

Load change-over gear L - B (empty-loaded)	Catalogue sheet	3611	11
Change-over gear G - P	" "	3611	12
Load-Change-over gear VZ combined with change-over gear G - P	" "	3611	13
Automatic slack adjuster DA 2	" "	4212	11
Automatic slack adjuster DA 3	" "	4212	25
Centrifugal dirt collector	" "	2316	11
Angle cock AK 8	" "	3212	11
Hose coupling 1" $\times$ 5/4"	" "	2641	11
Emergency brake cock H 1	" "	3218	21
Emergency brake valve AK 9	" "	3218	15
Emergency brake valve AK 6	" "	3218	11
Emergency brake pull box ZM 4	" "	3621	11

# Hildebrand-Knorr-Brake



## Hik

**Air Brake  
for passenger and goods trains**

**with triple valve Hikp1**

From September 1985 on  
**KNORR-BREMSE AG**

**KNORR-BREMSE GMBH MUNICH**

## Catalogue sheets

The following catalogue sheets — which, kindly, ask from Messrs. Knorr-Bremse G.m.b.H. — (13b) München 13, Moosacher Str. 80 — are at disposal of our customers for placing orders with us for complete brake equipments, single parts of the brake equipment and replacements:

Triple valve Hikp 1	Catalogue sheet	3351	11
Main triple valve Hikp 1	" "	3351	51
Release device Hik	" "	3351	97
Secondary triple valve Hik	" "	3351	98
Valve bracket Hik	" "	3351	99
Triple valve Hikp 1 (g)	" "	3352	11
Main triple valve Hikp 1 (g)	" "	3352	51
Triple valve Hikp 1 (p)	" "	3353	11
Main triple valve Hikp 1 (p)	" "	3353	51
Triple valve cut-out cock R $\frac{1}{2}$ "	" "	3211	11
Change-over gear in — out	" "	3611	21
Air reservoir	" "	2121	11
Steel brake cylinder 8"	" "	4111	21
Steel brake cylinder 10"	" "	4111	31
Steel brake cylinder 12"	" "	4111	41
Steel brake cylinder 14"	" "	4111	51
Steel brake cylinder 16"	" "	4111	61
Rigging release spring	" "	7131	11
Lever ratio change-over device LS 3	" "	4221	11
Lever ratio change-over device LV 4	" "	4221	12

## Table of contents

	Page
Preface . . . . .	5
Types of the Hildebrand-Knorr-brake . . . . .	6
Triple valve Hikp 1 . . . . .	8
Working of the triple valve . . . . .	17
1. Charging . . . . .	17
2. Application of the brake . . . . .	18
a) Brakes fully applied . . . . .	18
b) Gradual application of the brake . . . . .	19
3. Maintaining of brake cylinder pressure . . . . .	19
4. Inexhaustibility . . . . .	20
5. Release . . . . .	20
a) Full release . . . . .	20
b) Gradual release . . . . .	21
c) Manual release . . . . .	22
6. Removing over-charges . . . . .	22
Pressure records . . . . .	23
Braking equipment parts . . . . .	25
Triple valve cut-out cock, brake change-over gear in-out . . . . .	25
Air reservoir . . . . .	26
Steel brake cylinder . . . . .	26
Rigging release spring . . . . .	28
Lever-ratio change-over device . . . . .	28
Load change-over gear L- B . . . . .	29
Load change-over gear VZ combined with change-over gear G-P . . . . .	30
Change-over gear G - P . . . . .	30
Automatic slack adjuster . . . . .	32
Centrifugal dirt collector . . . . .	32
Angle cock AK 8 . . . . .	33
Hose coupling . . . . .	33
Emergency brake cock, emergency brake valve AK 9 . . . . .	33
Emergency brake pull box . . . . .	34
Emergency brake valve AK 6 . . . . .	34
Brake equipments . . . . .	35
Index of catalogue sheets . . . . .	43
Instruction-plates Charging / Application / Release . . . . .	Supplement

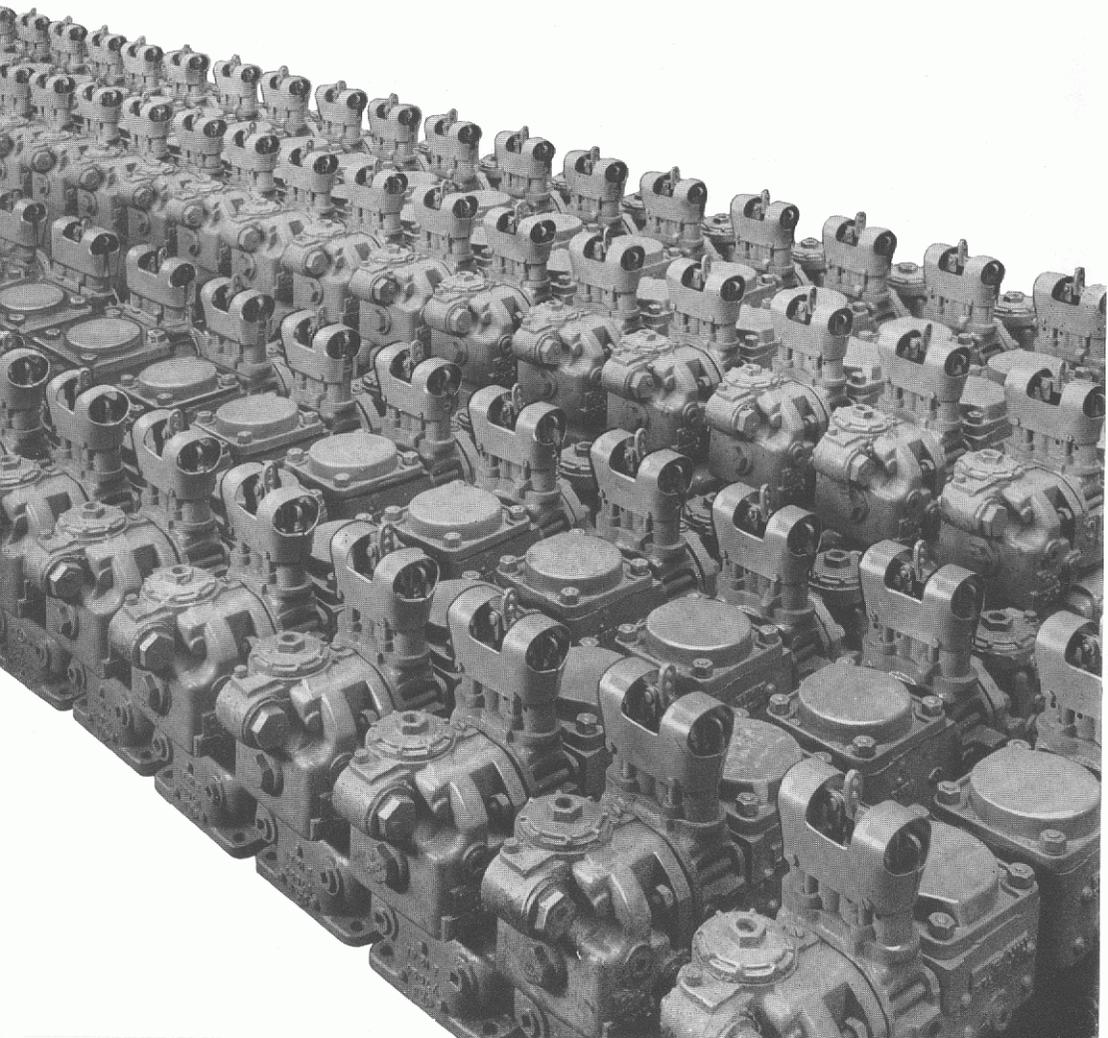
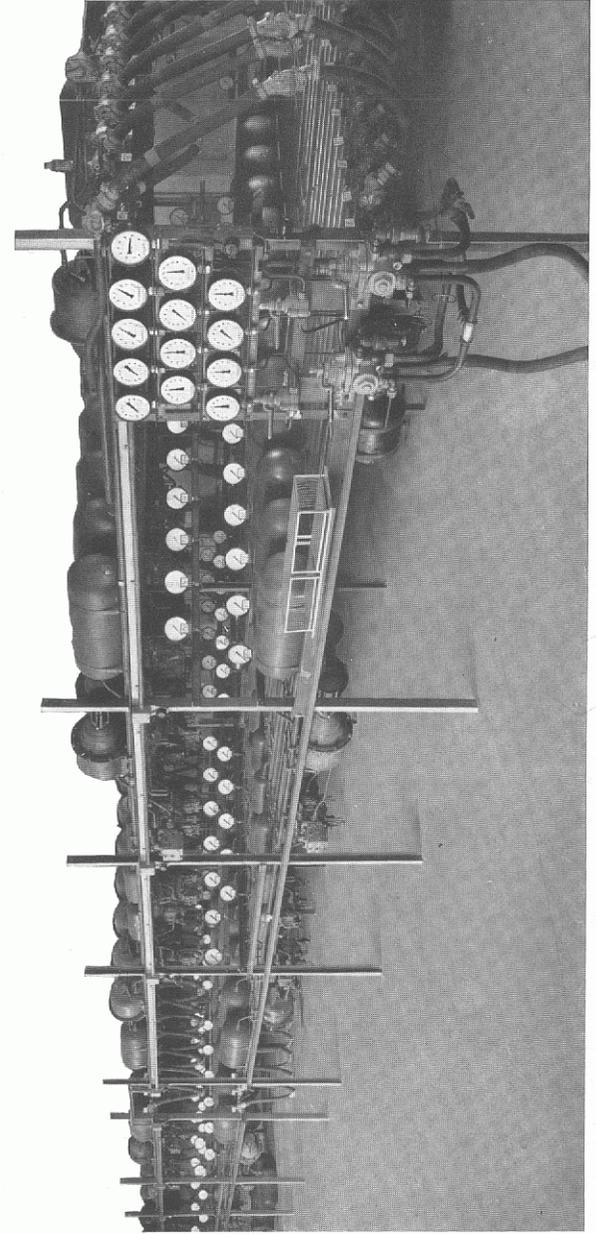


Fig. 45 Large-scale test stand: 2 locomotives — 104 wagons



4. For rail-cars  
with Hildebrand-Knorr-brake for passenger trains Hikpbr

- Triple valve Hikp 1 (p)
- Triple valve cut-out cock
- Brake change-over gear in — out
- Auxiliary air reservoir
- Supplementary air reservoir
- Steel brake cylinder
- Rigging release spring
- Centrifugal dirt collector
- Angle cocks
- Hose couplings
- Emergency brake valve
- Emergency brake pull boxes

The foregoing extent of delivery is still to be supplemented by the additional equipment for the engined rail cars such as the compressor unit for the supply of compressed air, the engine driver's brake valves etc.

## The Hildebrand-Knorr-Air Brake

The progress in railway transport and the demand for higher speeds with both passenger and freight trains require brakes which are able to face the stresses laid upon them by modern traffic. The vast experience gained during many decades of railway operation has been utilized in designing the Hildebrand-Knorr air brake and so a braking device has been evolved which meets all requirements ensuing from the conditions of modern traffic. It has been employed by the German State Railway in both passenger and freight trains for 20 years already and was adopted moreover, by many countries outside Germany.

The Hildebrand-Knorr brake is an automatic air brake with graduated release feature, whose triple valve is a combination of a two-pressure valve (main triple valve) and a three-pressure valve (secondary triple valve). Losses due to the pressure drop during the braking procedure within the braking cylinder and the supplementary reservoir for compressed air are in the Hik-braking device automatically compensated, so that the braking power of this brake type is really inexhaustible. In the Hildebrand-Knorr brake the pressure in the braking cylinder is independent of both the size of the brake cylinder and the stroke of the piston. Thus, all of the rail cars equipped with the Hik-brake are uniformly braked.

The Hildebrand-Knorr brake co-operates perfectly with all of the well-known brake designs (e. g. Westinghouse, Bozic, Kunze-Knorr etc.). It is constructed along UIC rules and regulations, which must be followed by the designers of compressed air brakes in international traffic.

## Types of the Hik-brake

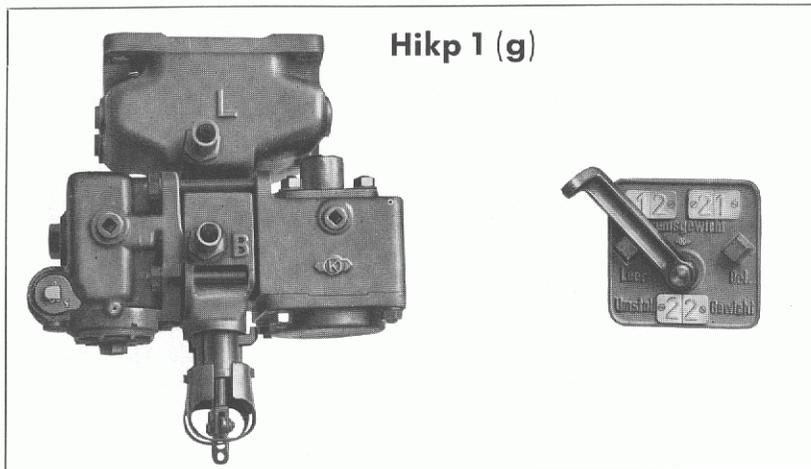


Fig. 2 Triple valve Hikp 1 (g) and load change-over gear L - B for wagons in normal goods train operation

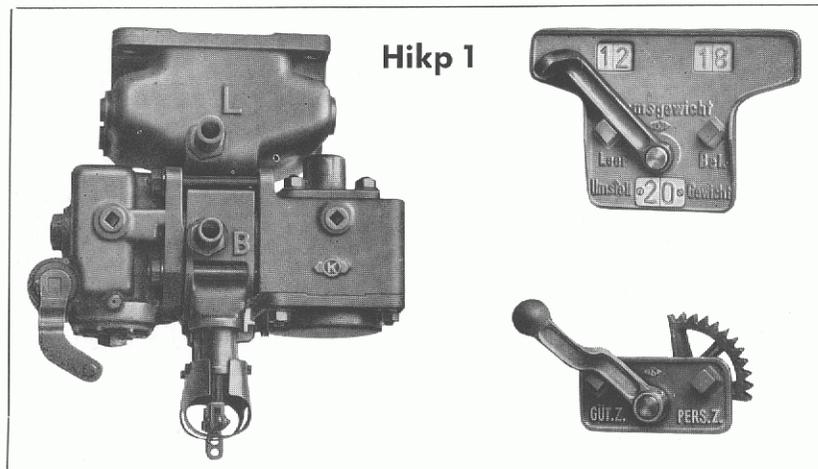


Fig. 3 Triple valve Hikp 1 and load change-over gear VZ combined with change-over gear G - P for wagons in express goods train operation

3. For wagons in passenger train operation, with Hildebrand-Knorr-brake for passenger trains Hikpbr

- Triple valve Hikp 1
- Triple valve cut-out cock
- Brake change-over gear in — out
- Auxiliary air reservoir
- Supplementary air reservoir
- Steel brake cylinder
- Rigging release spring
- Change-over gear G - P
- Automatic slack adjuster
- Centrifugal dirt collector
- Angle cocks
- Hose couplings
- Emergency brake valve
- Emergency brake pull boxes

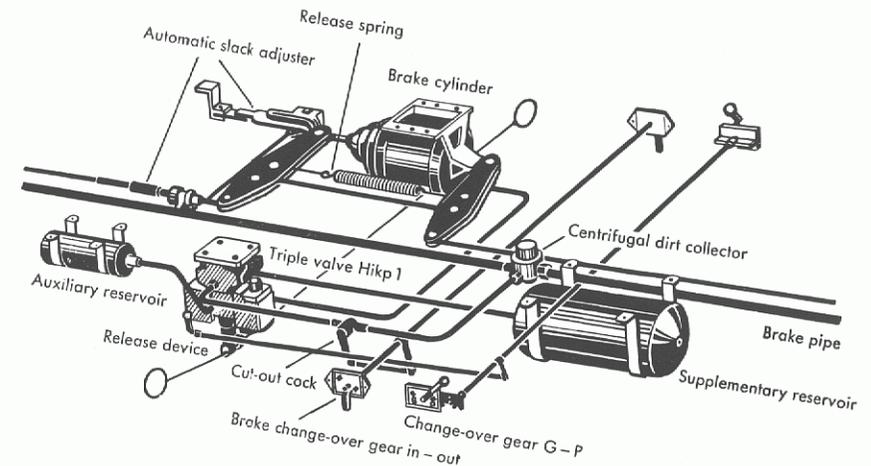
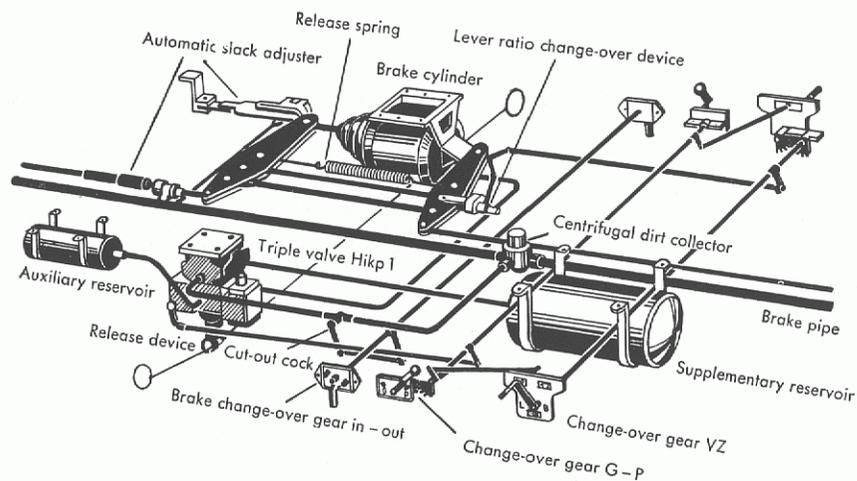


Fig. 44 Brake equipment Hikpbr with triple valve Hikp 1 and change-over gear G - P for wagons in passenger train operation

2. For wagons in express freight train operation  
with Hildebrand-Knorr-brake for passenger trains Hikpbr

- Triple valve Hikp 1
- Triple valve cut-out cock
- Brake change-over gear in — out
- Auxiliary air reservoir
- Supplementary air reservoir
- Steel brake cylinder
- Rigging release spring
- Lever ratio change-over device
- Load change-over gear VZ combined with change-over gear G - P
- Automatic slack adjuster
- Centrifugal dirt collector
- Angle cocks
- Hose couplings
- Emergency brake cock (for wagons with hand brake)



ig. 43 Brake equipment Hikpbr  
with triple valve Hikp 1, load change-over gear VZ combined with  
change-over gear G - P for wagons in express goods train operation

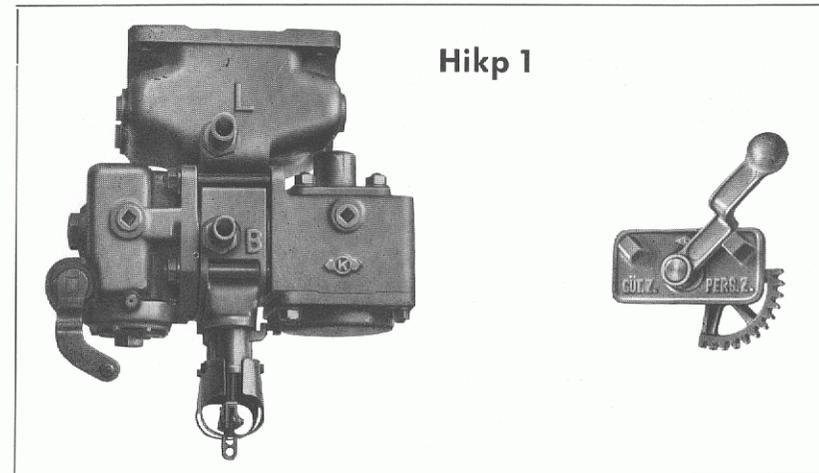


Fig. 4 Triple valve Hikp 1 and change-over gear G - P  
for wagons in passenger train operation

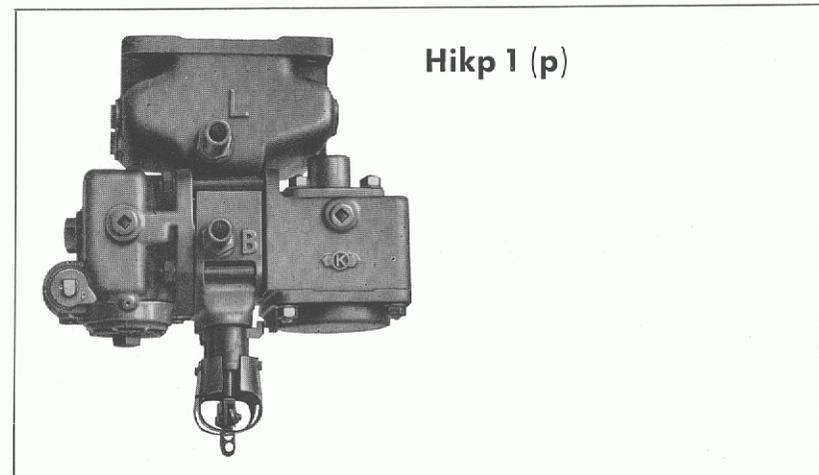


Fig. 5 Triple valve Hikp 1 (p)  
for rail-cars

The Hik-brake has found application for freight trains, passenger trains, rail motor cars and express trains. Three types of triple valve are built to-day, apart from some modifications which were evolved during the stage of development. These three triple valve types are mainly distinguished by the design of the change-over cock; they are:

1. Triple valve Hikp 1, with change-over cock to be adjusted to positions G or P resp.,  
the same valve as before, type Hikp 1 (g), but with change-over cock fixed in the G-position,  
the same valve as before, type Hikp 1 (p), but with change-over cock fixed in the P-position.
2. Triple valve Hiks with change-over cock for the positions G, P and S.
3. Triple valve Hikss with change-over cock for the positions G, P, S and SS.

The four different positions of the change-over cock allow to obtain the following effects:

- Position G: Slow-acting brake for normal freight train operation
- Position P: Quick-acting brake for the operation of passenger trains, multiple rail car units and express freight trains,
- Position S: Brake acting quickly and under large exertion of force, for normal express train operation,
- Position SS: Brake acting very quickly and under very large exertion of force, for the highest speeds attained so far.

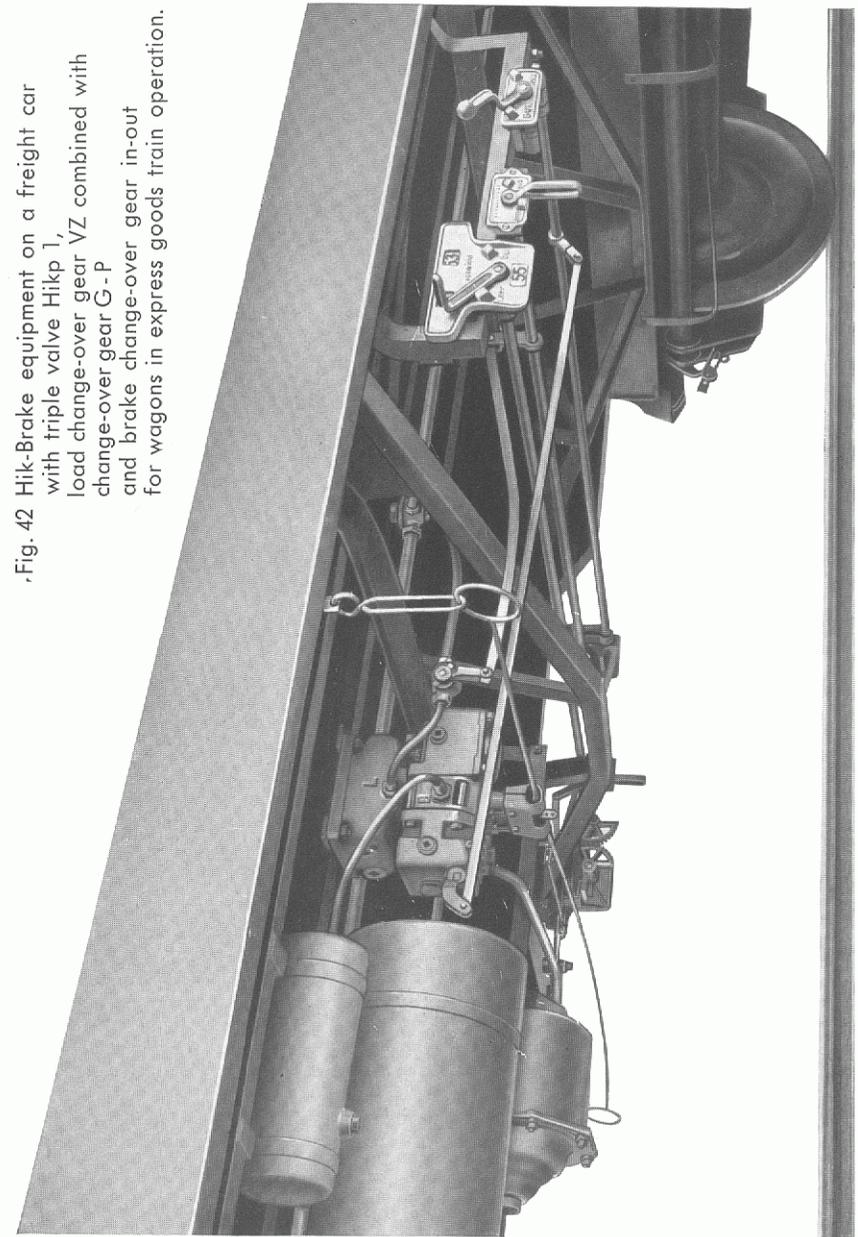
In this pamphlet the triple valve as mentioned under 1. is described in detail together with its modifications Hikp 1 (g) and Hikp 1 (p).

## The triple valve Hikp 1

Figure 6 is a view of the triple valve Hikp 1. It is constituted by three main parts, viz.

- The valve bracket with release device,
- the two-pressure valve (main triple valve),
- the three-pressure valve (secondary triple valve)

Fig. 42 Hik-Brake equipment on a freight car with triple valve Hikp 1, load change-over gear VZ combined with change-over gear G-P and brake change-over gear in-out for wagons in express goods train operation.



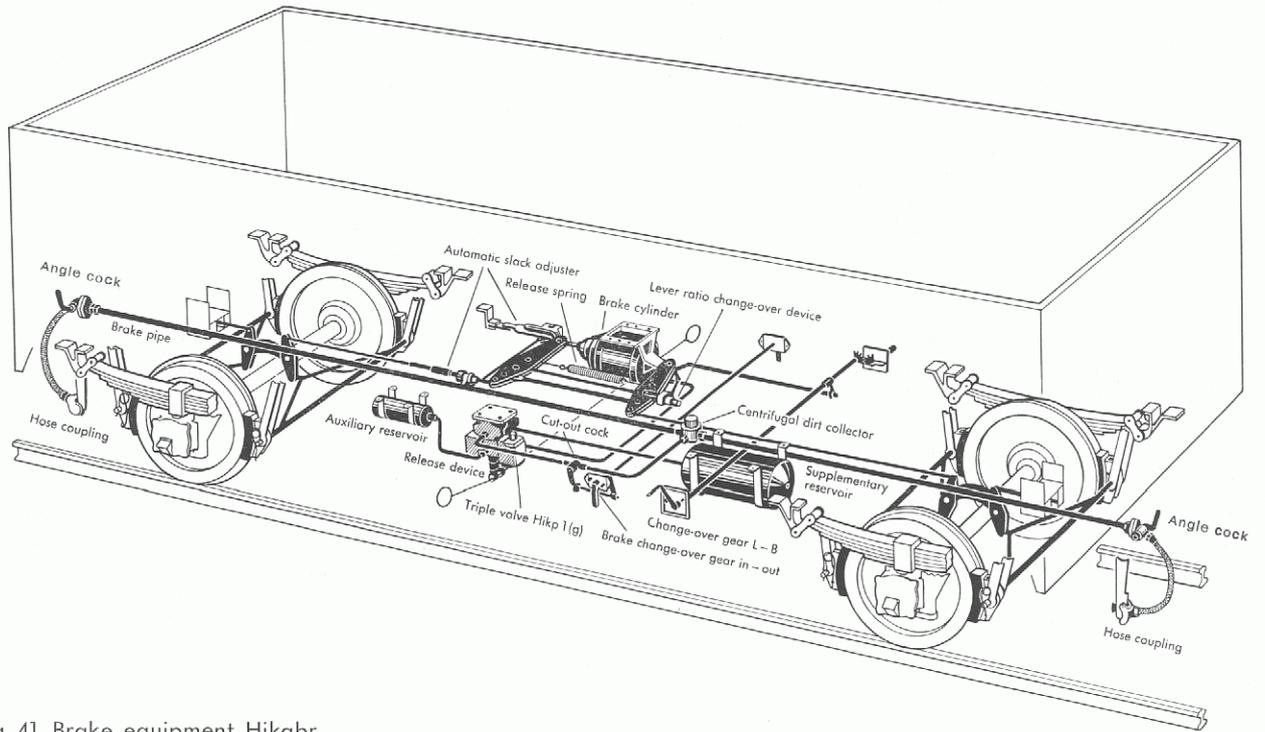
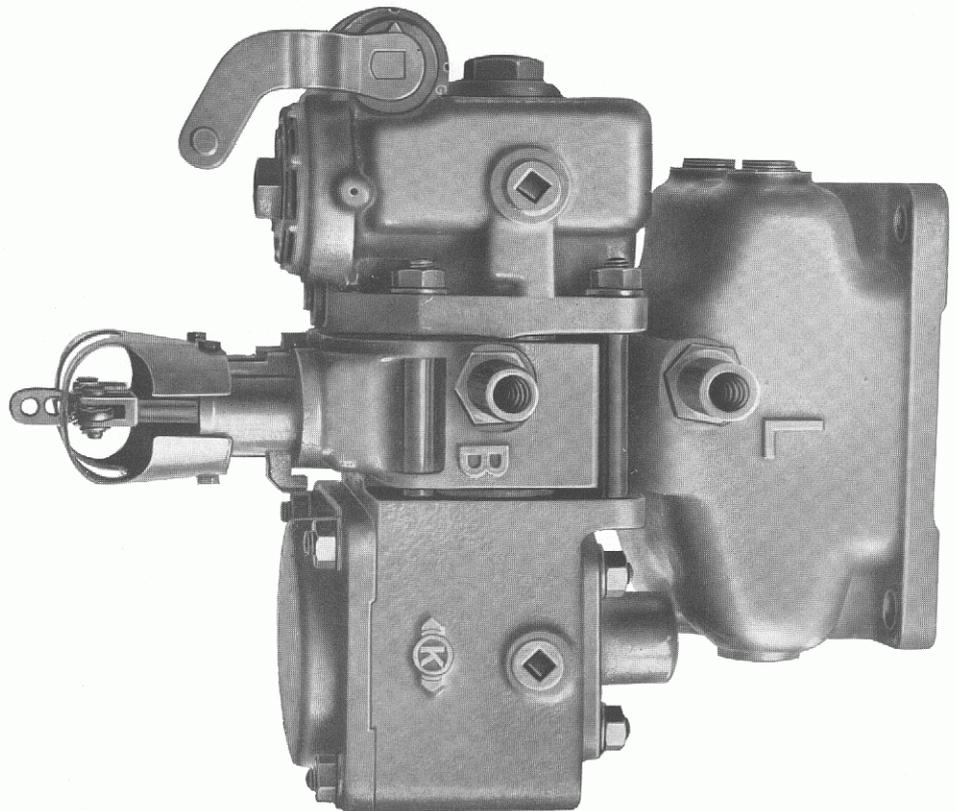


Fig. 41 Brake equipment Hikgbr with triple valve Hikp 1 (g), change-over gear L - B for wagons in normal goods train operation

Fig. 6 Triple valve Hikp



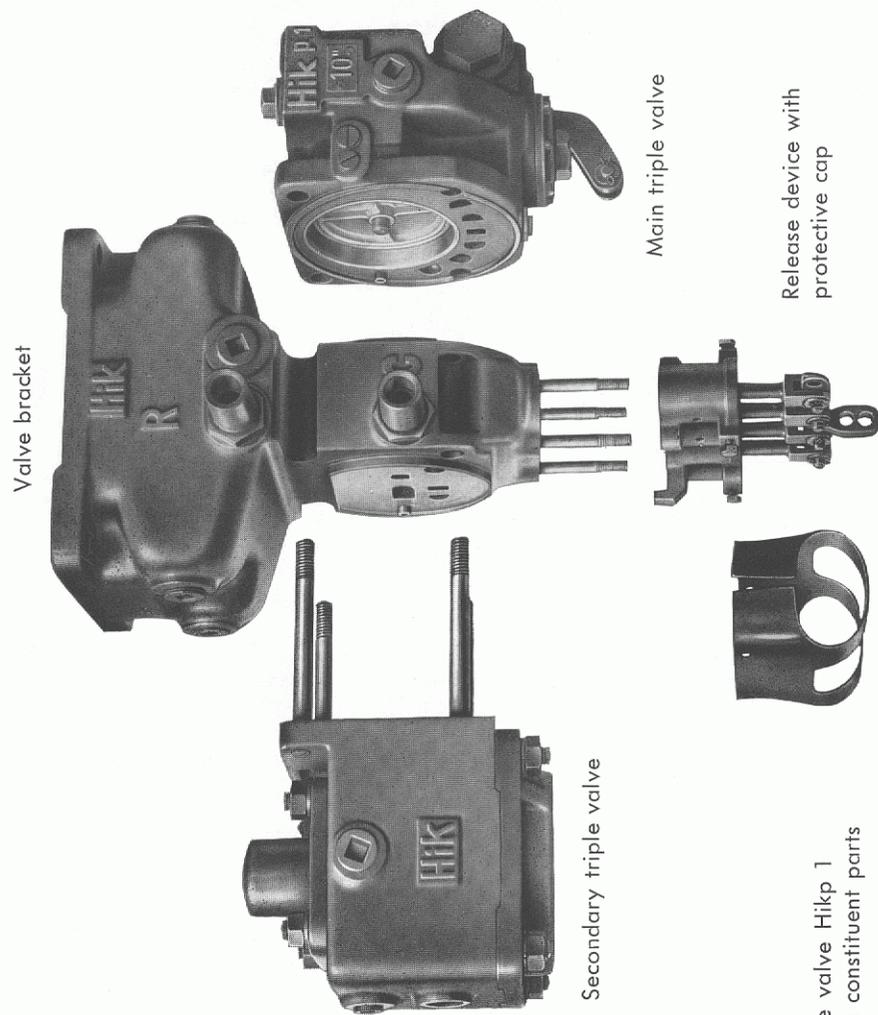


Fig.7 Triple valve Hikp 1  
Main constituent parts

## Brake equipments

The brake equipments have a different composition according to the purpose for which the wagons are intended. They differ from each other mainly by the construction of the triple valve, the change-over gears (load change-over gear "Empty — Loaded", load change-over gear VZ with change-over gear G - P, change-over gear G - P) and emergency brake device.

Thus, the following 4 principal kinds of brake equipment have been provided:

1. For wagons in normal freight train operation with Hildebrand-Knorr-brake for freight trains Hikgbr
  - Triple valve Hikp 1 (g)
  - Triple valve cut-out cock
  - Brake change-over gear in — out
  - Auxiliary air reservoir
  - Supplementary air reservoir
  - Steel brake cylinder
  - Rigging release spring
  - Lever ratio change-over device
  - Load change-over gear L - B (empty — loaded)
  - Automatic slack adjuster
  - Centrifugal dirt collector
  - Angle cocks
  - Hose couplings
  - Emergency brake cock (for wagons with hand brake)

### Emergency brake pull box

Emergency brake pull boxes are assembled in all of the wagons intended for the transport of passengers. In cases of accident this emergency brake device may be put into operation by a mere pull at the handle.



Fig. 39 Emergency brake pull box

### Emergency brake valve AK 6

The emergency brake valve AK 6 is on the one hand connected by means of a wire drag with the emergency brake pull boxes, on the other hand with the continuous air brake pipe. As soon as a pull is exerted at the handle of the emergency brake, the emergency brake valve becomes suddenly opened and uncovers immediately the full free area of the piping. This suddenly occurring heavy pressure drop in the main brake pipe produces an instantaneous quick-braking action on the whole length of the train.



Fig. 40 Emergency brake valve AK 6

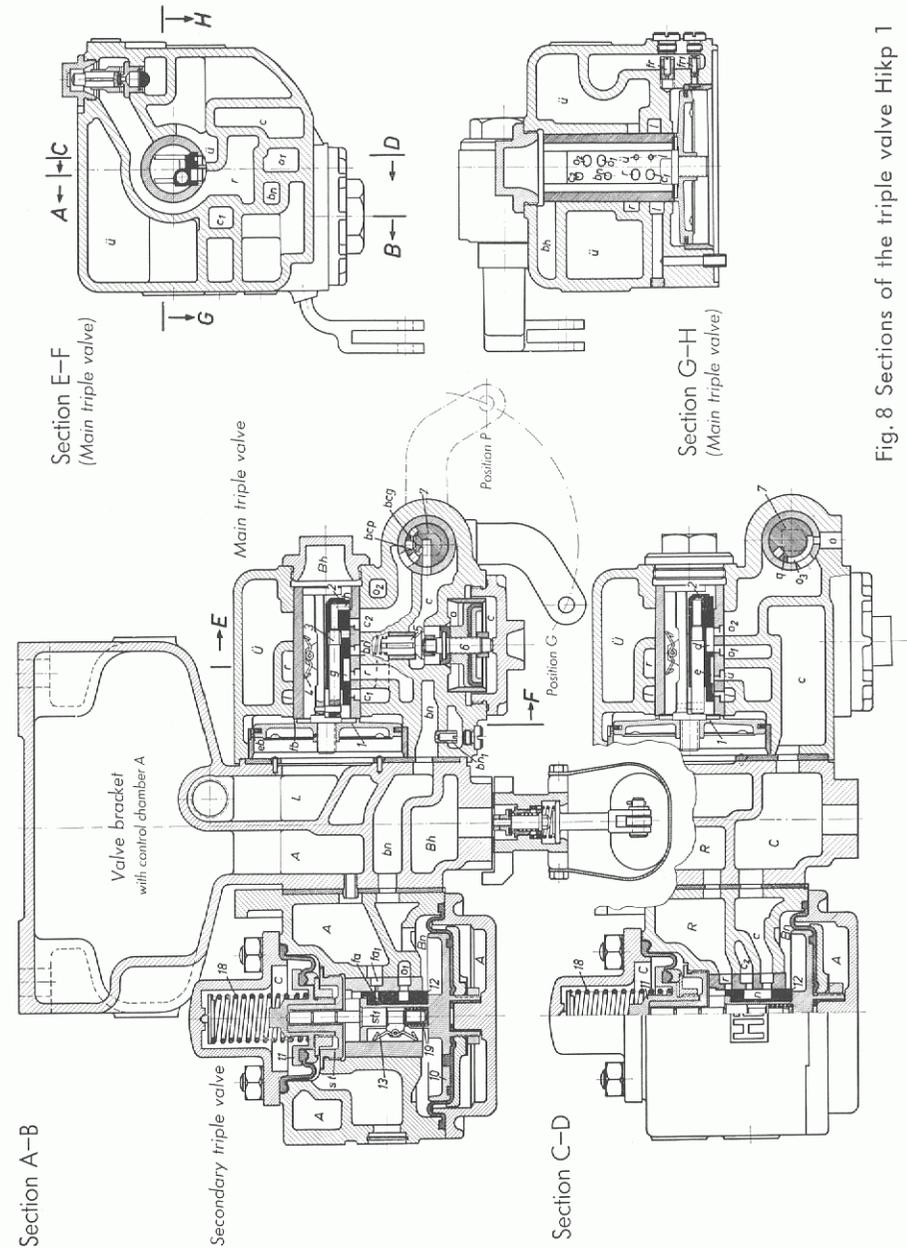


Fig. 8 Sections of the triple valve Hikp 1

## Main triple valve

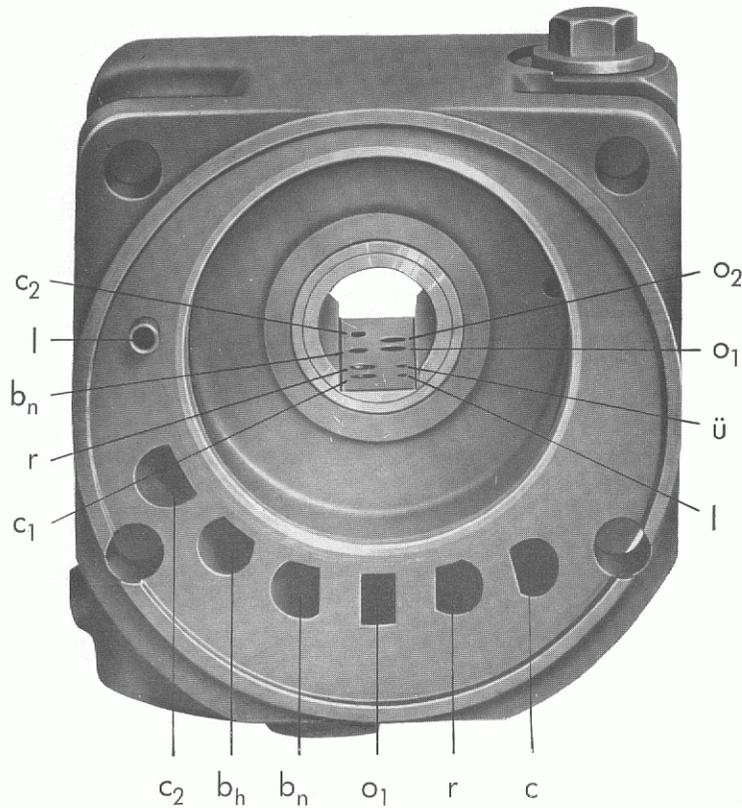


Fig. 9 View on the slide face in the body of the main triple valve

## Angle cock AK 8

Both ends of the wagon are provided with the angle cocks AK 8. The cut-out cocks are provided with a special plug, do not require any lubrication, are insensitive to dirt and can be easily revolved, even after an operation of many years.

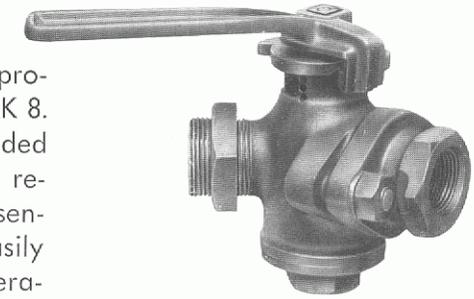


Fig. 36 Angle cock AK 8

## Hose coupling

The hose couplings are screwed to the angle cocks AK 8; they connect the various sections of the continuous brake pipe between the single wagons.



Fig. 37 Emergency brake cock

## Emergency brake cock, Emergency brake valve AK 9

Wagons with hand brake are provided with an emergency brake cock, which is embodied in the main brake pipe and may be operated from the brakeman's post by means of a pull rod.

Non-German railways adopted instead of the emergency brake cock the emergency brake valve AK 9. Its performance is analogous to that of the emergency brake valve AK 6 described on page 34.

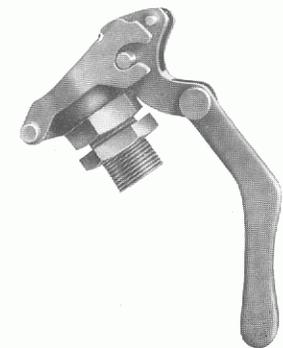


Fig. 38 Emergency brake valve AK 9

### Automatic slack adjuster

The disposition of a double-acting automatic slack adjuster is indispensable for the function of the mechanical load braking by means of the lever ratio change-over gear. It compensates at the same time automatically the increase in the stroke of the piston, which is caused by the wear of the brake shoes, of the tyres and of the brake rigging, so that the once established application stroke A will always remain unaltered. It provides, in addition, the advantage that too short a piston stroke, as it may occur for inst. after discharging a freight car or after replacement of the brake shoes, is immediately adjusted to the standard application stroke. There is, therefore, no need for re-adjusting the brake rigging by hand and at short intervals. The uniform stroke of the piston makes, moreover, for savings in braking air. The figure 34 is showing the brake cylinder with the automatic slack adjuster and the mechanical load braking by means of the lever ratio change-over gear.

### Centrifugal dirt collector

A centrifugal dirt collector has been embodied as an air strainer at that point where the piping of the triple valve derives from the main brake pipe, in order to prevent dirt and moisture from entering the triple valve. The compressed air which enters the centrifugal dirt collector is primarily deviated to the lower part of its casing, where dirt particles and moisture carried with the air are centrifuged and collected. The upper part, which contains an air filter cartridge, consisting of metal wool and wetted by grease, retains the remainder of dust particles which have been left over in the compressed air.

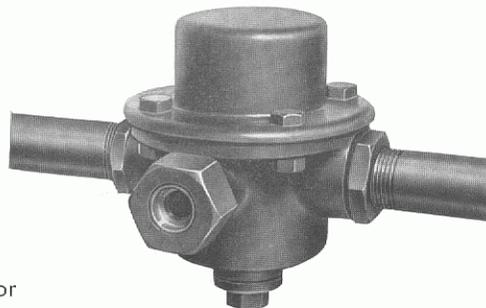


Fig. 35 Centrifugal dirt collector

### Main triple valve

Constituent parts



Fig. 10 Check valve 9

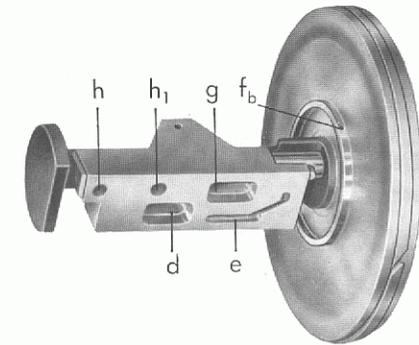


Fig. 11 Main control piston 1 with slide valve 2 and graduating valve 3

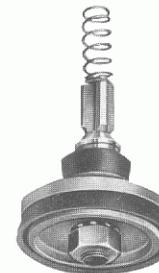


Fig. 12 Differential piston 6 with inshot valve 5

The main control piston 1, which has to separate pressure differences only temporarily, is provided with an obturator ring, which so far has stood all tests and which even with sub-zero temperatures will never interfere with the easy motion of the piston.

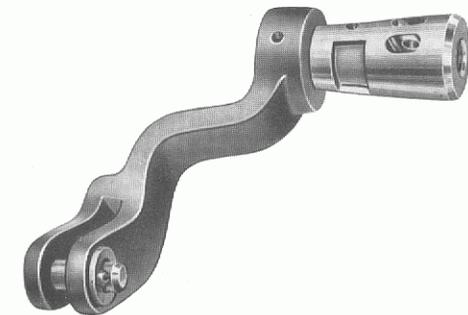


Fig. 13 Change-over cock 7 with forked lever

Secondary triple valve

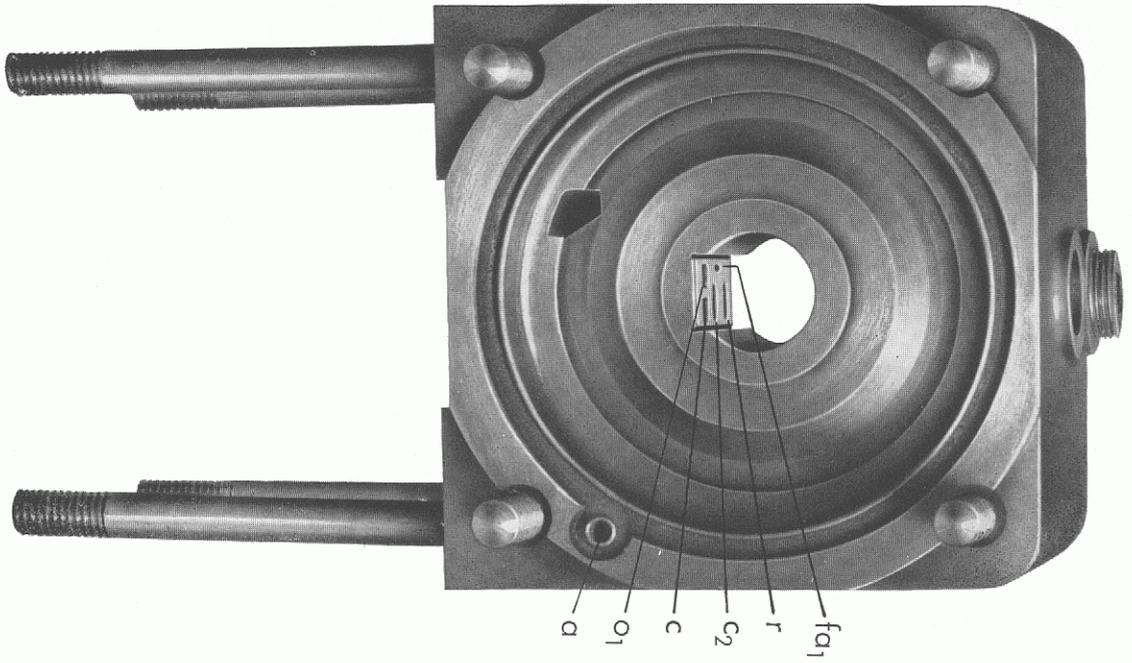


Fig. 14 View on the slide face in the body of the secondary triple valve



Fig. 33 Double-acting automatic slack adjuster

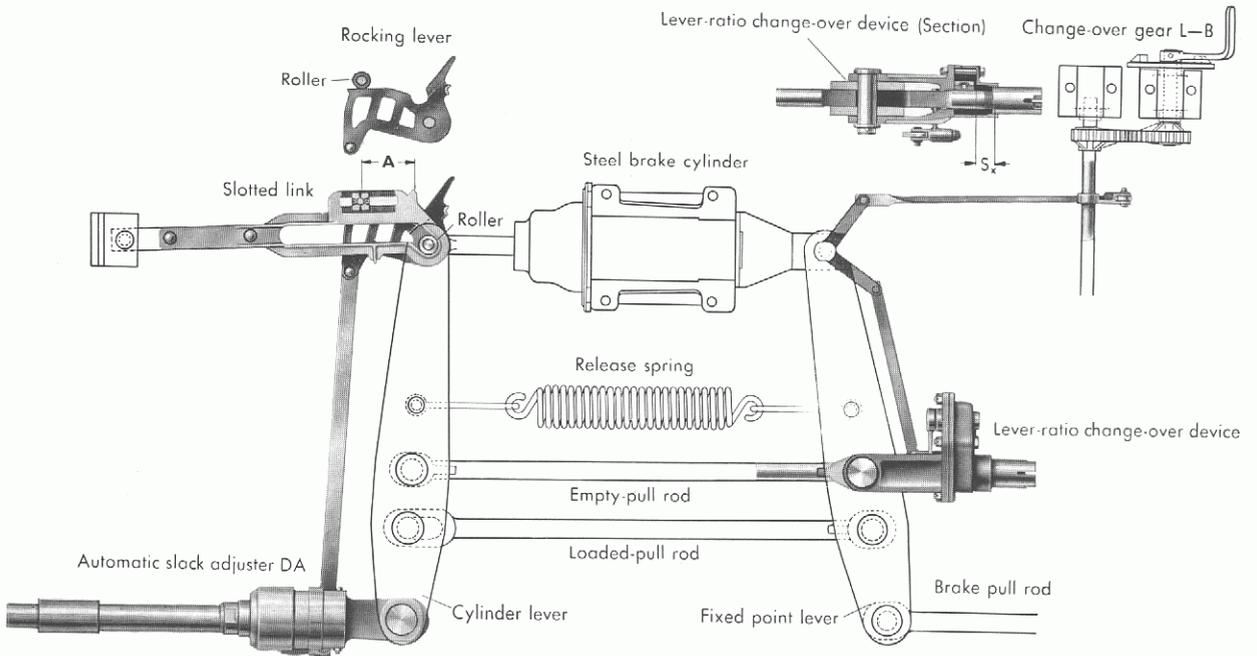


Fig. 34 Standard arrangement of the double-acting automatic slack adjuster and lever-ratio change-over device in the central brake rigging

### Load change-over gear VZ combined with change-over gear G - P

While the aforescribed change-over gear "empty-loaded" is embodied only in wagons of the normal freight traffic, the fast-running freight cars are equipped with the load change-over gear VZ with change-over gear G - P. The load change-over gear VZ as well as the load change-over gear "empty-loaded" allow the adjustment of the lever ratio change-over box. The change-over gear G - P acts on the change-over cock in the triple valve Hikp 1. The braking weight end-shield bracket VZ is provided with a displaceable number slide, since the braking weights in the position P of the triple valve are at a higher level than in the G position. This number slide is controlled by means of the change-over gear G - P in a manner that in the recesses of the braking weight end-shield bracket the braking weight numbers for freight train operation will appear in the G position, the higher numbers for passenger train operation in the P position. It is for this reason that the number slide has 4 number plates for the braking weights. The change-over weight is equal for both of the positions G and P.

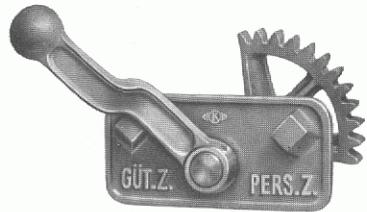


Fig. 31 Change-over gear G - P



Fig. 32 Load change-over gear VZ

### Change-over gear G - P

All of the passenger wagons are provided with the change-over gear G - P, by which the aforescribed change-over of the cock in the triple valve Hikp 1 from the position G to P and vice versa is performed.

Rail motor cars which are equipped with the triple valve of the Hikp 1 (p) type have no change-over gear G - P. The change-over cock is fixed in the P position.

### Secondary triple valve

Constituent parts



Fig. 15 Constituent parts of the piston 10

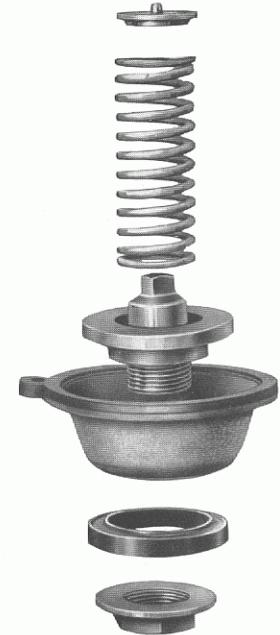


Fig. 17 Constituent parts of the piston 11

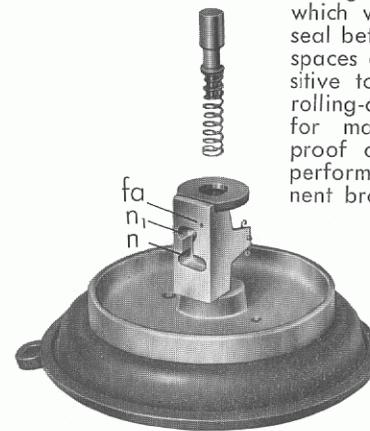


Fig. 16 Rolling-diaphragm piston 10 along with slide valve 12 and tappet with spring

The piston 10 and 11 are rolling-diaphragmpistons, which warrant a perfect seal between the various spaces and are very sensitive to motion. Rubber rolling-diaphragms have for many years given proof of their excellent performance in permanent brake operation.

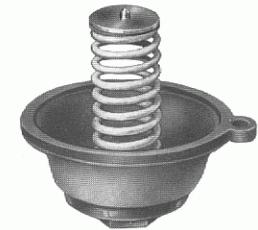


Fig. 18 Rolling-diaphragm piston 11



Fig. 19 Tappet guide and tappet

The control chamber A is lodged in the upper part of the valve bracket, the release device in its lower part. The release lever may be pulled in any direction in order to enable the triple valve to be located in any position whatsoever in conformity with the available space.

While the main and secondary triple valves as well as the release device are detachable (turn to fig. 7, please), the valve bracket, which besides the valves carries the pipe connections to the brake pipe, to the supplementary and auxiliary air reservoirs and to the brake cylinder, will remain fixed to the rail car after its first assembly has been performed.

The fig. 8 is showing the main sections of the triple valve, whilst views of the most important constituent parts of the main and secondary triple valves are shown on pages 12 to 15.

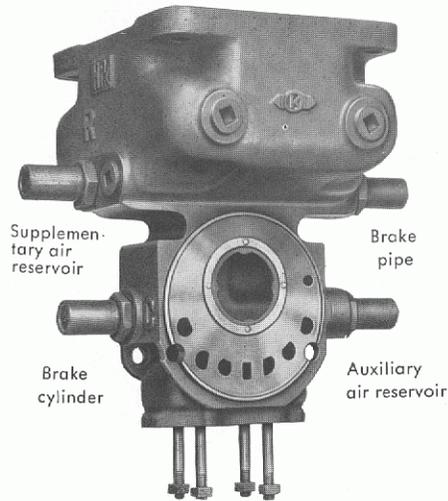


Fig. 20 Hik valve bracket with pipe connections

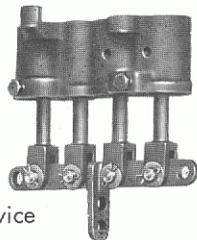


Fig. 21 Release device

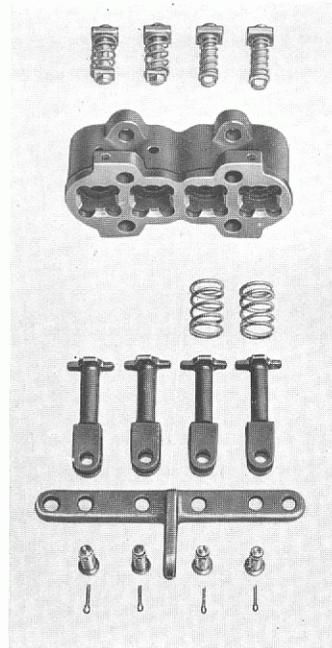
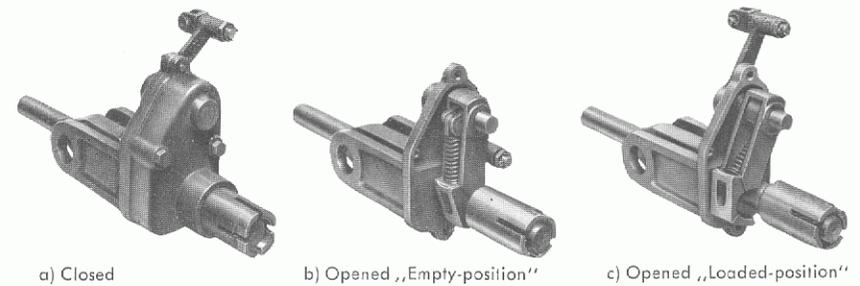


Fig. 22 Constituent parts of the release device



a) Closed b) Opened „Empty-position“ c) Opened „Loaded-position“

Fig. 29 Lever-ratio change-over device

slot, which is directed inwards (figure 28). With empty wagon the lever ratio change-over device is coupled to the "empty" pull rod, so that braking is performed by way of the small lever ratio. With loaded wagon the "empty" pull rod becomes disengaged and braking is performed by means of the large lever ratio of the "loaded" pull rod.

The adjustment of the lever ratio change-over device is performed by displacing the hand crank at the change-over gear L - B (Empty — Loaded) from L to B and vice versa.

### Load change-over gear L - B

The load change-over gear "empty — loaded" may be operated from both sides of the wagon. The braking weight end-shield support has three fixed number plates. The left-hand upper plate is showing the braking weight of the empty wagon, the right-hand upper plate the braking weight of the loaded wagon. The lower number plate is showing the change-over weight, i. e. the dead weight plus a predetermined, partial load. As soon as this latter weight has been attained, the hand crank must be changed over from the "empty" position to the "loaded" position.

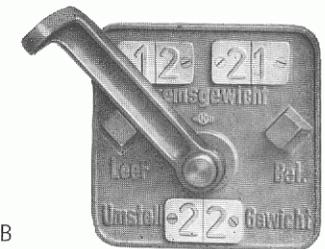


Fig. 30 Load change-over gear L - B

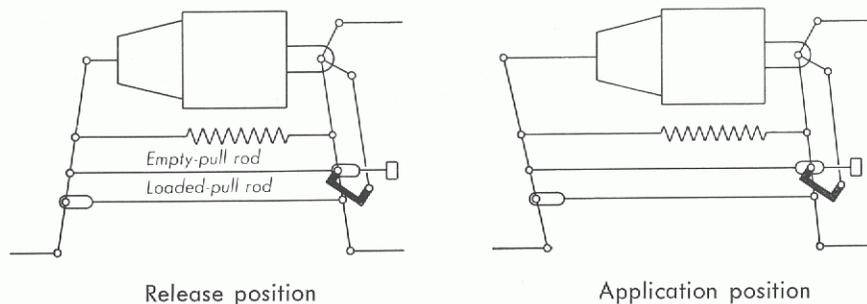
### Rigging release spring

The rigging release spring returns the brake rigging into its neutral position, if the brake is released.

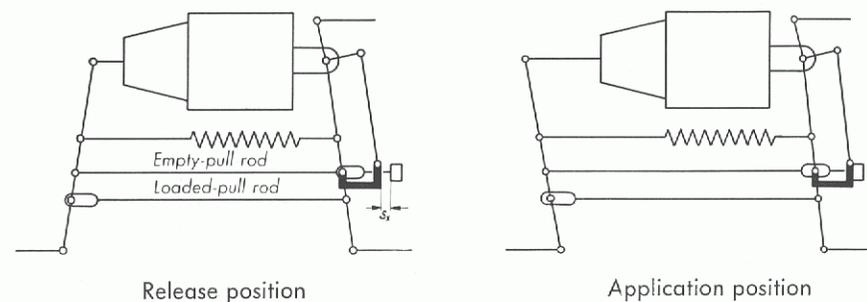
### Lever-ratio change-over device

The lever ratio of the rigging may be changed by means of the change-over device in order to attain with loaded goods vans a higher brake shoe pressure than with empty wagons. This is performed by means of two brake pull rods disposed between the cylinder lever and the fixed point lever of the medium equalizing rigging. The lever ratio change-over device is connected to the "empty" pull rod adjacent the brake cylinder at the right end of the former. The "loaded" pull rod has at one end an elongated

Fig. 28 a) Braking the loaded wagon "Loaded-position"



b) Braking the empty wagon "Empty-position"



## Working of the triple valve

The main triple valve along with the control piston, the slide valve and the graduating valve initiate the braking procedure and the release of the brake.

In order to obtain, if different sizes of brake cylinder are employed, always the same pressure curve with both brake application and release it is necessary, in spite of the main triple valve remaining always the same, to modify the chokes for charging, brake application and release.

The cock plug with its braking and release chokes may be exchanged according to the size of the brake cylinder, the screwed-in charging nozzle according to the size of the supplementary air reservoir. An identity mark at the main triple valve points at the size of the brake cylinder, as for inst. 8", 2×10", 10"+12".

The secondary triple valve has the same design for all of the constructions of the Hik-brake; it is intended for carrying through the operations of brake application, release and re-charging.

In the following the performance of the triple valve in its positions of charging, brake application and release shall be described in detail. The polychrome instruction plates at the end of this pamphlet allow to follow up the various operating phases.

### 1. Charging

When the brake is ready for service, air reservoirs R and B as well as control chamber A are charged with the standard pressure of 5 kg/cm<sup>2</sup> (71 lbs./sq. in.); brake cylinder C is vented. In this charging position main control piston 1 is in its right-hand extreme position, piston 10 of the secondary triple valve in its lowermost position, leaving a clearance "x" between pistons 10 and 11, whilst chokes fa and fa<sub>1</sub> are uncovered for charging control chamber A.

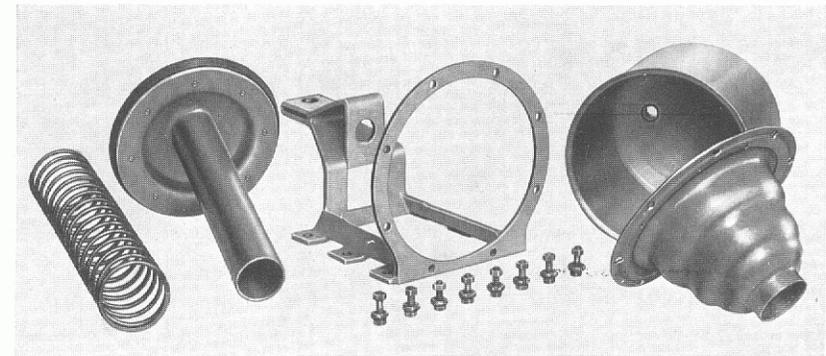
## 2. Application of the brake

### a) Brakes fully applied

If for braking the pressure in brake pipe L is lowered, piston 1 moves to the left until it abuts at slide valve 2, slides over sensitivity choke  $eb$  and charging choke  $fr_1$ , opens first graduating valve 3 and carries then slide valve 2 with to its left-hand extreme position. Consequently compressed air is tapped off main brake pipe L into quick service chamber  $\bar{U}$  through slide valve 2 via  $l$ ,  $e$  and  $\bar{u}$  and thus the pressure drop in L becomes increased. Compressed air flows, moreover, unthrottled from R through  $r$ ,  $g$  (slide valve 2),  $c_1$  and inshot valve 5 into brake cylinder C for quick application of the brake shoes until the inshot valve closes at a pressure of ab.  $0.6 \text{ kg/cm}^2$  (8.5 lbs./sq. in.). Compressed air flows at the same time from auxiliary reservoir B through  $bn_1$ ,  $bn$ ,  $h$  (slide valve 2),  $c_2$  (change-over cock 7) and  $c$  to brake cylinder C.

Due to the pressure drop in auxiliary reservoir B, in  $Bn$  and  $Bh$ , piston 10 is lifted, owing to the pressure in control chamber A, primarily by the distance of the clearance "x", whereby choke  $fa_1$  is covered by slide valve 12; thus, the pressure in control chamber A is maintained at its level of  $5 \text{ kg/cm}^2$  (71 lbs./sq.in.). Piston 10 continues its upward movement and carries slide valve 12 as well as piston 11 with it to the extreme position. Compressed air flows from the supplementary reservoir R through  $r$ ,  $n_1$  (slide valve 12),  $c_2$  to  $c$ , the cock adjusted to G (freight train), throttled via  $bcg$  and with cock adjusted to P (passenger train) via  $bcp$  in changeover cock 7 to brake cylinder C.

The ratio of sizes between pistons 10 and 11 is responsible for the fact that as the pressure in the conduits drops from  $5 \text{ kg/cm}^2$  (71 lbs./sq.in.) to  $3.6 \text{ kg/cm}^2$  (51.2 lbs./sq.in.) the pressure in the brake cylinder will rise from 0 to  $3.6 \text{ kg/cm}^2$  (51.2 lbs./sq.in.). This rise in pressure might be attained in one sole phase (full-braking or quick-braking) or also by steps.



recoil spring      piston      Supporting frame with lever bracket      Cylinder body and cover

Fig. 27 Constituent parts of the steel brake cylinder

be removed from the wagon during the inspections, without that the brake rigging is to be removed from the lever support.

The figures 26 and 27 are showing the individual parts, the section and the view of the brake cylinder.

The size of the brake cylinder depends on the pressure required for the brake shoes. The brake pressure is independent from the stroke of the piston. The brake cylinders of the sizes from 6" to 20" give with the end pressure of  $3.6 \text{ kg/cm}^2$  (51.2 lbs./sq.in.) and after deducting the pressure exerted by the piston recoil spring the following piston forces:

Brake cylinder Dia.		Piston forces after deduction of the counter-force exerted by the piston recoil spring in kg with the following piston strokes				Supplementary reservoir Capacity Litres
		100 mm = 4 in.	110 mm = 4 <sup>3</sup> / <sub>8</sub> in.	125 mm = 5 in.	140 mm = 5 <sup>1</sup> / <sub>2</sub> in.	
in.	mm					
6	150	610	610	605	605	14
8	203	1130	1130	1125	1125	25
10	255	1770	1765	1765	1760	40
12	300	2475	2475	2470	2465	57
14	355	3465	3460	3455	3450	75
16	406	4565	4560	4555	4550	100
18	460	5835	5830	5820	5810	125
20	510	7170	7160	7150	7140	150

## Air reservoirs

The two air reservoirs which belong to the equipment of a wagon are a small auxiliary reservoir with always the same volume of 9 litres (550 cu.in.) and a larger supplementary air reservoir, whose capacity is dependent on the actual size of the brake cylinder. Both of these reservoirs are, along the most recent manufacturing processes, cold-drawn of special steel sheets in two equal parts, which subsequently have been welded into one integral piece.

## Steel brake cylinder

A one-chamber brake cylinder, whose loose piston rod engages the brake rigging of the wagon, has been provided for the application of the brake shoes to the tyres.

The brake cylinders are drawn of steel sheets, which means a saving in weight to as much as 50 per cent, compared to the formerly employed cast iron cylinders.

The thin-walled cylinder bodies are provided with a special supporting frame for fastening the brake cylinder to the wagon. The cylinder body is rotatably located within this frame to give for the assembly favourable pipe connections, free from any stress. Thus, leaky connections are absolutely avoided. The brake cylinders are manufactured with or without lever supports in the frame in conformity with the purpose for which they are intended. Contrary to the cast iron brake cylinder the steel brake cylinder may

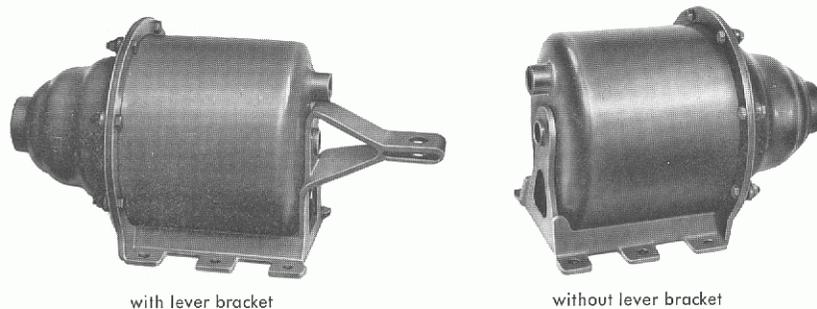


Fig. 26 Steel brake cylinder

## b) Gradual application of the brake

If the pressure in brake pipe L is decreased by a small percentage only, the braking procedure in the main triple valve will be carried on at first in just the same manner as before. But if the pressure in L is lowered below that in Bh, main control piston 1 will be moved to the right until graduating valve 3 in slide valve 2 closes passageway h and thus prevents compressed air from flowing furthermore from B to C. (Please, turn to the right-hand figure "Application lap position".)

In the secondary triple valve the braking procedure will be the same until the rising pressure in C assisted by piston 11 and against the pressure difference at piston 10 moves slide valve 12 downwards to an extent that the connection r, n<sub>1</sub>, c<sub>2</sub> is interrupted. The pressure within brake cylinder C will rise no longer and pistons 10+11 remain together with slide valve 12 in this application lap position. (Please, turn to the left-hand figure "Application lap position".)

If the pressure in brake pipe L is decreased by a further amount, the main and secondary triple valves will move anew into the brake application position, i. e. once more as long as the pressure in Bh is lower than that in L. Main control piston 1 and pistons 10+11 in the secondary triple valve move once more into the application lap position, as has been described above. This procedure may be repeated as often as full pressure is attained in the brake cylinder.

## 3. Maintaining of brake cylinder pressure

As soon as the secondary triple valve has closed a braking stage and the pressure within the brake cylinder C is dropping due to leakage, the force of piston 11 will decrease, piston set 10+11 moves upwards and lets, just as in brake application, flow the air anew from r to c<sub>2</sub> via valve hollow n<sub>1</sub> until the pressure in brake cylinder C has risen to such a level that piston 11 closes the connection via valve hollow n<sub>1</sub>.

#### 4. Inexhaustibility

Compressed air from B will flow through check valve 9 to R as soon as due to the re-charging of leaky brake cylinders the pressure within the supplementary reservoir R drops below the pressure in auxiliary reservoir B. The pressure in B is, consequently, lowered below that existing in L and main control piston 1, which by the end of the braking procedure had moved in application lap position, moves now once more into the extreme right-hand position, uncovering passageways eb and fr<sub>1</sub> (release position). The losses of compressed air in C are now made up from L through eb and fr<sub>1</sub>, since the air pressure in the brake pipe L is with gradual braking always higher than the pressure in the brake cylinder C. The secondary triple valve remains in application position.

#### 5. Release

##### a) Full release

Main control piston 1 moves into its extreme right-hand position, if the pressure in main brake pipe L after braking is raised once more to the standard pressure of 5 kg/sq.cm (71 lbs/sq.in.). Compressed air flows from brake pipe L through eb, fb, Bh and bh into auxiliary reservoir B and through bn<sub>1</sub> and bn to Bn, moreover through fr<sub>1</sub> and fr and check valve 9 into the supplementary reservoir R, as soon as the pressure below check valve 9 has risen above the pressure in R.

In the secondary triple valve piston set 10+11 is moved downwards due to the pressure rise in Bn, slide valve 12 opens the connection c, n (slide valve 12), o<sub>1</sub>, slide valve 2 connection o<sub>1</sub>, d (slide valve 2), o<sub>2</sub>. Compressed air from brake cylinder C escapes through change-over cock 7 into the open air, if the is cock adjusted to P through o<sub>3</sub> and if the cock is adjusted to G through q.

## Braking equipment

### Triple valve cut-out cock — brake change-over gear in — out

A cut-out cock is located between the centrifugal dirt collector and the triple valve. This cut-out cock may be actuated from both long sides of the wagon either directly by hand or via the brake change-over gear in — out, in order to be able to disengage the brake in case of injuries. The cut-out cock is opened, if the handle points vertically downwards.

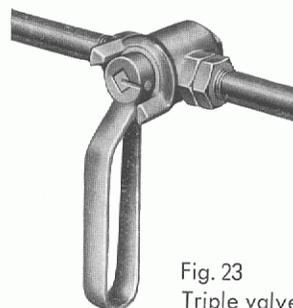


Fig. 23 Triple valve cut-out cock (opened) with springy cock handle

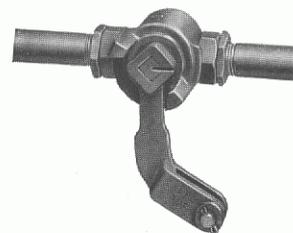


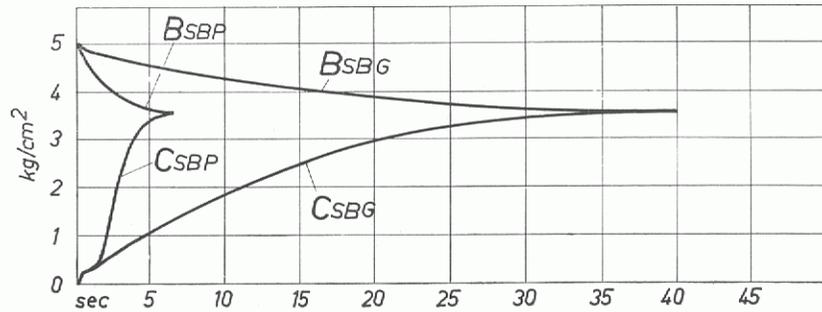
Fig. 24 Triple valve cut-out cock with angled forked lever



Fig. 25 Brake change-over gear in-out

### Full application or quick action resp.

piston stroke: 100 mm

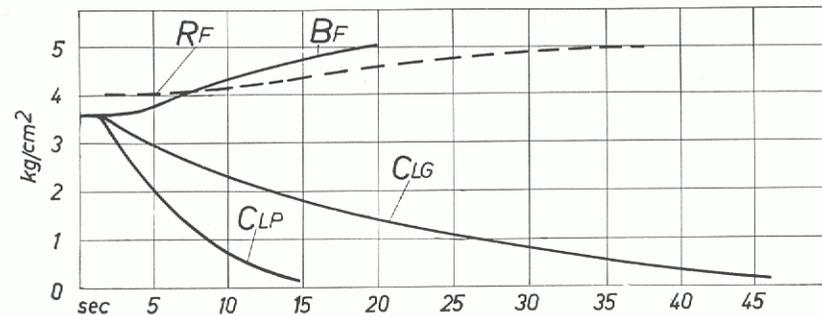


B SBP Pressure drop in auxiliary reservoir B in position P  
 B SBG Pressure drop in auxiliary reservoir B in position G  
 C SBP Pressure rise in brake cylinder C in position P  
 C SBG Pressure rise in brake cylinder C in position G

If the pressure in L is lowered continuously (full application) or also quickly (quick application), the pressure in B will drop and thus the pressure in C will rise according to positions G or P and in conformity with international rules.

### Full release

piston stroke: 100 mm



B F Pressure rise in auxiliary reservoir B  
 C LP Pressure drop in brake cylinder C in position P  
 C LG Pressure drop in brake cylinder C in position G  
 R F Pressure rise in supplementary air reservoir R

If the pressure in L is continuously raised to standard pressure, the pressure in B will rise, whilst the pressure in C will drop according to positions G or P and in conformity with international rules. At the same time the pressure in the supplementary air reservoir R is made up once more.

As soon as the pressure in C has dropped to ab. 0.6 kg/sq.cm (8.5 lbs/sq.in.) inshot valve 5 is opened due to the pressure in the quick service chamber U. The compressed air in U escapes into the open air just as from C.

As soon as the pressure in Bn equals approximately the pressure in A, piston 10 is separated from piston 11 under the pressure of the spring 19, moves by the distance of the clearance "x" into its lowermost position and uncovers the passageway fa (diagram 1 "charging position"). Thus, all possible pressure losses in A become compensated.

### b) Gradual release

If the pressure in main brake pipe L is raised after braking by a trifling value only, the release procedure will take place primarily just as with full release. As soon as the pressure in brake cylinder C has dropped to such an extent that the uniform pressure in A overcomes the aggregate pressure of Bn and C, piston set 10+11 will be moved upwards until slide valve 12 interrupts the connection c, n, o<sub>1</sub>. (Please, turn to the left-hand figure "release lap position".)

This procedure may be repeated in a variety of single stages as often as with the rise of the pressure in L to standard pressure of 5 kg/sq.cm. (71 lbs/sq.in.) the brake cylinder becomes completely vented and piston 10 has reached its lowermost charging position (diagram 1).

Due to the subdivision of the air reservoirs in a non-controlling supplementary reservoir R, whose volume depends on the actual size of the brake cylinder and a controlling auxiliary reservoir B, which holds 9 litres (550 cu.in.) and has equal size for all brake cylinder sizes, the time for release is considerably reduced, even with rather long trains, since the small auxiliary reservoir B, which controls the release procedure is re-charged in first place.

Quick and safe release, even if the rise in the pressure of the main brake pipe is, at the tail of long trains, very much pro-

tracted, is warranted by spring 18, which acts upon piston 11, so that piston set 10+11 will during release respond with more ease on the forces exerted upon it.

c) Manual release

Generally, releasing the brakes is performed from the engine driver's brake valve. In some special cases, as for inst. with compressed air braked wagons in marshalling yards or with wagons in a moving train which should have an overcharge of compressed air, the release of the brake may be performed manually by means of the release device. It is located at the valve bracket and is provided with four check valves, which are connected to the brake cylinder, to the auxiliary and supplementary air reservoirs and to the control chamber resp. The release device may be operated from both sides of the wagon by pulling a leverage.

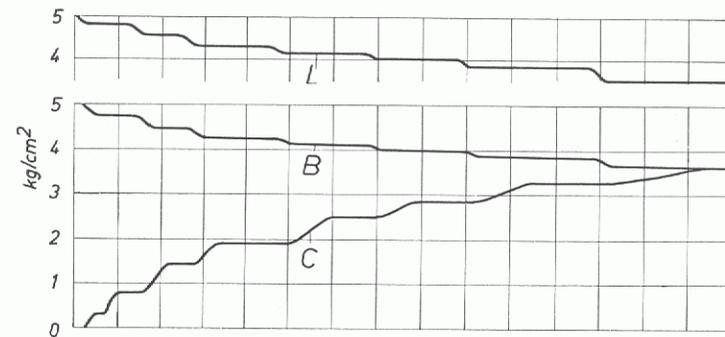
**6. Removing over-charges**

If with overcharged brakes the pressure in the main brake pipe L is by means of the engine driver's brake valve lowered very slowly, the spaces B, Bn and Bh will be in the charging position (diagram of connections 1) gradually discharged through sensitivity choke eb and passageways fr and fr<sub>1</sub> into main brake pipe L. In the same manner is control chamber A discharged through fa<sub>1</sub> and fa to B, without that the main and secondary triple valves would move into application position.

Main and secondary triple valves of the Hik-brake supervise and assist themselves mutually. This co-operation is realized by the action of the pressure in the auxiliary reservoir B, which aids in controlling both valves. The variations in pressure in auxiliary reservoir B, which correspond to the variations in pressure of the main brake pipe affect the secondary triple valve, so that this latter will respond to the variations in pressure subsequently to the main triple valve. Charging as well as venting brake cylinder C is performed through the main and the secondary triple valves.

**Pressure records**

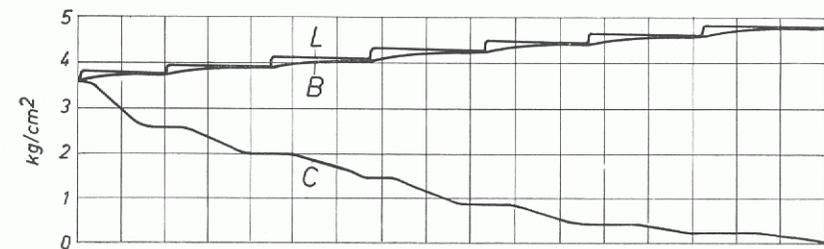
**Gradual application of the brakes**



- L Pressure drop in the brake pipe L
- B Pressure drop in the auxiliary air reservoir B
- C Pressure rise in the brake cylinder C

If the pressure in L drops by steps, the pressure in B will drop continuously, whilst the pressure in C rises proportionately.

**Gradual release**



- L Pressure rise in the brake pipe L
- B Pressure rise in the auxiliary air reservoir B
- C Pressure drop in the brake cylinder C

If the pressure in L is raised by steps, the pressure in B will rise continuously, whilst in proportion the pressure in C will drop by steps.