calculated speed v= 0.83 m/sec, a distance of 0.83 metre, or 830 millimetres, is covered in a second by this circumference in one revolution, then the wheel will make 830 : 69 = 12 revolutions per second, or 12 × 60 = 720 revolutions in a minute. As there is a 24 to 1 reduction gear on the engine between the armature pinion and the driving wheels, the armature will turn 720 × 24 = 17,280 times a minute. In an hour, this locomotive armature will make 17,280 × 60, or about a million revolutions, at the calculated speed.

These figures show the performance the little motors in MÄRKLIN engines are capable of, and will make it easy to understand why the service instructions tell you not to forget altogether to oil the bearings and inspect the brushes on the commutator of the motor.

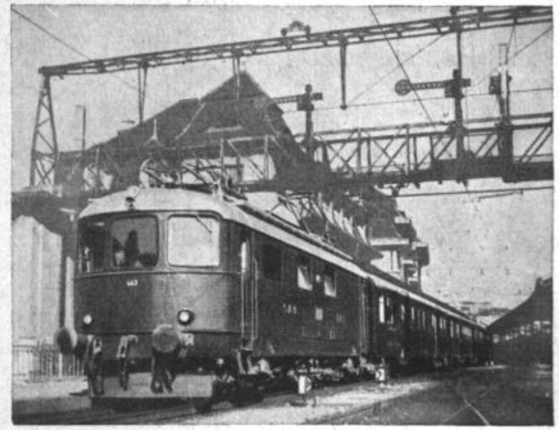


Fig. 165
Swiss Federal Railways Locomotive Type Re 4/4 prototype of the MÄRKLIN RET 800 locomotive

2. The Timetable

The train service on a large model railway system will be all the more interesting if the trains are not merely run aimlessly over the track, but on a service definitely based on a timetable. When making out timetables, the kind of route to be followed must be taken into consideration. The traffic density on a double track line will be considerably heavier than on a single line in a rural district. When the timetable is being made out, remember that express and fast trains only run over main lines passenger trains and goods trains over main and branch lines. The timetable should follow, as far as possible, the conditions met with in full-size railway working.

On a section the trains run over in the direction of a large town or city, passenger trains should be arranged so that they arrive there some time between about 6 a.m. and just before 8 a.m., as they are used almost exclusively by work-people, office staff and schoolchildren. Returning trains should be fitted in to suit the hours the passengers have to work. In with other trains during the evening, there should be one included running to the town and returning about midnight, so as bring theatregoers and other people back home again. Express trains can run at any time; if the period of their journey falls mainly during daylight hours, they must have a dining or restaurant car attached, and if they run at night time, they must have a sleeping car attached.

Goods trains will mostly have to travel at night over sections with a high passenger traffic density.

It is best to use a diagrammatic type of timetable like the one shown in fig. 167 when making out a timetable, as a table of this description not only gives the times at which trains run, and their numbers, but all the technical details of the routes as well. As will be seen from the diagram, operational and motive power depots are shown on the table, together with distances in kilometres, the gradients and track contours.

Timetables of this kind are made out showing the distances in kilometres and the places along the line on a horizontal line, while the times are shown by a vertical line. The timetable shown in the figure is only a part of the real one and gives the train service over a section 14 kilometres long during the hours of 8 and 9 a.m.

Express, fast and passenger (slow) trains are shown on the table by black lines first of all, then the goods trains are shown in the remaining space by blue lines. Each train is given a number and a code (see the following table).

Black Lines		
━━━━	=	Express or fast train, or fast interurban train
━ ━ ━	=	Extra express train
═══	=	Train with express goods
═ ═ ═	=	Extra train for express goods
────	=	Passenger train or local fast train
─ ─ ─	=	Extra passenger train or extra fast local train
─o─o─	=	Empty train
-o-o-	=	Extra empty train
─o─o─	=	Light engine
- o - o -	=	Extra light engine
Blue Lines		
════	=	Express goods train
═ ═ ═	=	Extra express goods train
────	=	Fast goods train, cattle train, light goods train, milk train or mail train
─ ─ ─	=	Extra fast goods train
────	=	Freight goods train
— — —	=	Extra freight goods train
....	=	Freight goods train taking passengers
....	=	Fast goods train taking passengers
A	=	Service train
D	=	Express train
De	=	Through fast goods train
DER	=	Special trains of the DER Study Group
Dg	=	Through goods train
Dt	=	Express railcar
E	=	Fast train
Et	=	Fast railcar
F	=	Long-distance express train
Ft	=	Long-distance express railcar
Gmp	=	Goods train taking passengers
Küb	=	Small interchange train between adjoining stations
Lgo	=	Train of empty goods wagons with open goods trucks
Lt	=	Empty railcar train
Lz	=	Light engine
N	=	Local express train
Ne	=	Local fast goods train

Ng	=	Local goods train
P	=	Passenger (slow) train
Po	=	Mail train
Pt	=	Passenger railcar
Pto	=	Passenger railbus
Prw	=	Workshops test train
S	=	Metropolitan express train
Sg	=	Express goods train
St	=	Metropolitan express railcar
S	=	Train runs Sundays and holidays
W	=	Weekdays only
nS	=	Runs weekdays after Sundays and holidays
vS	=	Runs weekdays before Sundays and holidays
So	=	Sundays only
Mo	=	Mondays only
Di etc.	=	Tuesdays only, etc.
[Mo] [Di]	=	Runs daily: Except Mondays, Tuesdays etc.
⊗	=	Runs only by special order
No symbol	=	Daily
Bk	=	Signal box
Hp	=	Stopping point
Hst	=	Halt
□	=	Locomotive reserve station
⊠	=	Locomotive changing station
▽	=	Water station
2○ 11/23	=	Locomotive turntable — The figure on the left shows the number of turntables at this station and the figures on the right the diameters of the turntables
⊥	=	Weighbridges
×	=	Stops only if necessary
+	=	Stops only for service reasons
◖	=	Stops only to set down passengers
◗	=	Stops only to pick up passengers

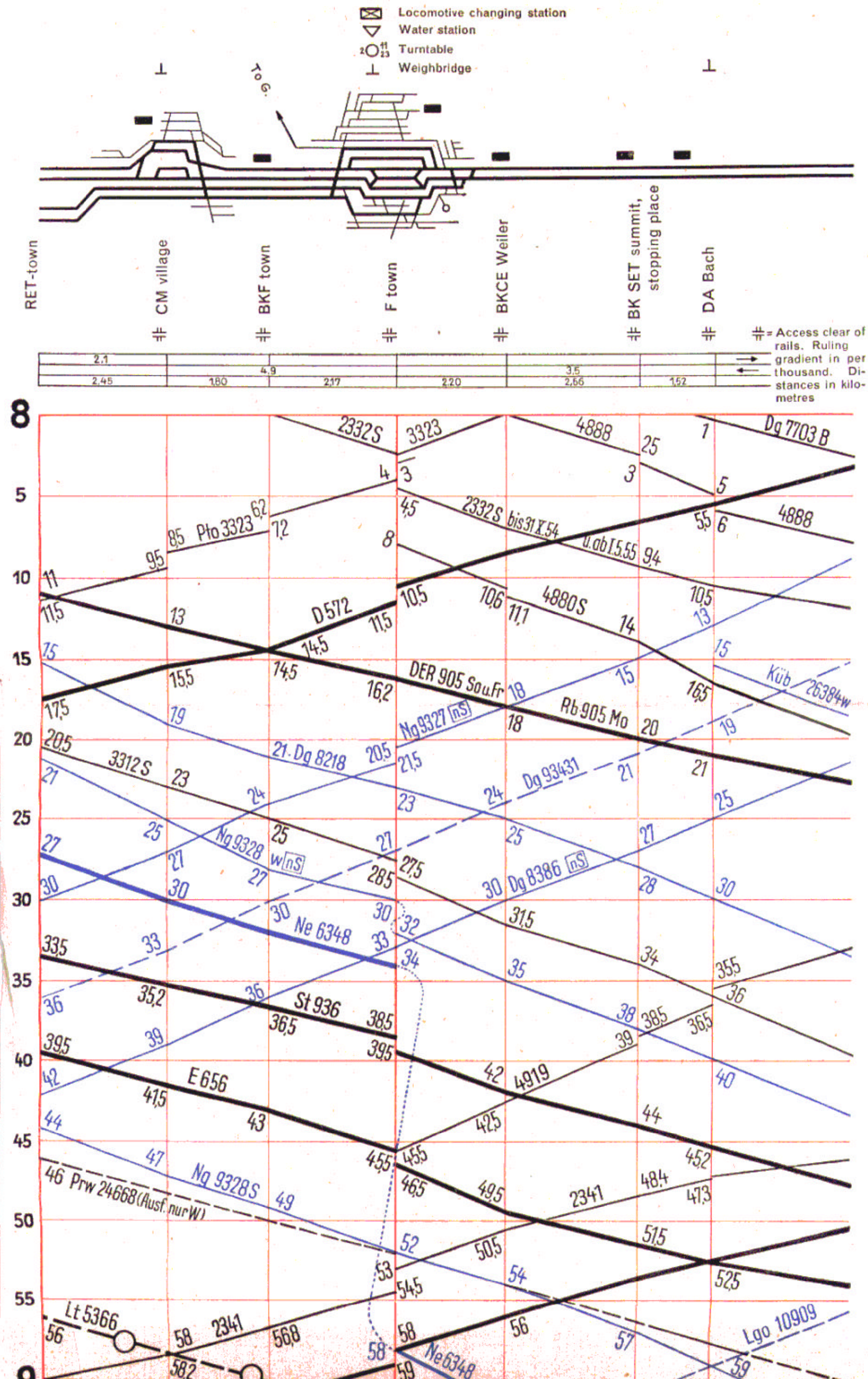


Fig. 167. Diagrammatic Timetable. Section showing the Rail Traffic during the period between 8 and 9 a.m.

The trains marked on the Timetable (fig. 167) call for a few more explanations.

Passenger (slow) Train No. 4919

According to the Timetable, this train arrives at DA-Bach at 8,35,5 a.m. After stopping there one minute, it leaves again at 8.36,5 a.m. in the direction of BK SET-Höhe (summit) stopping place, where it arrives at 8.38,5 a.m. Leaving again at 8.39 a.m., it passes the signal box at BK CE-Weiler and reaches the town of F at 8.45,5 a.m., where passengers have an immediate connection with fast train E 656, if they require it, to go back at once in the same direction.
There is no connection for this train for continuing the journey to the town of RET, and passengers who want to go in that direction had better use:
Passenger (slow) Train No. 2341, leaving DA-Bach at 8.47,3 a.m. and reaching the town of F at 8.53. After a short stop it leaves again at 8.54,5 a.m. in the direction of the town of RET.

Passenger Railbus Pto 3323

Arrives at the town of F at 8.03 a.m. From the Timetable (the short, marked line) it is seen that this train does not come from the direction of DA-Bach, but from the branch line that goes to the town of G. It leaves at 8.04 again for the town of RET, where it arrives at 8.11,5 a.m.

The Local Fast Goods Train No. 6348

Leaving the town of RET at 8.27 a.m., this train reaches the town of F at 8.34 a.m. After shunting there, it leaves again at 8.58 a.m. for DA-Bach. The stop for shunting is shown by a dotted line. When making out a timetable for double-line tracks, bear in mind that the next train cannot leave until the previous train has passed the next block section. In the case of trains 3312 S (leaving the town of RET at 8.20,5 a.m., and Ng 9328w nS leaving the town of RET at 8.21 a.m., this would not be the case, for instance. As, however, train 3312 S runs only on Sundays and the local goods train Ng 9328w nS runs only on weekdays, there is no risk for either of these two.

After studying the meanings of the symbols etc. on the timetable ,it should not be so very difficult to understand the rest of the connections on the Table correctly.
In the plan of the route at the top of the timetable a double-track suburban line is shown, running from the town of F towards the village of CM and terminating in the main station of the town of DL. The timetable for the train service on this line will be given on a separate sheet.

Timetable Time

If the timetable minute be kept the same as the actual minute of time by the clock, miniature railway working would be very slow indeed. Although the miniature railway is made to a certain scale, on most model systems, the distances between stations on the lines are shortened out of all proportion. As an example, a distance of 14 kilometres on a full-size railway with three stations at most would mean a miniature track 161 metres long. Since the amount of room available is generally limited in size, the timetable minute will have to be shortened for the miniature system. Trials will show what reduction in time gives the best results on any particular system.

For this, it is advisable to make an hour equal to 10, 12, 15 or 20 minutes on the model system (as 60 can be divided exactly by these numbers without any remainders). By using a system like this, it should not be difficult to read the times on a miniature railway by an ordinary clock after a little practice.

3. The Timetable when Trains are Late (fig. 169)

Interruptions of some kind or other will occur in the timing of traffic on a model railway just the same as on a full-size railway, due perhaps to an unexpected rush of passengers or weather conditions, or a coach or wagon may even be derailed. As not all trains will be delayed

Electric Locomotives waiting their turn at a Railway Works.

Fig. 169 Train Delay Notices

to the same extent, some kind of regrouping will have to be arranged so far as the order in which the trains run is concerned. Under ordinary railway regulations, trains are dealt with in the order of priority shown below.

1. Urgent rescue or breakdown trains
2. Hospital trains
3. Main line expresses and other expresses
4. Fast trains
5. Express goods trains
6. Through fast goods trains and mail trains
7. Passenger (slow) trains
8. Cattle trains and milk trains
9. Local goods trains for express goods
10. Light goods trains
11. Through goods trains
12. Light engines and local goods trains.

The traffic superintendent is allowed to make slight alterations in this running sequence if traffic, taken as a whole, can be accelerated by his doing so, but no extensive alterations can be made, except by the Management.

4. Special Trains

If the workpeople in a factory wish to have a works outing, the organisers will arrange for a special train. A train of this kind cannot run until a timetable has been made out for it.

When the scheduled trains are unable to cope with the rush of passengers on special occasions (such as winter sports, Whitsun excursion traffic, and so on), extra trains to run both before and after those in the timetable will be made up and placed into service.

In addition to the types of train mentioned, service trains, breakdown trains, light engines, snow ploughs and rolling stock journeys are also treated as special trains, though no special timetable is made out for breakdown trains.

5. Overtaking "On the Run" (fig. 170).

Supposing the line between station A and station B to be 10 kilometres long, *then a* goods train travelling at 20 kilometres per hour will take half an hour, or 30 minutes:

$$T = \frac{S}{V} = 10 + 20 = \tfrac{1}{2} \text{ an hour},$$

travelling from A to B. An express train travelling the same distance at 100 kilometres per hour will take only 6 minutes:

$$T = \frac{S}{V} = 10 + 100 = 0.1 \text{ hour} = 6 \text{ minutes},$$

to do the same journey if it runs through station A non-stop. From these figures it is clear that slow trains take up a good deal of time on the line, and as long as the goods train is in the section, practically no other trains can travel from A to B. Making up a timetable becomes difficult through this, and traffic will be delayed all the more if anything untoward happens. Of late years, however, safety devices have been developed to such an extent that trains can be allowed to travel over the left-hand track as well, as a temporary measure, provided the safety equipment required for doing so is available. Under these conditions, then, a faster train may overtake a *slower one by travelling over* the left-hand track of a double- track line, and the difficulties just mentioned can at least be partly overcome by this means. As both trains are in motion at the time of passing, this practice is called "Overtaking on the run". This kind of overtaking can easily be copied on a model railway and promises to make railway working very interesting indeed.

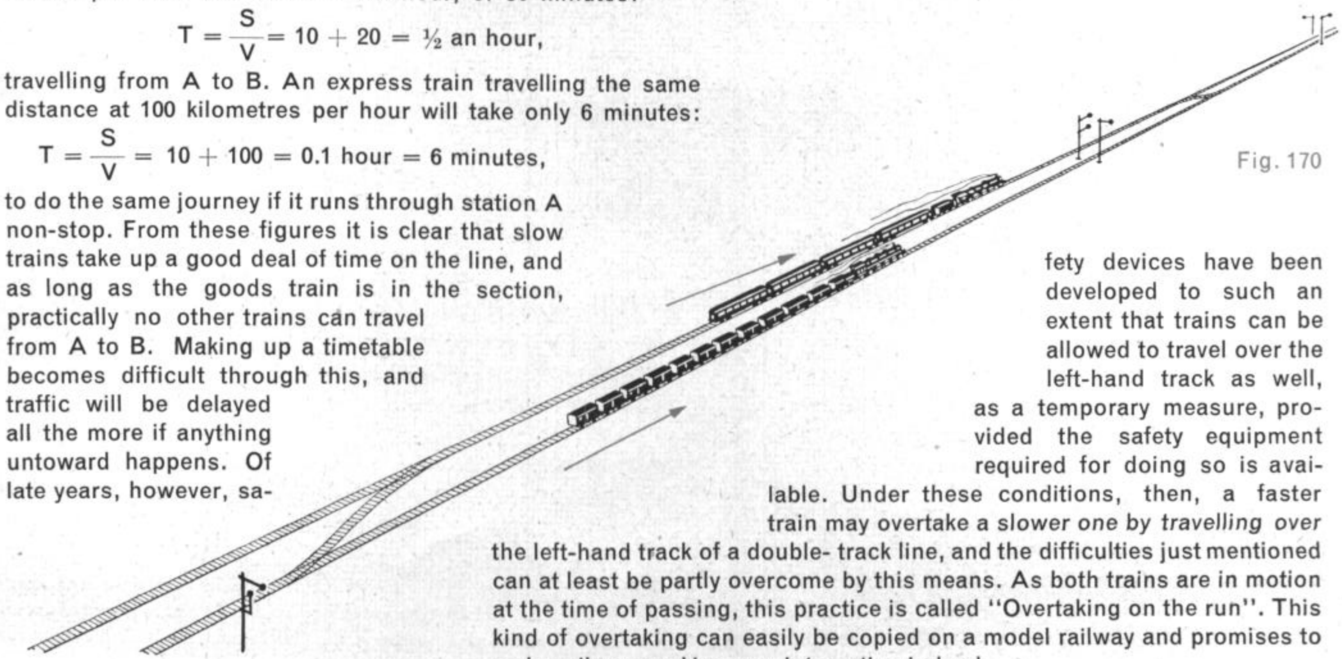


Fig. 170

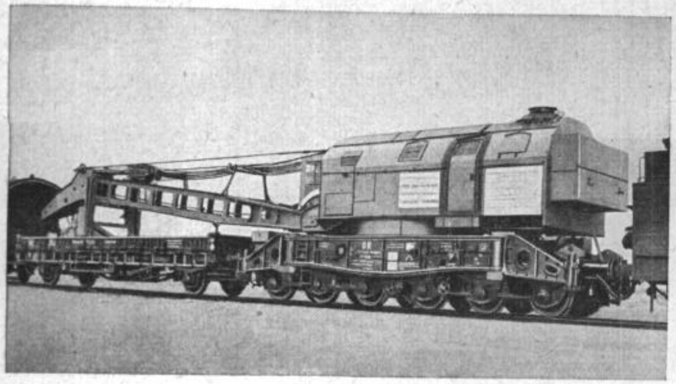


Fig. 171 The travelling crane on a Breakdown Train

V. An Accident on the Line

As the motorisation of traffic increases, so, unfortunately, does the accident rate, and even railways are not altogether immune from accidents, despite unceasing modernisation and the adoption of safety equipment. Faulty roadbeds cause derailment; negligence by the human element results in collisions, should, by some unfortunate mischance, the safety appliances fail to work; boilers on engines, and containers for gas and compressed air may explode, and railways also have sometimes to suffer from natural catastrophes in addition to these other causes of accidents.

A high percentage of accidents is due to cloudbursts, avalanches, floods, snowdrifts and fires, and therefore to force majeure for which the railway service cannot be blamed in any way. Many railway accidents occur at places where rail and road traffic meet, i. e., at level crossings, and these crossings are dangerous when the angle at which the road crosses the railway is very acute, as in fig. 172, for instance. The regulations governing the construction of level crossings on railway therefore stiputate that this angle must not be less than 30 degrees.

As a result of the safety equipment provided and the far-reaching regulations that have been drawn up for the prevention of railway accidents, individuals are now rarely involved in accidents, and so the railways can justly claim that their traffic is "safe"; the Chairman of a model railway system should be able to make the same claim for his traffic also.

A railway accident sets off a whole series of operatio nal reactions and these we will look into by describing an accident on a full-sized railway.

1. Description of an Accident on a Full-sized Railway

Let us suppose, for example, that a car has crashed through the closed barriers of a level crossing at a place where the view is obstructed, and has been struck by an oncoming express No. FD 5, one occupant of the car having been killed and two others seriously injured. In such a case, both lines of the double-track line are generally blocked. The guard of the train will first render such first aid as he can immediately. He will then arrange for those involved in the accident to be looked after; he will also obtain whatever particulars and proof sare available for the enquiry that will be held later on into the cause of the accident. He will also close off the scene of the accident and block the other track. In the quickest way possible he will notify the traffic controller at the nearest station and call for a breakdown train (fig. 171). This will have a first-aid coach and breakdown wagons with appliances and tools for rerailing derailed stock

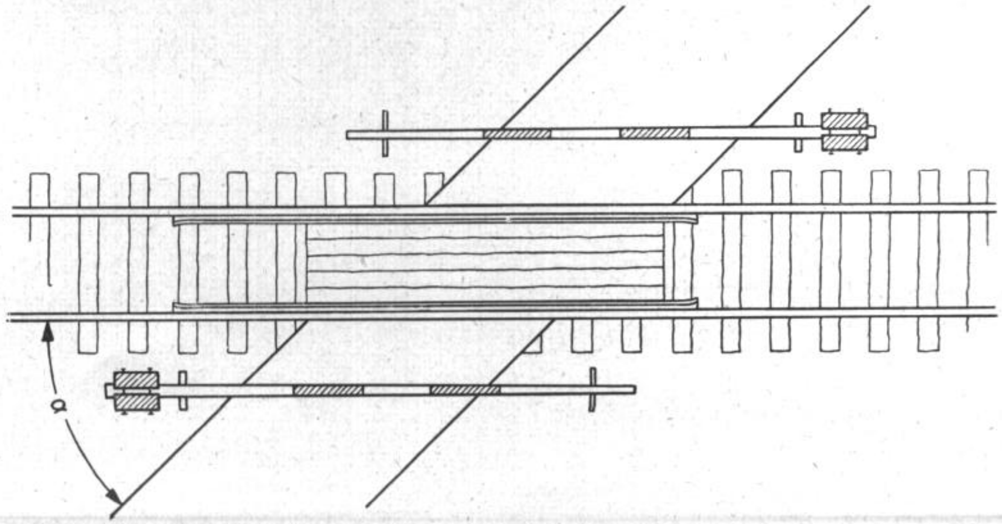
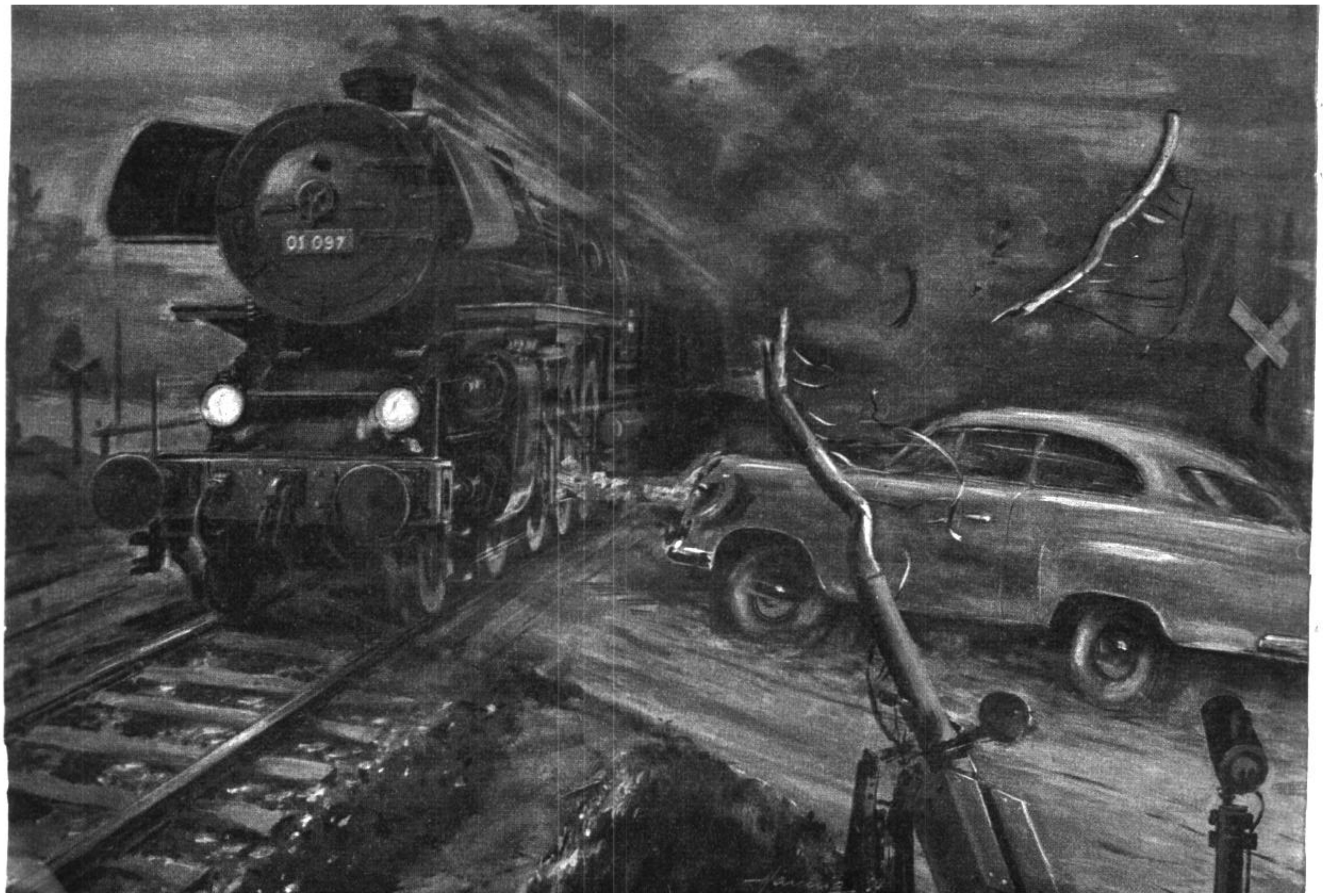


Fig. 172


01 097

and clearing and illuminating the scene of the crash. The breakdown train may possibly also include overhead linemen's gear to repair damaged overhead wires, as well as special engineering wagons such as travelling cranes (figs. 83 and 171) and wagons, and emergency bogie wagons. The Public Prosecutor and the Police Authorities concerned will also be notified. They will investigate the question of responsibility and take whatever photographs of the scene of the accident are required for the Court proceedings later on. When all this has been completed, the scene of the accident can be cleared up. If necessary, single line shuttle working may be arranged until the section of the line is fully repaired.

2. Accidents on a Miniature Railway

These are far less costly in every case and can usually be put right by hand. They will be welcomed to a greater or lesser extent, according to the temperament of the traffic superintendent of the model railway, as they impart variety to an ordinary timetable. Dealing with an accident in a "scale model" way could be done sometimes, however. The breakdown train standing by should be drawn by a locomotive taking its current from the overhead wire, if possible, as then it will not be affected by any short-circuiting in the third-rail system. In unusual circumstances it may be worth while taking photographs for production to the Court dealing with Accidents in Miniature, where the question of responsibility and those who are to blame will be decided. Any fine levied, proportional to the extent of negligence found, will be payable to the Accountant for Model Railway Construction.

KEY WORD INDEX

KEY WORD INDEX

KEY WORD INDEX

PHOTOS

The remaining photos are taken from the MÄRKLIN archives


MÄRKLIN