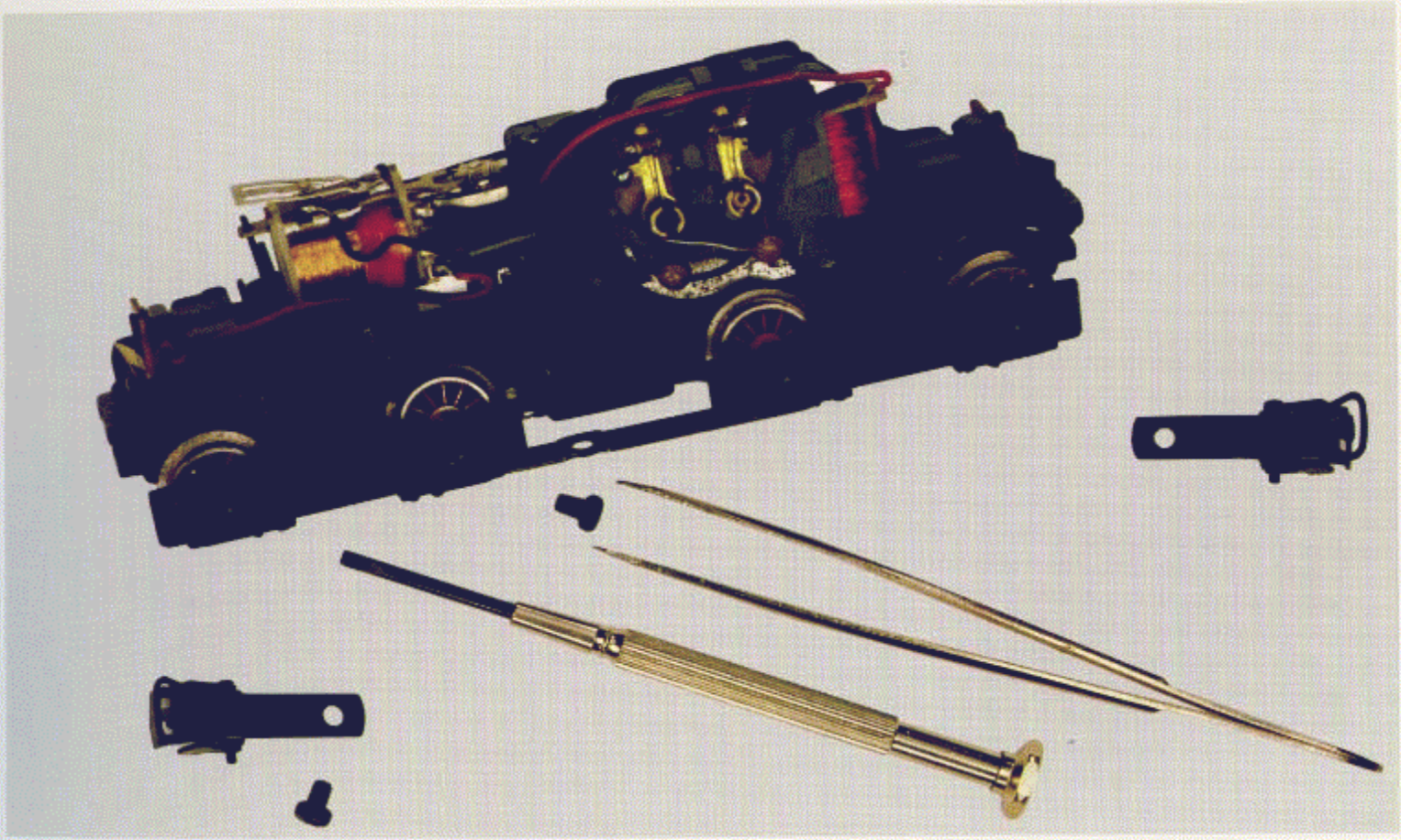
märklin
HO



Service Manual

0733

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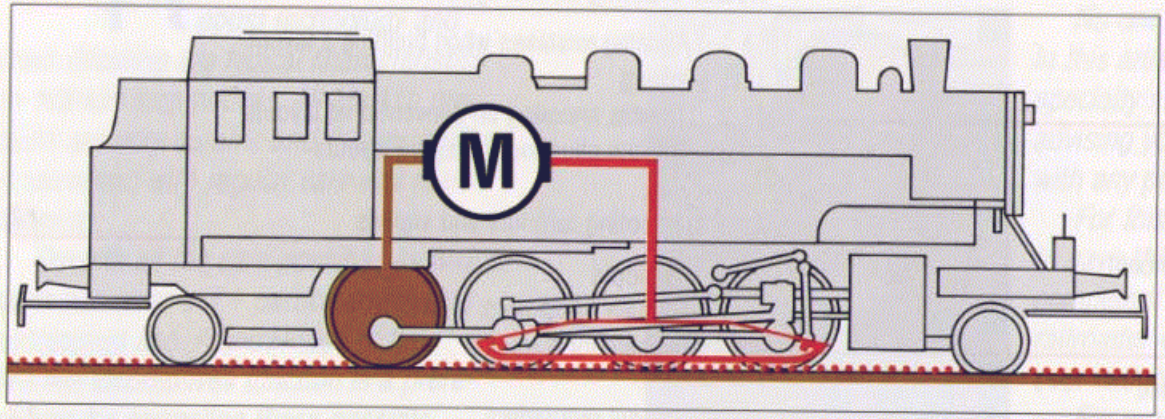
Märklin HO – the system

Operating reliability

There is nothing more important for the operation of an electric model railroad than reliable electrical contact.

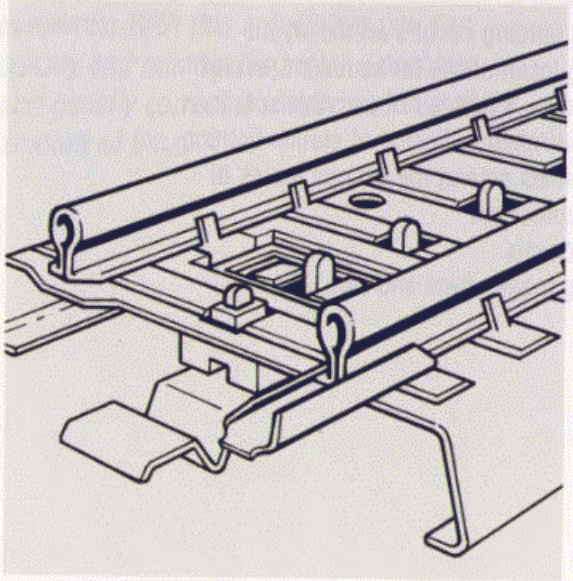
Märklin has the optimal system for this:



Electrical pickup for a locomotive

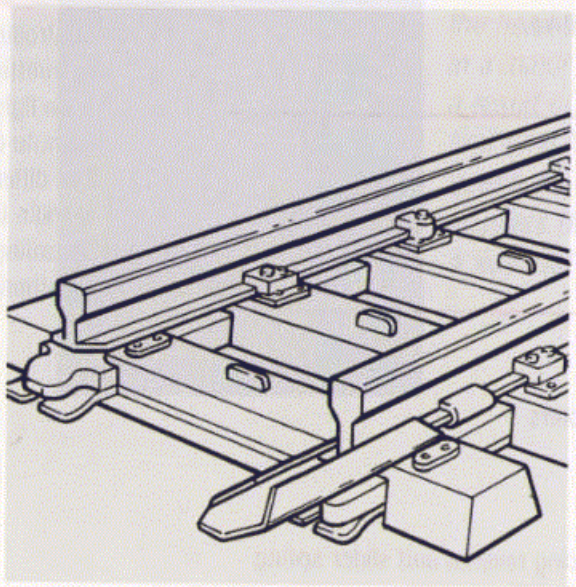
The pickup shoe, the typical characteristic of all AC locomotives, always touches 6 to 10 of the stud contacts which are almost hidden in the track.

The return flow of electricity takes place through all of the locomotive's wheels which are not equipped with traction tires. This guarantees reliable electrical pickup in any operating situation.



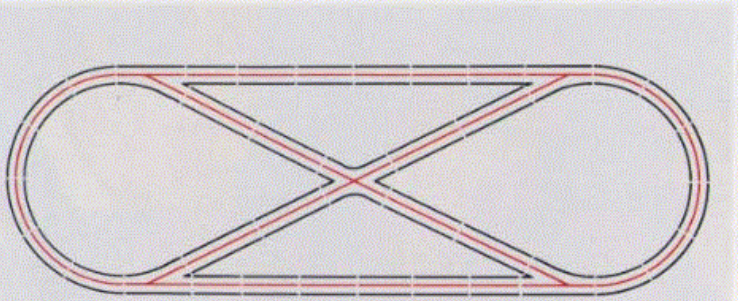
M Track

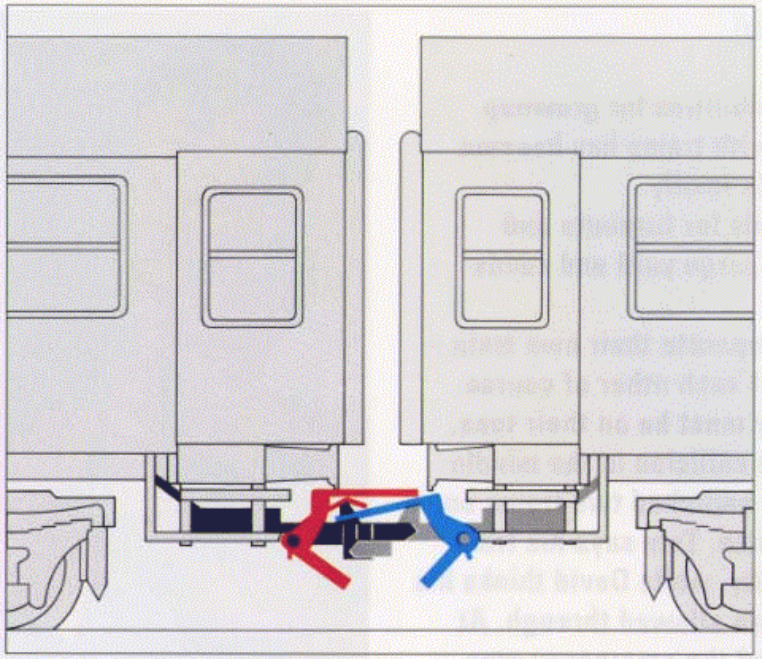
With M track the entire metal roadbed serves as an electrical pole. The snap-together connection in the middle at the ends of the track provides a constantly trouble-free electrical connection for the stud contact – the third rail. The third rail is the second electrical pole.



K Track

K track has four connections, two rail joiners as well as two spring-loaded contact tongues for the third rail. Two lug connections in the tie strip provide a trouble-free mechanical connection.





Easy-to-understand electrical flow

The Märklin system allows you to build any type of track pattern. Reverse loops and wyes, which always require additional aids and circuits in other electrical systems because of polarity problems, can be done with no problems at all. Simply put the track together, wire up the turnouts – you're done.

Direction of travel

The direction of travel is switched in the locomotive, not in the track. The "built-in locomotive engineer" operates independently of the direction of other locomotives, even when crossing over several track circuits. You can do this even if you haven't run your trains for quite a while.

Close Coupler

In 1987, the first year of its delivery, Märklin's close coupler was designated "Model of the Year" by the model railroad magazine "eisenbahn-magazin". In practical tests the readers praised the trouble-free preun-coupling feature, the ease with which the couplers engage and the reliable connection produced by the couplers.

New passenger cars are being equipped at the factory with the close coupler and cars already in the catalog are increasingly being replaced by new models with the close coupler.

New propulsion concept

In 1988 Märklin presented a new propulsion concept, the five star propulsion system. This propulsion system is also available as a retrofit kit and can be installed in all locomotives with a drum-style commutator on the armature.

The electronically controlled propulsion system enables you to set the maximum speed individually for a locomotive, to operate extremely slowly (the acceleration rate can also be adjusted) and to keep the speed nearly constant on grades.

Märklin Digital

means:

- up to 80 locomotives can be operated independently of each other.
- up to 256 turnouts and signals; uncoupler tracks can be switched using a common connection.
- lighting circuits and other electric accessories can be digitally controlled.
- even accessories such as the turntable, transfer table or crane can be digitally controlled without additional control components.

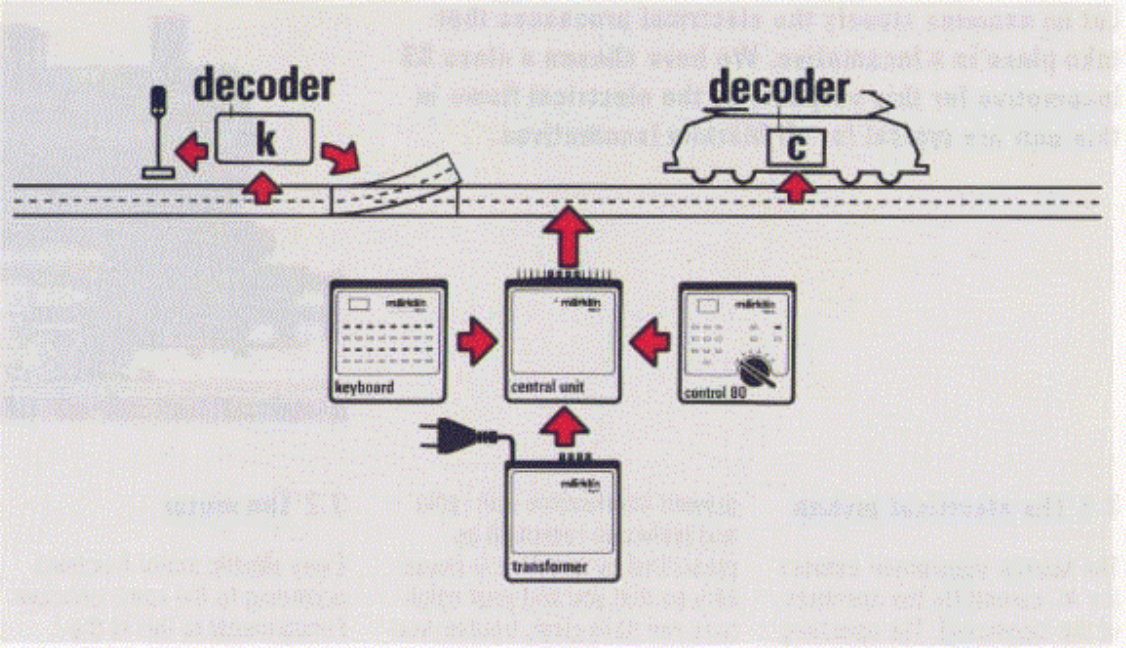
The wiring is limited to only two conductors for each circuit and to the connections for the decoders. These decoders transmit the commands from the Central Unit on to the locomotives, turnouts and signals. The control information is transmitted together with the electric power through the track.

The Digital system consists of various components. This means you need to purchase only the Digital parts necessary for your plans. Additional components can be integrated into the system later without any problem.

An already existing model railroad layout can be converted to Märklin Digital gradually in steps. If you have already wired and finished your layout for operation, you can continue at first to control the turnouts and signals conventionally.

Start off by having your Digital dealer convert your locomotives to the Digital system by installing a locomotive decoder. These dealers are specially trained and have the necessary tools to convert your locomotives. You will be given a one year guarantee for the decoder panel when your Digital dealer does the installation.

You can still operate Digital locomotives on a conventional layout, if you have not yet converted your layout to Märklin Digital train operation. Only the auxiliary function available on Digital locomotives can not be switched on; this is only possible in the Digital system.



Hint:

All else remaining constant, a locomotive will operate trouble-free in the Digital system only if it operates conventionally with no problem. Expressed another way, a locomotive which is to be converted to Digital must be in good mechanical operating condition. If it is quite worn out from use, it must be thoroughly overhauled before being converted.

At first, operate only a part of your layout digitally. The best area would be where you run a large number of locomotives and do a lot of switching, such as the freight yard or the locomotive maintenance facility. Here you will get the best feel for the advantages of the Digital system.

Forget about the following:

Stopping a locomotive – turning off power to that track – turning on power to another track – operating a second locomotive, etc.

Simply call up a locomotive – it does not matter where it is standing – and drive it to another track, while you control your ICE in the station.

If you intend to convert your layout, then map out digital control of the turnouts right from the start. Later you will be able to switch entire routes, control your staging yard or work with a track diagram control board simply by plugging in additional Digital components.

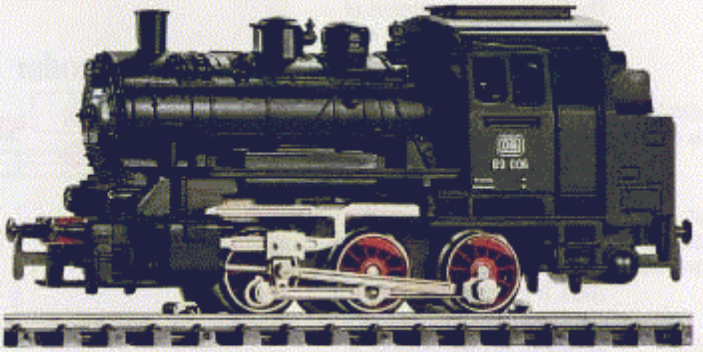
A tip before you start:

Before you install Digital, read the many tips about the uses of Digital that are published regularly in the Märklin-Magazin (German text) or buy the Märklin book "Model Railroad – digitally controlled", catalog number 0303. (Note: For English readers there is also available the book "A User's Guide to the Märklin Digital System" by Dr. Thomas Catherall, catalog number 2675 in the USA).

You will learn everything important about using Märklin Digital including many tips about converting layouts. This will allow you to determine your actual needs for Digital components and plan your purchases accordingly.

The electrical operation of a Märklin locomotive

Let us examine closely the electrical processes that take place in a locomotive. We have chosen a class 89 locomotive for this purpose, as the electrical flows in this unit are typical for all Märklin locomotives.



3.1 The electrical pickup

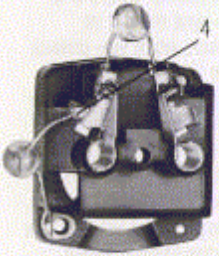
The Märklin transformer delivers the AC current for the operation of the locomotive. The operating voltage can be adjusted infinitely up to 16 volts using the speed control knob. To reverse the locomotive, the speed control knob is turned to the left past the stop; this results in a reversing voltage of 24 volts.

The current flows from the red socket on the transformer through the third rail of the track (1) to the pickup shoe (2) of the locomotive. The pickup shoe is insulated from and mounted on the locomotive frame.

A wire leads via the FM choke (3) to the main solder point (4) on the brush plate.

The two small capacitors mounted on the brush plate are used, like the FM choke, to prevent interference with radio and television reception as prescribed by law. This is necessary so that you and your neighbors can have clear, trouble-free television and radio reception.

From the main solder point there is a wire connection to the headlight(s) (14) and to the coil (9) of the reverse unit. The main current flows through the brush springs and the brushes (5) into the motor.



Brush plate with brushes

3.2 The motor

Every electric motor functions according to the same principle. Fundamental to this is the magnetic law according to which like magnetic poles repel each other and unlike poles attract each other. A magnetic field is created when an electric current is passed through a coil of wire.

The Märklin series-wound motor consists of a fixed field magnet (6) and in it a rotating armature (7). Both have a metal core which is wound with numerous turns of thin, varnished copper wire.

The current flow is directed in such a way that the effect of the magnetic poles attracting and repelling each other causes the armature to rotate. This rotation is used for the locomotive's propulsion system.

In the middle of the armature is the armature shaft or axis (8). A gear, the pinion gear, sits on this shaft. It engages the first gear wheel of the gear train and thus powers the locomotive.

The speed at which the armature turns depends, for example, on the number of windings on the armature or on the voltage. If you turn the speed control knob up, a higher voltage is fed to the armature and the field magnets. The armature turns faster.

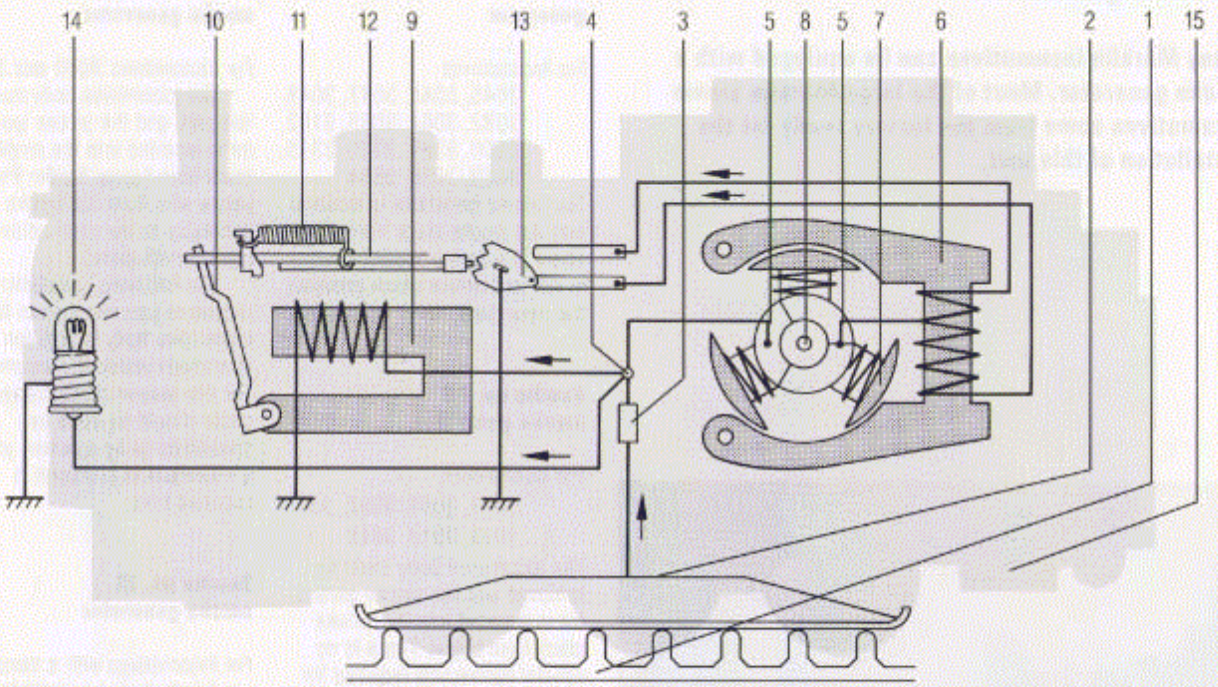
In order to be able to operate in the opposite direction, the armature and the gear train must turn in the other direction.

The field magnet has two windings that are wound over each other. The end of the bottom winding and the beginning of the top winding are soldered together on the brush plate.

The current flows from the armature through the brush on the right side back to the brush plate, from there to the middle of the coil on the field magnet and either to the right around through the bottom winding or to the left around through the top winding – according to the position of the rocker (13) on the reverse unit.

If the directional flow of the current in the field magnet coil is changed, then the magnetic poles in the field magnet align themselves in the opposite pattern, while the pole in the armature remains unchanged. The armature turns in the opposite direction.

This change in the direction of the current is achieved in the reverse unit.



3.3 The reverse unit

The current from the main solder point reaches the reverse unit in a manner parallel to that for the motor. Magnetic force is also used here.

A coil is wound around an iron core. The magnetic induction of the coil attracts a reverse unit armature (10) to the reverse unit magnet (9). The reverse unit slider spring (11) holds the armature back, however. The magnetic field does not become strong enough to overcome the resistance of the slider spring until the reversing voltage of 24 volts is reached. The armature is pulled over and the reverse unit slider (12) is pushed to the right. The armature then pushes a rocker (13) from right to left or vice versa and the current then flows through the other half of the field coil winding.

3.4 The headlights

The light bulb(s) (14) are connected parallel to the circuit for the motor. A wire connects the main solder point with the headlight(s). The current flows via the insulated socket(s) through the bulb(s) to the locomotive frame (15).

The motor and reverse unit also have electrical contact with the locomotive frame. The current flows through all locomotive wheels not equipped with traction tires and both running rails (K track and 2000 series track) or the entire roadbed (M track) back to the brown socket on the transformer.

3.5 Overview of the circuit

1	third rail	9	reverse unit magnet
2	pickup shoe	10	reverse unit armature
3	FM choke	11	reverse unit slider spring
4	main solder point	12	reverse unit slider
5	brushes	13	rocker
6	field magnet	14	light bulb
7	armature	15	locomotive frame
8	armature shaft		

4.1 Smoke generator kit

Many Märklin locomotives can be equipped with a smoke generator. Most of the large Märklin steam locomotives come from the factory ready for the installation of this unit.

No. 7226 Märklin smoke generator

For locomotives
3045, 3046, 3047, 3048, 3082, 3084, 3085, 3102, 3308, 3309, 3310, 3315, 3609, 3610, 3684

The smoke generator is inserted into the smoke stack from above. There is a spring-loaded contact in the locomotive which provides the necessary power connection.

Seuthe no. 20 smoke generator

For locomotives
3083, 3091, 3092, 3093, 3318, 3518, 3618

The locomotive body must be removed and the smoke generator is inserted into the smoke stack from below. There is no special connection required for these units, because it is already installed at the factory.

Seuthe no. 8 smoke generator

For locomotives 3089 and 3094

The locomotive body must be removed and the smoke generator is inserted into the smoke stack from below. Solder the yellow wire from the smoke generator to the main solder point (brush plate).

The following installation tips require in part changes to the locomotive body in addition to alterations inside the locomotive. For this reason these conversions should be done by specialists or by a dealer, as a maximum of precision is required here.

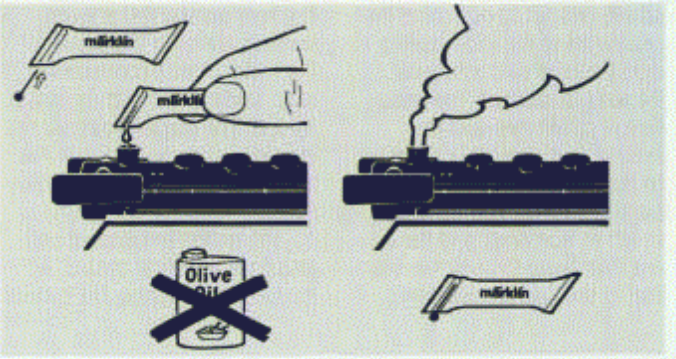
Seuthe no. 21 smoke generator

For locomotives with a narrow smoke stack and a metal body. Internal alterations are required for these units. In some cases the front headlight illumination must be relocated or removed.

Seuthe no. 100 smoke generator

For locomotives with a plastic body. Internal alterations are required for these units. In some cases the front headlight illumination must be relocated or removed. The smoke stack must be sawed off and replaced by components included with the smoke generator.

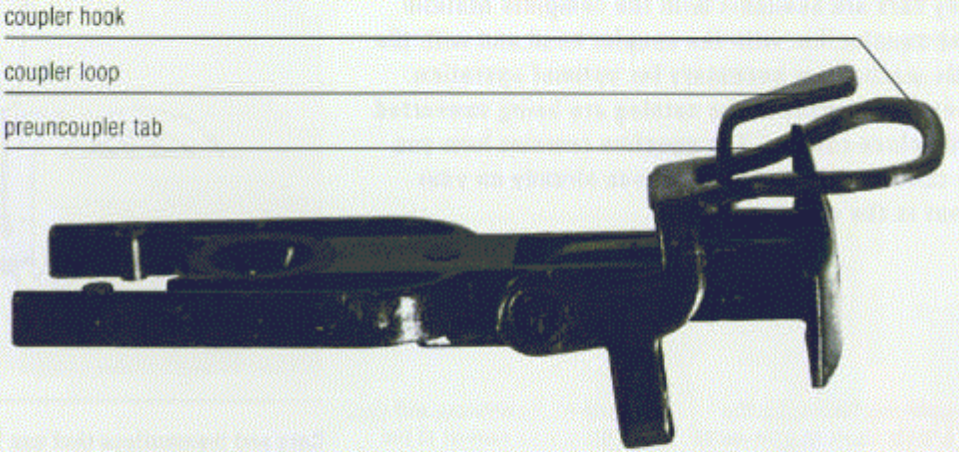
Seuthe smoke generators are available from your dealer. The Seuthe Company, Frühlingsstr. 15, D-7321 Eschenbach, Federal Republic of Germany, will be happy to send you a list of dealers.



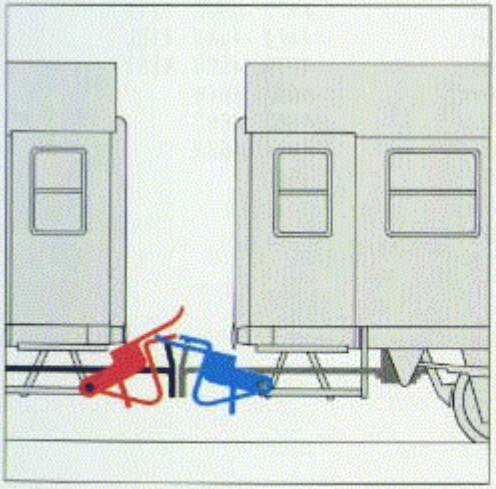
4.2 Couplers

All locomotives and cars, whose couplers are equipped with a preuncoupler tab, can be preuncoupled with the help of an uncoupler track. When uncoupling by remote control over an uncoupler track, this tab prevents the coupler loop from reengaging. In this way preuncoupled cars can be pushed to any spot on the layout and left there (principle of the RELEX coupler).

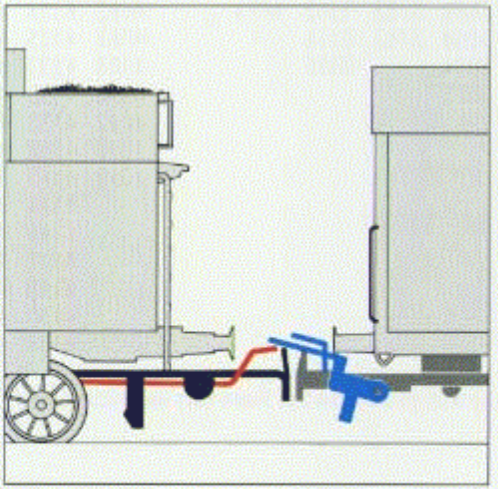
Märklin couplers consist of three parts



RELEX coupler



TELEX coupler



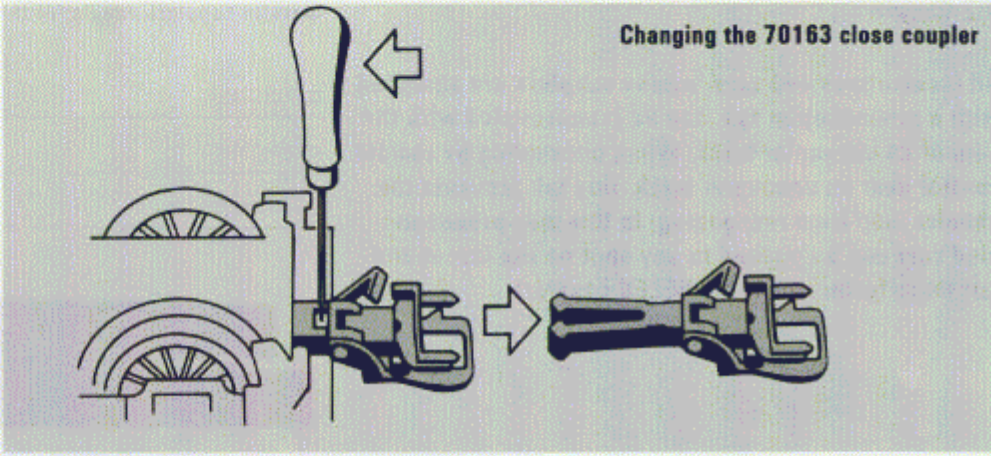
Several Märklin locomotives are equipped with the TELEX coupler. These units can be found in the current H0 catalog. These locomotives can be uncoupled from their cars at any spot on the layout by remote control at the transformer.

The first reversing impulse uncouples the locomotive but keeps the same direction of travel. It is with the second reversing impulse that the locomotive changes direction and the coupler returns to its normal position.

In the Digital system the TELEX coupler is operated by remote control as an auxiliary function. Pressing the "function" button turns the TELEX coupler on and pressing the "off" button turns it off again.

4.3 Retrofitting close couplers

Many cars are available with the complete Märklin close coupler, i.e. with the coupler head and with the guide mechanism necessary for optimal operation. Other cars already in the catalog are being converted to the close coupler. The question remains how you can convert cars and locomotives already on your layout to the close coupler.



Changing the 70163 close coupler

The guide mechanism for the new Märklin close coupler would require considerable changes to the frame, trucks and on some cars and locomotives also to the body and interior for the close couplers. For this reason retrofit installation of the complete close coupler is not possible in existing cars and locomotives. Changing the numerous components for a retrofit also does not make sense.

A partial retrofit is provided for a large number of the H0 cars and locomotives. This makes it possible to use the close coupler without the guide mechanism and still allows the use of the other advantages of the Märklin close coupler in addition to providing a noticeable decrease in the car spacing. A close coupler head was developed for this purpose which can be used on locomotives and cars with the plastic version of the Märklin standard coupler. A set of couplers offered under the catalog number 7205 contains 10 coupler heads for locomotives and 40 coupler heads for cars.

Cars and locomotives of other makes with the NEM coupler pocket can be retrofitted with the 7203 close coupler. You must make sure that the coupler pocket is suitable for close couplers and that the standard height according to NEM 362 is within the allowable tolerance (8.5 mm ± 0.2 mm). This is not guaranteed with all makes. In certain situations the buffer plates must be filed away to allow clearance or be replaced with Märklin buffers.

Cars and locomotives that can be retrofitted are

Locomotives

3028 3146 3324 3646
3041 3153 3327 3653
3043 3160 3355 3655
3049 3163 3352 3674
3058 3167 3356
3074 3366
3075

Cars

4074 4121 4153 4220
4084 4122 4154 4221
4091 4123 4157 4222
4092 4124 4158
4093 4125 4159
4095 4134 4160
4096 4135 4161
4097 4138 4162
4098 4139 4164
4099 4140 4165
4145 4166
4146 4168
4147 4175
4149 4176
4150 4177
4151 4180

all cars in the 4400 series

4674 4687 4699
4675 4689 4700
4676 4690 4710
4677 4692 4718
4678 4693 4780
4679 4695 4781
4680 4696
4682 4697
4684 4698
4685

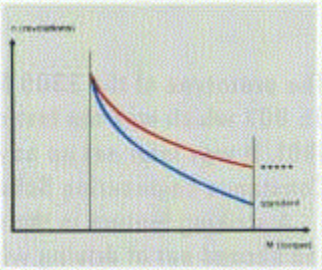
as well as variations of these cars and locomotives.

4.4 The "five star" propulsion concept

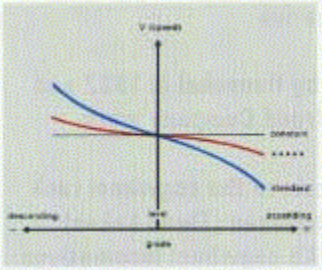
Märklin locomotives have traditionally distinguished themselves with strong motors and efficient mechanisms which bring high tractive effort to the track. The operational dynamics and reliability of the Märklin propulsion system can be considered as a standard for present day model railroads.

A further development of the Märklin motor with a new type of control electronics (which monitors the entire propulsion system) is used for the new locomotive generation (3500 series). This allows these locomotives to achieve absolutely prototypical operating characteristics and enormous power reserves. Moreover, it is possible for the model railroader to adapt the operating characteristics of the locomotives to his individual requirements.

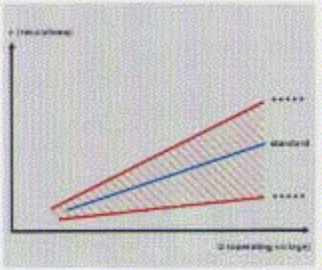
Important requirements for modern motive power that have arisen from model railroading practice are fulfilled by the "five stars" of the new propulsion concept:



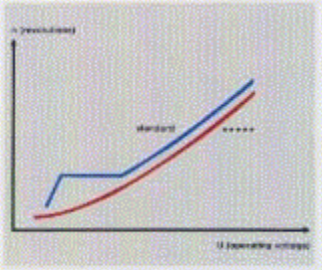
★★★★★
The five-pole high efficiency motor delivers especially high torque across the entire speed range. It runs with absolute quiet and smoothness at the slowest speeds and with a load.



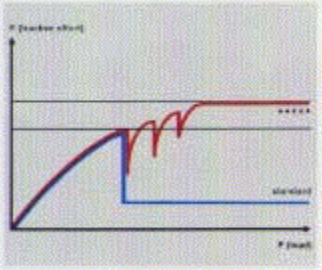
★★★★★
The electronic control of the speed compensates for changing locomotive loads. This makes it possible to have near constant speeds on grades, sharp curves, through dense concentrations of turnouts, with heavy train loads or when pushing cars.



★★★★★
The speed preselection feature allows you to adjust the desired maximum speed infinitely in the locomotive to fit the type of locomotive and its application.



★★★★★
The acceleration rate control causes the locomotive to start slowly from a standstill and accelerate in a prototypical manner to the desired speed. This feature is individually adjustable.



★★★★★
The anti-wheel slip control continually adjusts the effective output of the propulsion system to the operating situation. Wheel slippage at the load limit of the unit is prevented, thus resulting in a considerably higher tractive effort.

The motor as well as the electronic circuit plate are protected against overloads by a current limiter. This eliminates damage to the propulsion system and the motor in the event the locomotive should become blocked or jammed.

All locomotives with the drum-style commutator motor (brushes no. 60146) can be retrofitted with the five-star propulsion system. A conversion kit for this – armature, circuit plate and all necessary wiring and mounting hardware – is available under catalog no. 7180. As the retrofit installation of this propulsion system requires a certain amount of knowledge, it should be carried out by a trained Märklin dealer. When the installation of the conversion kit is done by an authorized dealer, you will receive a one year guarantee for the electronic circuits.

Design of a Märklin locomotive

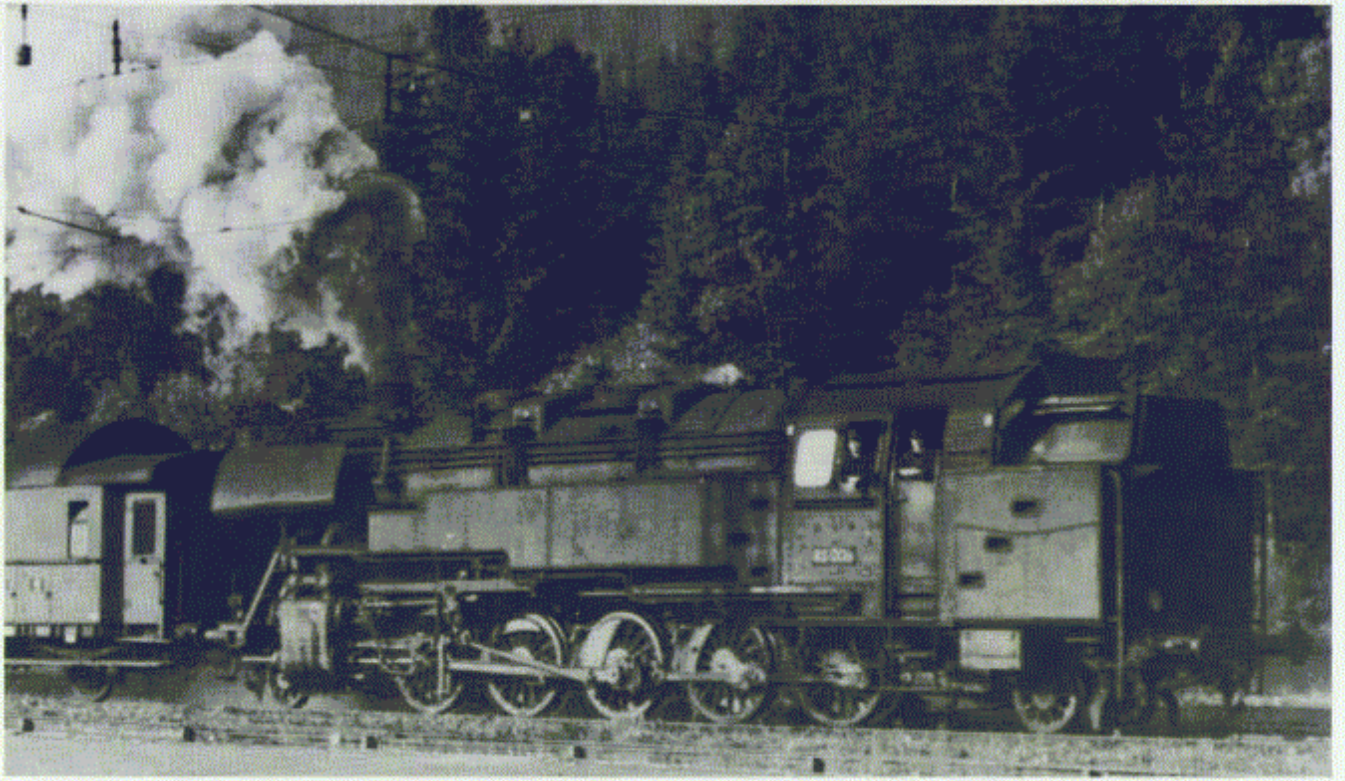
5.1 The class 85 steam locomotive

The 10 locomotives delivered by Henschel in 1932 and 1933 to the German State Railroad Company were tremendous power houses.

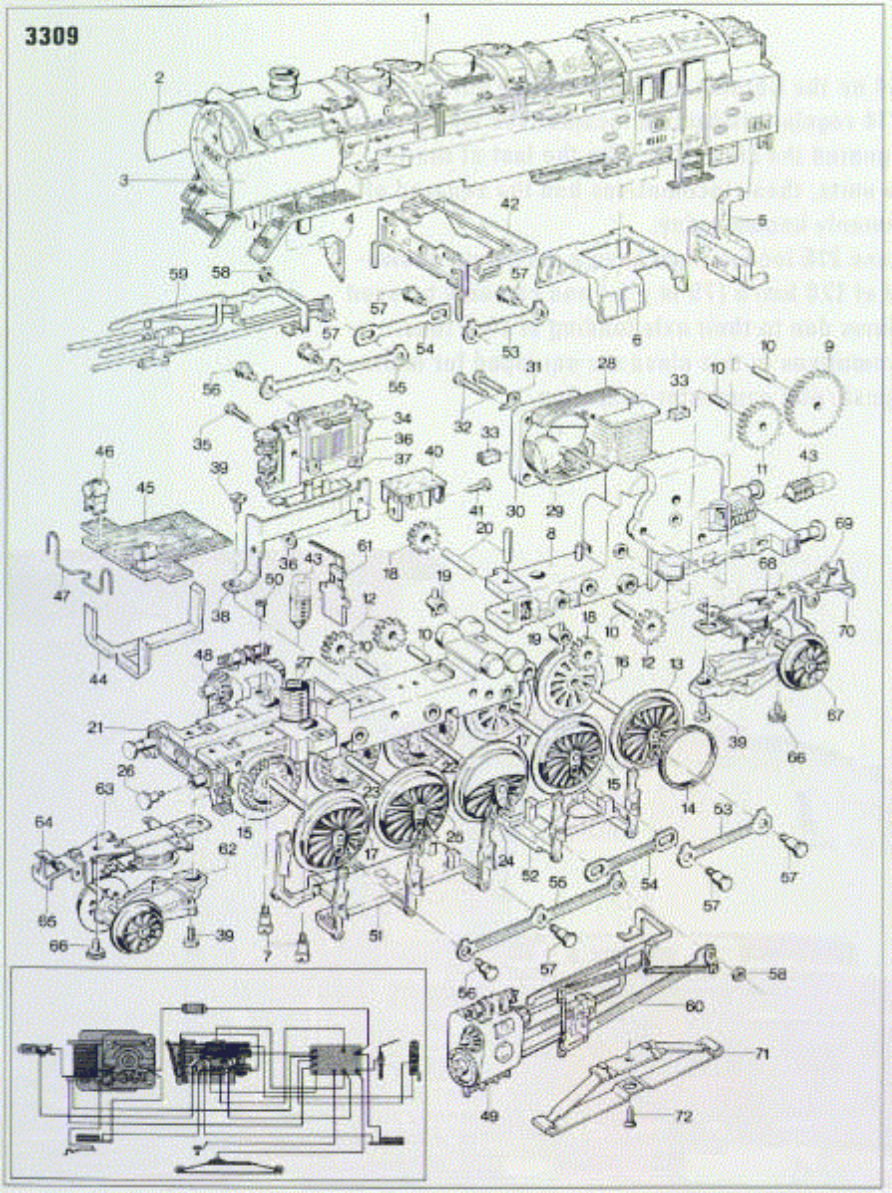
They made it possible to remove the cogwheel rack system on the Höllental and Dreiseen (Three Lakes) Lines and replaced the class IXb cogwheel locomotives of the former Baden Railways. Their weight of 133 tons made them the heaviest tank locomotives ever to be operated in Germany.

The prototype of the 3309 Märklin locomotive is the 85 007 which was the last of its kind to be retired in 1961. It was later set up as a memorial in front of the Constance Engineering School.

A striking feature is the offset counter weights on the second set of driving wheels; the drive rod for the inner cylinder works off of this axle.



3309



No.	Description	Catalog No.
1	locomotive body (complete)	24494
	with	
2	smoke deflector (right)	23278
3	smoke deflector (left)	23279
4	headlight lens	24495
5	headlight lens	24496
6	window	24497
7	mounting screw	75314
	frame (complete)	24469
	with	
8	rear supporting frame	24475
9	intermediate gear (Z 36/7)	23916
10	bearing pin	23184
11	gear wheel (Z 24)	23245
12	gear wheel (Z 16)	23246
13	driving wheel and axle (Z 33, D 16)	23489
	with	
14	traction tire	7153
15	driving wheel and axle (Z 33, D 16)	23487
16	driving wheel with traction tire (D 16)	22907
17	driving wheel (D 16)	22905
18	gear wheel (Z 17)	23453
19	bearing	23452
20	shaft	23451
21	front support frame	24477
22	driving wheel and axle with traction tire (Z 33, D 16)	23456
23	driving wheel and axle (Z 33, D 16)	24471
24	driving wheel with traction tire	23454
25	driving wheel (D 16)	24474
26	buffer	76147
27	retaining ring	60492
28	field magnet	23139
29	armature	24548
30	brush plate (black)	23135
31	solder lug	23147
32	screw	78514

No.	Description	Catalog No.
33	pair of brushes	60146
34	reverse unit	22970
35	screw (plastic)	78606
36	insulating washer	72136
37	pressure guide	24459
38	swivel arm	24468
39	screw	75018
40	circuit board	24680
41	screw	78505
42	valve gear rigging	24467
43	light bulb	60010
44	headlight lense	24465
45	deck plate	24466
46	lantern	24286
47	headlight grab iron	22958
48	cylinder (right)	24578
49	cylinder (left)	24579
50	rivet	78023
51	brake rigging	24492
52	brake rigging	23446
53	coupling rod	23447
54	coupling rod	23448
55	coupling rod	23449
56	hex head mounting bolt	75513
57	hex head mounting bolt	75514
58	hex head nut	75702
59	valve gear (right)	24479
60	valve gear (left)	24483
61	contact plate	24486
62	pilot truck (complete)	24488
63	magnet	24490
64	armature	24457
65	coupler hook	24456
66	screw	75312
67	trailing truck (complete)	24584
68	magnet	22924
69	armature	24461
70	coupler hook	24460
71	pickup shoe	7164
72	screw	75609

D = diameter in millimeters
Z = gear teeth count

Design of a Märklin locomotive

5.2 The class 216 diesel locomotive

At the end of 1960 the six locomotives of the new class V 160 appeared in Hamburg-Altona and supplemented the V 200 in driving the class 03 express steam locomotives from their accustomed base of operations.

At that time the catenary network did not reach to Hamburg. Steam locomotives still dominated the scene there.

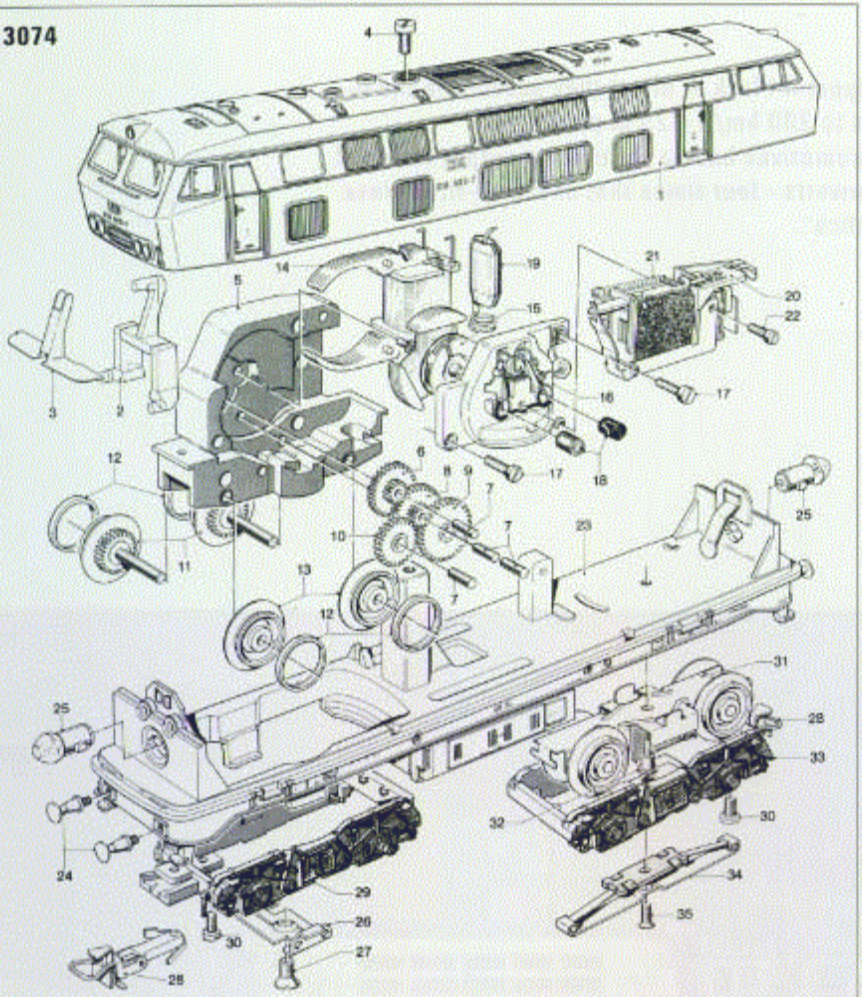
The new, general purpose diesel locomotives resulted from the development of a 1,900 hp, 16 cylinder V-shaped motor.

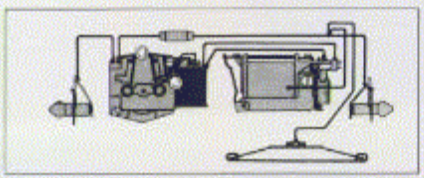
From 1964 on the German Federal Railroad purchased a total of 214 regular production locomotives which were now designated the class 216. Like the last of the 10 prototype units, these locomotives had the squared off ends commonly known today.

The class 216 locomotives have a maximum allowable speed of 120 km/h (75 m.p.h.) and can only be used on main lines due to their axle loading of 18.5 tons.

All locomotives in this class are equipped for multi-unit and push/pull commuter operation.

3074





No.	Description	Catalog No.
1	locomotive body (complete)	22560
	with	
2	headlight lens assembly	22563
3	light shield	22564
4	screw	75151
	power truck (complete)	22544
	with the most important parts:	
5	power truck frame	22545
	mounted on it:	
6	idler gear (Z 30/13)	22261
7	bearing pin	22310
8	idler gear (Z 32/14)	22263
9	intermediate gear (Z 33)	21677
10	gear (Z 23)	22546
11	driving wheel and axle (Z 22, D 12)	21574
	with	
12	traction tire	7154
13	driving wheel with traction tire (D 12)	21567
14	field magnet	22218
15	armature	21745
16	brush plate	21673
17	screw	78560
18	pair of brushes	60030

No.	Description	Catalog No.
19	FM choke	60091
20	reverse unit	20824
	with	
21	slider arm spring	7194
	and	
22	screw	78511
23	frame	22552
	with	
24	buffers	76107
25	light bulb	60015
26	support plate	21462
27	counter sunk screw	78619
28	coupler	70156
29	truck frame (power truck)	22557
30	screw	78507
31	truck (complete)	22550
32	mounting screw	75351
33	truck frame	22555
34	pickup shoe	7164
35	screw	75610

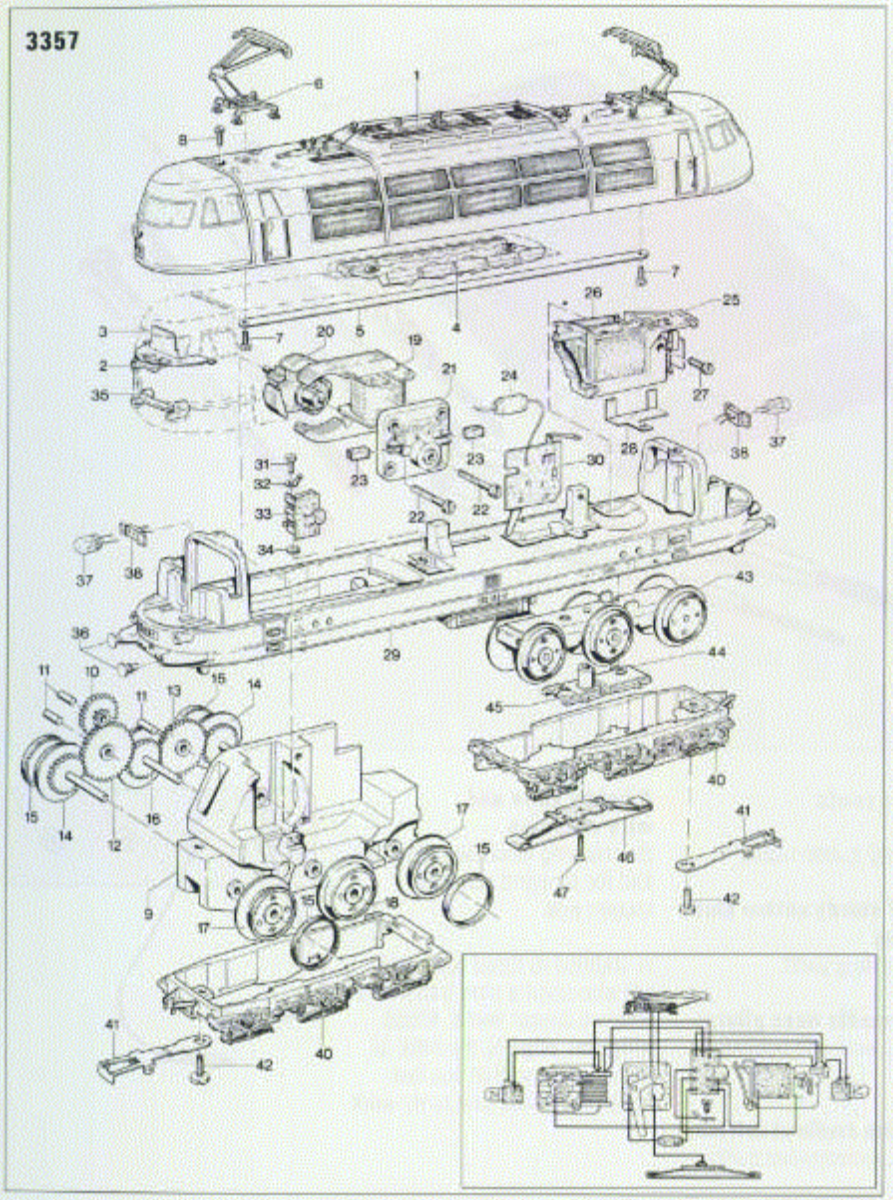
D = diameter in millimeters
Z = gear teeth count

5.3 The class 103 electric locomotive

The star locomotives of the German Federal Railroad have been and still are the class 103 electric locomotives. Their streamlined form is a striking departure from the electric locomotives previously purchased and reminds one somewhat of the famous E 19 from the period of the German State Railroad Company.

With an apparent lack of effort they accelerate the IC expresses to 200 km/h (125 m.p.h.).

The locomotives have a continuous output rating of 7.400 kilowatts - four times that of the oil-fired class 012 "Pacifics".



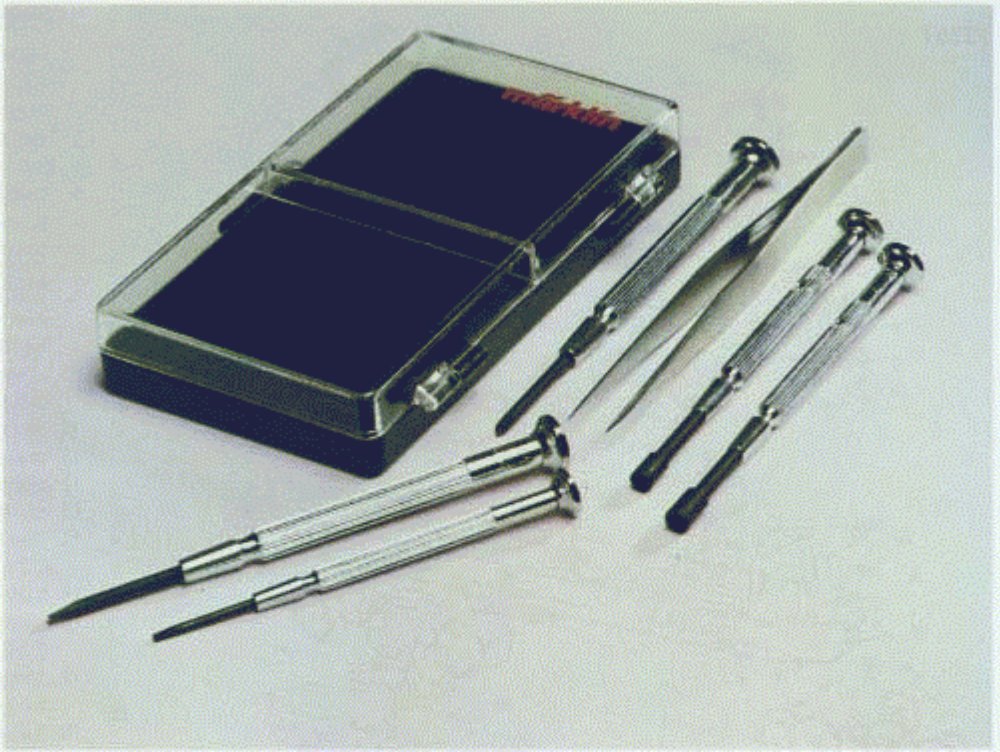
No.	Description	Catalog No.
1	locomotive body (complete) with	24 760
2	headlight lens assembly	22 290
3	light shield	22 289
4	roof windows	22 293
5	contact strip	22 294
6	single arm pantograph	24 166
7	screw	78 507
8	screw	75 600
	power truck (complete) with the most important parts:	25 212
9	power truck frame mounted on it:	24 716
10	idler gear (Z 36/9)	24 717
11	bearing pin	23 184
12	intermediate gear (Z 42)	23 731
13	intermediate gear (Z 36)	23 687
14	driving wheel and axle (Z 27, D 14)	22 309
15	traction tire	7 153
16	driving wheel and axle (Z 27, D 14)	22 307
17	driving wheel with traction tire (D 14)	21 761
18	driving wheel (D 14)	21 766
	in addtion	
19	field magnet	23 139
20	armature	24 548
21	brush plate	23 135
22	screw	78 512
23	pair of brushes	60 146
24	FM choke	60 091
25	reverse unit with	25 220
26	slider arm spring and	7 194
27	screw	78 510

No.	Description	Catalog No.
28	pressure guide	24 459
29	bracket	24 720
30	catenary selector switch	21 476
31	screw	78 507
32	solder lug	70 351
33	circuit board (with wire)	24 680
34	insulating washer	72 136
35	headlight lens (bracket)	22 287
36	buffer	76 119
37	light bulb	60 008
38	lamp socket	25 992
39	solder lug	47 504
40	truck frame	22 303
41	coupler hook	22 313
42	screw	75 020
43	truck (complete)	22 283
44	C clip	60 802
45	insulation (without wire)	21 470
46	pickup shoe	7 164
47	screw	75 608

D = diameter in millimeters
Z = gear teeth count

Useful tools for your workbench

You will need special tools for most of the repairs described in the following chapters. You probably already have many of them on your workbench now, but for the sake of completeness all important tools and equipment will be listed once again.



6.1 The 19005 tool kit

The most important small tools are contained in the no. 19005.

Two screwdrivers
for all slotted screws on Märklin locomotives and powered units, but also for plugs and sockets.

A cross point screwdriver
for screws on plastic passenger cars and for some of the newer Märklin locomotives and powered units.

Two nut drivers, sizes 3.0 and 3.5 mm
for loosening and tightening the hexgonal nuts and shoulder screws on locomotive valve gear and drive rods.

A small pair of tweezers
for changing brushes, installing springs and much more.

6.2 Other tools

The following is also useful

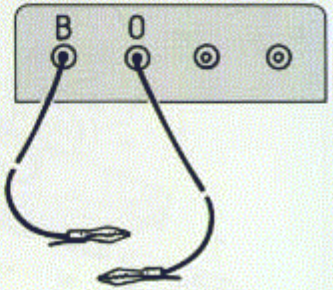
A piece of sturdy cotton cloth or linen rag
for cleaning dirty parts.

A pair of needle nose pliers
for bending work and holding parts.

A locomotive cradle of soft foam
for holding a locomotive during repairs.

A hobby knife and wire strippers
for stripping insulation from wire and for scraping varnished copper wire.

In addition to these tools, you will also need a train transformer and two jumper wires. Attach **alligator clips** to the ends of these wires, so that you can keep your hands free to do work.



6.3 Working with a soldering iron

If you do not have any experience doing soldering, it is best to leave this work to a trained dealer. It is very easy to destroy plastic parts with poor soldering work.

All types of electronic components are especially vulnerable during soldering work, such as the circuit plate in the 3300 series locomotives. In any event, avoid doing any soldering work on components of the Digital system – such as locomotive decoder panels. Your Digital dealer has a specially equipped work area for these situations.

If you would like to do your own soldering, please take note of the following:

All surfaces to be soldered must be bare and clean, i.e. free from paint, grease, oil etc...

Only use rosin core solder. Never use flux as it usually contains acid and will attack the metal around the solder joint and insulation.

Wait until the tip of the soldering iron is really hot before doing any work! Wipe the tip on a wet artificial sponge each time before doing any soldering.

Tin the tip of the soldering iron first and then both of the areas to be soldered.

Hold both of the pieces to be soldered together and heat them with the soldering iron until the solder begins to flow.

Do not move the two soldered pieces while the solder joint is cooling, otherwise the joint may break. If necessary, reheat the solder joint.

The following are needed for soldering:

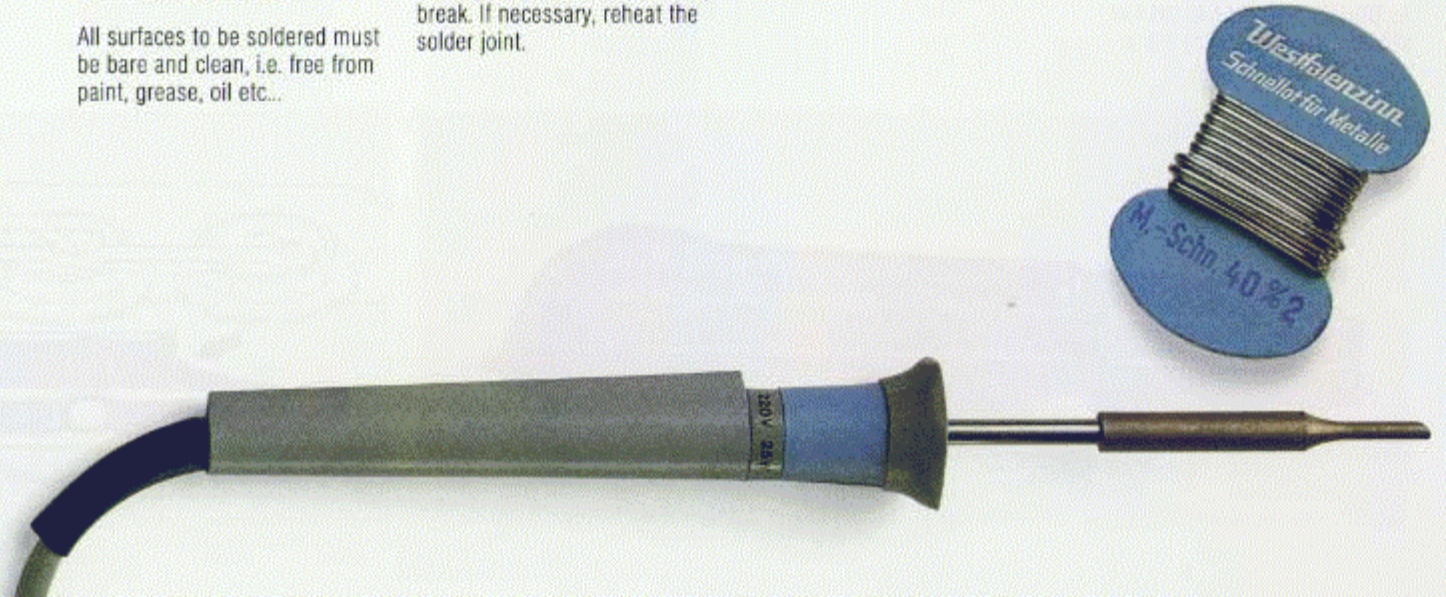
A **soldering iron** (25-30 watts) with a small **steel-jacketed tip.** Copper tips flake easily and have to be changed frequently. Make sure your dealer also has replacement tips.

A **soldering station** with temperature control is better, but more expensive. During soldering work the tip is immediately reheated to the desired temperature, so that there is no noticeable loss in temperature.

An **artificial sponge** for cleaning the soldering tip. A steel brush is highly recommended if you are using a soldering iron with a copper tip.

Fine rosen core solder.

A **"third hand".** It has two arms which can be turned and swung up or down; at the end of each arm is an alligator clip. For example, you can clip a wire in the "third hand", hold the second wire opposite it and still have a hand free to hold the soldering iron.



Locomotive maintenance

Märklin locomotives are robust and very durable. Many a collector is proud of 30 or 40 year old "Oldtimers" which still tirelessly run around the track.

Yet, even Märklin locomotives need some care; some parts have to be changed from time to time.

You can perform maintenance jobs by yourself with no difficulty, even without knowing how to solder. The necessary spare parts are available at your dealer. An overview of spare parts can be found in chapter 10.

7.1 Changing pickup shoes

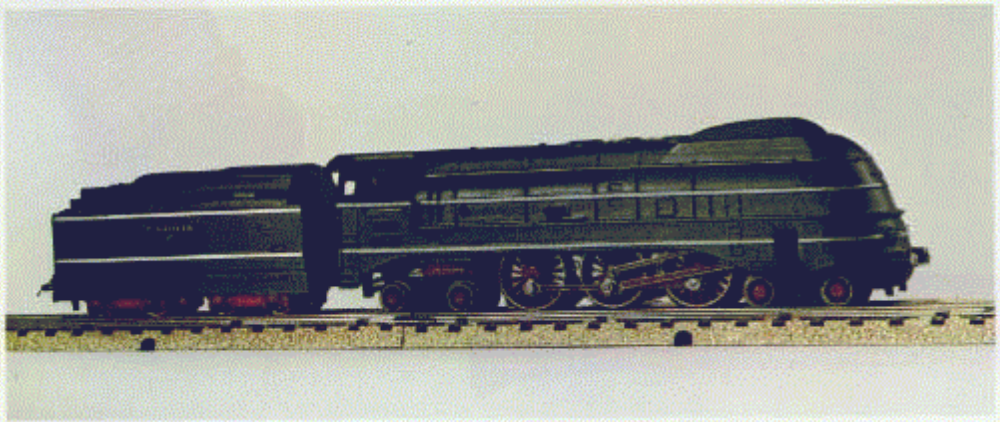
The pickup shoe should extend approximately 2 mm below the wheels in order to insure good contact with the track. If it no longer does this because the springs have lost their tension or because the shoe itself is worn out and has grooves or pits, then it must be changed. If there are no grooves present, you can carefully adjust it to the proper position.

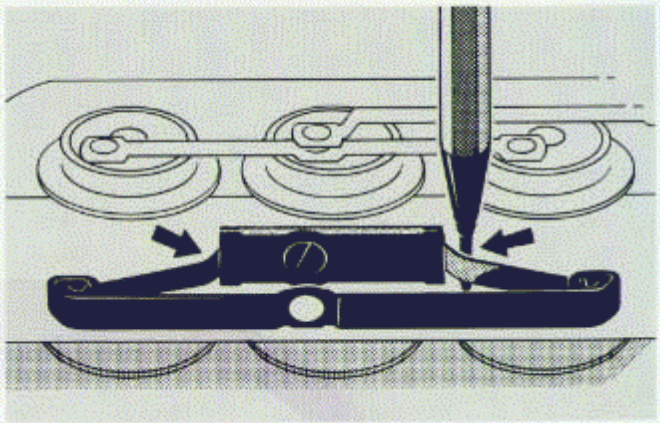
Be careful with pickup shoes with asymmetrical mounting holes that the shoe is correctly screwed on. Otherwise you may have a short circuit. If the mounting tabs for the shoe are bent or loose, squeeze them flat against the insulation plate with a pair of flat nose pliers. Use only the original screw with its special threads for mounting the pickup shoe. If it is lost, you can get replacements from your dealer.

The pickup shoes for older locomotives from the 1960's had longer insulation plates. The most common types are still available under the spare part numbers 20157 (asymmetrical) and 21201 (symmetrical).

In general, you can also use the pickup shoes for the current locomotives, but the screws must be tightened more.

The SK 800 was manufactured by Märklin from 1947 to 1959 in different versions. Today it is a desired collector's item.





7.2 Changing headlight bulbs

60 010 screw-base bulbs for metal sockets
Hold the socket firmly while screwing the bulb in or out.

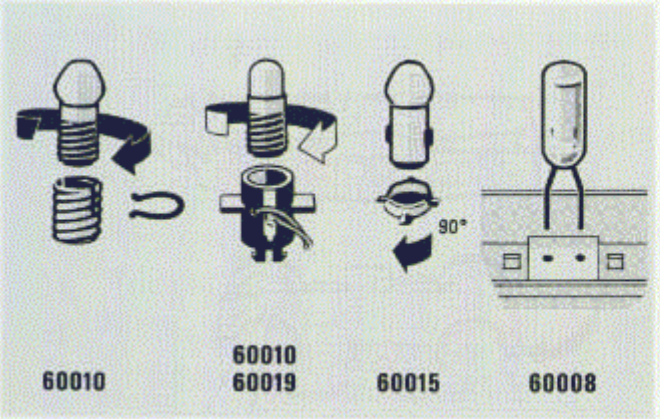
60 019 and 60 010 screw-base bulbs for plastic sockets
Current is provided by two wires. One is connected to a solder terminal which has a spring-loaded base. The spring tension must be strong enough to produce contact with the bulb. The other wire is stripped of some of its insulation and passed through an opening on the side of the socket.

Be careful that the bare wire on the inside extends to the opening of the socket along the inside wall of the socket, thus providing good contact for the bulb. Locomotives converted to digital operation that also have plastic sockets take the 60 010 19 volt bulb.

60 015 bayonet bulb
Turn the bulb 90° and remove. Check to see if the contact spring has sufficient tension. Push the new bulb into the opening and turn it 90°.

60 000 cartridge bulbs (for older locomotives without lucite lenses
Lift the bulb out and replace. Check contact spring tension.

60 008 bulb
Pull the bulb out of the socket with a pair of tweezers and insert the new bulb.



7.3 Adjusting and changing couplers

You can easily adjust bent metal couplers by yourself. You will need a no. 7001 coupler gauge as well as a pair of flat nose pliers for this.

Most couplers are mounted with only a screw. If there is also a positioning spring present (ex. on the 3065 locomotive), then care must be taken that the spring is screwed on straight and that the coupler is properly centered.

On some locomotives and cars the couplers have metal mounting plates.

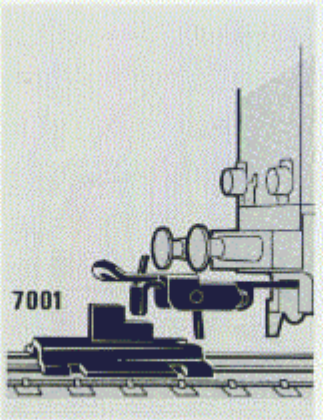
First unscrew the body (or the truck frames on locomotives), bend the mounting plate tabs up with a screwdriver, then bend them straight with flat nose

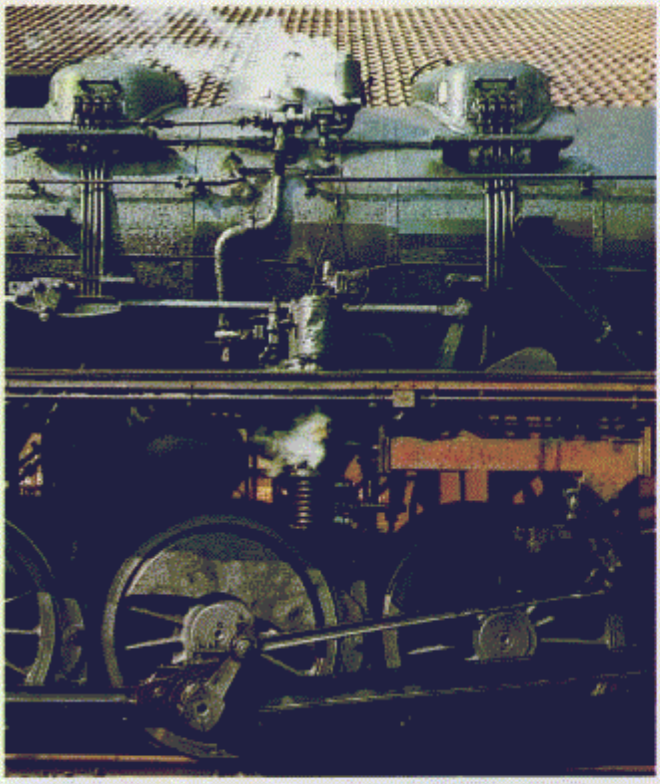
pliers and remove the plate and coupler.

Install the mounting plate with the new coupler and bend the plate tabs over. The coupler must swing to the sides with spring tension and sit in the center in its normal position.

Replacment mounting plates are available under no. 22741.

Older locomotives such as the 3075 have a different mount and an additional cover plate which must lie under the bent tabs of the mount. The cover plate is not needed with the new mount.





7.4 Replacing traction tires

Märklin H0 locomotives are equipped with traction tires to prevent a locomotive's wheels from slipping when it first starts up and to increase traction, especially on grades. The tires of certain driving wheels are grooved for this purpose.

On **locomotives with coupling rods** remove these rods first. The best tool for this is the nut drivers in the Märklin 19005 tool kit.

On **locomotives with truck frames** unscrew and remove the truck frames first. On most of these locomotives the coupler and truck frame are held on with a common screw.

Pull off the old traction tire with a small screwdriver or with a pair of tweezers. Press the new one in the groove with your index finger and finish pulling it on with the screwdriver.

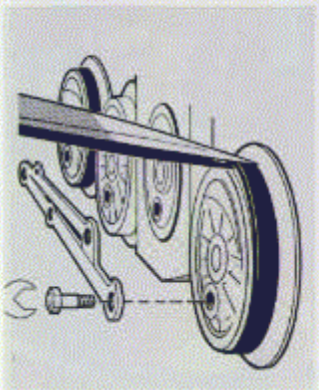
Sometimes the traction tires become twisted when installing them. Insert the tweezers between the edge of the wheel andthe traction tire and lift the tire slightly. Then with the thumb of your free hand, rotate the wheel one or two turns and the traction tire will slip into place.

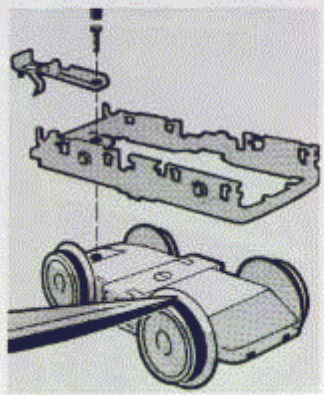
Wheels on locomotives with DC motors (ICE, Red Arrow, 0050) as well as the RE 800 cannot be turned by hand and the tires must be removed and reinstalled.

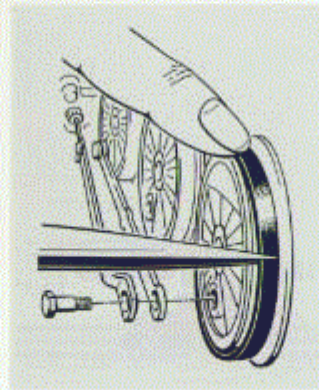
On other locomotives turn the wheel by hand only on the side with the gear train; otherwise the driving wheel can become loose.

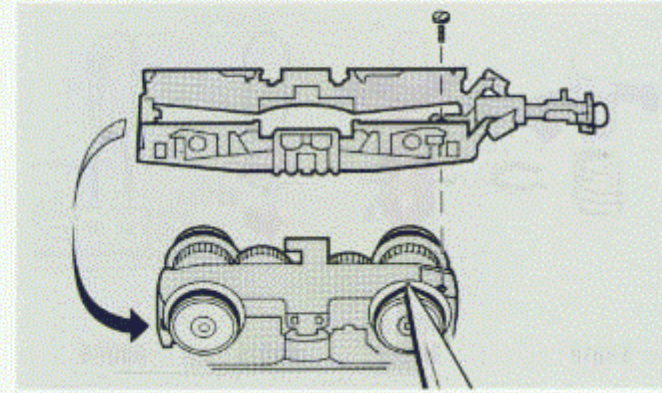
When mounting the truck side frames back in place, be careful that the two little mounting lugs are positioned correctly in their depressions in the frame.

Of course on the German Federal Railroad there never were traction tires. Sand was sprayed heavily on the tracks in case of ice and snow, and on steep grades. The engineer had to pull back on the throttle quickly when starting up if the wheels began to slip.









7.5 Oiling

The most important places to oil on a Märklin locomotive are the armature bearings. Most of the locomotives with flat commutator motors have an oil reservoir at both ends of the armature shaft which is filled with foam sponge.

If an oil resevoir is empty, stuff a bit of foam with a pair of tweezers into it before oiling, making sure that the foam also gets **under** the armature shaft, so that the foam does not pop out again during operation. Put 1–2 drops of the Märklin 7199 special oil in each resevoir.

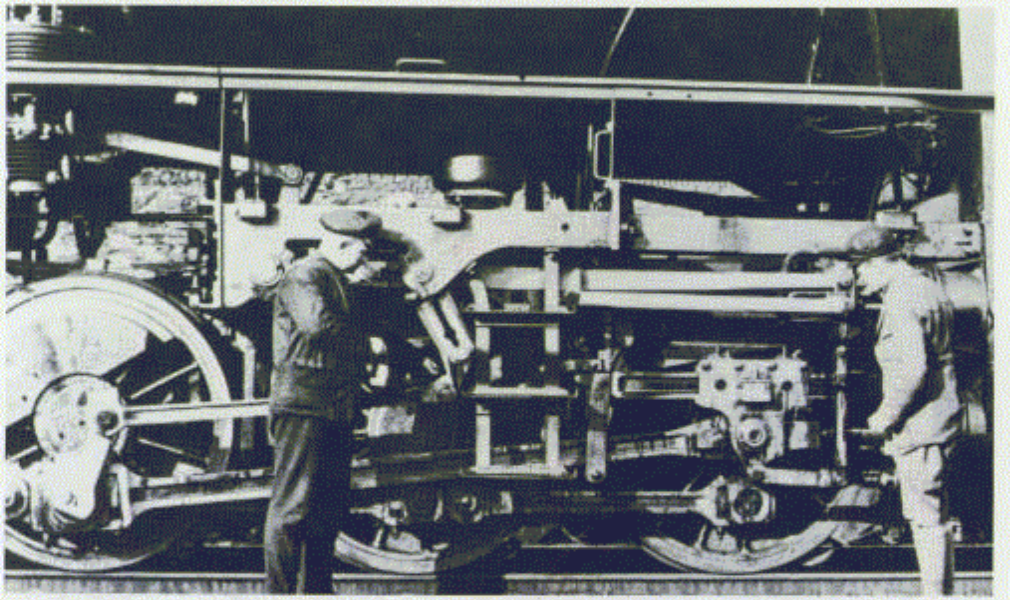
On motors with drum-style commutators, put a drop of oil on each end of the armature shaft.

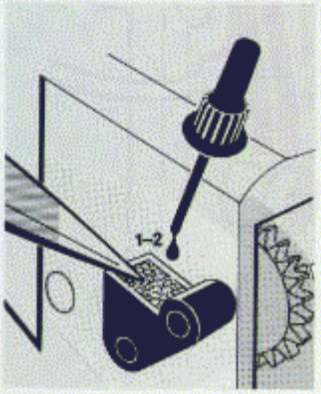
Other places to oil: The wheel bearings and the gears.

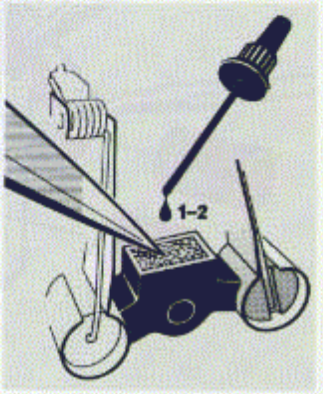
Use Märklin's special oil only; salad oil **destroys** motors and sewing machine oil is too thin.

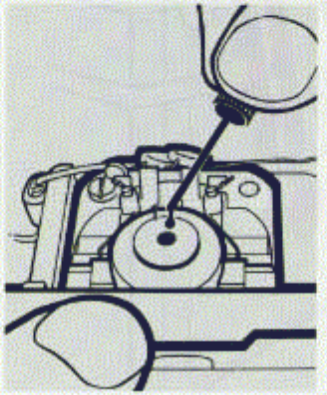
On no account should oil be put into the motor housing or on the pickup shoes. Never use 0241 smoke fluid for oiling purposes.

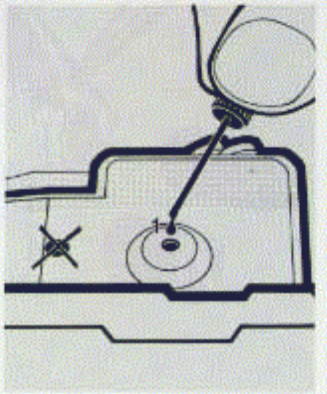
On the prototype oil must also be put into the axle bearings. For Märklin locomotives it is better not to use an oil can this size.











7.6 Changing brushes

7.6.1
60 030 for motors with a flat commutator

Brushes create the electrical contact with the armature. The copper-mesh brush cleans the commutator surface. If the brush has become too short or if the contact surface of the brush has become irregular, problems with electrical contact to the motor will occur. In addition, an extremely dirty copper mesh brush can no longer clean the commutator surface. Both brushes must be changed.

Lift both brush springs out of the way. Using tweezers, pull or push the brushes out.

No trace of the old brushes can be allowed to remain in the brush wells. Clean the latter with a cotton swab or with a thin wooden stick wrapped in a bit of rag.

Insert the new brushes with the copper brush on the side with the brush spring bent at the end. Reposition the brush springs so that they have good contact with the brushes.

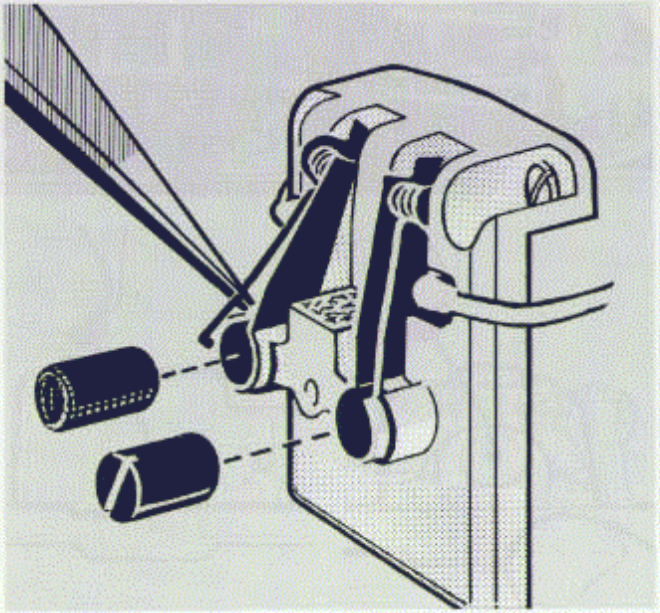
If the locomotive still does not operate properly or comes to a stop after a short while, check the following:

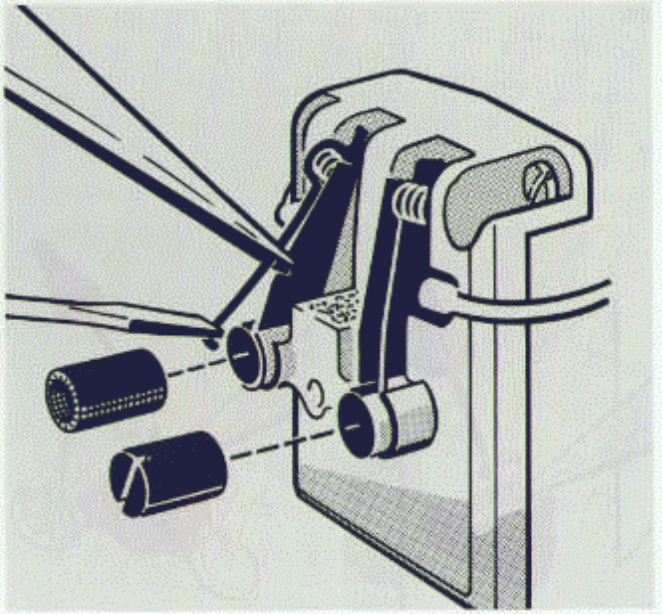
Are the brushes seated properly on the commutator surface? Are there still pieces of the old brushes present?

Are the brush springs properly positioned on the brushes? The brush spring with the bent end must stick in the middle of the copper mesh brush.

With the transformer turned on, press on the brushes with the tweezers. If the locomotive operates, then the brush tension is too weak. Lift the springs out and bend them slightly inward. It is best if you grasp the spring about 5 mm from the end with the tweezers and press at the same time on the end with a small screwdriver.

Your dealer has replacements for lost or broken brush springs (part no. 20 078 and 20 094).



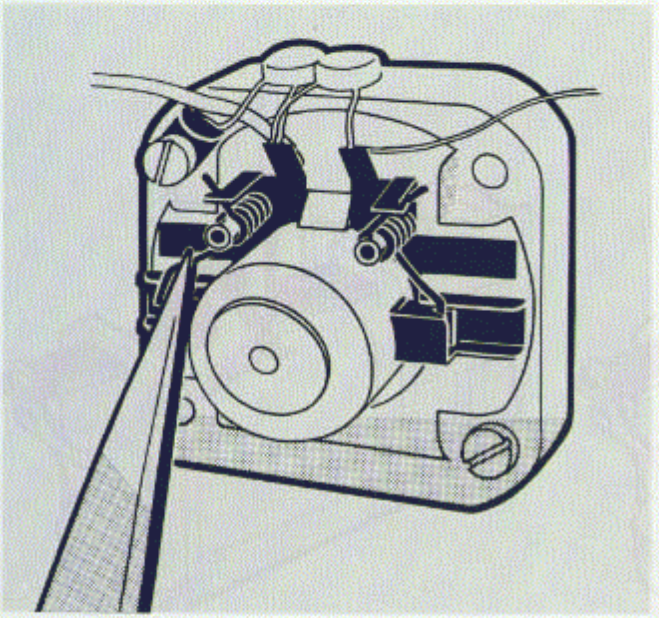


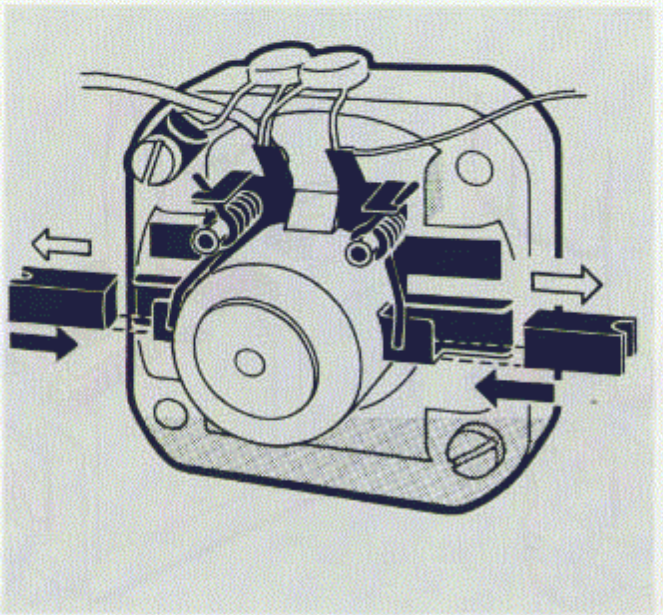
7.6.2
60 146 for motors with drum-style commutators

Lift both brush springs out with the tweezers. Do not bend the springs!

Push the brushes out. Insert new brushes with the tweezers, then replace both brush springs in the slots with the tweezers.

Be careful that the brush does not fall into the motor housing. If it does happen, you can usually get it out by shaking the housing a bit. Occasionally the brush plate has to be unscrewed to get at it. On no account can the brush be allowed to remain in the motor housing, as it could jam the armature.





7.7 Installing, adjusting or replacing the reverse unit slider spring

First slip one end of the slider spring over the plastic hook using a pair tweezers. Press on the loop of the spring with your thumb, thus holding the spring in place. Hang the loop at the other end of the spring over the brass hook.

If the locomotive reverses by itself at high speed or just stands and makes a buzzing noise, then the brass hook must be bent to the left to increase the spring's tension. If this does not work, then the spring can be hung on the hook several loops from the end.

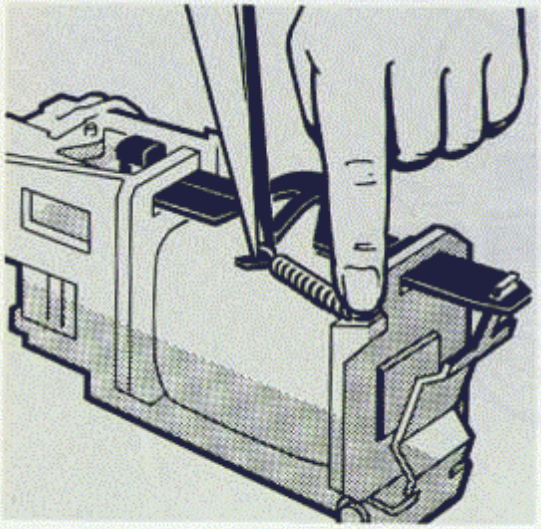
If the locomotive reverses direction only after jumping down the track a bit or does not reverse at all, then the hook must be bent to the right to decrease the spring's tension.

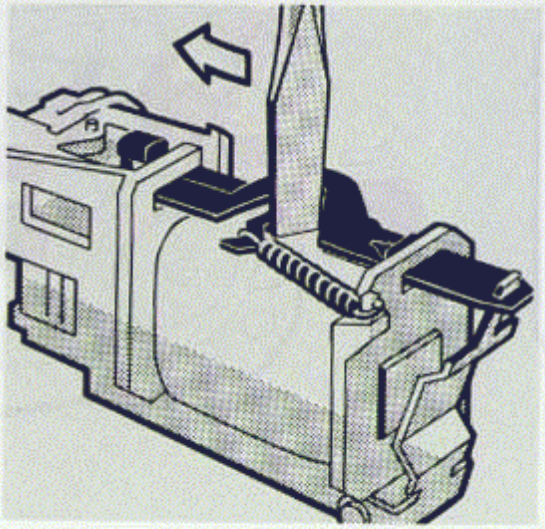
If this does not work, the spring can be streched.

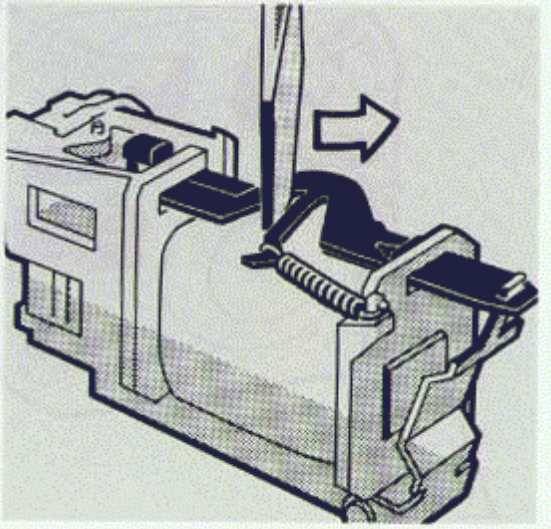
Be careful that the hook is not bent up or down, as this will cause the reverse unit to function incorrectly.

If the hook should break from frequent bending, the reverse unit slider is available as spare part no. 20 821. The slider spring is also available at your dealer under catalog number 7194.

For reverse units on locomotives with TELEX couplers or on rail cars with headlight reversal, the tension of the slider spring can only be adjusted by stretching it or by hanging it several loops from the end. Be careful that the spring is free to move and is not obstructed by the wire soldered on the same side.







7.8 Adjusting or changing pantographs

If a pantograph no longer has proper tension, then the cause is usually the springs used for keeping it pressed against the catenary wire; they are either missing or worn out.

New springs can be hung easily between the hooks provided for this purpose.

Replacment springs:

Single arm pantograph	76 563
Scheren pantograph	76 560
old Scheren pantograph (ex. 20 780)	20 136

To change a damaged pantograph, the locomotive body usually has to be removed and the pantograph mounting screw taken off from inside. The instructions for a locomotive in question give more precise directions for this. Be careful that the insulators are positioned properly on the roof of the body.

7.9 Cleaning a locomotive

The chemical cleaning solutions (electrolytic baths) on the market or cleaning oils do not make up for the need to remove residual dirt from the locomotive. There is the problem of how to dispose of these liquids which may be hazardous to the environment.

For these reasons it is best to use only a strong cotton rag, a pair of tweezers and a small screwdriver for cleaning purposes.

7.9.1 Cleaning the driving and pilot/trailing wheels

The wheels create the electrical contact between the rails and the locomotive. When they are very dirty, arcing can occur during operation and there can be problems with electrical pickup.

Use a hobby knife or a small screwdriver to scrape dirt from the wheels and then polish them with a rag.

7.9.2 Cleaning the interior of the locomotive and the mechanism

If your layout is on a carpet, it is very easy for carpet fibers to get into the mechanism.

Remove all fibers, particles of material, bits of grass and other scenery with a pair of tweezers.

7.9.3 Removing oil from the locomotive

Remove all traces of oil with a rag. On many locomotives there is a C-clip on the end of the armature shaft at the brush plate. Remove this clip and take the brushes out of the brush wells.

Unscrew the brush plate and carefully lift it away from the mechanism. Take the armature and field magnet out (being careful not to break the wires to the fieldmagnet). Clean all traces of oil from the motor housing with a rag.

If the commutator surface is very dirty, clean it with a pencil eraser or a fine fiber glass brush and then scrape out the gaps between the armature segments with a pin. Sometimes the commutator needs to be turned to true up its surface. Leave this job to your dealer or to a repair station that has the necessary equipment for this work.

We advise against using gasoline as a cleaning agent. It can attack plastic parts such as gears either dissolving them or making them brittle, thus causing them to break.

8.1 Overview of possible operating problems

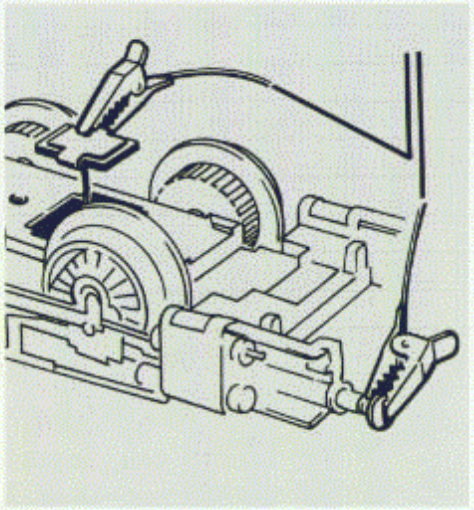
Correcting problems with locomotives

9.1 Locomotive does not operate – headlight doesn't work – transformer indicates a short circuit

9.1.1 Check to see if a metal coupler is so bent that it touches the third rail of the track.
If this is the case, adjust the coupler with the help of the 7001 coupler gauge or replace the coupler (see chapter 7.3).

9.1.2 Take the locomotive off the track. If the transformer still shows a short circuit:
The problem is on the layout, not in the locomotive (see chapter 11).

9.1.3 Unscrew the pickup shoe. Clip one test lead to the locomotive's ground and the other to the pickup shoe's contact plate (pull the latter slightly out from the locomotive).



Possible causes of the problem if the motor now functions:

a..... Incorrect pickup shoe for the locomotive.
Replace pickup shoe

b..... The pickup shoe was incorrectly screwed onto the locomotive.
Install the pickup shoe correctly

c..... An incorrect screw for mounting the pickup shoe was used. A screw with too large a head can cause a short circuit.
Replace screw

d..... Pickup shoe is damaged.
Replace pickup shoe

e..... The pickup shoe is touching the frame because the springs are bent or have lost their tension.
Replace pickup shoe

f..... The wire to the contact plate has a bare spot.
Replace wire

g..... The solder point on the contact plate is too thick and presses against the locomotive frame.
Remove the excess solder and resolder the wire flat on the contact plate

h..... The bare wire end at the solder point is too long and touches the frame.
Shorten the wire end and resolder or replace the wire

9.1.4 Put the pickup shoe back on and tighten its screw. Remove the body and clip the second test lead to the pickup shoe.

If the motor now works:

A short circuit is being produced between the body and a wire or a solder point on the locomotive. Sometimes the source of the problem can be traced by the location of a burn spot on the interior of the body and the problem can then be corrected.

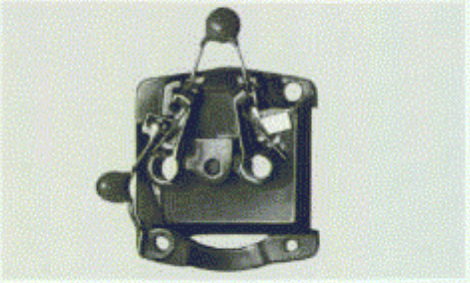
Possible causes

a..... A wire was clamped to the frame and part of its insulation destroyed when the body was screwed on.
Replace wire

b..... A solder point (ex. on the choke) is no longer insulated.
Insulate the solder point with shrink tubing

c..... One of the two capacitors on the brush plate extends too far out and is pressing against the locomotive body.
Bend the capacitor downwards

d..... The contact spring for the smoke unit is bent and is pressing against the body.
Bend the spring back to its original position



9.1.5 Now unsolder the headlight wire(s) from the main solder point.

If the motor now operates:
On locomotives with several headlights touch the main solder point with the wires, one at a time, to determine which headlight is causing the short circuit.

Possible causes of the problem

a..... The headlight wire has a bare spot.
Replace wire

b..... On bulbs with a plug-in socket (60 015):
The spring contact plate is not correctly installed and the spring is touching the locomotive body.
Place the spring contact plate correctly in the slots provided for it

c..... The bulb is missing and the spring is pressing against the locomotive body.
Replace bulb

d..... On older locomotives with spring contact plates (bulb no. 60 000):
The springs are bent (usually down) and are touching the locomotive body.
Bend the spring contact plate slightly up

e..... For bulbs with plastic sockets
Unsolder the wires from the lamp sockets' solder terminals. If the motor now works, the bare end of the wire on the side is probably too long and is bent downwards in the socket; it is touching the spring contact plate.
Bend the end of the wire up and screw the bulb all the way into the socket

9.2 The locomotive does not operate – headlights do not work – transformer does not indicate a short circuit

9.2.1 Test for the presence of current by momentarily bridging the third rail and a running rail with a metal object (ex. small screwdriver) thus creating a short circuit.

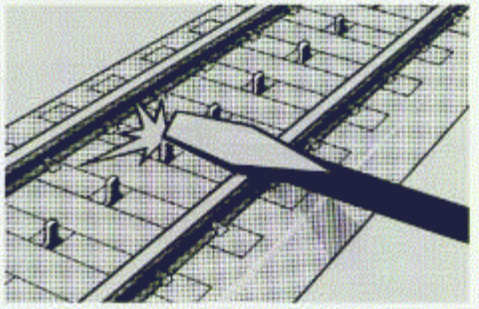
9.2.2 Using an electric locomotive, test:

a..... Is the selector switch set for operating from track?
Reset the selector switch if necessary

b..... Is the upper part of the plastic switch lever correctly seated on the metal switching plate?
Clip the switching plate under the switch lever

c..... Does the metal switching plate lie directly on the contact plates for the lead wires?
Bend the switching plate to produce a more reliable contact

If the problem is still not corrected in cases **b** and **c**, then the selector switch must be replaced.
On many locomotives the selector switch is mounted to the locomotive frame with rivets. The rivets must be drilled out to remove the switch. The new switch can usually be installed with small screws and nuts.



9.2.3 Take the locomotive off the track. Clip a test lead to the locomotive ground and a second lead to the pickup shoe.

If the motor now works:

a..... The pickup shoe does not have adequate contact with the third rail.
Replace pickup shoe

b..... The wire from the contact plate to the main solder point is loose.
Resolder the wire

9.2.4 Unscrew the body. Clip a test lead to the main solder point instead of the pickup shoe.

If the motor now works:
Check the wire between the contact plate and the main solder point. There may be a poor contact.
Resolder the wire

If the problem still exists, the choke may have to be replaced. Take the locomotive to a dealer.

9.3 The locomotive does not operate – headlights work

9.3.1 Check the following points first:

a..... The driving wheels cannot be turned by hand:
Gear damage. The locomotive must be taken to a dealer. On the ICE, Red Arrow, RE 800, 0050 and Köf, the driving wheels are designed not to be turned by hand.

b..... The brushes are missing or are too short.
Replace brushes (see chapter 7.6)

c..... The connections between the field magnet and the reverse unit are broken.
Replace or resolder the wire(s)

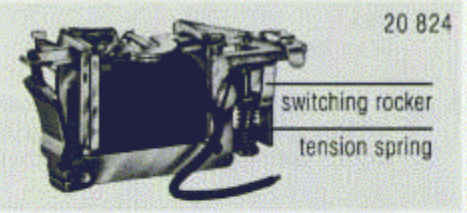
d..... The solder connection between the field magnet's center tap and the brush plate is broken.
Resolder both wires

e..... The reverse unit is engaged as soon as the transformer speed control knob is turned up.
Reverse unit slider spring must be adjusted (see chapter 7.7)

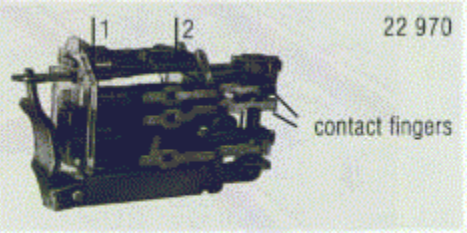
9.3.2 Using tweezers, first press against the brushes, then against the brush springs.

If the motor now works:
Increase the tension of the springs (see chapter 7.6)

9.3.3 The switching rocker on the reverse unit is jammed and has no contact with the contact plate.
Press the tension spring downwards with a pair of tweezers until the rocker is free to move again.



9.3.4 On reverse units with interrupter switches:
Press the end of the contact spring (1) carefully down with a small screwdriver. If the locomotive now works, the spring for the interrupter switch has too little tension.
Carefully bend the bridge (2) up a little bit. Replace the interrupter switch (no. 21 683) if necessary (this is difficult due to the end of the coil wire soldered here).



9.3.5 On reverse units with a switching drum and spring-loaded contact fingers:

a..... The field magnet buzzes loudly when you turn the transformer speed control knob up.
Using an insulated screwdriver, carefully lift back one of the two fingers for operating current.

If the locomotive now operates, see section 9.10.2 in this chapter

b..... The field magnet does not buzz when the transformer speed control knob is turned up.
Using an insulated screwdriver, carefully press first one and then the other operating current contact fingers against the switching drum. If the locomotive begins to function in one or the other case, then the fingers do not have enough tension.

Grasp the operating current contact finger approximately 5 mm from the end with a pair of tweezers and lift it slightly away from the drum. Using a small screwdriver, press down on the end of the finger and bend it slightly towards the drum.

9.3.6 On older reverse units with fingers bent inwards
Insert a small screwdriver in the crook of the finger. Bend the finger up by slightly turning the screwdriver.

9.4 Locomotive will not operate off of catenary

9.4.1 Check to see if there is electrical current in the catenary. Place another electric locomotive set for catenary operation on the track.

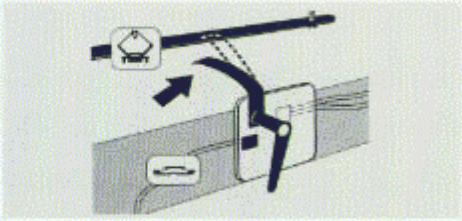
If this unit does not operate, check the connections in the catenary system.

9.4.2 Then check the following:

a..... Is the selector switch set for catenary operation?
Reset the switch if necessary.

b..... Is the selector switch defective?
See section 9.2.2 b/c in this chapter for repairs.

9.4.3 Check to see if the spring from the selector switch has contact with the pantograph.
Bend the spring up if necessary.



9.4.4 Test to see if the pantograph has adequate pressure against the catenary in the raised position.
Possible causes:

a..... The pantograph springs have become disconnected or are missing.
Replace the springs (see chapter 7.8)

b..... The pantograph is bent.
Replace the pantograph (see chapter 7.8)

9.5 The locomotive only operates in one direction

9.5.1 Check the solder joints
- between the field magnet and the reverse unit
- between the field magnet and the brush plate (both center taps).

Resolder the wires.

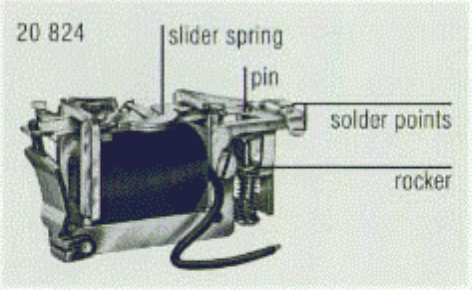
9.5.2 Check to see if the rocker on the right side of the reverse unit has contact with the contact plate for only one setting.
Adjust the rocker stroke or replace the reverse unit.

9.5.3 Test to see if the reverse unit always pushes the rocker to the same side (locomotive operates, but only in one direction):

Possible causes

a..... The reverse unit slider is disconnected.
Reattach slider.

b..... The pin on the slider which pushes the rocker back is bent.
Using a pair of pliers, carefully bend the pin down so that it is perpendicular.



c..... The hook for the slider spring on the slider is bent up or down.
Straighten the hook with a pair of flat pliers.

d..... After placing the body back on the frame, a wire is pressing against the rocker.
Reroute the wire away from the rocker.

9.5.4 Check to see if the rocker possibly has no contact with the solder contact plate because the latter is bent:
Carefully bend the solder contact plate down and adjust the rocker stroke.

9.5.5 On reverse units with a switching drum and contact fingers:
Using an insulated screwdriver, carefully press the contact finger for the faulty direction of travel against the drum. If the locomotive now works, see section 9.3.5 for repair procedure in this chapter.

9.6 Locomotive operates too slowly

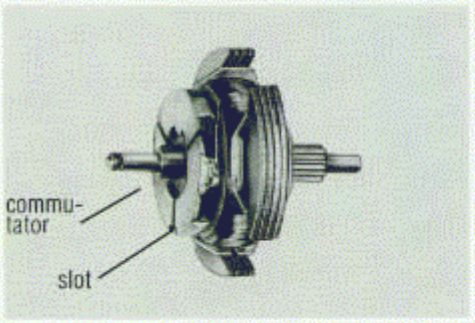
9.6.1 Push on the brushes with a pair of tweezers.
If the locomotive now operates faster:
Replace brushes (see chapter 7.6)

9.6.2 Lift the brush springs slightly up.
If the locomotive now operates faster, the brush spring tension is too strong and is acting as a brake on the armature.
Bend the brush springs slightly back

9.6.3 If no increase in speed is achieved by these measures, remove the armature.

a..... If the commutator is very dirty:
Clean the commutator and scrape the slots between the segments with a pin or small screwdriver. If this does not help, install a new armature.

b..... If a winding on the armature is scorched:
The armature must be replaced. In the event the field is also scorched, it must also be replaced.



9.7 Locomotive suddenly comes to a stop after a while or at high speed

9.7.1 The reverse unit armature is engaging:
The slider spring is too weak (see chapter 7.7)

9.7.2 The locomotive operates after the brushes are pressed against the commutator with a pair of tweezers:
Replace brushes (see chapter 7.6)

9.7.3 The field magnet buzzes on reverse units with a switching drum:
see section 9.10.2 in this chapter

9.8 Locomotive does not reverse, but begins to race when reversing is attempted

9.8.1 The slider spring has too much tension
(see chapter 7.7)

9.8.2 The rocker on the reverse unit is jammed
(see section 9.3.3 in this chapter)

9.9 Locomotive continues to operate at high speed in the new direction during the reversing procedure

9.9.1 The solder terminal (usually the outer one) on the contact plate of the reverse unit is bent down
or
the contact plate is partially melted due to sloppy soldering and the outer solder terminal has slipped down.
In this abnormal condition the rocker still has contact with the solder terminal.
Carefully bend the solder terminal or the entire contact plate slightly up. Often the only thing that can be done is to replace the reverse unit.

9.9.2 For reverse units with interrupter switches:
The interrupter switch has continuous contact with the slider beneath it due to a bare wire, for example, or too large a solder joint.
Check the solder joints and the wire connections

9.10 The more the transformer speed control knob is turned up, the more slowly the locomotive operates and finally it comes to a stop

9.10.1 The pilot light on the transformer becomes weaker at higher voltages:
There is a faulty connection on the layout (see chapter 11.1)

9.10.2 The locomotive's field magnet buzzes, the locomotive has a reverse unit with switching drum and contact fingers (example: with TELEX couplers):

If the fault occurs in only one direction, then one of the two upper contact fingers has too much spring tension on the switching drum.
Get the locomotive running in the direction in which the fault occurs. Turn the transformer to the point where the locomotive comes to a stop and the field magnet buzzes. Both coil windings of the field magnet are receiving current.

Because there are voltage peaks present in the reverse unit which could give you a minor, irritating shock, grasp the locomotive with a cloth. Using an insulated screwdriver, raise the finger hanging down slightly away from the drum; the locomotive will immediately operate in the right direction. Bend the same finger back several times, until the locomotive operates properly.

If the locomotive now will not operate at all in the opposite direction, you have bent the finger back too far.
Grasp the finger 5 mm from its end with a pair of tweezers and carefully bend it back, then bend the end slightly towards the drum by pressing on it with a small screwdriver.

If the problem occurs in both directions, then both fingers have too much spring tension.

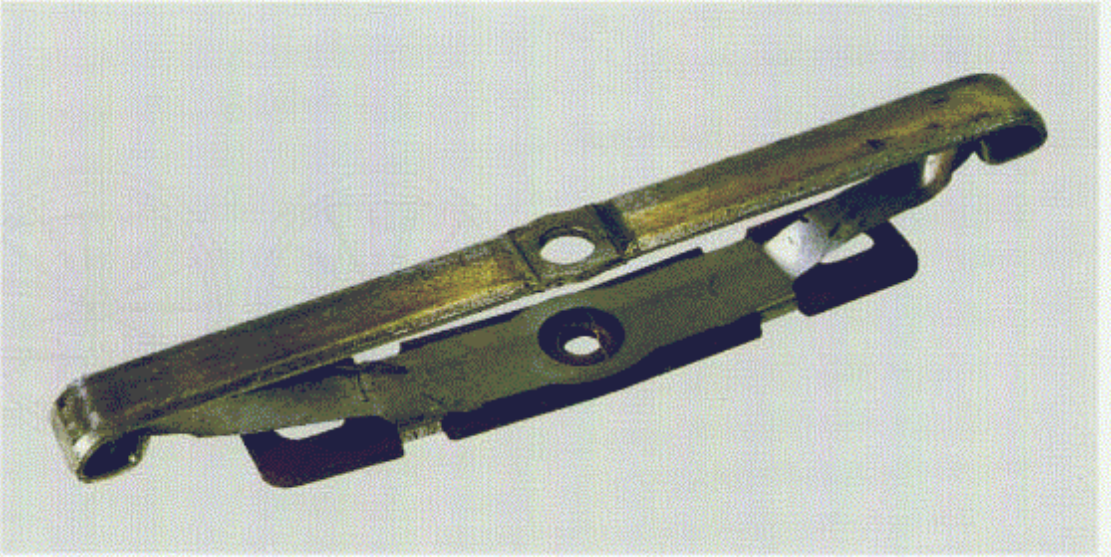
9.11 Locomotive operates haltingly, headlight flickers

9.11.1 Check to see if the pickup shoe has sufficient pressure on the center rail and if the shoe itself has a groove or burn spots.
Change the pickup shoe if necessary (see chapter 7.1)

9.11.2 Is there a poor solder joint on the contact plate, the choke or the main solder point?
Solder in new wires if necessary

9.11.3 If the wheels are very dirty:
Check the track on the layout for dirt particles such as carpet fibers, stray scenery particles, etc. and vacuum or clean.
Clean all locomotive wheels and replace wheel sets or trucks if necessary.

9.11.4 On three-axle locomotives where only one axle is powered: (ex. 3029, 3087, 3090, 3104)
The center axle must have spring contact with the running rails, otherwise the wheels will not have sufficient ground contact. If you cannot feel any spring tension from this axle, then the spring is missing or is bent.
Unscrew the reverse unit; beneath it is the opening for spring (no. 76 562). Insert a new spring and screw the reverse unit back into place.



9.12 Locomotive only operates intermittently

9.12.1 The locomotive needs to be oiled (see chapter 7.5)

9.12.2 Turn the driving wheels with your thumb.

a..... The wheels cannot be turned with complete freedom in both directions (strong resistance or completely blocked).
Check to see if there is a foreign object between the gear teeth. Clean the gear train.

Unscrew the brush plate and check to see if there is a foreign object in the motor housing.

If a gear is defective, then the locomotive must be taken to a dealer.

b..... You can feel that a gear is worn out (when it is turned there is no resistance at times; the gear slips).

The locomotive needs to be checked over by a dealer.

c..... One of the wheels on the powered axles is loose (it can be turned on the axle itself).

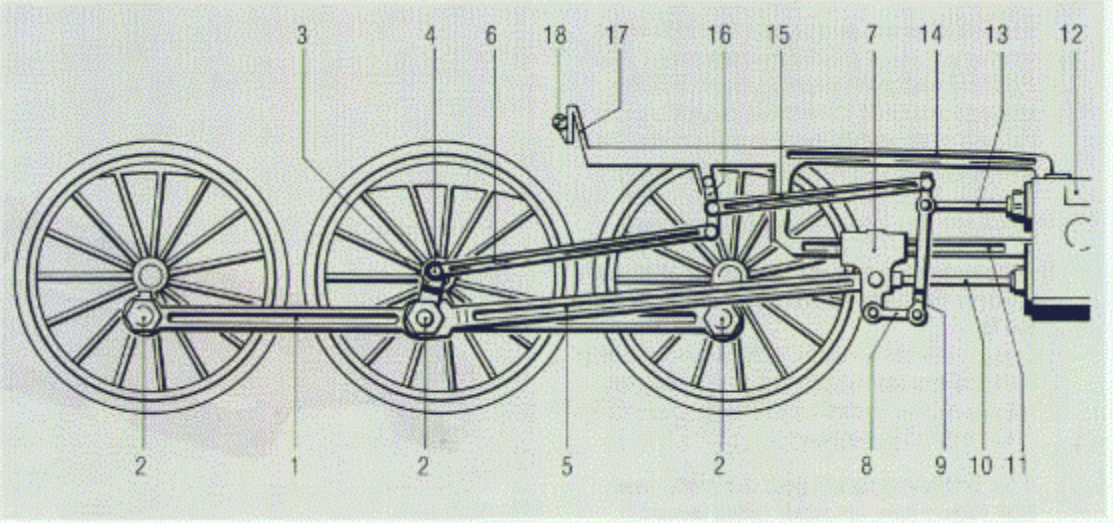
The wheelset must be renewed by a dealer.

9.12.3 On locomotives with Heusinger valve gear:

a..... If the main rod (5) and eccentric crank (3) are incorrectly screwed onto the main crank pin (2), the eccentric rod (6) can become jammed.

If the axle is perpendicular to the main crank pin (2), the angle between the axle-main crank pin and the eccentric rod linkage (4) – main crank pin must be 0-20°, depending on the type of locomotive.

1 Side rod
2 Main crank pin
3 Eccentric crank
4 Eccentric rod linkage
5 Main rod
6 Eccentric rod
7 Cross head
8 Union link
9 Combination lever
10 Piston rod
11 Cross head guide
12 Cylinder housing
13 Valve stem
14 Guide hanger
15 Valve rod
16 Link
17 Support bracket
18 Mounting screw



b..... If the combination lever (9) and the union link (8) are hanging behind the cross head (7) (instead of in front), the eccentric rod (6) will become jammed.

c..... In the event that none of the problems described thus far apply, unscrew the entire valve gear including the side rods. On some locomotives where both sets of valve gear are mounted to the locomotive with a common screw (18), the reverse unit must first be unscrewed. In this situation a temporary wire must be connected between the frame and the reverse unit which is now lying loose and isolated on the locomotive.

The locomotive should now operate without any problem.

Screw on each part, one after the other, and check after each step whether the problem reoccurs. On locomotives with only one axle powered, both side rods must be screwed on before trying the locomotive for the first time (ex. 3089/3094).

If the problem happens again after installing a side rod:

a..... The side rod is bent.

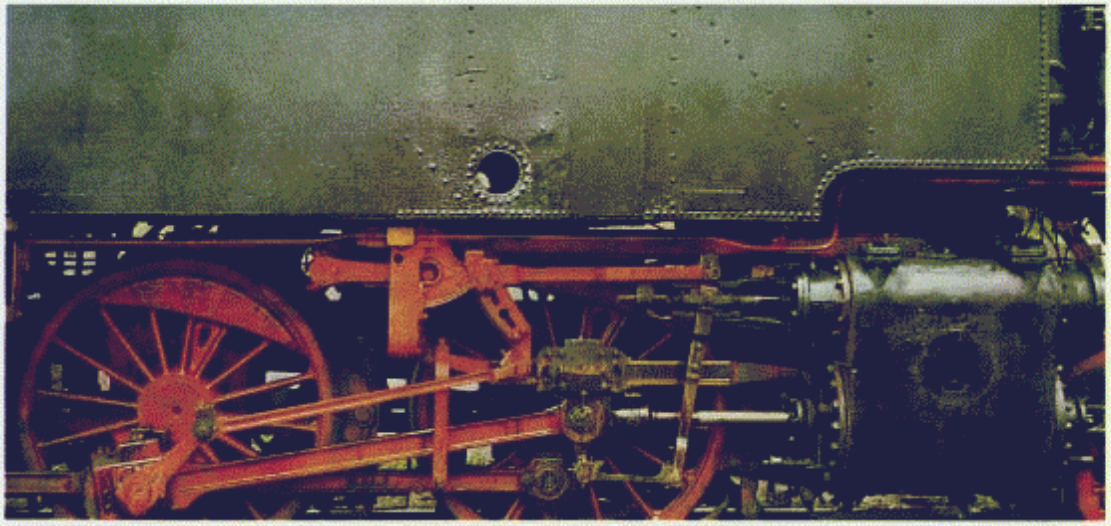
b..... The driving wheels are out of sync with each other, because one wheel set has too much side play, for example.

Check: The mounting holes for the side rod must all be simultaneously perpendicular beneath the axles.

If the problem happens again after screwing a set of valve gear on again:

Partially or totally loosen the screw (18) for mounting the valve gear to the frame. If the locomotive once again operates with no problem, then the mounting bracket (17) is bent which usually distorts the cross head guide (11).

Carefully bend the mounting bracket slightly in or out until the problem is corrected.
Check to see if the cross head guide (11) itself is bent, thus jamming the cross head (7). Check to see if the piston rod (10) and the valve stem (13) move freely in the cylinder housing (12) or if one of the two rods is bent.



Correcting problems with locomotives

9.13 Locomotive rocks or wobbles

9.13.1 The traction tires are missing, dirty, twisted or improperly seated:
Change traction tires (see chapter 7.4)

9.13.2 Lay the locomotive upside down in the locomotive cradle, connect test leads to it and check at slow speed if one or more driving wheels are wobbling.
If this is the case, take the locomotive to a dealer.

9.13.3 On locomotives with valve gear or side rods: One wheel set (usually the center set) shifts back and forth from side to side. The valve gear or side rod is bent.
(See section 9.12.3 for test in this chapter)

9.14 Locomotive wheels slip

9.14.1 Traction tires are missing or have lost their elasticity:
Install new traction tires (see chapter 7.4)

9.14.2 The wheels or the rails are oily:
Clean both. Use less oil in the future (also, no thin oil).

9.15 Locomotive derails on curves

9.15.1 Truck frames are incorrectly installed or are defective (pivot is broken or damaged).
Install the truck frames correctly or replace them.

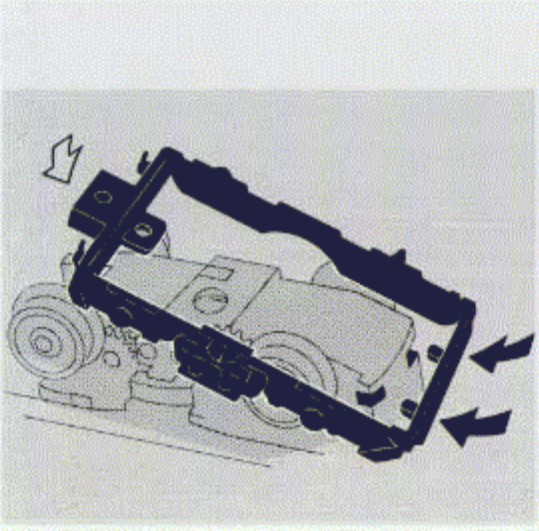
9.15.2 Power truck or frame does have not full freedom of movement from left to right:

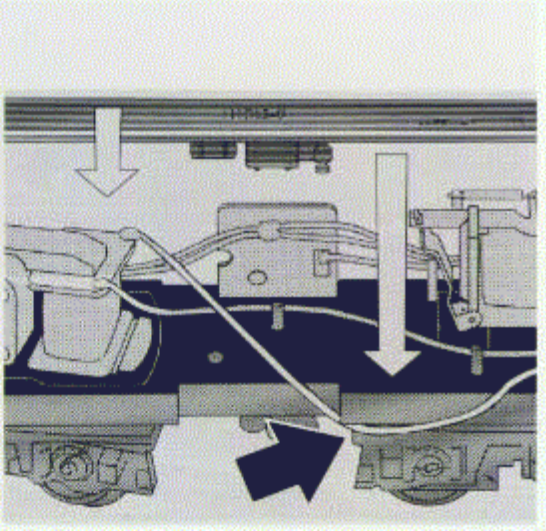
a..... A wire is caught in the mechanism
Reroute the wire

b..... Choke is pressing against the body
Reroute wire

c..... Power truck is not hanging correctly in the suspension mount
Install truck correctly

9.15.3 On locomotives with a tender
Wires leading to the tender may possibly be too short and do not allow enough play on curves:
String the wires with greater slack
Solder in longer wires if necessary





9.16 Locomotive derails on turnouts

9.16.1 Guide rail for M track turnouts is loose
Remove turnouts and bend the guide rails from below so that they are not loose or glue the guide rails in place with super glue

9.16.2 Traction tires are missing on the locomotive
Install new traction tires (see chapter 7.4)

9.17 Locomotive headlight does not work

9.17.1 Test to see if the bulb is defective
Change bulbs

9.17.2 Check to see if the bulb is properly screwed into the socket
Unscrew bulb and screw it into the socket again

9.17.3 Check wire connections and solder joints for the headlight
Solder in new wires if necessary

9.17.4 On locomotives with electronic reversing or a digital decoder, additional tests must be done by a dealer.

9.18 Smoke generator does not work

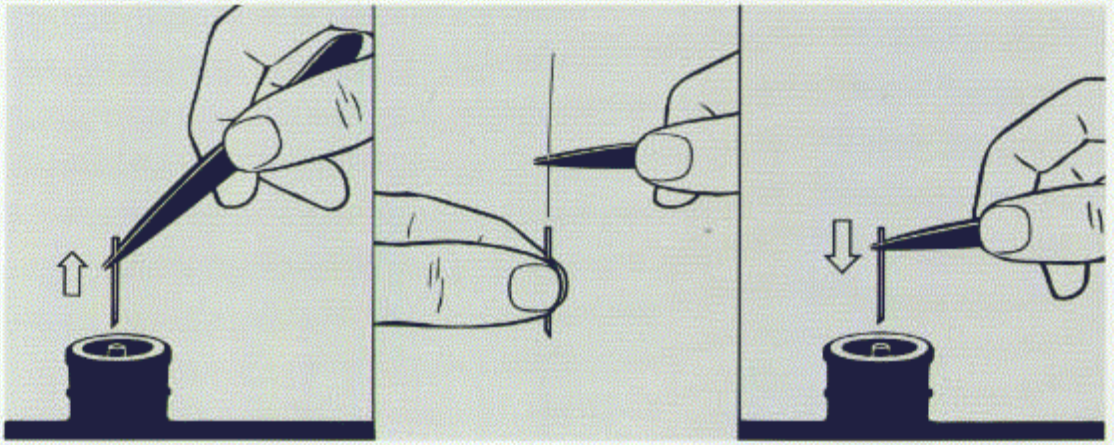
9.18.1 Check to see if the contact spring under the smoke generator is properly seated.
Bend the contact spring if necessary

9.18.2 Is there a good electrical connection to the contact spring?
Check the solder joints and, if necessary, resolder or put in a new wire

9.18.3 Remove the smoke generator from the locomotive.
Clip a test lead to the tube and another lead to the small wire on the bottom of the smoke generator. If the smoke generator now functions:

a..... The small wire has no contact with the contact spring
Bend the wire down slightly

b..... The smoke generator does not have sufficient ground contact.
Using a pair of pliers, squeeze the smoke generator a little to make it wider and put it back on the locomotive



9.18.4 Take the smoke tube out and push a fine pin through it (do not do this with locomotives 3083, 3091, 3092, 3093).

9.18.5 If the smoke generator still does not work:
The heating coil is burned out.
Replace the smoke generator

Correcting problems with locomotives

9.19 TELEX coupler does not work

9.19.1 Check to see if both wires for the TELEX coupler are properly soldered to the bottom contact finger on the reverse unit and to the ground connection.
Resolder loose or poorly soldered wires.

9.19.2 Clip a test lead to the locomotive frame. Activate the reverse unit for "TELEX on" and turn the transformer speed control knob to setting "50".
Hold the second test lead on the metal pivot shaft of the switching drum and, using a pair tweezers, slightly press the lower contact finger against the contact plate on the switching drum.

If the TELEX coupler responds, the tension for the contact finger is too weak.
Adjust the tension of the finger (see section 9.3.5b in this chapter)

9.19.3 Unsolder both wires for the TELEX coil from the ground and the reverse unit. Check whether the TELEX coupler now works, by connecting up both test leads. If this is the case, then one of the two causes already listed is the problem. Otherwise, remove the TELEX coupler:

Locomotive 3096 and 3309:
Unscrew the pilot truck and pull out the wire for the TELEX coil
Loosen the coupler screw
Lift out the entire coupler and pull out the wires to the TELEX coil also

Locomotive 3065 and 3031:
Unscrew the coupler
Bend up both tabs for the TELEX coil mount on the frame

Remove the TELEX coil along with its wires

Locomotive 3047:
Unscrew rear truck on tender

9.19.4 Check to see that both wires are properly soldered to the coil.

If this is not the case:
Resolder the wires. This is especially difficult on the 3065 and 3031 locomotives, as their plastic coil mounts are very sensitive to heat.

9.19.5 If a coil wire is torn or if the coil is damaged
– due to an unsuccessful attempt at soldering:

Replace the TELEX coil. Replacement coils with lead wires already soldered on:

Loco-no.	Coil-no.
3065 and **3031**	**21 405**
3309 front	**24 490**
rear	**22 924**
3047	**21 368** (complete rear tender truck)
3096	**22924**

9.20 Additional tips for locomotives with electronic reversing

It is important to realize that the reverse unit must be totally insulated from any ground potential. For example, the no. 20 824 standard reverse unit replaces the no. 25220 (see table in chapter 10).

Do not try to do any soldering work on the electronic circuit board. If you have soldering experience, you can safely replace a defective circuit board. All connections are color coded.

9.21 Additional tips for digital locomotives

Although you can't open up a digital decoder to check out a problem, it is easy to track down a problem in the digital system.

All digital locomotives can also be operated on conventional layouts.

Set the locomotive on a conventionally controlled stretch of track.

The locomotive does not work
The fault is not in the digital system. Check out the locomotive as you would a conventional unit.

The locomotive does work
The problem is in the digital system.

Now set a conventional locomotive on a digitally controlled stretch of track.
If the locomotive works, the problem is in the digital locomotive.
If the locomotive does not work, the problem is in the digital system (see chapter 11.3).

Code the digital locomotive for another address and set it on the digitally controlled stretch of track.

The locomotive operates
The coding switches on the locomotive decoder were not properly set.

The locomotive does not work
The locomotive decoder is defective and must be replaced.

When testing digital locomotives, always connect the test leads to the frame and the pickup shoe only, **never** to the back of the decoder panel; this can destroy the unit.
Do not attempt to carry out repairs on the decoder panel, as this will void its warranty.

Spare parts for locomotives and powered units

This table contains important spare parts for all AC locomotives and powered units which have been offered in Märklin catalogs since 1957.

Individual locomotives and powered units were listed under the old numbering system and were then included in the new numbering system in 1957 without any significant change in their design. Their are:

Catalog No. until 1957	Catalog No.	Model
CM 800	3000	class 89
CE 800	3001	class E 63
CEB 800	3002	class E 63
FM 800	3003	class 24
TM 800	3004	class 80
DA 800	3005	class 23
SK 800	3007	class 06
F 800	3008	class 01
GN 800	3009	class 44
DL 800	3010	diesel locomotive
SET 800	3011	class E 44
SEF 800	3012	class 10000
SEH 800	3013	class 1100
RET 800	3014	class Re 4/4
CCS 800	3015	Ce 6/8.III
DB 800 K	3016	VT 95/795
ST 800	3017	Railcar set
GS 800 brown	3018	Da
GS 800 green	3019	Da

Some spare parts for locomotives and powered units that have been out of production longer than this are no longer available. Check with your dealer to see if he still has particular pieces in stock.

There are units which have had design changes over the course of the years and parts for the older designs are shown in parentheses, ex. (7185) 7164.

Where there are two numbers separated by a diagonal slash, ex. 60 008/09, both parts are in the unit in question.

Some parts can be substituted for others. Examples are:

Replacements for reverse units which are no longer available:

old	new
20 301	20 824
20 866	23 400
21 175	23 400
21 218	20 824
21 374	22 970
21 899	23 400

Replacements for field magnets which are no longer available:

old	new
20 287	22 220
21 144	22 218
21 407	21 533
21 710	22 218

Catalog number	Class	Railroad	Traction tires	Pickup shoe	Pantograph	Bulb	Brushes	Reverse unit	Armature	Field magnet	Coupler front	Coupler rear
3000	69	DB	7154	(21453) 7185	-	(60000) 60010	60030	(20031) 20824	20068	(21401) 21533	20001	20001
3001/02	E 63	DB	7153	20157	7218	60000	60030	(20031) 20824	20068	21401	20001	20001
3003	24	DB	7153	(21453) 7185	-	(60000) 60010	60030	(20031) 20824	20068	(21407) 21533	20214	70154
3004	80	DRG	7153	21201	-	60000	60030	21175	20293	22220	20309	20309
3005	23	DB	7152	20157	-	60000	60030	(21175) 20824	20068	21401	20381	70154
3007	06	DRG	7152	21201	-	60000	60030	21175	20283	20287	-	70154
3008	01	DB	7152	21201	-	60000	60030	21175	20293	20287	-	70154
3009	44	DB	7153	7175	-	60000	60030	21175	20580	20287	20381	70154
3010	diesel locomotive		7154	20718/19	20780	60000	60035	21175	-	-	20636	20636
3011	E 44	DB	7153	20157	20780	60000	60030	(21175) 20824	20293	20287	20771	20771
3012	BB 10000	SNCF	7153	20157	20780	60000	60030	(21175) 20824	20293	20287	20837	20837
3013	1100	NS	7153	20157	20780	60000	60030	(21175) 20824	20293	20287	20837	20837
3014	Re 4/4 I	SBB	7153	20157	20780	60000	60030	(21175) 20824	20293	20287	20837	20837
3015	Ce 6/8 III	SBB	7153	7175	20780	60000	60035	(20866) 23400	20707	20881	21331	21331
3016	VT 95,795	DB	7153	(7174) 7164	-	(60000) 60010	60030	(20031) 20824	20068	21401	20989	20989
3017	Rail car set		-	20718/19	20780	60000	60035	21175	20707	20701	-	-
3018	Da brown	SJ	7153	20157	20780	60000	60030	21175	20068	21401	21128	21128
3019	Da green	SJ	7153	20157	20780	60000	60030	21175	20068	21401	21128	21128
3021	V 200,220	DB	7154	7183	-	(60000) 60010	60030	20824	20293	(21144) 21218	21166	21166
3022	E 94,194	DB	7153	(7185) 7164	7218	60015	60030	20824	21745	(21710) 22218	21842	21842
3023	E 18 blue	DB	7153	21201	20780	60000	60030	20824	20293	20287	21331	21331
3024	E 18 green	DB	7153	21201	20780	60000	60030	20824	20293	20287	21331	21331
3025	Express rail car set	DB	-	7177	-	60000/01	60035	21175	20707	20701	20636	20636
3026	01	DB	7152	21201	-	60000	60030	21374	20293	20287	20381	21252
3027	44	DB	7153	7175	-	60010	60030	21374	20580	20287	20381	21252
3028	B15,515	DB	7154	7164	-	60001/15	60030	21899	20068	21486	70412	70412

Spare parts for locomotives and powered units

Catalog number	Class	Railroad	Traction tires	Pickup shoe	Pantograph	Bulb	Brushes	Reverse unit	Armature	Field magnet	Coupler front	Coupler rear
3029	Industrial locom.		7154	7164	-	-	60030	20824	20068	21401	20001	20001
3030	Da brown	SJ	7153	7185	7218	60015	60030	20284	20068	21401	21128	21128
3031	B1	DB	7154	20157	-	60010	60030	21374	20068	21401	21376	21376
3032	B1	DB	7154	20157	-	60010	60030	20824	20068	21401	21411	21411
3034	E 41,141 blue	DB	7153	(7185)	7218	60015	(60030)	20824	(20068)	(21486)	21484	21484
				7164			60146		23144	23139		
3035	E 424	FS	7153	(7185)	7218	60015	(60030)	20824	(20068)	(21486)	21484	21484
				7164			60146		23144	23139		
3036	1141	ÖBB	7153	(7185)	7218	60015	(60030)	20824	(20068)	(21486)	21484	21484
				7164			60146		23144	23139		
3037	E 41,141 green	DB	7153	(7185)	7218	60015	(60030)	20824	(20068)	(21486)	21484	21484
				7164			60146		23144	23139		
3038	BB 9200	SNCF	7153	(7185)	7218	60015	(60030)	20824	(20068)	(21486)	21773	21773
				7164			60146		23144	23139		
3039	E 10,110	DB	7153	7164	7218	60015	(60030)	20824	(20068)	(21486)	21484	21484
							60146		23144	23139		
3040	E 40,140	DB	7153	7164	7218	60015	(60030)	20824	(20068)	(21486)	21484	21484
							60146		23144	23139		
3041	1043	ÖBB	7153	7164	7219	60015	60030	20824	21745	22218	70412	70412
3042	111	DB	7153	7164	7218	(60015)	60146	20824	23144	23139	70156	70156
						60008						
3043	Rc	SJ	7153	7164	7218	60015	60030	20824	21745	(21710)	70412	70412
										22218		
3044	EA 800		7154	7185	7219	60015	60030	20824	20068	21533	20001	20001
3045	N	DSB	7153	7175	-	60010	60030	21175	20580	20287	20381	70154
3046	150 X	SNCF	7153	7175	-	60010	60030	21175	20580	20287	20381	70154
3047	44	DB	7153	7175	-	60010	60030	21374	20580	20287	20381	21252
3048	01	DB	7152	21201	-	60010	60030	21175	20293	20287	-	70154
3049	104	DRG,DB	7153	7185	(7218)	60015	60146	20824	23144	23755	70412	70412
					7207							
3050	Ae 6/6	SBB	7153	7164	7218	60015	60030	20824	21745	21710	21708	21708
3051	1200	NS	7154	7164	7218	60015	60030	20824	21745	21710	21783	21783
3052	1020	ÖBB	7153	7185	7218	60015	60030	20824	21745	21710	21842	21842
3053	E 03,103	DB	7153	7185	7218	60015	60030	20824	21745	21710	22313	22313
3054	103	DB	7153	7164	7218	60015	60030	20824	21745	22218	22313	22313
3055	1200	NS	7154	7164	7218	60015	60030	20824	21745	22218	22783	22783
3056	Be 6/8 III	SBB	7153	7164	7218	60015	60146	20824	23144	23139	70156	70156
3057	151	DB	7153	7164	7218	60015	60146	20824	23144	23755	70412	70412

Catalog number	Class	Railroad	Traction tires	Pickup shoe	Pantograph	Bulb	Brushes	Reverse unit	Armature	Field magnet	Coupler front	Coupler rear
3058	151	DB	7153	7164	7218	60015	60146	20824	23144	23755	70412	70412
3059	BB 9200	SNCF	7153	7185	7219	60015	60030	20824	20068	21486	21773	21773
3060	F7 Santa Fe	USA	7154	7185	–	60015	60030	20824	20068	21486	21583	21586
3061	F7 UP	USA	7154	7185	–	60015	60030	20824	20068	21486	21583	21586
3062	F7 NH/RG	USA	7154	7185	–	60015	60030	20824	20068	21486	21583	21586
3063	1600	CFL	7154	7164	–	60015	60030	20824	21745	21710	21783	21783
3064	V 60,260	DB	7153	7185	–	60010	60030	20824	20068	(21401) 21533	21411	21411
3065	V 60,260	DB	7153	7185	–	60010	60030	22970	20068	(21401) 21533	21376/ 21377	21376/ 21377
3066	204	SNCB	7154	7164	–	60015	60030	20824	21745	(21710) 22218	21783	21783
3067	MY 1100	DSB	7154	7164	–	60015	60030	20824	21745	(21710) 22218	21783	21783
3068	Di 3a	NSB	7154	7164	–	60015	60030	20824	21745	(21710) 22218	21783	21783
3069	260	SNCB/NMBS	7153	7185	–	60010	60030	20824	20068	21401	21411	21411
3070	RAm 500 TEE	SBB/NS	7154	7164	–	60001/15	60030	22049	21745	21710	21929	21951
3071	RAm 500 TEE	SBB/NS	7154/75	7164	–	60001/15	60030	22049	21745	(21710) 22218	–	21951 21954 21929
3072	V 100,212	DB	7154	7164	–	60010	60030	20824	21745	(20287) 22220	21842	21842
3073	Warship, D	BR	7154	7183	–	60010	60030	20824	20293	21144	21166	21166
3074	216	DB	7154	7164	–	60015	60030	20824	21745	22218	70156	70156
3075	216	DB	7154	7164	–	60015	60030	20824	21745	(21710) 22218	70156	70156
3076	515/815	DB	7154	7164	–	60001/15	60030	20068	21899	21486	70412	70412
3077	Rail Zeppelin		7154	7164	–	60015	60030	20824	20068	21486	–	–
3078	DHG 500		7154	7185	–	60015	60030	20824	20068	21533	20001	20001
3080	DHG 500		7154	7185	–	–	60030	20824	20293	22218	20001	20001
3081	220	DB	7154	7183	–	60010	60030	20824	20293	22218	21166	21166
3082	41	DB	7153	7164	–	60015	60146	20824	23144	23139	21843	21842
3083	231	ETAT	7152	7185	–	60015	60030	20824	21745	22220	–	21842
3084	050	DB	7153	7164	–	60015	60146	20824	23144	23139	21843	21842
3085	003	DB	7152	7164	–	60010	60146	20824	23144	23139	–	21842
3086	64	SNCB/NMBS	7152	7185	–	60015	60030	20824	20068	21401	22418	21842
3087	Ct	KLVM	7154	7185	–	–	60030	20824	20068	21533	20001	20001

Spare parts for locomotives and powered units

Catalog number	Class	Railroad	Traction tires	Pickup shoe	Pantograph	Bulb	Brushes	Reverse unit	Armature	Field magnet	Coupler front	Coupler rear
3089	03.10	DRG	7152	7185	-	60015	60030	20824	21745	(20287) 22220	-	70154
3090	Ct	KLVM	7154	7185	-	-	60030	20824	20068	21533	20001	20001
3091	18.4	DB	7152	7185	-	60015	60030	20824	21745	22220	-	21842
3092	S 3/6	K.Bay St.B.	7152	7185	-	60015	60030	20824	21745	22220	-	21842
3093	18.4	DB	7152	7185	-	60015	60030	20824	21745	22220	-	21842
3094	03.10	DRG	7152	7185	-	60015	60030	20824	21745	(20287) 22220	-	70154
3095	74	DB	7153	7185	-	60010	60030	20824	20068	21533	22532	21842
3096	86	DB	7153	7164	-	60015	60030	22970	21745	(20287)	(21843)	(21843)
										22220	22897	22897
											22924	22942
											24456	24456
3097	23	DB	7152	21201	-	60000	60030	20824	20068	21401	20214	70403
3098	38	DB	7152	7185	-	60015	60030	20824	20068	21401	22418	21842
3099	38,038	DRG	7152	7185	-	60015	60030	20824	20068	21401	22418	21842
3102	53, Mallet		7153	7185	-	60015	60146	(20824) 25220	23144	23139	21843	21842
3104	89.0	DB	7153	7185	-	-	60146	20824	23144	23755	20001	20001
3106	78	DB	7153	7164	-	60015	60146	20824	23144	23755	24281	24281
3107	232 TC	SNCF	7153	7164	-	60015	60146	20824	23144	23755	24281	24281
3108	44	DB	7153	7175	-	60010	60030	20824	20580	22220	20381	70154
3109	T 18	KPEV	7153	7164	-	60015	60146	20824	23144	23755	24281	24281
3125/26	RBe 2/4	SBB	7154	7164	25640	60008	-	-	Motor:	25789	-	-
3129	F7 SP	USA	7154	7185	-	60015	60030	20824	20068	21486	21583	21586
3133	54	SNCB/NMBS	7154	7164	-	60015	60030	20824	20068	21486	21783	21783
3141	260	DB	7153	7185	-	60010	60030	20824	20068	21533	21411	21411
3144	V 10	TGOJ	7154	7185	-	60015	60030	20824	20068	21533	20001	20001
3145	Y 50100	SNCF	7154	7185	-	60015	60146	20824	23144	23755	70156	70156
3146	236	DB	7154	7185	-	60015	60146	20824	23144	23755	70156	70156
3147	212	DB	7154	7164	-	60010	60030	20824	21745	22220	21842	21842
3149	80	SNCB/NMBS	7153	7185	-	60010	60030	20824	20068	21533	21411	21411
3150	Northlander	ONR	7154	7164	-	60001/15	60030	22049	21745	22218	21929	21951
3151	Ae 3/6 II	SBB	7153	7185	24800	60015	60146	20824	23144	23755	70156	70156
3152	16	SNCB/NMBS	7153	7164	7218	60015	60146	20824	23144	23139	70156	70156
3153	120	DB	7153	7164	7208	60015	60146	20824	23144	23139	70412	70412
3155	3155 S-Bahn	DB	7153	7164	7218	60015	60146	20824	23144	23139	70156	70156
3156	140	DB	7153	7164	7218	60015	60146	20824	23144	23139	21484	21484

Catalog number	Class	Railroad	Traction tires	Pickup shoe	Pantograph	Bulb	Brushes	Reverse unit	Armature	Field magnet	Coupler front	Coupler rear
3157	E 60,160	DB	7153	7185	7218	60010	60146	20824	23144	23755	21842	21842
3159	1020	ÖBB	7153	7164	7218	60015	60030	20824	21845	22218	21842	21842
3160	1043	ÖBB	7153	7164	7218	60015	60030	20824	21745	22218	70412	70412
3161	1200	NS	7154	7164	7218	60015	60030	20824	21745	22218	22783	22783
3162	E 424	FS	7153	7164	7218	60015	60146	20824	23144	23139	21484	21484
3163	16	SNCB/NMBS	7153	7164	7219	60015	60146	20824	23144	23139	70156	70156
3165	BB 9200	SNCF	7153	7164	7218	60015	60146	20824	23144	23139	21773	21773
3167	Ae 3/6 II	SBB	7153	7185	24800	60015	60146	20824	23144	23755	70156	70156
3168	1200	NS	7154	7164	7218	60015	60030	20824	21745	22218	21783	21783
3172	111	DB	7153	7164	25827	60008	60146	20824	23144	23139	70156	70156
Locomotives with electronic reversing												
3304	80	DB	7154	20182	–	60008	60146	61001	61003	23139	70163	70163
3308	85	DRG	7153	7164	–	60010	60146	25220	24548	23139	24456	24460
3309	85	DB	7153	7164	–	(60019)	60146	22970	24548	23139	(24456)	(24460)
						60010					24457	24460
											22924	22925
3310	012	DB	7152	7164	–	(60019)	60146	25220	24548	23139	–	32540
						60010						
3311	C	K.W.St.E.	7152	28251	–	–	–	–	–	–	–	70163
3312	T5	K.W.St.E.	7153	7185	–	60019	60146	25220	24548	23139	21842	21842
3313	75	DB	7153	7185	–	60019	60146	25220	24548	23139	21842	21842
3315	50	DB	7153	28027	–	60008	60146	–	23144	23139	21843	21842
3318	18.4 Rheing.	DRG	7152	7185	–	60008	60146	61001	61003	23139	–	70163
3322	194	DB	7153	7164	25530	60010	60030	25220	21745	22218	21842	21842
3323	Re 4/4 IV	SBB	7153	7164	7219	(60019)	60146	25220	24548	23139	24810	24810
						60010						
3324	1100	NS	7153	7164	7218	60019	60146	25220	24548	23139	70156	70156
3325	BB 7200	SNCF	7153	7164	7219	60010	60146	25220	24548	23139	24810	24810
3326	1600	NS	7153	7164	7219	60019	60146	25220	24548	23139	24810	24810
3327	1100	NS	7153	7164	7218	60019	60146	25220	24548	23139	70156	70156
3328	Re 4/4 IV	SBB	7153	7164	7219	(60019)	60146	25220	24548	23139	24810	24810
						60010						
3329	191	DB	7153	7185	25783	60008	60146	25220	24548	23139	25776	25776
3330	Re 4/4 IV	SBB	7153	7164	28049	60010	60146	25220	24548	23139	24810	24810
3332	Ae 6/6	SBB	7153	7164	25827	60008	60030	25220	21745	22218	21708	21708
3346	236 double unit	DB	7154	7185	–	60019	60146	25220	24548	23139	70156	70156
3350	Ae 6/6	SBB	7153	7164	25069	60008	60030	25220	21745	22218	21708	21708

Spare parts for locomotives and powered units

Catalog number	Class	Railroad	Traction tires	Pickup shoe	Pantograph	Bulb	Brushes	Reverse unit	Armature	Field magnet	Coupler front	Coupler rear
3352	Ce 6/8 III	SBB	7153	7164	25953	60008	60146	25220	21745	22218	70156	70156
3353	120.1 red	DB	7153	7164	23846	60008	60146	61001	61003	23139	70412	70412
3354	103	DB	7153	7164	7218	60019	60030	25220	21745	22218	22313	22313
3355	111 S-Bahn	DB	7153	7164	7247	60007/08	60146	25220	23144	23139	70156	70156
3356	Be 6/8 III	SBB	7153	7164	25460	60008	60146	25220	24548	23139	70156	70156
3357	103	DB	7153	7164	7247	60008	60146	25220	24548	23139	22313	22313
3358	103 red	DB	7153	7164	23846	60008	60146	61001	61003	23139	22313	22313
3366	152	DB	7153	7164	25783	(60019) 60008	60146	25220	24548	23755	70412	70412
3371	ICE	DB	7154	7164	25445	60007/08	-	-	-	-	-	-
Locomotives with the 5 star propulsion system												
3504	80	DB	7154	20182	-	60008	60146	61000	23139	61003	70163	70163
3511	C	K.W.St.E.	7152	28251	-	-	-	-	-	-	-	70163
3518	18.4	DRG	7152	7185	-	60008	60146	61000	23139	61002	-	70163
3553	120.1	DB	7153	7164	23846	60008	60146	61000	23139	61002	70412	70412
3558	103	DB	7153	7164	23846	60008	60146	61000	23139	61002	22313	22313
Digital locomotives												
3604	80	DB	7154	20182	-	60008	60146	6080	23139	61002	70163	70163
3605	RBe 2/4	SBB	7154	7164	25640	60008	-	60289	-	-	-	-
3609	T 18	KPEV	7153	7164	-	60015	60146	6080	23144	23755	24281	24281
3610	012	DB	7152	7164	-	60010	60146	6080	23144	23139	-	32540
3611	C	K.W.St.E	7152	28251	-	-	-	-	-	-	-	70163
3615	50	DB	7153	7164	-	60008	60146	6080	23144	23139	21843	21842
3618	18.4	DRG	7152	21453	-	60008	60146	6080	23144	23139	70163	70163
3623	Re 4/4 IV	SBB	7153	7164	7219	60010	60146	6080	23144	23139	24810	24810
3625	BB 7200	SNCF	7153	7164	7219	60010	60146	6080	23144	23139	24810	24810
3629	191	DB	7153	7185	25783	60008	60146	6080	24548	23139	25776	25776
3630	Re 4/4 IV	SBB	7153	7164	28049	60010	60146	6080	23144	23139	24810	24810
3642	111	DB	7153	7164	7218	60015	60146	6080	23144	23139	70156	70156
3646	236	DB	7154	7185	-	60015	60146	6080	23144	23139	70156	70156
3650	Ae 6/6	SBB	7153	7164	25069	60008	60030	6080	21745	22218	21708	21708
3652	Ce 6/8 III	SBB	7153	7164	25953	60008	60146	6080	23144	23139	70156	70156
3653	120	DB	7153	7164	7208	60008	60146	6080	23144	23139	70412	70412
3654	120.1 red	DB	7153	7164	23846	60008	60030	6080	21745	22218	22313	22313
3655	111 S-Bahn	DB	7153	7164	7247	60007/08	60146	6080	23144	23139	70156	70156

Catalog number	Class	Railroad	Traction tires	Pickup shoe	Pantograph	Bulb	Brushes	Reverse unit	Armature	Field magnet	Coupler front	Coupler rear
3657	103	DB	7153	7164	7247	(60010) 60008	60146	6080	23144	23139	22313	22313
3658	103, red	DB	7153	7164	23846	60008	60146	6080	24548	23139	22313	22313
3665	260	DB	7153	7185	–	60010	60030	6080	20068	21486	21376/77	21376/77
3671	ICE	DB	7154	7164	25445	60007/08	–	–	–	–	–	–
3672	212	DB	7154	7164	–	60010	60030	6080	21745	22218	21842	21842
3674	216	DB	7154	7164	–	60015	60030	6080	21745	22218	70156	70156
3680	Köf II,323	DB	–	7164	–	–	–	–	–	–		
3684	50,050	DB	7153	7164	–	60015	60146	6080	23144	23139	21843	21842
3696	86	DB	7153	7164	–	60015	60030	6080	21745	22218	(24456) 22897 22924	(24456) 22897 22924

Trouble shooting on the layout

11.1 Avoiding mistakes when building a layout

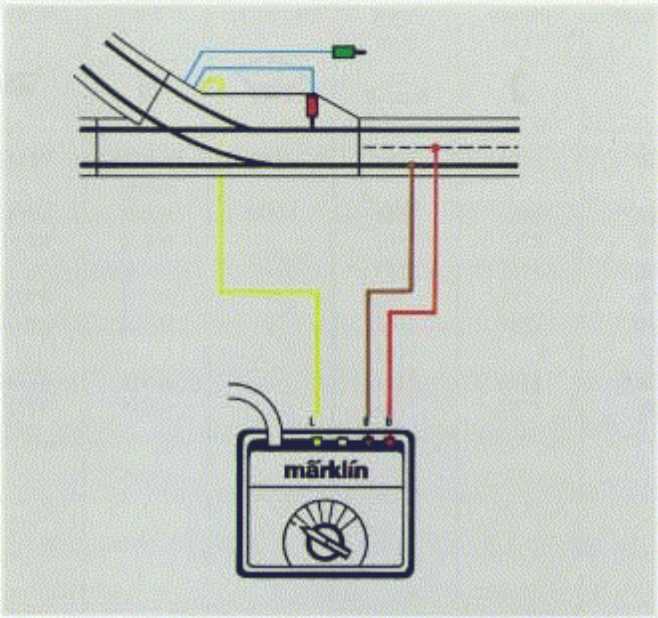
Building a Märklin layout is generally trouble free. However, during the construction phase you should be careful that all track and solenoid accessories function perfectly. This applies particularly when construction is resumed on a layout after a considerable length of time.

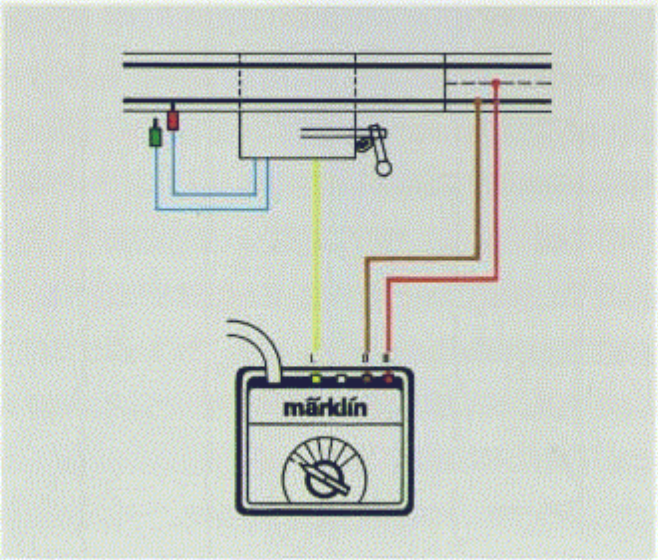
It makes sense to hook up a transformer to a feeder track when laying the first pieces of track. Test a locomotive on each new stretch of track before mounting the latter permanently.

This way you can immediately recognize defective sections of track, short circuits and voltage drop in areas of track at some distance from the transformer. With voltage drop – the locomotive operates with increasing slowness for a given setting on the speed control knob – additional feeder tracks must be installed with feeder wires back to the transformer. This will allow the locomotive to reverse properly and to operate without unintended drops in speed.

If a locomotive comes to a stop somewhere during a test run, then there is either a third rail insulator from earlier use between the third rail clips or the clips are bent and do not have contact with each other.

Solenoid accessories (turnouts, signals or uncoupler tracks) should be tested for proper operation at your workbench with a separate transformer before being installed on the layout. Otherwise, you could run into some unpleasant surprises involving additional unnecessary work after the installation, mounting and wiring for these accessories is finished.





Test these accessories as follows:

Plug the yellow plug into the yellow socket (terminal clip) on the transformer.

Touch the running rails with first one and then the other plugs of both blue wires.

The solenoid accessory should operate properly at this point and the appropriate light bulbs should light up for each switching position.

Signals are installed on the layout as described in the instruction sheet included with each signal. If you have misplaced these instructions, you can use the wiring plans in the 0342/0361 signal manuals. The signal block should be tested after the signal has been installed and the two red feeder wires have been connected. Set the signal by hand for the test run. If the locomotive overruns the signal when it is set at stop, then both track insulators must be checked. If the locomotive stops when the signal is set for go, then the contacts in the signal mechanism are either dirty or jammed.

Be sure to include a feeder track in the area between two signals, so that this "intermediate" stretch of track is supplied with power for normal operation.

When mounting the track with track screws, do not tighten the latter too much; this will distort the track, the turnouts will not function properly and you may break the screw heads. It is best to start the screws with a pilot hole, using a 1.6 mm (approx. 1/16") drill for M track and a 1.2 mm (approx. 3/64") drill for K track.

11.1.1 Wiring

The power output for all model railroad transformers is limited by law.

The output figures for our transformers are:

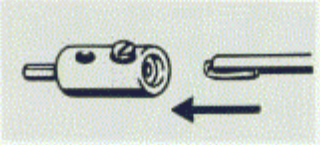
Train transformer		10 watts (only in starter sets)
Train transformer	6671	16 watts
Train transformer	6631	30 watts
Accessory transformer	6611	40 watts
Digital transformer	6002/03	52 watts (220/240 volts)
Digital transformer	6000/01	50/42 watts (110/120 volts)

The power consumption for all users on the layout must be measured against this:

Output circuits for Digital components	10 watts
Locomotives	10 watts
Light bulbs in car lighting or solenoid accessories	1 watt
Switching current for solenoid accessories	6 watts
Turntable	10 watts
Magnet crane	10 watts
Crossing gates	8 watts

The solenoid accessories should be divided among the transformers so that no transformer is overloaded. On larger layouts it is best to have separate transformers for solenoid accessories and lighting circuits. This also applies to the turnout/signal decoders for digital operation.

All yellow wires should be connected to distribution strips which are then connected to the transformers – keeping the distribution strips for one transformer separated from those for other units. Be careful that the blue wires do not come into contact with the track's roadbed (M track). If light bulbs do not burn, then the bulb is defective or the yellow wire is not properly seated in the yellow plug (ex. not enough wire insulation has been stripped off).



When attaching a wire to a plug, it is best to twist the copper wire and bend it over after stripping it and then insert it into the plug. Tinning the wire with solder also produces a good connection, but this also creates a weak spot at the end of the tinned part of the wire. If the wire is taken up and relaid often, this can lead to a break in the wire that cannot always be detected immediately.

Lay the wiring under the layout so that it is accessible. This will make ait easier to work on later if problems occur. Number all solenoid accessories on the wires underneath the layout and enter these numbers on your track plan. This will enable you to find the "culprit" more quickly later on among a group of turnouts or signals.

Experience has shown that the system shown below for designating different items works quite well:

S1	S2	S3	for signals
T1	T2	T3	for turnouts
L1	L2	L3	for lights and lighting circuits
P1	P2	P3	for power to the track
R1	R2	R3	for universal relays

Be careful when wiring that the set screws for two adjacent plugs do not touch each other.

Some people like to lay the wires under the M track roadbed. This is not advisable, because the set screws on the plugs can come into contact with the metal roadbed for the rails and cause a short circuit or continuous current to a signal or turnout mechanism. Wire laid this way can also be damaged when the track is screwed down on a layout. Both problems are very difficult to track down.

In addition, the cover plates under the turnouts should not be removed, as they protect the mechanism as well as the linkage springs.

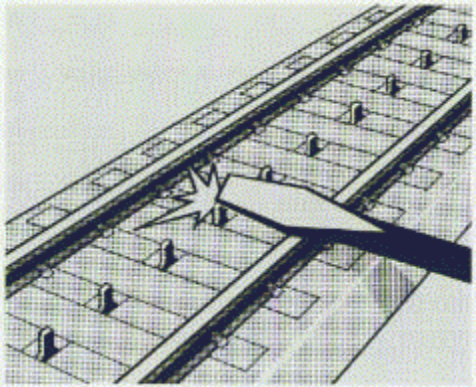
Trouble shooting on the layout

11.2 Trouble shooting on conventional layouts

(problems not covered under part 11.1)

11.2.1 Locomotive will not operate even when directly on a feeder track. Transformer does not indicate a short circuit

Take the locomotive off of the track. Using a screwdriver, check whether there is current in the track by placing the screwdriver across the center and running rails, thus causing a short circuit.



If current is present, the problem is in the locomotive. Otherwise, check the following:

Is there current coming out of the transformer (short circuit test)?

Are the wires properly attached to the plugs?

Is a feeder wire broken?

Has a wire come loose from the solder joint on the feeder track?

11.2.2 The locomotive operates only to a certain spot on the track

Check the connection for the third rail at this spot.

11.2.3 The locomotive does not operate, the transformer shows a short circuit when the speed control knob is turned up

a..... Take the locomotive off the track.
If the short circuit now disappears, the problem is in the locomotive.

b..... Take the cars, one after the other, off the track.
If the short circuit disappears after taking off a certain car, then a bent coupler was probably touching the third rail. On cars with lighting, a short circuit in the car can also be the cause.

c..... Pull the plugs from the red and yellow sockets on the transformer.
If the short circuit remains with the speed control knob turned up, then the transformer is defective and must be taken to a dealer.

d..... Stick the plugs back into the transformer.
Look on the layout for any small pieces of metal on the track.

e..... If necessary, you must dismantle the affected track circuit until you have found the source of the problem.

11.2.4 The transformer indicates a short circuit when the speed control knob is not turned up

a..... The accessory wire (yellow) has contact with the track ground somewhere on the layout.
With M track check if there is a bare wire under the track

Check if plugs have been connected in reverse

Check if a ground wire has been mistakenly connected to the wrong distribution strip

b..... The transformer is defective and must be taken to a dealer

11.2.5 A turnout or signal cannot be operated, that is, it immediately resets itself to its original position and the solenoid buzzes

a..... The opposite pole of the solenoid has continuous contact.
Shut off the current immediately; otherwise the solenoid can burn out.
(possible causes same as 11.2.4 a)

b..... When the solenoid accessory is hooked up to a circuit track, the circuit track's cam is stuck and is causing a continuous contact.
Check the cam

11.3 Trouble shooting on digital layouts

Check points 11.2.1–3 as you would on a conventional layout

The most frequently occurring problems are the following:

a..... The emergency stop button has been pressed.
Restart the system by pressing the "go" button

b..... A decoder or a digital component is incorrectly coded or hooked up.
Check codings and connections

c..... The power circuits are not separated from each other (or track insulators were not removed from various locations on the layout before converting to Digital).
Check all locations for track insulators

Other possible problems:

11.3.1 When a locomotive passes over the separation point between digital and conventional sections of a layout, the control panel cuts out (the pilot light on the Central Unit goes off)
At slow speeds the locomotive's pickup shoe short circuits both power circuits. The automatic protection against overloads cuts off the power.
The rocker-type insulator is missing at the separation point or has become loose. Install a new insulator at this location. (stock numbers: K track = 38558, M track = 38555)

After correcting this problem, start the digital system by pressing the "go" button on a Control 80 or by briefly turning the main power off and on.

11.3.2 A command entered at a control unit has no effect
Before checking the track connections as well as the connections and codings for the turnout decoders, you should make sure that the digital components are plugged together so that they have reliable electrical contact with each other. Retainer clips are included with each digital control component. Insert these clips into the slots provided for them on the bottom of each component. The clips insure reliable electrical contact between the components.
On a permanent layout fasten the digital control components to a board with screws.

Trouble shooting turnouts and signals

12.1 Turnouts

12.1.1 All electromagnetic turnouts (K + M)

a..... The turnout can only be set for one position.
Possible causes are:
- A blue wire is broken
- A blue wire is disconnected from its solder joint on the solenoid
- A winding on a solenoid is broken
- A solenoid is burned out

Check the wires as well as the solenoid

b..... The turnout cannot be operated electrically
The turnout tongue has spring action
The causes are the same as in a, but both connections are bad or the yellow wire has become disconnected (the light is not burning!)
Check the wires as well as the solenoid

12.1.2 M track turnouts

a..... The turnout tongue is jammed/cannot be moved
- The turnout base plate is bent
- The linkage hook on the turnout tongue (1) is bent and is bumping against the turnout base plate

Carefully bend the turnout base plate or linkage hook

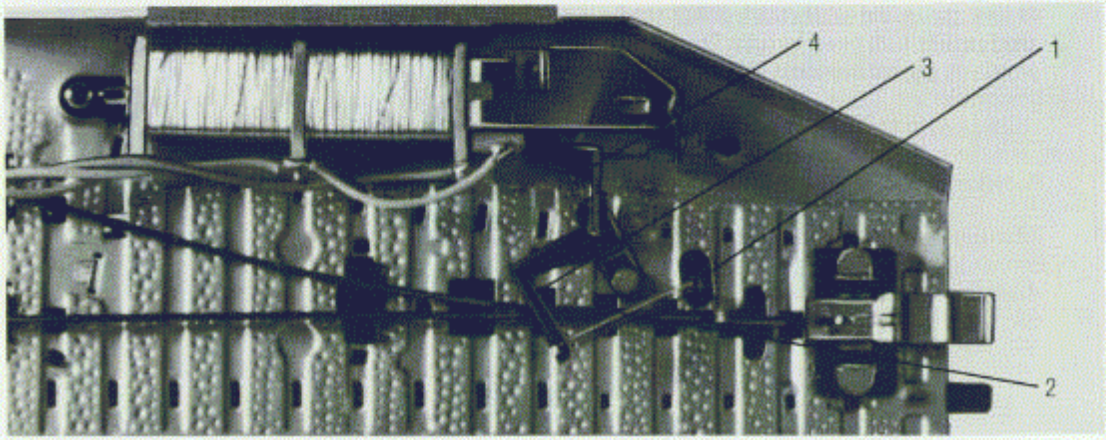
b..... The turnout tongue can be moved, but has no spring action.
On double slip switches:
The linkage arm is worn out or broken.
This part can be replaced after removing the base plate and two C clips. Pay attention to the type of double slip switch and year of production (two different linkage arms).

12.1.3 For all other turnouts

Linkage spring is missing (2)
Replace spring (no. 35308)

Bell crank (3) is disconnected from the armature arm (4) or – on manual switches – from the weight lever.
Reconnect bell crank

a..... Turnout tongue has spring action, turnout lantern assembly can be turned, but the turnout tongue does not move.
Install the turnout lantern assembly correctly



12.2 Signals for M track

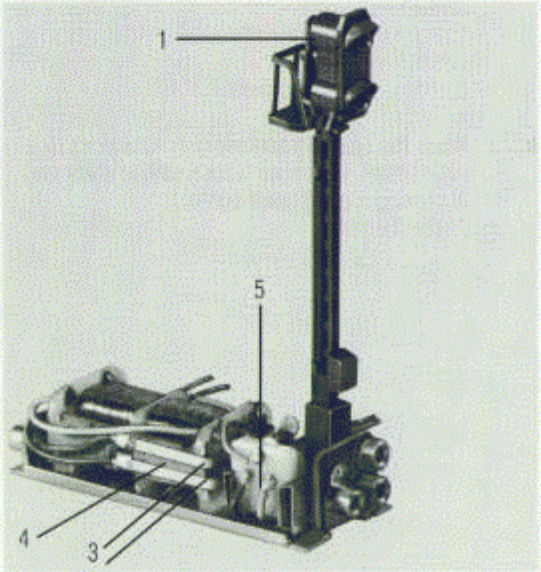
Using the 7188 home color light signal as an example

a..... Signal switches over, lights do not burn

Bulbs are defective
Replace bulbs

Base plate does not have proper contact with the track

Older base plates do not have contact springs; they were clipped under the bottom edge of the roadebed. On newer pieces of M track the bottom edges are crimped over so that the base plates no longer clip into place.
Install a piece of older track at the location of the signal or purchase a newer base plate with contact springs from your dealer.



The contact plate (1) is not correctly clipped into place or is broken.
Install the contact plate correctly or replace it

b..... The signal does not switch over completely when activated. It sticks.
The mechanism housing is not properly installed.
Adjust the housing so that does not interfere with the mechanism

The armature (2) is jammed in the solenoid or the armature is stuck
- The armature is fused (ex. from a short circuit)
- The springs on the spring supports are bent
- The relay spring is worn out
- The cam for the relay is no longer properly seated in the armature guide

See the end of this section for repair instructions

c..... The signal does not switch over; the unit's bulbs are lit
Check the blue wires including the solder connections
The solenoid is burned out; replace it
A solenoid winding is broken; solder it

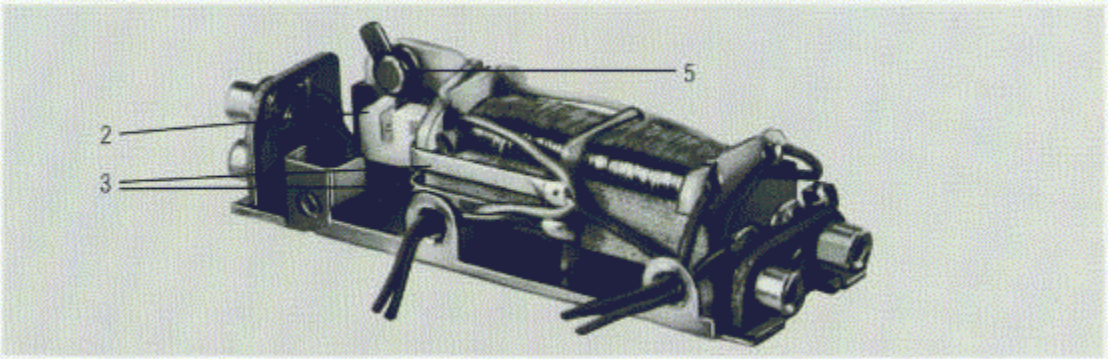
d..... The signal does not switch over; the unit's bulbs are not lit.
The yellow wire has a defect or the solder connection has come undone; check for either condition

e..... The signal causes a short circuit
There is a bare wire (ex. on the back side of the signal mast)
Replace or insulate the wire
Mistake in hooking up the wires, check connections

f..... The signal switches over flawlessly, but the train control does not function. The train remains stopped even with a green light.

- A red wire has become disconnected from its solder connection
- The contact springs (3) for the spring support (4) are frozen together or worn out.

Repair procedure:
Pull the relay (5) slightly up and out. Using a small screwdriver, reach under the solenoid on the right side and lift it up until the armature (2) can be pulled out. Bend the springs of the spring support (4) in or replace the spring support if necessary.
The spring support on the mast side switches the current to the track, while the spring support on the opposite side switches the current to the catenary. Press the solenoid and relay back into their mount.



12.3 Signals for K track

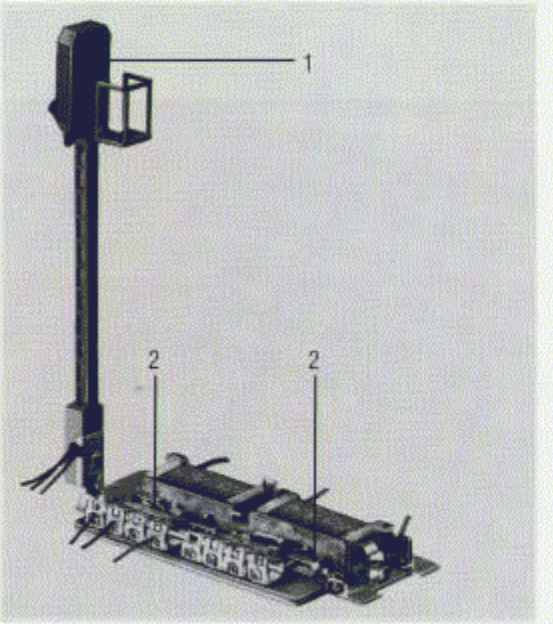
Simple repairs

a..... Contact plate (1) is bent or broken (usually due to improper procedure for changing the bulbs).
Replace the contact plate

b..... A solder connection on the contact plate has worked loose.
Resolder this connection

c..... The contact fingers (2) no longer have sufficient springiness (one or several bulbs are not lit).
Bend the contact fingers to their proper position

d..... The contact fingers are bent (one or several bulbs are not lit or two bulbs are lit at the same time).
Carefully bend the contact fingers straight



Tips for model railroaders

13.1 Controlling lighting circuits on the layout

Conventional Märklin layouts

On larger layouts it is best to use one or more separate accessory transformers for lighting circuits and solenoid accessories.

If you purchase regular train transformers instead of accessory transformers with their constant 16 volt output, you can then regulate the brightness of the building and street lighting on your layout. Simply connect the lighting circuit to the brown and red (instead of the yellow) sockets on the transformer.

This gives you two advantages. You can have more realistic lighting and at the same time increase the life of the light bulbs considerably.

Layouts with digitally controlled solenoid accessories

The power supply for the accessory's mechanism and its lighting circuit must be separated electrically.

The connection between the middle of the solenoid (yellow wire) and the bulb must be removed. Solder a separate wire to the insulated pole of the bulb socket and lead it out of the mechanism.

For M track signals, unsolder the wire to the signal mast from the solenoid or relay (7188) and lead it separately out of the mechanism.

On K track signals the circuits for lighting and for the mechanism are already separated.

On the transformer used for controlling the lighting circuits, connect the brown socket as usual to the track ground and connect the separate wire for lighting on the accessory to the red socket on the transformer.

13.2 Retrofitting locomotives for headlight reversal

Circuit using older Märklin locomotives as a model

Remove the wire between the main solder point and the headlight bulbs. Solder a wire from the front bulb to one solder terminal (1) on the contact plate of the reverse unit and solder a second wire from the rear bulb to the other solder terminal (2) on the same plate.

For reverse units with a switching drum, the headlight wires must be soldered to both contact fingers for power to the motor.

If the front bulb is lit for the reverse direction of travel and vice versa, then the headlight wires must be swapped at their connections on the reverse unit.

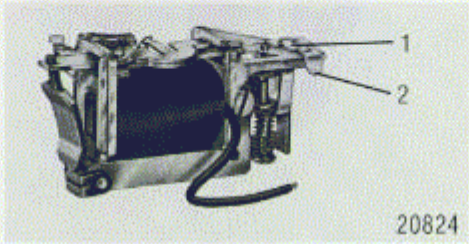
The current to power the lighting now flows through the winding on the field magnet that is normally without power.

Disadvantages of this circuit:

The motor's output is reduced (since a weak counter magnetic field is set up)

the locomotive headlights are somewhat dimmer than normal

the circuit cannot be used on locomotives with a small field magnet (23139 and 23755, see table in chapter 10).



Tips for model railroaders

Installing a 21899 reverse unit for headlight reversal (as in the 3028 rail car and 3076 rail car set)

First determine if there is sufficient space in the locomotive for this reverse unit and for the contact fingers to have freedom of movement.

Unsolder the old reverse unit and remove it.

Unsolder the headlight bulb wires from the main solder point.

Screw the 21889 reverse unit in place and be careful that the end of the coil winding under the mounting screw (1) does not break (hold the solder lug in place with your finger).

Solder a wire between the pickup shoe/main solder point and one of the two rivets on the back of the interrupter switch (2). The reverse unit should now operate flawlessly.

Solder the bulb wires to the ends of both of the upper contact fingers (3 and 4).

Solder the ends of the coil windings for the field magnet to the ends of both of the lower contact fingers (5 and 6).

If, for example, the front bulb is lit for the reverse direction of travel, then the connections for the two coil windings (5 and 6) must be reversed.

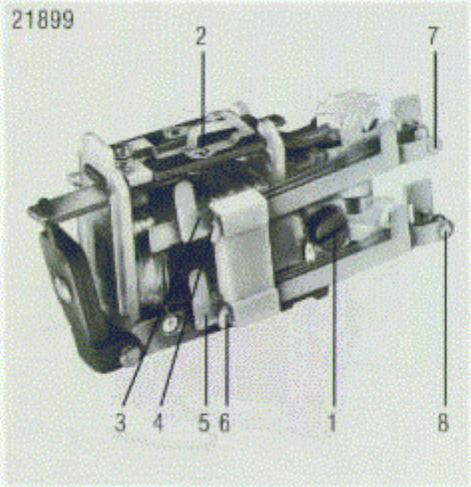
After the installation is complete, the contact fingers may have to be adjusted:

a..... The headlights at both ends are lit for a particular direction of travel:

All three upper contact fingers on the right side (7) have contact with each other simultaneously. One of the two outer fingers (which are creating contact with the wrong bulb) must be bent slightly out.

b..... One bulb is not working

The contact finger on the right for this bulb must bent slightly in, until it has contact with the middle contact finger.



c..... The locomotive does not operate and the field magnet buzzes.

All three lower contact fingers on the right side (8) have contact with each other at the same time. One of the two outer fingers (which are making contact with the wrong field magnet winding) must be bent out.

d..... The locomotive does not operate in one direction and the field magnet does not buzz.

The finger in question on the right side must be bent slightly in until it has contact with the middle finger.

The faults in a) through d) can also occur in both directions at the same time.

e..... The locomotive does not operate at all – the interrupter switch must be adjusted (see 9.3.4).

13.3 Train lighting – a number of possible solutions

Constant train lighting when the train is stopped at a signal

When the train stops before a signal set for stop, the train lighting remains on only if the car lighting is powered from a pickup shoe located outside of the insulated block. A wire connection to the forward cars is required.

The latest thing offered by electronic shops are miniature plugs which enable the cars to be separated from each other (and assembled in any desired combination).

On cars with plastic couplers the couplers' metal loops can be used as contacts for the lighting circuit. When soldering a lighting circuit wire to the loop the latter must be removed from the coupler; otherwise, the plastic coupler head will melt from the heat. All plastic cars must have ground springs.

Constant train lighting on digital layouts

If catenary is present (which is not being used to power locomotives:

Solder a wire from the pantographs of the electric locomotives to the loops on the plastic couplers or to the miniature plugs above the couplers. The cars cannot be equipped with pickup shoes. All cars to be lighted must have a ground contact, ie. on plastic cars the copper ground springs (no. 41493) are necessary under the trucks.

Connect a conventional train transformer to the track ground and to the catenary, thus allowing the brightness of the train lighting to be adjusted over a range of voltage.

13.4 Remote controlled switching of station lighting

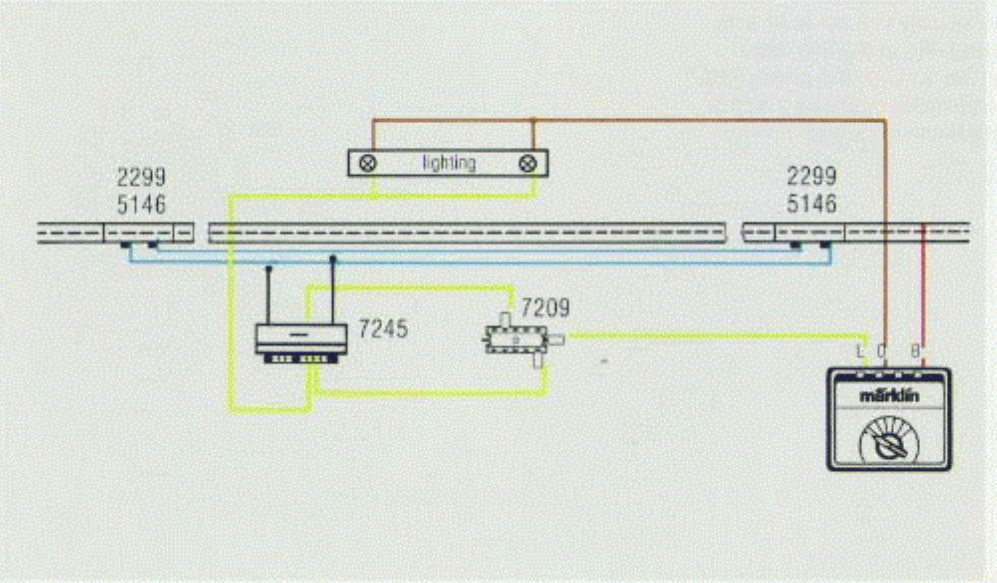
Platform lighting is not turned on unti shortly before the arrival of a train for stations on the German Federal Railroad with only a few trains stopping at them at irregular freqencies.

A circuit reproducing this situation can be created with the help of a universal relay and two contact tracks.

The universal relay controls the lighting and is activated by a contact track or reed switch before the arrival of a train in the station.

After the train departs from the station, the universal relay shuts off the lighting, again with the help of a contact track (or reed switch).

The circuit works regardless of the direction of the train.



13.5 The differences among the various series of Märklin locomotives

In certain situations it can be important to be able to quickly determine whether a special locomotive is equipped with electronic reversing, control electronics, or a digital decoder.

Märklin locomotives produced in recent years are not automatically given an individual prototype railroad number for each series, so that externally it is difficult to tell the series apart.

There is a way, though, to quickly identify the series without having to remove the locomotive body.

Each locomotive that leaves the factory has a number on the frame. These numbers are assigned consecutively during production in order to be able determine at any time which series a locomotive comes from. This number contains a digit of great interest to you.

The first character in the number on the frame is a type designation from which you can quickly identify the series.

This can be:

	XXXXX	Series 3000 and 3100	mechanical reverse unit
E	XXXXX	Series 3300	electronic reverse unit
R	XXXXX	Series 3500	high efficiency motor and control electronics
D	XXXXX	Series 3600 and 3700	digital decoder

Record the frame numbers for your locomotives. In the event a locomotive goes astray, you have a clue with which to identify it.

13.6 Mounting decals

A set of decals is included with many Märklin models. To mount them you need the following:

small pair of scissors
pair of tweezers
hobby knife
paint brush size 2 or 3
piece of cloth
basin of lukewarm water

Cut the decal as carefully as possible from its sheet so that the minimum amount of the border resulting from the manufacturing process is transferred to the model. Dip the decal in the lukewarm water for about 10 seconds and then let if soften, until the decal can be pushed around on its paper backing.

Hold the paper backing by a corner with the tweezers and push the decal with the hobby knife into the desired position on the model. If the decal is difficult to move, wet it with a drop of water. If the decal is too wet, draw off some of the water with the paint brush.

When the decal is properly positioned, remove the water with the paint brush and carefully press the decal with the cloth; this will draw off the remaining water. If you have inadvertently moved the decal out of position, moisten it with a drop of water again to move it back.

After the decal has completely dried, it cannot be moved or removed.

13.7 Weathering locomotives and cars

There are differing schools of thought on "weathering", the process of painting locomotives, cars and other aspects of a layout so that they have the same appearance as the prototype after years of service. The two fundamental, opposing positions on "weathering" are:

"Model locomotives and cars should be used as they are delivered from the factory – at the most it is permissible to mount decals included with the model by Märklin. Any attempt with paint, brush or spray gun to make the model look prototypically dirty and used devalues the model. A locomotive or car treated in this way not only looks ugly – it clearly loses its collector value".

"Everything must be in harmony on a model railroad layout – down to the finish on the locomotives and cars. In real life locomotives and cars only look "new" for a few days after being delivered – then wind, weather and environmental factors begin to alter the units' appearance. Locomotives and cars on a model railroad should also look used and dirty like the prototype – of course an old steam locomotive used in switching work will look "dirtier" than a modern passenger car which is washed on a regular basis in real life. It is likewise understood that models treated in this manner lose in collector value".

You must decide for yourself if you want your models "weathered" or not. We are not able to give tips for weathering here – there are just too many different methods that can be used. A good source of information is the book "Lackieren, Altern und Beschriften" by Christian Wilke (German text), in the "Alba-Modellbahn-Praxis" series published by Verlag Alba Publikation, Düsseldorf (Note: For English readers, check back issues of magazines such as Model Railroader and Railroad Model Craftsman for articles on weathering, lettering and painting).