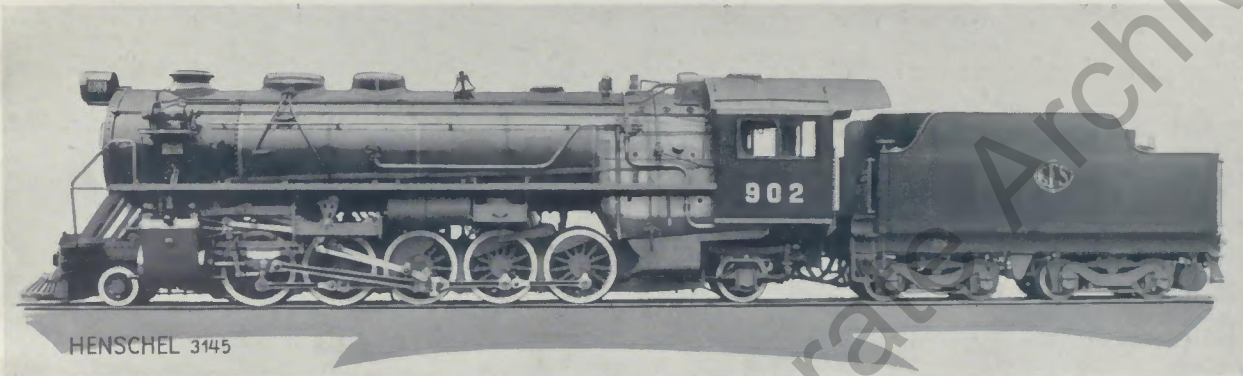


HENSCHEL REVIEW

2

1930

DECEMBER



21 577
2:10:2 SUPERHEATED STEAM 3-CYLINDER GOODS LOCOMOTIVE OF THE SOROCABANA RAILWAYS

Gauge	3' 3 ³ / ₈ "	1000	mm	Number of flues	34	34
Diameter of cylinders	3 × 20 ¹ / ₈ "	3 × 530	mm	Number of boiler tubes	182	182
Piston stroke	3 × 22 ¹ / ₁₆ "	3 × 560	mm	Diameter of flues	5 ¹ / ₂ "	131/140 mm
Diameter of drivers	4'	1220	mm	Diameter of boiler tubes	2 ¹ / ₄ "	51,5/57 mm
Diameter of running wheels	24 ¹³ / ₁₆ /34"	630/863	mm	Diameter of superheater elements	1 ¹ / ₂ "	30/38 mm
Wheelbase, rigid	12' 9 ⁹ / ₁₆ "	3900	mm	Length of tubes between plates	19' 3 ³ / ₈ "	5800 mm
Wheelbase, total	33' 1 ⁵ / ₈ "	10100	mm	Weight empty of locomotive	80, 8 t.	82,1 t
Boiler pressure	200	lbs./sq.in.	14 atü	Weight in running order of loco-		
Grate area	53,28	sq.in.	4,95 m ²	motive	92 t.	93,5 t
Heating surface of firebox in con-				Weight on drivers	77, 7 t.	79 t
tact with fire	186,22	sq.in.	17,3 m ²	Tractive force (0.75 p)	44880 lbs.	20400 kg
Heating surface of firebox in con-				Diameter of tender wheels	2' 4"	710 mm
tact with water	199,13	sq.in.	18,5 m ²	Wheelbase of tender bogies	5' 4"	1626 mm
Heating surface of tubes, in con-				Total wheelbase of tender	15' 3 ³ / ₁₆ "	4652 mm
tact with fire	2709,30	sq.in.	251,7 m ²	Water capacity of tender	3740	Imp. Gall. 17 m ³
Heating surface of tubes, in con-				Coal capacity of tender	7 t.	7 t
tact with water	2965,48	sq.in.	275,5 m ²	Weight empty of tender	18,6 t.	18,9 t
Boiler heating surface, in contact				Weight in working order of		
with fire	2895,52	sq.in.	269,0 m ²	tender	42,2 t.	42,9 t
Boiler heating surface, in contact				Max. speed	37 miles	60 km/h
with water	3164,61	sq.in.	294,0 m ²	Smallest radius of curves	295'	90 m
Superheater surface, ext.	1016,12	sq.in.	94,4 m ²	Total wheelbase of locomotive and		
Superheater surface, int.	801,92	sq.in.	74,5 m ²	tender	56' 3 ³ / ₁₆ "	17167 mm

2:10:2 SUPERHEATED STEAM 3-CYLINDER GOODS LOCOMOTIVS FOR THE E.F. DE SOROCABANA (BRAZIL)

BY CHIEF-ENGINEER HEISE

In June 1929, the E. F. de Sorocabana placed an order with Messrs. Henschel & Sohn A.G. for a 2:10:2 (Santa Fé) superheated 3-cylinder goods locomotive with 8-wheeled tender. A general layout of the engine and principal dimensions were stipulated by the Railway. The gauge is 1000 mm (3'3³/₈" in.). The axle load was not to exceed 15,7 tons. The engine was to be able to negotiate curves of 90 m (295 ft.) radius on the road and of 70 m (230 ft.) in switches. Speed requirements were 25 km/h

(15,5 m.p.h.) as an average and 60 km/h (37 m.p.h.) as top speed. An output of not less than 1800 I.H.P. was specified, to be ascertained by indicator diagrams on the trial run. The leading dimensions are those given overleaf (see fig. 1 and plate 2).

In order to ensure easy negotiation of curves, the leading axle was combined with the adjoining coupled axle to form a Krauss truck with side play at the pivot, the displacement to either side being limited to 150 mm ($5\frac{7}{8}$ " in.) for the leading truck axle, 70 mm ($2\frac{3}{4}$ " in.) at the pivot and 20 mm ($\frac{13}{16}$ " in.) for the coupled axle. The driving and intermediate trailing coupled wheels are flangeless and wider on the thread than the other wheels. The trailing truck axle with outside boxes is carried in an American type bissel truck affording 105 mm ($4\frac{1}{8}$ " in.) free play to either side. The boiler center is 2500 mm ($8'2\frac{7}{16}$ " in.) above rail level. The firebox is of steel and 2300 mm ($7'6\frac{9}{16}$ " in.) long by 2150 mm ($7\frac{5}{8}$ " in.) wide above the grate. The brick arch is supported by four water tubes. The grate is of the combined rocking and dump type. The ashpan is arranged in three sections between and outside of the frames. Besides the customary dampers, free air passages are provided longitudinally between the foundation ring and the ashpan. Emptying of the ashpan is effected through bottom slides. Spark arrester plates with close-pitched perforations are fitted in the smokebox.

The boiler feed is obtained by two No. 9 "Simplex" injectors. American "Okadee" boiler blow-off cocks are arranged on the firebox sides. A "Nathan" water gauge and three pet-cocks are provided.

The two "Pop Coale" type safety valves have a free passage of $3\frac{1}{2}$ in. each. Two "Superior" tube cleaners are located on the firebox sides.

The frame is formed of bars 100 mm ($3\frac{15}{16}$ " in.) thick with plate extensions of 40 mm ($1\frac{9}{16}$ " in.) thickness extending rearwards from behind the trailing coupled axle. The boiler is rigidly held down on the cylinder saddle casting and free to expand in the barrel carrying brackets, the front firebox carrier and the expansion plate below the firebox back plate. The two horizontally arranged outside cylinders and the inclined inside cylinder drive on a common driving axle which is the middle one of the 5 coupled axles. The cylinders are fitted with "Hunt-Spiller" bushes. The pistons and valves are lubricated by a "Detroit" lubricator.

The leading intermediate coupled axle had to be cranked to provide sufficient clearance for the inside cylinder connecting rod.

In accordance with modern practice, independent valve motions were adopted. The valve of the r. h. cylinder is actuated by a standard Walschaert gear. On the left side of the locomotive, the "Walschaert" gears controlling the l. h. outside and the inside cylinder are arranged side by side, the respective quadrants being controlled by a twin return crank (fig. 1). With this arrangement excellent results were obtained.

There is a steam reversing gear of an approved type as adopted by the South African Railways. Each cylinder is equipped with an automatic bypass valve. Braking is effected by a vacuum brake and a steam brake, both acting on the wheels of

Sorocabana km 104,7

B. Tobias km 93,5

Inhayba km 89,7

Piragibú km 84

Rodovalho km 79

Pantojo km 73,7

Mayrink km 69,3

S. Roque km 63,3

G. Piza km 58,5

Maylasky km 53,7

S. João km 48

Altitude in metres .

Distance in km . .

Kilometer post . . .

Curve radii in m. .

Schedule arr. . . .
dep. . . .Running time in
minutes

Water consumption

Coal consumption .

Boiler pressure . .
atm. = lbs.Superheating tem-
perature in centi-
grades.

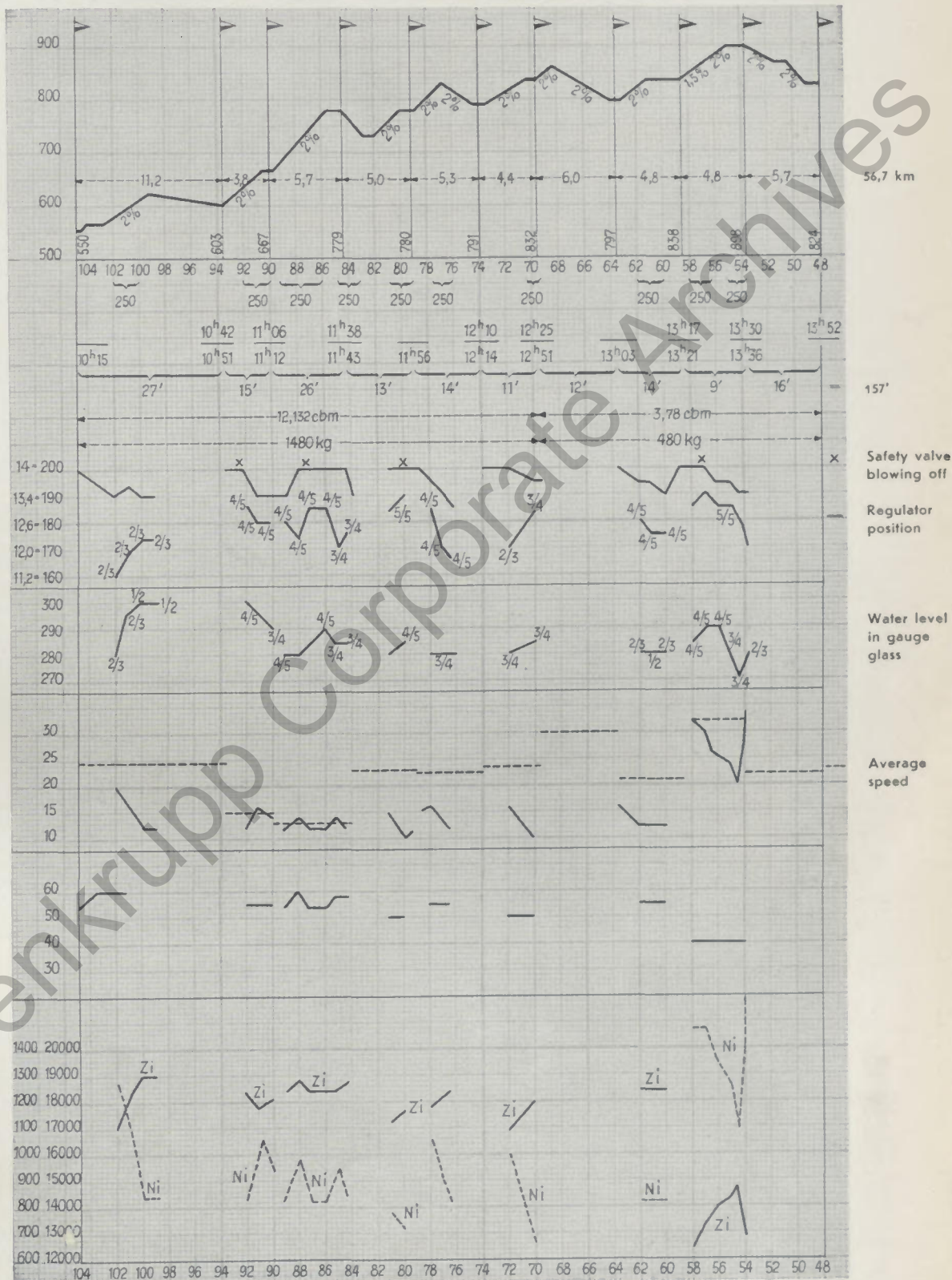
Speed in km/h . .

Cut off ε.

Output in I.H.P. .

Indicated tractive
force in kg

Kilometer post . .



RESULTS OF THE DYNAMOMETER RUN FROM SOROCABANA TO S. JOÃO—MARCH 6th 1930

2

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31

the four rigid coupled axles by means of one block in front of each wheel. The two large cylinders of the vacuum brake are supported on brackets secured to the boiler barrel, as they could not be accommodated in the narrow space between the frames. With this arrangement they are particularly accessible. The boiler is lagged with magnesia enclosed by planished sheets. The locomotive is fitted with a sturdy cow-catcher, "Henricot" automatic couplers, "Hasler" speed recorder, "Pyle National" electric lighting equipment with type E 1500 watt turbo-generator, "Franklin" radial buffer between the engine and tender and a powerful hand screw brake on the tender.

The results of one of the trial runs appear from the diagram on page 31. This train consisted of 15

wagons having a total weight of 581 tons. Gradients were up to 20‰, the smallest radius of curves being 250 metres (820 ft.).

Fuel: Cardiff coal. Weather: very warm and dry. The comparatively low temperature of superheating is explained by the fact that the water level in the boiler was kept very high during the whole run in order to increase the adhesive weight which was near the limit. Steaming was excellent and the working pressure could be easily maintained.

On March 22nd 1930 a trial run was made during which indicator diagrams were taken. The maximum average output was 1905 I.H.P. The engine had thus considerably exceeded the requisite 1800 I.H.P. and expectations were fully realized.





Cape Point light house

4

THE CAPE OF GOOD HOPE

SOUTH AFRICAN RECOLLECTIONS

BY

DIRECTOR H. v. GONTARD



5

The turning point of the sea-man bound for India! After doubling the Cape, the course which was so far generally south, becomes due east for the first time. This fact poured fresh confidence into the minds of those who were trying to find the sea-route to India and made the Cape of Good Hope the landmark of South Africa, although it is not the south end of



the black continent. The Cape was discovered in 1486 by Bartholomeo Dias who came as far south as Cape Agulhas, the southernmost point of South Africa. Vasco da Gama doubled the Cape on November 22nd 1497 during the voyage in which he discovered the sea route to India.



The Court Building, Johannesburg

7



Adderley Street, Cape Town, the main thoroughfare and business center

9



The Town Hall, Durban

8



A Boer settlement in the Cape Province

10



On the Natal shore, southwest of Durban

11

THE TERRITORY OF THE UNION OF SOUTH AFRICA,

comprising the Cape Province, Natal, Transvaal and the Orange Free State, hardly conveys the impression of belonging to the "black" continent. The larger towns have an entirely European appearance. The country is covered with a comparatively dense net of railways. The South African Railways are extremely well developed and in a few regards



The Dragon Mountains (Natal) from the east

12



Prince Albrecht Pass (Cape Province)

13



An artificial lake near Pretoria

14

may be considered as a model institution, even from a European point of view. Rail traffic is complemented by bus and air lines, and numerous wireless stations keep even the remotest farm in connection with the world outside. Lovely watering places are found along the coast and the interior offers scenery of overwhelming beauty. Indeed, South Africa is often chosen as a **winter resort** instead of **Egypt**. The South African Railways have travel offices of their own in the most important cities of the world, such as London and New York. Cape Town — situated about 30 miles north of the Cape at the



Entering the Hex Valley down grade (snapshot taken in a curve from the Johannesburg-Cape Town Express).

15



The Cape Town-Johannesburg Express in the Hex Valley

16



In a Cape Province railway station

17

north foot of the Table Mountain (3550 ft. high) and developed from a Dutch fort founded in 1652 — is still the seat of Parliament but upon the foundation of the Union it had to give over its rank as a capital to Pretoria, about 30 miles distant from the mining center Johannesburg. The General Management of the South African Railways is in Johannesburg, whilst the Railway Ministry, together with the other Government Departments, resides in Pretoria. Durban is known as the most important harbour of the South African east coast. An idea of the vastness of the country is conveyed by the fact that Cape Town and Johannesburg are more than 1000 miles distant from each other.



The Lion's Head near Cape Town

18

THE VICTORIA FALLS



are one of the finest spectacles of nature in South Africa. About 30 miles below the junction of the Tshobe River with the Zambezi, the latter, which is 5932 ft. broad at this point, falls from a height of 390 ft. into a crevice 144—328 ft. wide, crossing the valley at right angles. Livingstone was the first white man to see the falls in 1855. — The immense potential force present in these falls immediately suggests their being utilised for the generation of electric power. In fact, a company

was formed with this aim in view, but the construction of the power station has not begun as yet, because the chief consumers of current are so far away that the economy of the project appears problematic owing to the high cost of the long distance mains. Bulawayo, the **nearest** traffic center of any importance, is almost 250 miles away from the falls. Moreover, the installation of long distance mains seems objectionable in view of the exceedingly strong tendency to electric storms in that region.



20 a

The railway bridge across the Zambezi east of the Victoria Falls (on the Bulawayo-Livingstone-Elisabethville line which forms the principal connection between Rhodesia and the Belgian Congo)



20 b

Rapids of the Zambezi above the Victoria Falls



21

Cañon below the Victoria Falls



22

A native kraal in Southern Rhodesia

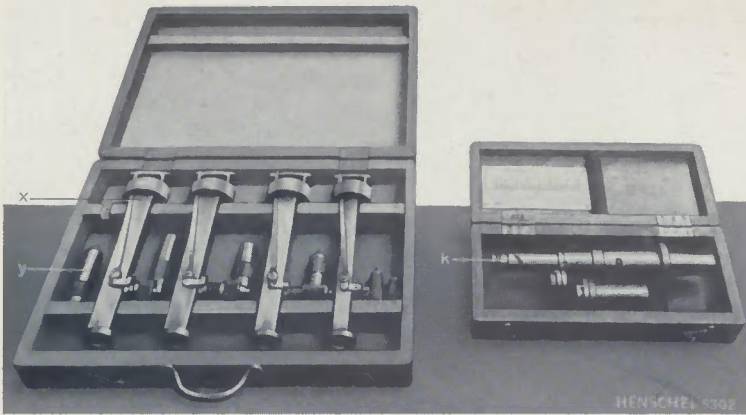


23

The Orange River near Vereeniging (Transvaal)

MODERN CHECKING METHODS FOR THE MANUFACTURE OF LOCOMOTIVE PARTS

BY DIRECTOR DR. FICHTNER, KASSEL



BOX WITH TELL-TALE GAUGES, CALIPER PINS AND MICROSCOPE

1. BENCH FOR CHECKING LOCOMOTIVE CONNECTING AND COUPLING RODS

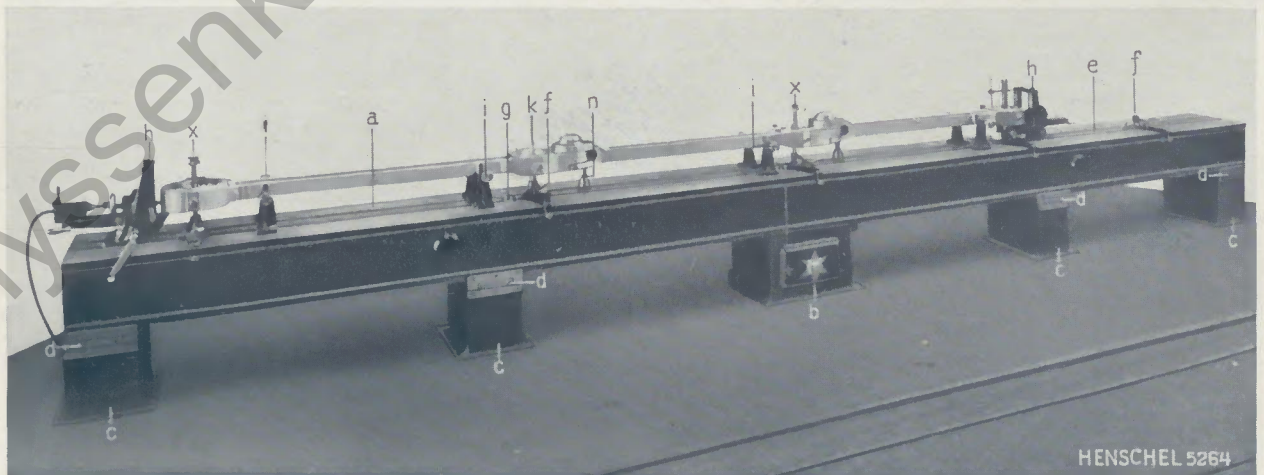
Interchangeability as applied to locomotive construction for a number of years has necessitated the development of special working methods and measuring devices for boilers, frames, cylinders, wheel sets, axleboxes, driving and motion gear details.

The finishing and checking of connecting and coupling rods requires an extensive equipment, considering that in these parts accurate distance between, and parallelity of, the end bores play a particularly important part. The tools used hitherto for checking were trammels and calipers. They are however unfit to comply with up-to-date requirements whereby tolerances are reduced to $\frac{1}{10}$ mm (.00393 in.).

Messrs. Henschel & Sohn have developed a rod checking bench on which a microscope and tell-tale gauges are used in conjunction with a measuring rod having a microscopically fine graduation.

Description: The device consists of a bench (a) 8 metres (26 ft. 3 in.) long, supported on 5 stands (see fig. 25). It is rigidly bolted to the center stand (b), whereas roller supports (d) are provided in the other 4 stands (c) to allow of longitudinal expansion under the influence of temperature variations (fig. 27). In the longitudinal center line of the bench a measuring rod (e) with a microscopically accurate graduation is let in (fig. 26, 28, 32). Running parallel with this rod are two T-shaped grooves in which the bases (f) taking the microscope and measuring pins and equipped with a fine motion (g) are secured by clamps. The carrying brackets (h) and guides (i) are arranged to slide in the grooves in a similar way (fig. 25 & c.).

Each of the bases (f) has a taper bore into which the microscope (k) (fig. 28 and 33) and measuring pin (l) (fig. 29) are alternately inserted.



ARRANGEMENT FOR THREE RODS

25



ARRANGEMENT FOR TWO RODS

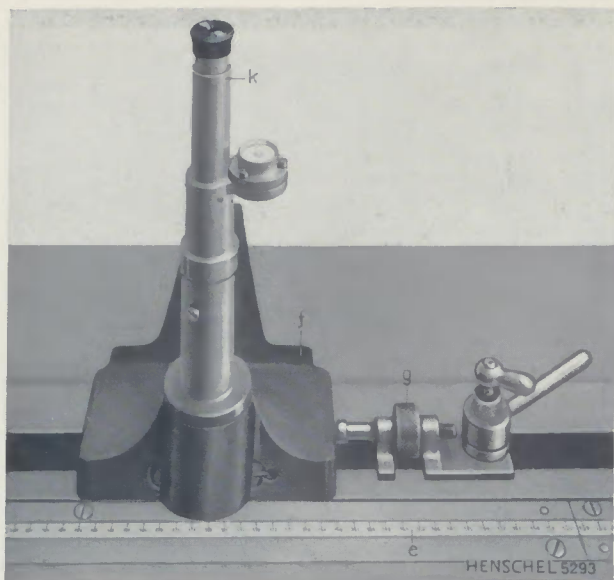
26



27

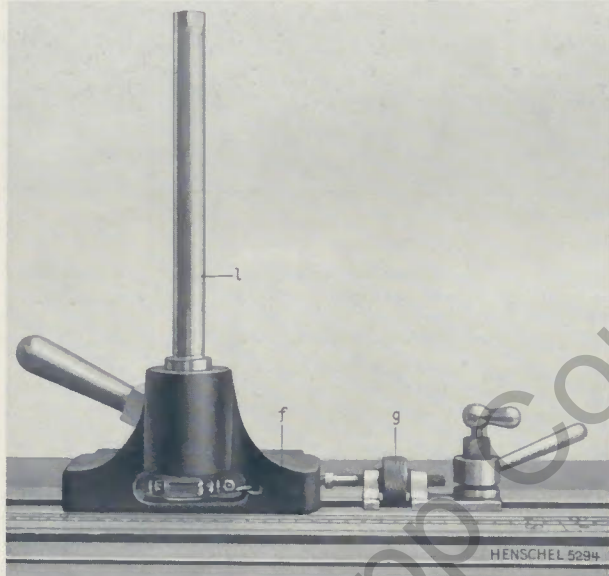
THE ROLLER SUPPORT OF A BENCH STAND

Below the taper bore an electric lamp is fitted to the base to illuminate the measuring rod (fig. 30), the current being supplied through the arm (m) (fig. 31) which encompasses the edge of the bench and ends in the contact (n). The latter slides on the contact strip (o) arranged in the front surface of the bench and connecting with an accumulator located in the center stand (b) (fig. 25). This arrangement permits of illuminating the field of vision of the microscope (k). The carrier brackets (h) (fig. 31) can be clamped to the bench in any position. Each bracket is fitted with a supporting shelf (p) on which the rods are placed and which can be moved up and down by a screw, accurate adjustment being obtained by a millimeter graduation (q) and a vernier. In the carrier brackets a screw spindle (r) is arranged in the longitudinal center line of the bench to provide for longitudinal displacement of the rods by means of the handwheel (s). The screw spindle (r) has an internal bore extending for its full length and a slide (t) carries a small compressed air drill (u) the tool (v) of which is passed through the bore in the spindle to mark a permanent center in the rod end as a reference for further work on it. True alignment of the rods is obtained by the guides (i) (fig. 31).



THE MICROSCOPE

28



THE GAUGE PIN

29



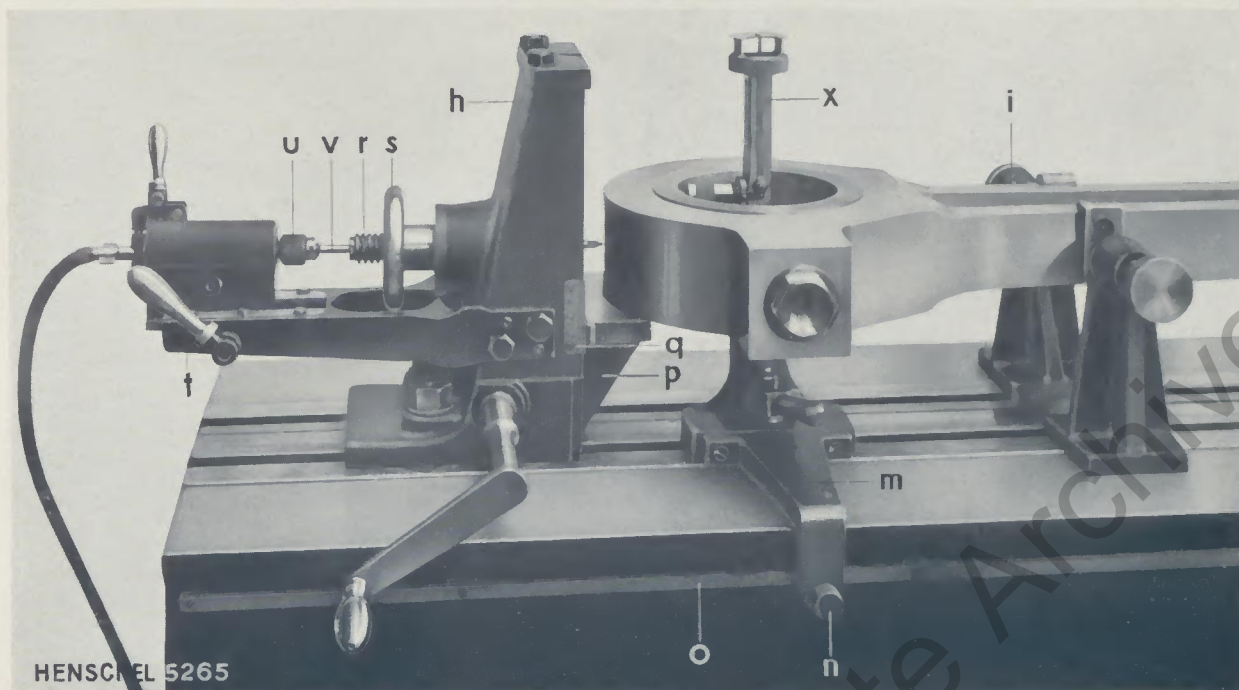
THE FIELD OF VISION OF THE MICROSCOPE 30
IS ELECTRICALLY ILLUMINATED

38

Additional support for long rods is provided for by special screw jacks (n) placed on the bench as may be required (fig. 25).

The microscope (k) (fig. 28) for adjustment of the bases (f) is a hollow pin housing the optical system. A very sensitive bulb serves to verify the vertical position of the microscope. The latter makes it possible to adjust the base centers (f) taking the gauge pins to 0.01 mm (.000393 in.) reading of the measuring rod led into the bench. The bottom ends of the gauge pins (l) (fig. 29) fit the taper bore in the bases (f). The top portion is cylindrically ground and carries the tell-tale gauges (x) (fig. 32) which serve to check the bores in the rod ends for parallelity and true center coincidence in relation to the gauge pin (l) (fig. 36). The gauge consists of a sleeve with a rectangular attachment to take the feeler pin (y) (fig. 24 and 32), the latter being spring loaded and connected with an indicator hand moving along a graduation to $\frac{1}{20}$ mm (.001968 in.).

Operating method: The connecting and coupling rods—with brasses fitted—are placed on the bench and traced for drilling with their theoretical centers as a point of reference. In the case of coupling rods the set is completely assembled, whereas connecting rods are individually placed on the bench with the ends resting on the shelves (p) of the carrying brackets (h) (fig. 31). These shelves are adjusted for correct height, according to the thickness of the rod ends, by means of the millimeter scale (q) so that all rod ends are parallel with the bench. A base (f) is then secured below the center of every rod end in one of the T-grooves of the bench, the microscope (k) is inserted into the taper bore of the first base through the bore in the rod end and after switching on the light the base is moved until the zero mark of the microscope (k) coincides with that of the measuring rod (e) (fig. 33). Next, the other bases are displaced in a similar way along the measuring rod (e) for exact distance from the first base as given in the drawing, so that, when the operation is ended, each bore in the rod has its corresponding base adjusted to the nominal dimensions. A gauge pin (l) (fig. 34) is then inserted into the taper bore of each flange and the rods are transversely and longitudinally aligned by means of the guides (i) and carrying brackets (h) so as to have the centers of the rod ends coincide with the centers of the gauge pins (l).



DRILLING PERMANENT CENTERS IN THE ROD ENDS

31

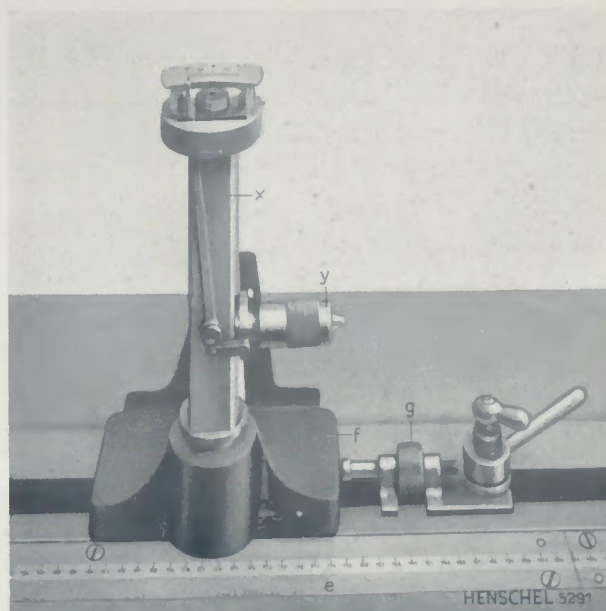
For this operation a straight edge (z) with a millimeter graduation is used (fig. 34).

By means of the scribing needle (a₁) (fig. 35) a reference circle is drawn on every rod end for alignment and boring of the bearings on the drilling machine. At the same time the rod center is marked by drilling permanent centers in the ends (fig. 31) to take the points of the clamping device on the boring machine. This ensures coincidence of the rod center with the boring machine center line and a true rectangular position in relation to the tool support.

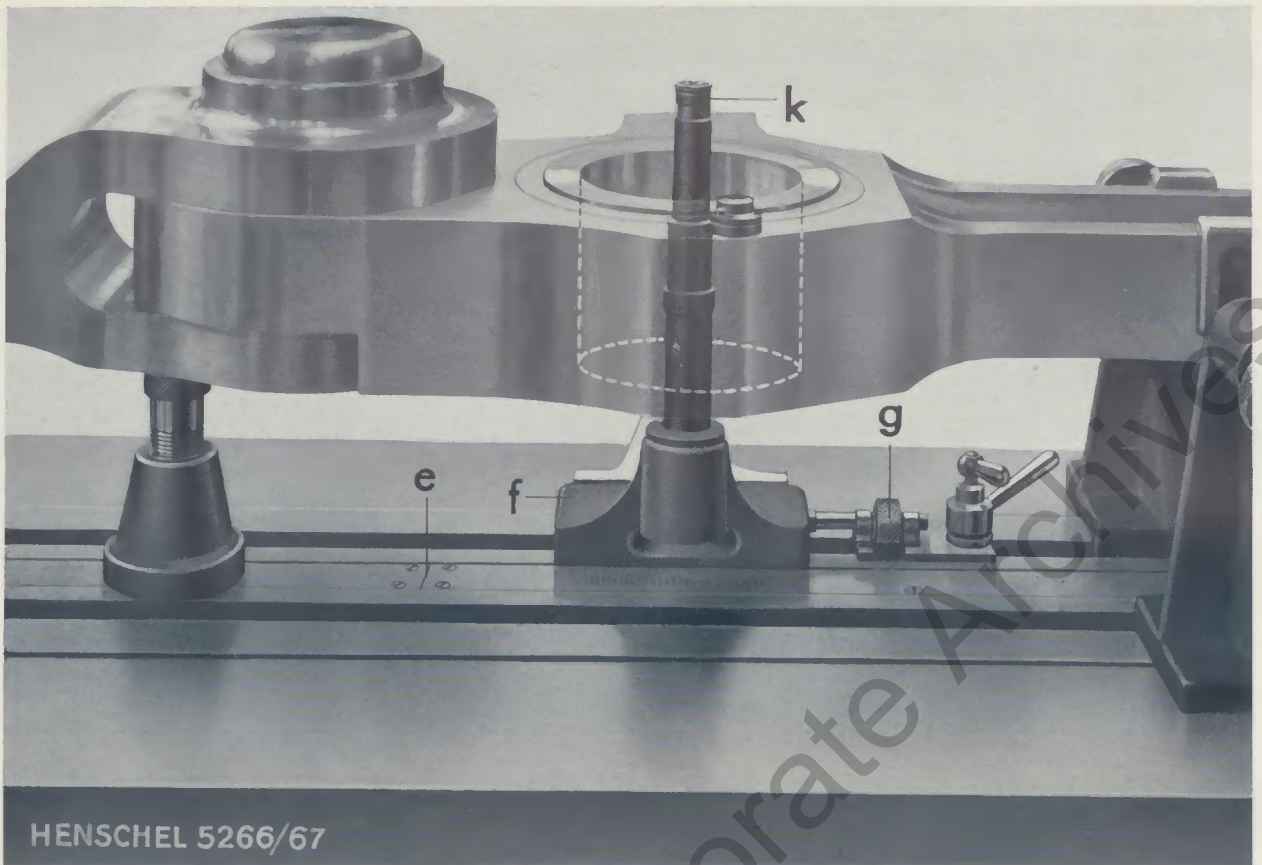
When the boring is completed, the rods are again placed on the bench to check the finished bores with the aid of the gauge pins (l) inserted into the bases (f) which is done by means of the tell-tale gauge (x) (fig. 36). A rod bearing is set to a true center with a gauge pin (l) whereupon the second bearing is examined for deviation of its axis from that of the corresponding gauge pin. By moving the feeler attachment (x) up and down on the pin (l), the parallelity of the bore in the rod is checked whilst turning it around the pin shows whether the bore is accurate or out of center and whether the rod is longer or shorter than the distance between base centers as previously adjusted. Deviations are shown on the gauge in $\frac{1}{20}$ mm

(.001968 in.). The positions of the base centers can be checked at any stage of the measuring operation by inserting the microscope.

This tracing and checking method ensures interchangeability of connecting and coupling rods within a few hundredths of a millimeter in length. Messrs. Henschel & Sohn A.G. have supplied several such checking equipments to locomotive repair shops.

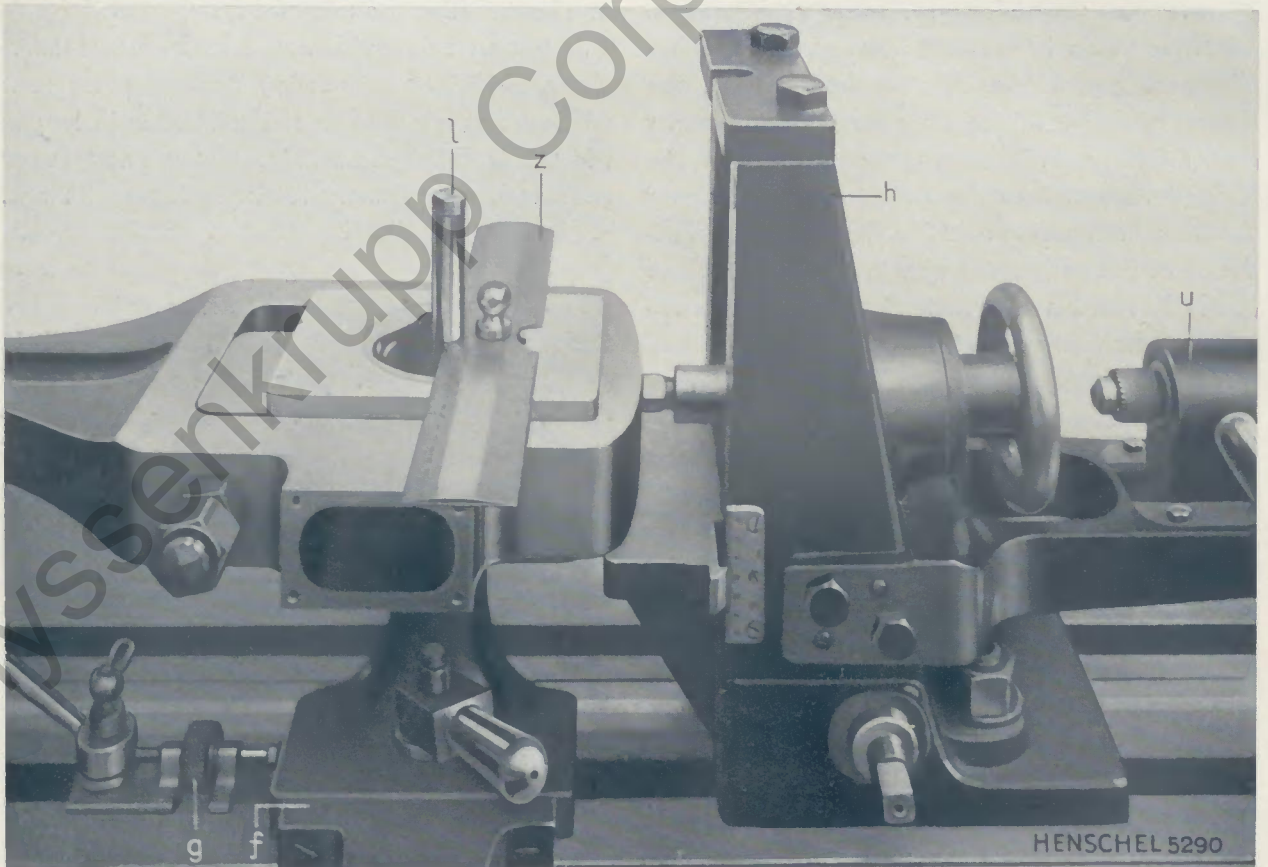


THE TELL-TALE GAUGE (x) WITH THE PIN (y)



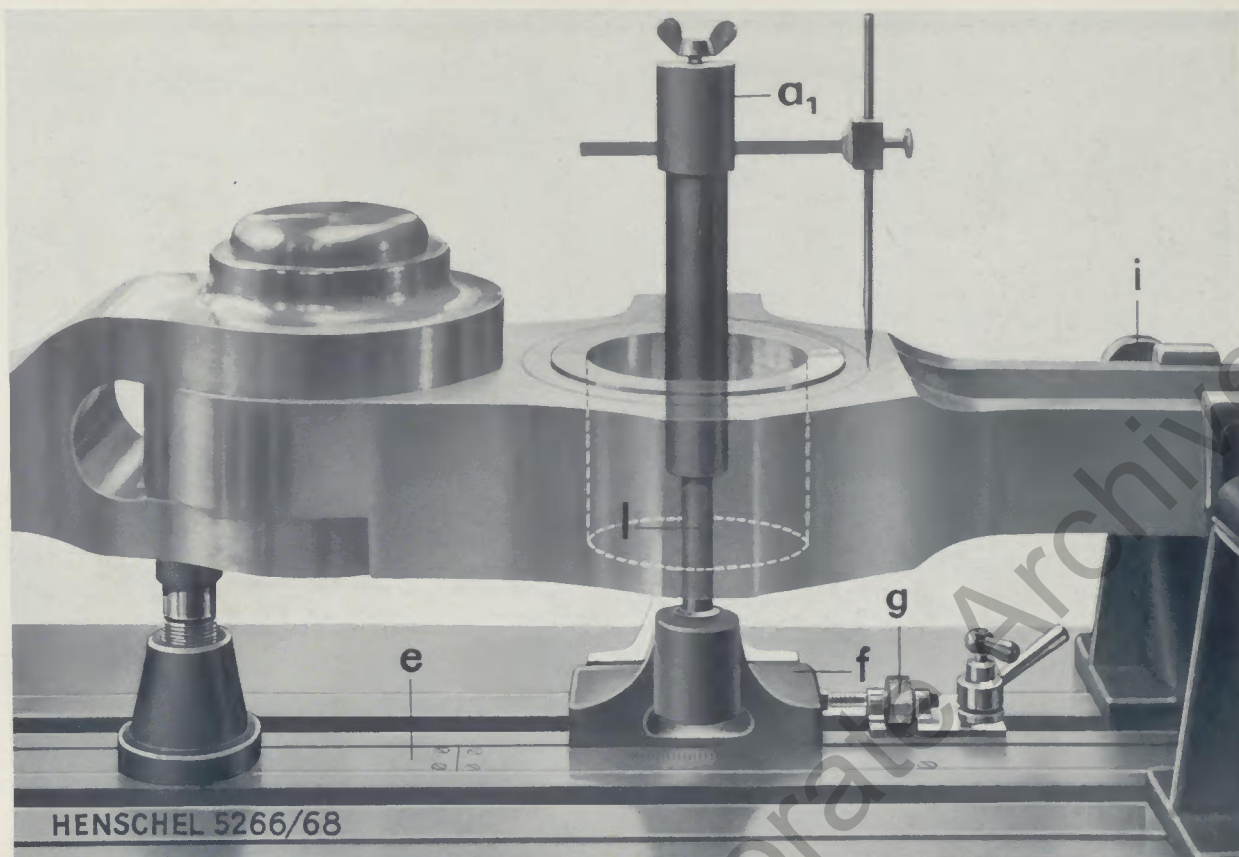
HENSCHEL 5266/67

THE BASE (f), WHICH IS TO TAKE THE GAUGE PIN AT A LATER STAGE OF THE CHECKING, IS ADJUSTED TO THE BEARING CENTER LINE BY MEANS OF THE MICROSCOPE (k) 33

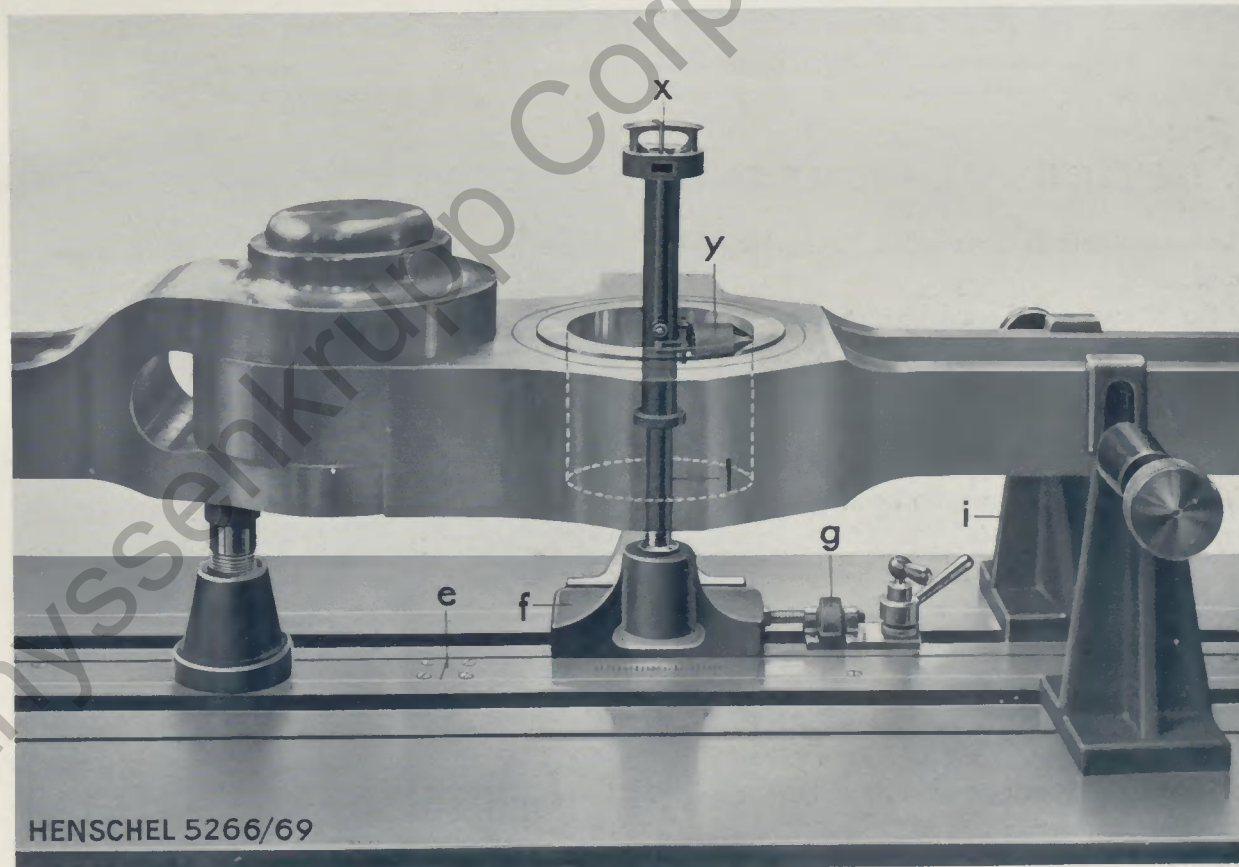


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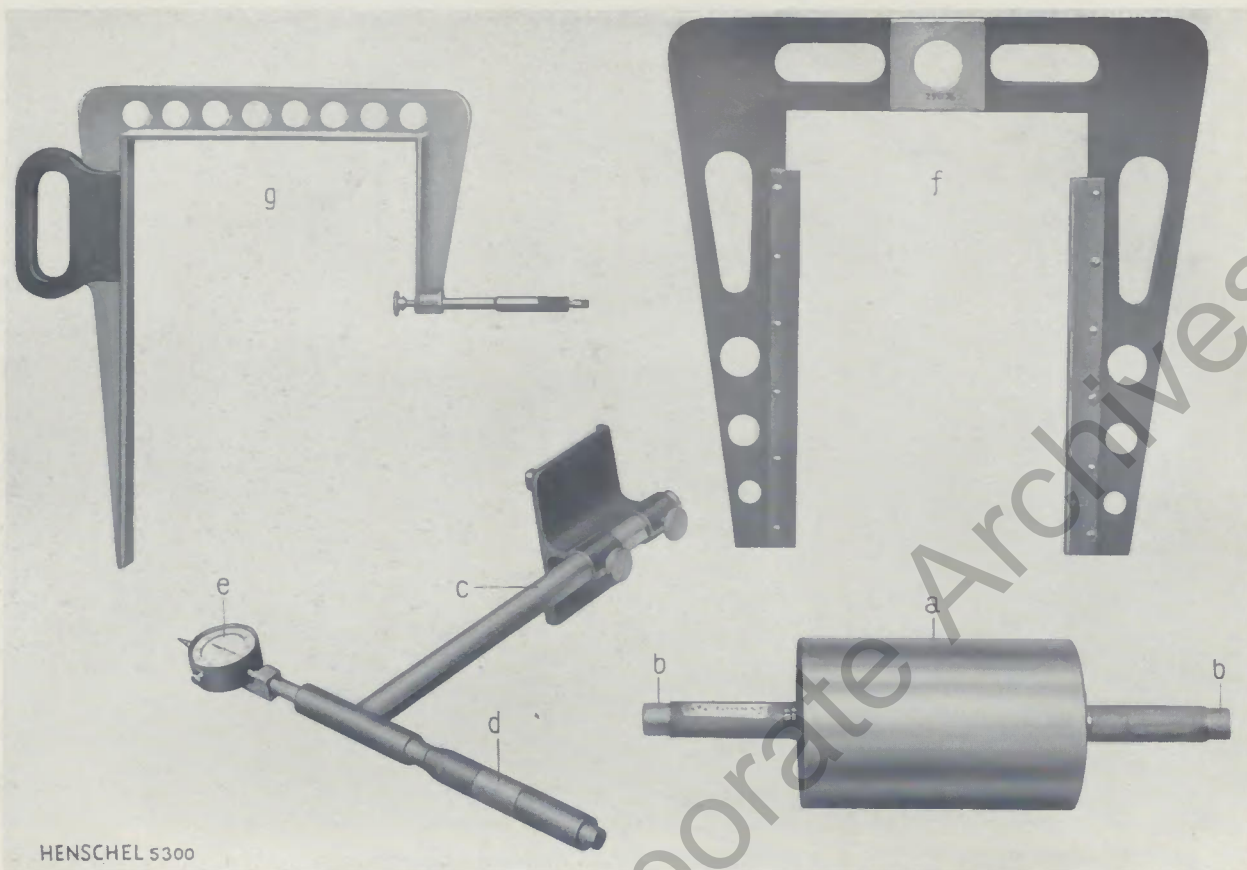
SETTING THE ROD END TO A TRUE CENTER WITH THE GAUGE PIN (l) 34



TRACING REFERENCE CIRCLE ON ROD END PREVIOUS TO BORING OUT THE BEARING 35



CHECKING THE BORE IN THE ROD END



THE MEASURING TOOLS REQUIRED FOR THE CHECKING OF LOCOMOTIVE AXLEBOXES

37

(a) Mandril with ground ends (b), (c) Measuring device with micrometer screw (d) and tell-tale gauge (e)

(f) Outside gauge
(g) Micrometer gauge

2. DEVICES FOR CHECKING LOCOMOTIVE AXLEBOXES

The main items to be verified in checking axleboxes are:

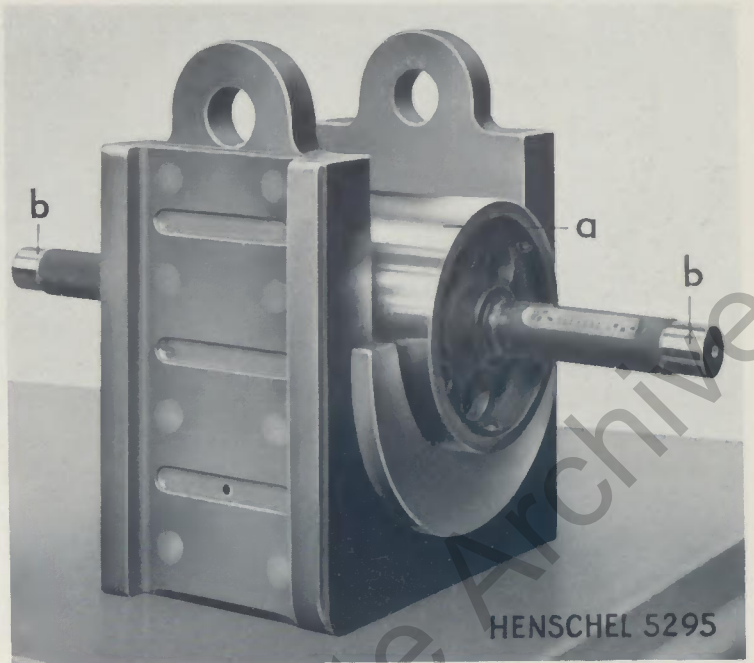
- a) the diameter of the axlebox bore (fig. 38),
- b) the distance between the axis of the axlebox bore and the hornfaces (fig. 39),
- c) the distance between the hornfaces of each axlebox (fig. 40 and 41),
- d) the distance between the bearing face and the hornface centers (fig. 42),
- e) the length of the bearing (fig. 42).

Ad a). The diameter of the axlebox bore is checked by a mandril (a) which is ground to the finished diameter (fig. 37 and 38), the spindles (b) being also accurately ground. The mandril is placed into the carefully finished bore and when turned shows to which extent the contour of the bore deviates from its circumference.

Ad b). The tell-tale gauge (c) (fig. 37) consists of a light slipper through the bore of which a T-shaped

tube is passed. The short shank of the T carries a micrometer screw (d) and the gauge (e).

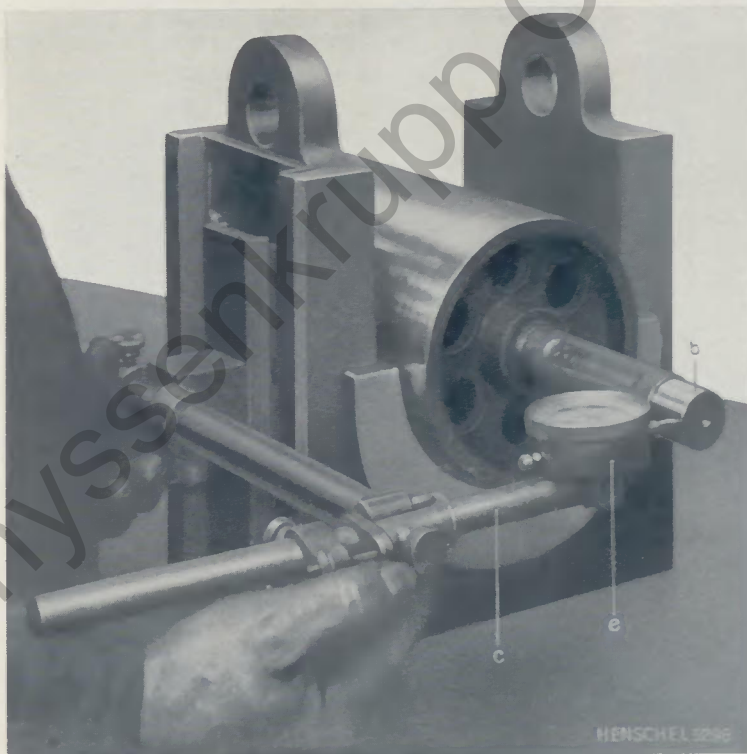
Checking with the tell-tale gauge (c) (fig. 39) begins at the hornface which is in contact with the vertical guide secured to the frame. The micrometer screw (d) is set to the dimension given in the drawing as the distance between the hornface and the axis of the axlebox bore, whereupon the slipper (c) is moved up and down on this hornface, when the point of the gauge must slide over one of the ground mandril ends (b). If the bearing is accurately finished, the hand of the gauge must be at zero when the shortest distance between the mandril spindle (b) and the hornface is reached. If it fails to do so, the gauge reading expresses in $\frac{1}{100}$ mm (.000393 in.) deviation from the zero mark the amount of inaccuracy of the distance from the hornface to the axis of the bearing. Then, with the tell-tale gauge turned through 180° , the distance



38

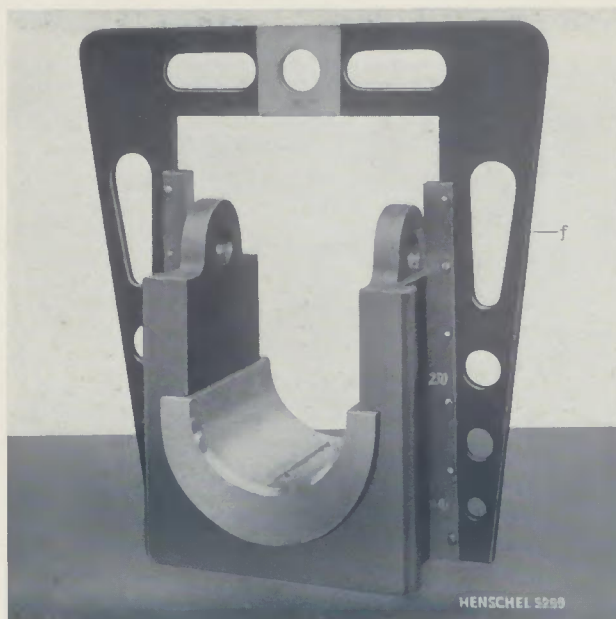
from the same hornface to the opposite spindle (b) is measured. If the two distances are equal, the axlebox bore is parallel with the hornface. The gauge can be turned so as to have the dial always pointing upward.

Ad c). The checking of the distance between the hornfaces of the same axlebox is done with an outside gauge (f) (fig. 37 and 40) with shanks sufficiently long to make contact with the hornfaces over their whole length.

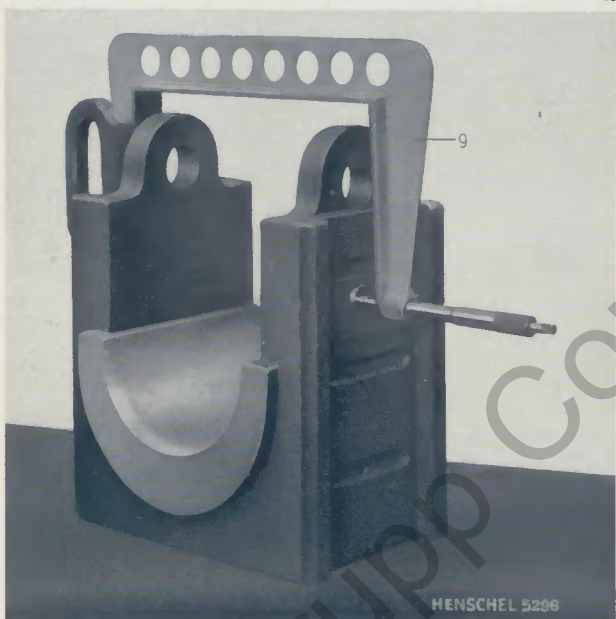


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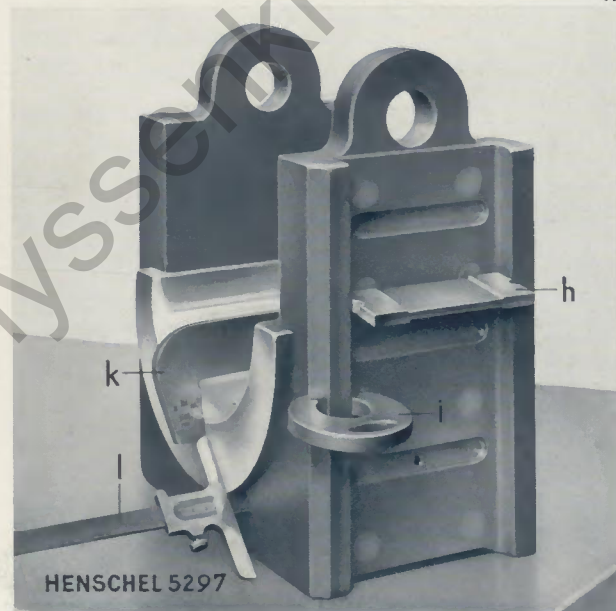
CHECKING THE DISTANCE BETWEEN THE AXIS OF THE AXLEBOX BORE AND THE HORNFACE



40



41



42

This outside gauge can be replaced by a micrometer gauge (g) (fig. 37 and 41) which permits of measuring the distance to $\frac{1}{100}$ mm (.000393 in.).

Ad d) and e). The checking of the correct position of the bearing in the axlebox—length of bearing and distance between bearing face and hornface center—does not require any special devices, but is done with normal tolerance gauges (h, i, k), and a depth gauge (l) (fig. 42).

In the Henschel shops axleboxes which have thus been checked and found correct are fitted on the journals without any scraping of bearings.

This checking method which is intended for axleboxes of new locomotives can also be applied to repair engines. In this case, however, mandrils of varying diameter are required, considering that the **axle journals** of engines which have been in service for some time are worn to a greater or lesser extent. A very useful expedient for such purposes is the Henschel adjustable checking mandril (m) (fig. 43), which permits of a variation in diameter of 15 mm (.59 in.) and even of direct measuring of the axlebox bore to $\frac{1}{100}$ mm (.000393 in.).

It consists of a drum (m) with six bars (n) which can be radially displaced by turning a milled sleeve (o). The diameters thus obtained can be read in millimeters on the graduation of the inner sleeve (p) and in hundredths of millimeters on the graduation on the sloping face of the outer sleeve (o).

The longitudinal bore of the adjustable mandril takes a ground tube (q) from which the distances between the axis of the bearing and the hornfaces are measured as described under (b) (fig. 44). In order to check the diameter of the bearing, the mandril is placed into the latter so as to have three of its bars make contact, whereupon the diameter is read on the graduation by means of the vernier.

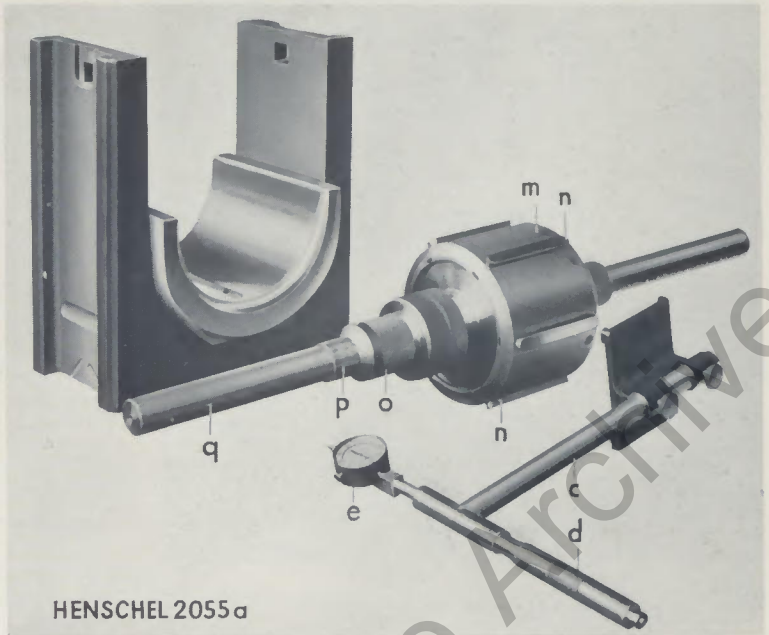
40—41: CHECKING THE DISTANCE BETWEEN THE TWO HORNFACES

40: BY MEANS OF THE OUTSIDE GAUGE

41: BY MEANS OF THE MICROMETER GAUGE

42: CHECKING THE LENGTH OF THE BEARING AND THE DISTANCES BETWEEN BEARING FACES AND HORNFACE CENTERS

HENSCHEL - 2 - 1930

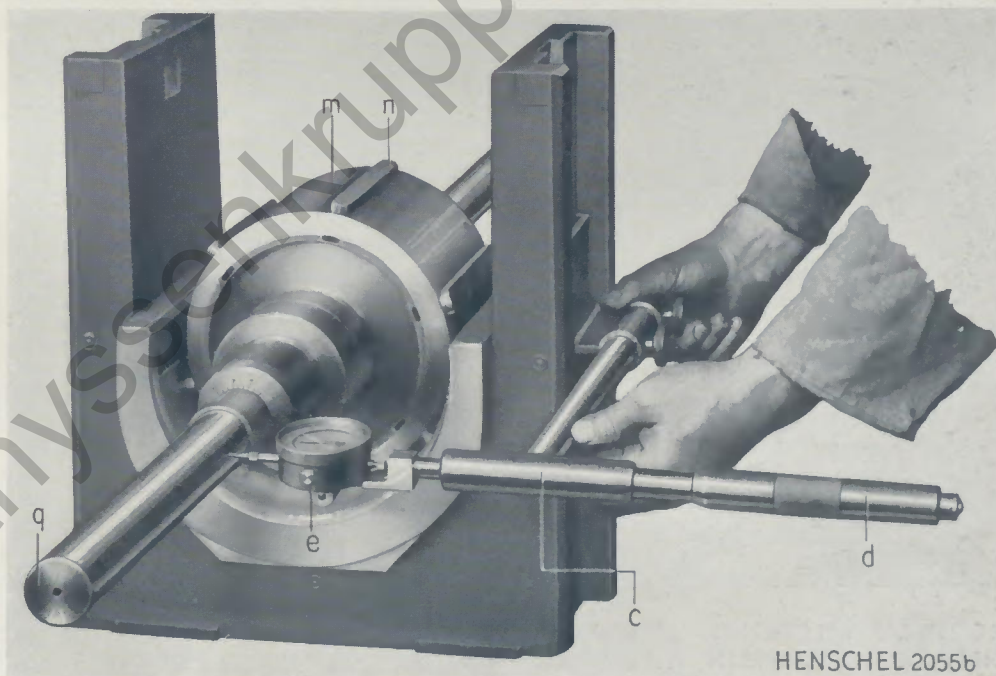


43

All other verifications are made in the same way and with the same instruments as for axleboxes of new locomotives.

The adjustable axlebox checking mandril is manufactured with a margin of radial displacement of 10 mm (.3937 in.) for diameters of 120 to 140 mm (4.7244—5.5118 in.) and of 15 mm (.5905 in.) for diameters above 140 mm (5.5118 in.). For the check-

ing of bushes, mandrils of 50—120 mm (1.9685 to 4.7244 in.) diameter, graded every 10 mm (.3937 in.), are available, each size with 10 mm (.3937 in.) margin for adjustment, the number of bars being 3 or 4, according to size. It will be interesting to note that numerous locomotive repair shops have embodied Henschel axlebox checking mandrils and tell-tale gauges in their equipment.



CHECKING THE
AXLEBOX
OF A REPAIR
LOCOMOTIVE

44



LEFT TO RIGHT:
H. E. TSIANG TSO PING
OSCAR HENSCHEL
DR. LIANG

45

On October 30th 1930
our works

had the visit of

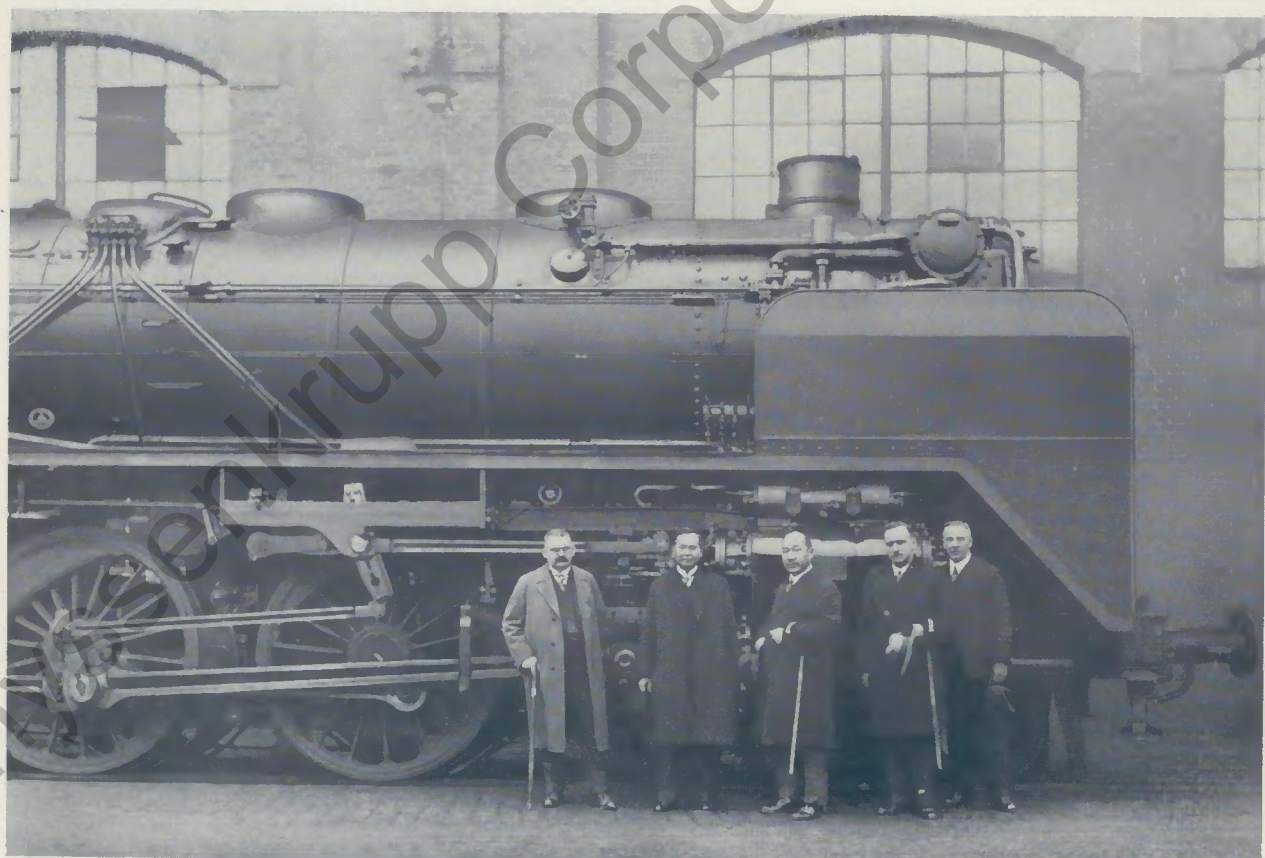
H. E. the Chinese

Ambassador in Berlin

TSIANG TSO PING

and DR. LIANG

Councillor to the Chinese
Embassy of Berlin



LEFT TO RIGHT: DIRECTOR DR. FICHTNER, DR. LIANG, H. E. TSIANG TSO PING, MR. SIXT OF THE SHING MING TRADING CO. OF TIENTSIN, THE CHINESE FIRM OF OUR REPRESENTATIVES FOR CHINA, MESSRS. MERCK & CO., DIRECTOR VON GONTARD

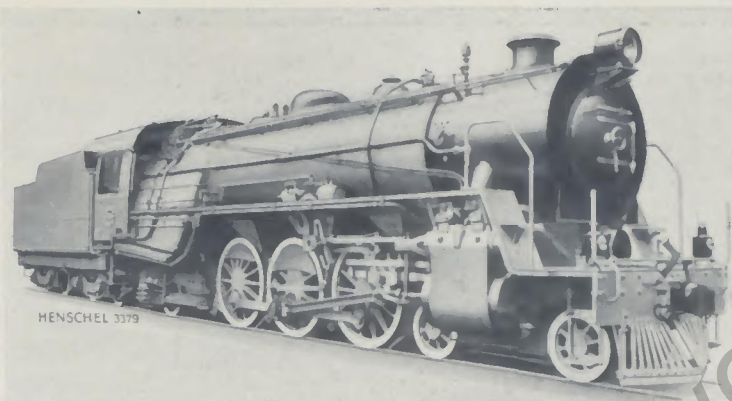
46

THE LATEST DEVELOPMENT OF THE 4:6:2 EXPRESS LOCOMOTIVE 16 DA CLASS OF THE SOUTH AFRICAN RAILWAYS

BY CHIEF ENGINEER BÖHMIG, DIPL. ING.

21749

PISTON VALVE GEARED LOCOMOTIVE



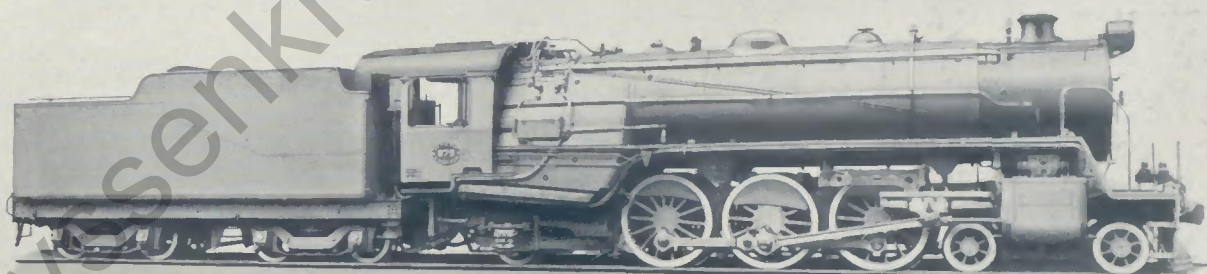
56

Among the different orders recently placed with Henschel & Sohn A.G. by the South African Railways, the one completed in August 1930 comprising six 16 DA class locomotives is of special interest. The specifications governing this contract called for a number of special features modifying the original design of Messrs. Baldwin and which merit a short description of the leading characteristics of these modified 16 DA type locomotives.

In order to increase the efficiency of the existing locomotives for heavy express service, the grate area was enlarged from 45 to 60 sq. ft. and the grate changed from bar grate to the perforated grate type (plate No. 3). Exhaustive trials carried out in South Africa had shown that the perforated grate was the most suitable type for use with the local coal having a calorific value of 3100.

In these engines the air space is 26% of the total grate area. The air passes uniformly through the conical holes having a smallest diameter of $\frac{3}{4}$ in. The grate is designed with 56% rocking grate and 23% dump grate. The ashpan is carried on the frames; air is admitted on either side by means of openings on a level with the foundation ring, which openings are covered by perforated plates hinged to the ashpan sides. There are no dampers in the ashpan.

The good results obtained with the Multiple Valve Regulator for use with the superheated engines induced the SAR to specify this type for the new 16 DA locomotives. When operating the regulator lever, a small auxiliary valve is first opened to superheated steam and then, as the lever is moved further, the main valves are operated, this system

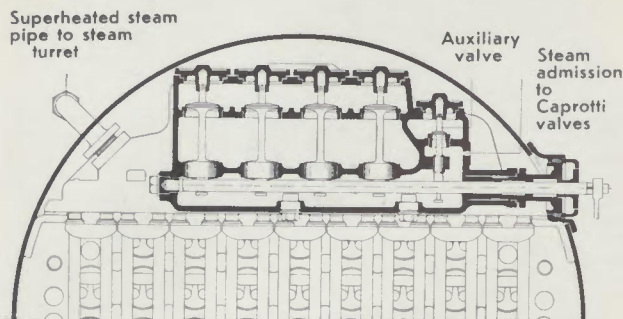


21754

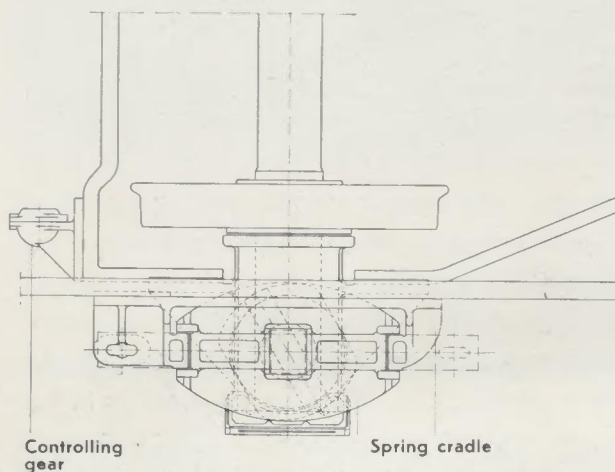
57

LOCOMOTIVE WITH CAPROTTI VALVE MOTION

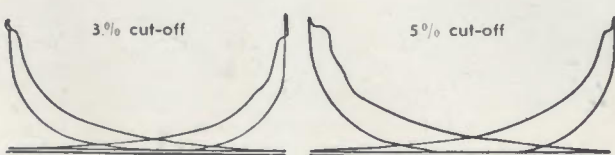
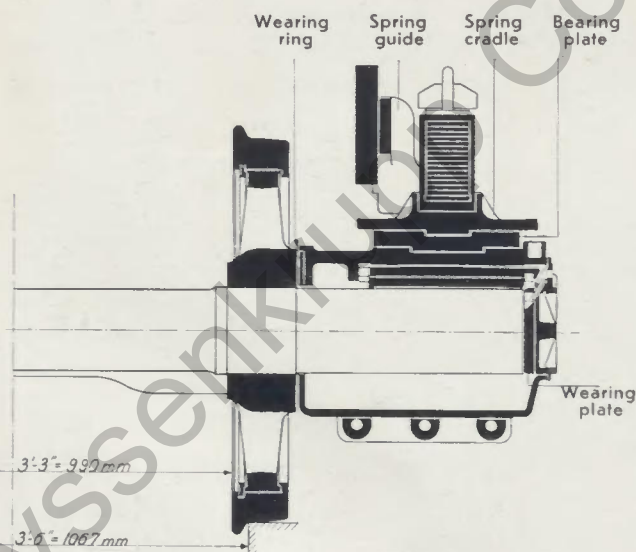
Gauge	3' 6"	Grate area	60 sq. ft.	Water capacity of tender	6000 Imp. gal.
Diameter of cylinders	2' 23"	Evaporative heating surface, in contact with fire	2347 sq. ft.	Coal capacity of tender	121
Piston stroke	26"	Superheater surface, int.	668 sq. ft.	Diameter of tender wheels	2' 10"
Diameter of drivers	5' 0"	Weight, adhesive	53 t 19 cwt.	Weight empty of tender	29 t 14 cwt.
Diameter of running wheels	2' 6" / 2' 10"	Weight empty of the locomotive	81 t 1 cwt.	Weight in running order of tender	67 t 4 cwt.
Wheel base rigid of locomotive	11' 0"	Weight in running order of the locomotive	90 t 11 cwt.	Wheel base of locomotive and tender	60' 3 1/8"
Wheel base total of locomotive	30' 8"	Tractive force (.75 p)	.33526 lbs.	Max. speed	55 m. p. h.
Boiler pressure	195 lbs. / 59 in.			Smallest radius of curves	275 ft.



CROSS SECTION THROUGH SUPERHEATED 58
STEAM REGULATOR



THE TRAILING BISSEL
ABOVE: PLAN, BELOW: CROSS SECTION 59



CAPROTTI VALVE GEAR DIAGRAMS 60
FOR 47 m. p. h. SPEED

making for light working of the regulator lever (fig. 58). As seen in plate 3, a cut-off valve between the dome and the superheater header enables the latter to be absolutely cut off from the steam supply. The chief advantage of superheated steam regulators is that the elements are always full of steam, which is a protection for the tubes and guarantees a supply of dry steam for starting.

Another condition in connection with the superheated steam regulator was the supply of superheated steam to the auxiliaries—a measure often adopted in America. The superheated steam is carried from the superheater header to the steam turret through a pipe (2 1/4 in. ext. diam.) along the boiler barrel on the outside. As in the case of these engines, in order to utilize standard fittings, it was necessary that some of the mountings should operate on saturated steam, the steam turret had to comprise two compartments. The dynamo, blower, whistle and brake ejector are operated on superheated steam. The corresponding steam valves on the turret have cast steel bodies and stainless acid steel spindles and valves having a tensile strength of 40—45 tons p. sq. in. The superheated steam for whistle and blower is taken directly from the superheater header.

In other respects, the boiler follows the SAR standard which has been explicitly dealt with in a former article.*) Among American specialties, the Sellers drifting valve and the Barco blower valve are worthy of mention. When running with closed regulator, the drifting valve allows live steam to enter the steam pipe and by means of the Detroit lubricator supplies oil to the piston valves and pistons. The Barco blower valve comprises a non-return valve between the blower and the blower steam valve and is fitted with a connection to allow of the blower being operated by steam from an outside source when raising steam. The trailing truck (fig. 59) is of a new design. The outside axleboxes are fitted with friction plates against which the ends of the axle bear, thus avoiding any side play. The vertical movement of the springs is guided by cast steel frames and the spring rests on a shoe which is free

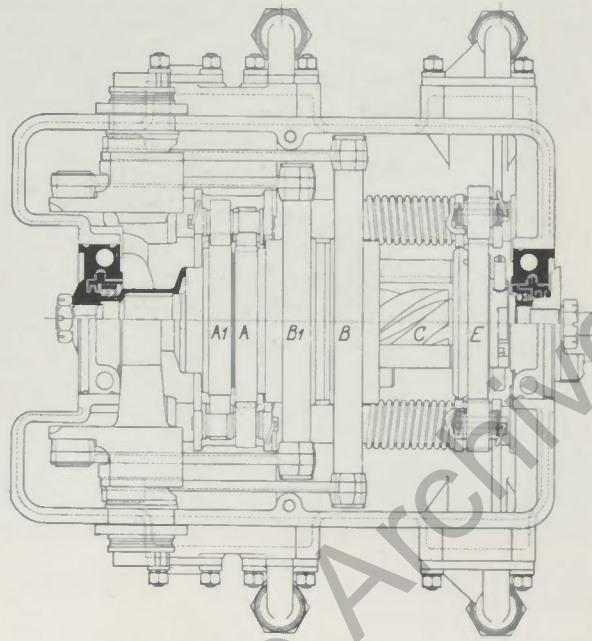
*) See Henschel Review No. 1, 1930.

to slide in a groove in the axlebox, thus allowing the axle to move through its arc of displacement.

According to American practice, thrust collars were fitted on the driving and coupled axles between the axleboxes in order to avoid excessive side play (plate No. 3). In this way, the wear of the axlebox faces is reduced, but at the expense of increased frictional resistance in the locomotive.

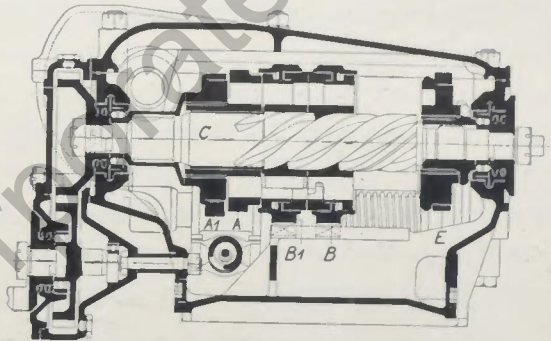
The use of solid bronze driving and coupled axleboxes makes for low maintenance costs and this is why this type has been used instead of the cheaper cast steel or forged steel axlebox with pressed-in brasses and cast-in wearing plates. The driving and coupled axleboxes, connecting and coupling rods are grease lubricated. The latter are fitted with floating bronze bushes running in steel bushes of 40—45 tons p. sq. in. tensile strength pressed into the rod ends. The bronze bushes are perforated with a large number of holes through which the grease penetrates (plate No. 3). The grease lubrication requires very little attention.

The sixth locomotive of this contract was experimentally fitted with Caprotti poppet valve gear (fig. 65 and plate No. 3). The camshafts of the two gear boxes are driven by a transverse shaft running through the smokebox saddle casting, this shaft being driven through a bevel gearing by a cardan shaft from the leading coupled axle. All important gears are provided with dirt-proof cases. The valve gear details can be confined to a small number for all locomotive types, which permits of considerably reducing production costs when manufacturing in sufficiently large quantities. The chief advantage of the Caprotti gear lies in its steam economies due to reduction of losses by wire drawing and the possibility of running with very low cut-offs (fig. 60). The gear boxes (fig. 61—63) are developed in such a manner that by moving a normal reversing wheel (or reversing lever) the two inlet cam sheaves A and A1 in the gearbox of each cylinder are rotated one in relation to the other by means of collars B and B1 fitted on a fast thread cut in the camshaft C, thus determining the opening, the duration of opening and the closing of the valves and by this means vary the steam cut-off and place the engine



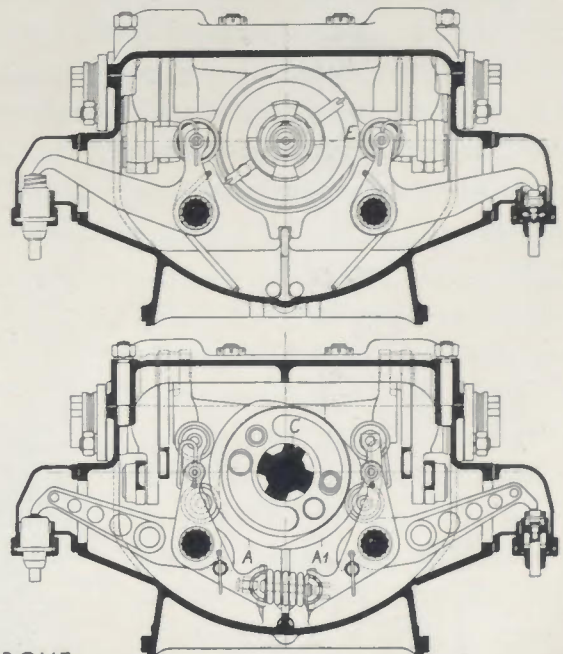
PLAN — COVER REMOVED

41



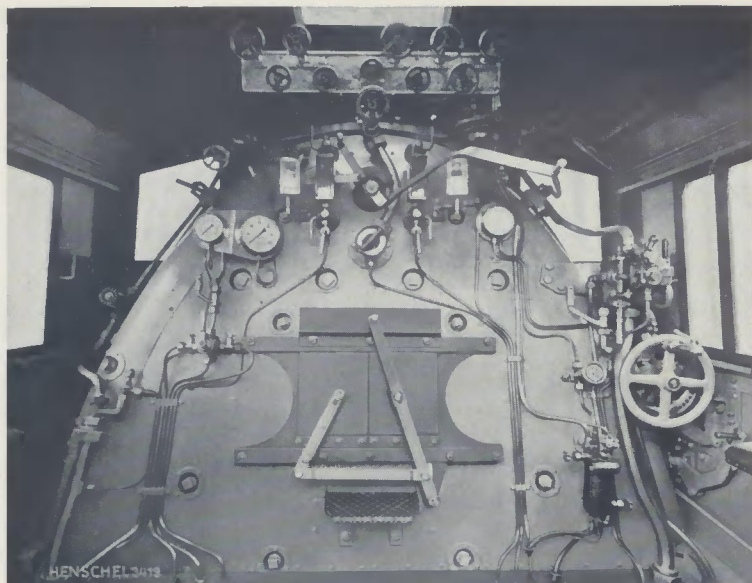
LONGITUDINAL SECTION ON CENTER LINE

42



ABOVE:
CROSS SECTION THROUGH EXHAUST VALVE PLANE
BELOW: CROSS SECTION THROUGH INLET VALVE PLANE

63



DRIVER'S CAB OF LOCOMOTIVE FITTED WITH CAPROTTI ⁶⁴ VALVE GEAR

in fore or back gear. The cam acts on two bell cranks the long arms of which bear on the inlet valve spindles and open the valves against steam pressure. When the pressure of the cam on the bell crank is released, the steam pressure closes the valve by acting on the piston-like extension of the valve spindle. The exhaust valves are operated in a similar manner. All valves are held closed by the steam pressure, no valve springs being used.

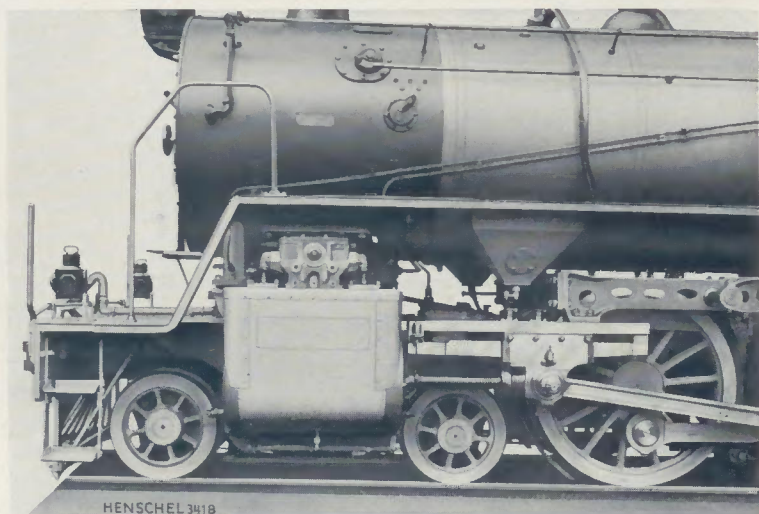
This design requires no special bye-pass valves. With the regulator open, steam is supplied to the steam chest under the valve spindle. With the regulator closed, the absence of steam pressure causes all valves to fall into the open position and thus establishes steam connection between the two sides of the piston when drifting.

Whereas the exhaust valve bell crank makes contact with the exhaust cam sheave E by means of but one roller, each of the inlet valve bell cranks is connected with a double armed lever at the ends of which two rollers are arranged so that one of them makes contact with the inlet cam sheave A1 controlling the opening and the other with the inlet cam sheave A controlling the closing of the valve. When running in back gear the functions of these inlet cam sheaves are inverted. The

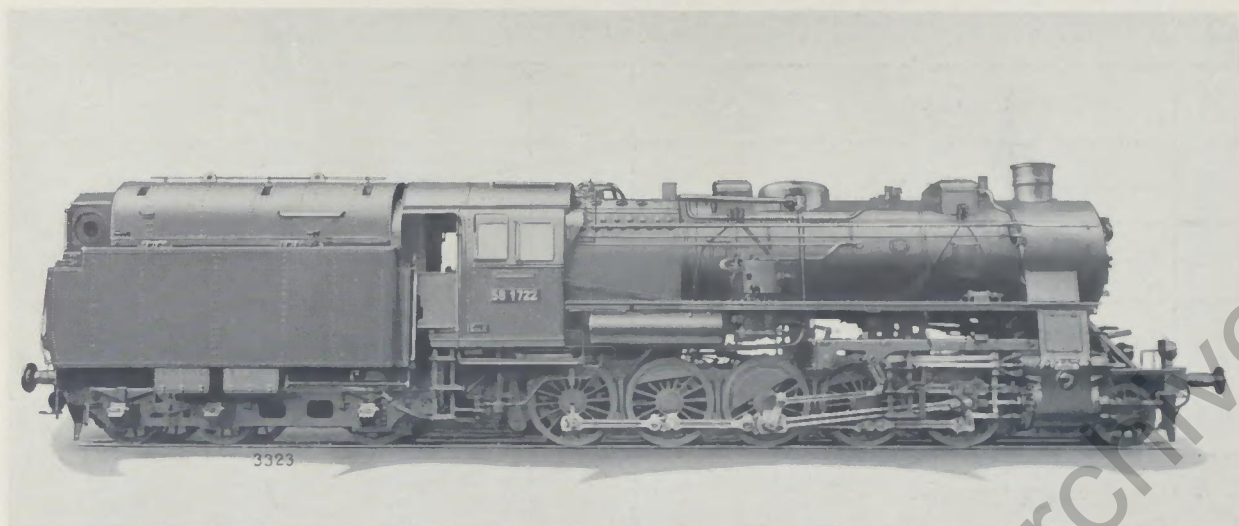
relative positions of the cam sheaves which run free on the cylindrical end of the camshaft are obtained by sliding the collars B and B1 along the camshaft. The screw on the latter imparts a rotating motion to the collars and this motion is transmitted to the inlet cam sheaves by a suitable arrangement of rods parallel to the camshaft passing through holes and arc-shaped slots in the cam sheaves and collars. The exhaust valves are controlled by cam sheave E also fitted on the blank portion of the camshaft and which gives the same compression and release points for all cut-offs either in fore or in back gear. The rotating

movement of the camshaft C is transmitted to this cam sheave by a suitable device on the camshaft, the reversing from fore gear to back gear and vice versa being effected by two rods connecting the cam sheave E with the inlet cam sheaves A and A1. These rods engage in a ring-shaped slot in the exhaust cam sheave E and turn the sheave as required when reversing.* The Caprotti valve gear has met with success on the Italian Railways; the results of the trials in South Africa are eagerly awaited.

* The working of the Caprotti gear is particularly set out in the "Österreichische Monatsschrift für Eisenbahnbetrieb und -Werkstätten" 1929, p. 1, and "Die Lokomotive" 1930, p. 1.



CYLINDER AND GEARBOX OF LOCOMOTIVE FITTED ⁶⁵ WITH CAPROTTI VALVE GEAR



2:10:0 SUPERHEATED 3-CYLINDER GOODS LOCOMOTIVE, G 56.16 CLASS, SERIES 58, OF THE GERMAN STATE RAILWAYS, EQUIPPED WITH THE LATEST DESIGN OF STUG PULVERIZED FUEL FIRING DEVICE ⁶⁶

Gauge	4' 8 1/2"	Firebox width, bottom	5'1"	Max. axle load	16,61
Diameter of cylinders	3 x 22 7/16"	Firebox volume	223 cu. ft.	Tractive force (.75 p)	52900 lbs.
Piston stroke	26"	Evaporative heating surface, in contact with fire	2077 sq. ft.	Max. speed	40.4 m. p. h.
Diameter of drivers	4' 7 1/8"	Superheater surface, ext.	737 sq. ft.	Water capacity	548 cu. ft.
Boiler pressure	199 lbs. p. sq. in.	Weight on drivers	80.4 t	Coal dust capacity	706 cu. ft.
Firebox length, bottom	8' 2 3/16"	Weight in running trim	92.8 t	Weight of tender in running trim	51.2 t

Literature: The Journal of the American Society of Mechanical Engineers, New York 1930 (author's report)

NEW "STUG" TYPE (STUDIENGESELLSCHAFT) LOCOMOTIVES

BY CHIEF ENGINEER R. ROOSEN, DIPL.-ING., KASSEL

The latest "Stug" type locomotives supplied to the German State Railways by Messrs. Henschel & Sohn A.G. (fig. 66 and plate 2) represent an exceedingly simple design.

Fig. 67 shows the lay-out of the coal dust firing equipment of one of these engines. The steam motor, auxiliary burner with accessories, stirring device and air reservoir which were found in the former type have been suppressed. The blowers and conveyor worms are driven by a single turbine. This simplification made it possible to increase the dust bunker capacity from 424 to 706 cu. ft. while maintaining the existing tender, so that the latter now takes about 11 tons of coal dust.

The dust intimately mixed with the primary air which is about one half of the total air required for combustion, is blown into the firebox through two Stug spray burners. The balance of the air is drawn into the firebox as secondary air below the brick arch. This admission of secondary air which originates from experiments carried out by the Stug on their

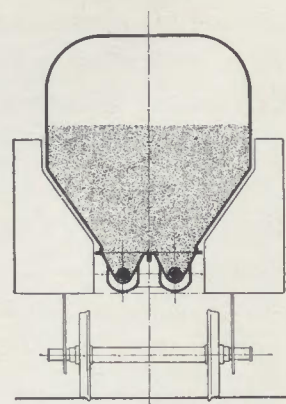
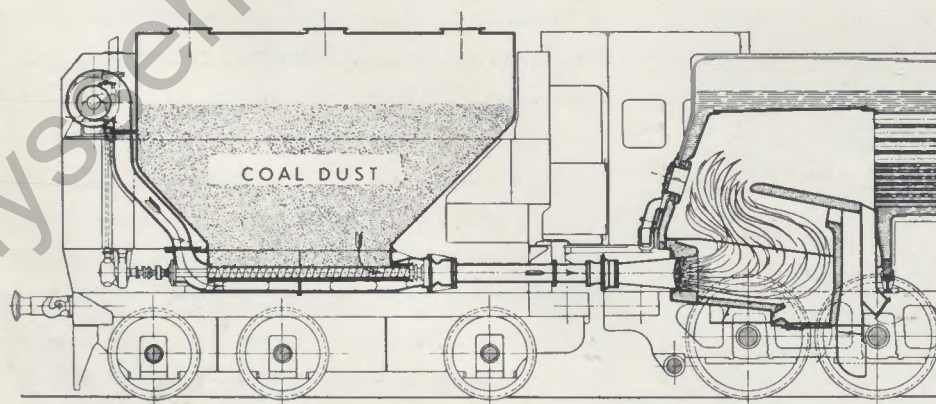
test stand at Kassel, has given very satisfactory results in the first two Stug locomotives of the German State Railways. The table overleaf gives a few data of tests with the Stug firing device, columns 4 and 6 showing the comparative figures obtained with the former design in which all of the air was injected through the burners as primary air.* As it appears from the comparison, the results arrived at with secondary air are just as good. By the admission of secondary air, the power required for driving the blower turbine on the tender is reduced to about 3% of the total steam production.

The two new Stug conversion engines were delivered in June 1930. One of them, after exhibition at the World Power Conference, was turned over to the German State Railways' Testing Department at Grunewald for an extended series of trial runs which have given full satisfaction. The second engine was assigned to the State Railways' Halle section for regular service in June 1930, after the

* See Henschel Review 1930, 1 p. 19.

RESULTS OF TESTS WITH STUG DUST FIRING DEVICE BURNING LIGNITE DUST

1	Lower heat value of dust	BTU.p.lb.	9604	9366	9364	9432	9366	10052
2	Residue on 4900 mesh sieve	%	23,96	17,60	17,18	19,20	17,60	28,32
3	Quantity of dust fired per hour	lbs.p.h.	1415	2000	3197	3790	4520	4210
4	Firebox stress	BTU p.cb.ft.h.	$0,606 \cdot 10^5$	$0,836 \cdot 10^5$	$1,34 \cdot 10^5$	$1,60 \cdot 10^5$	$1,90 \cdot 10^5$	$1,90 \cdot 10^5$
5	Water evaporated per hour	lbs.p.h.	9017	12080	19050	23150	26280	26520
6	Feed water temperature	°F	208	201	210	217	205	212
7	Evaporation ratio, gross	—	6,37	6,04	5,97	6,10	5,82	6,30
8	Steam production per hour and sq. ft. of heating surface	lbs.p.sq. ft.h.	4,32	5,80	9,12	11,1	12,6	12,7
9	Boiler pressure	lbs. p.sq.in	202	199	201	202	202	202
10	Mean temperature of superheated steam	°F	639	651	714	711	738	741
11	Mean temperature of exhaust gases in smokebox	°F	554	576	639	642	705	709
12	Flue gas analysis: CO ₂	%	13,2	13,0	12,9	14,8	13,8	14,4
13	Flue gas analysis: O ₂	%	6,0	6,4	6,4	4,4	5,6	5,0
14	Flue gas analysis: CO	%	0,0	0,0	0,0	0,1	0,1	0,1
15	Boiler efficiency calculated from fuel consumption	%	77,2	76,2	76,7	77,2	75,8	76,0



LAYOUT OF STUG PULVERIZED FUEL FIRING DEVICE

67



STUG LOCOMOTIVE NO. 58 1722 WITH GYPSUM TRAIN EMERGING FROM BLANKENHEIM TUNNEL

new design had been proved practical by a few schedule runs in the vicinity of Kassel.

Fig. 68 shows this engine with a 1600 ton goods train emerging from the Blankenheim tunnel in the Eastern Harz mountains on the same section on which the first two Stug locomotives are in operation. The new engine has furnished evidence, ever since it was placed in service on this road, of the particular advantages obtained by the greatly simplified design. Besides actuating the secondary air trap, the fireman's work is now confined to operating a single hand wheel which controls the admission of air and dust. The two conveyor worms can be cut

in or out in a very convenient manner, according to power requirements. Their maximum speed is 150 r. p. m. When the engine is drifting, only one burner is kept in operation, with the conveyor worm rotating at a proportionately reduced speed. The brick lining has behaved in a satisfactory manner. The removal of ash deposits from the firebox for which operation a blower in the firebox back plate can also be made available, takes considerably less time than with the grate fired locomotives of the same class running on this section.

This simplified design lays the road open to the application of dust firing to locomotives on a large scale.

ELECTRIC LIGHTING OF STEAM VEHICLES

BY R. BAUMANN, POWER STATION ENGINEER, KASSEL

Electric lighting of locomotives is becoming more and more important. Almost invariably small turbogenerators are used as a source of current and these have been successfully manufactured by Messrs. Henschel & Sohn A. G. for some considerable time.

Dynamos for electric lighting are nowadays so perfectly developed, owing to rational design and practical experiments—as has also been proved by the German State Railways' Experimental Department at Grunewald—that they should be specified for all new types of locomotives.



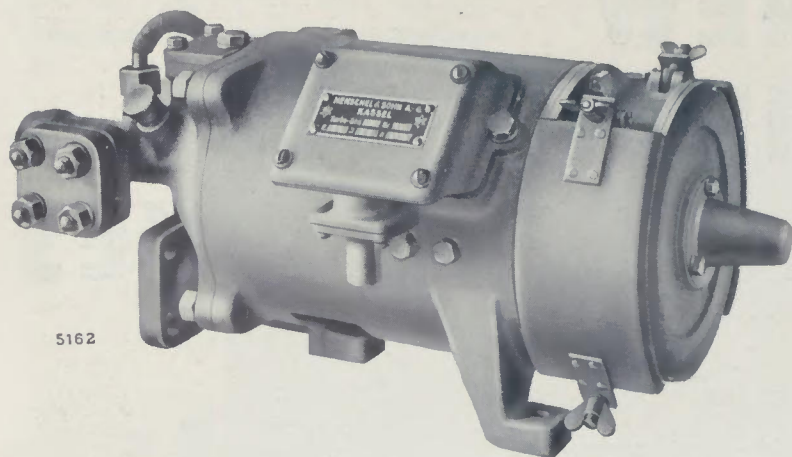
EXPRESS LOCOMOTIVE S.36.18 OF THE GERMAN STATE RAILWAYS WITH ELECTRIC LIGHTING 69

Their application to existing locomotives, however, can be considered as their economy and technical improvements over gas lighting with its attendant expenses for generation, filling, storing and maintenance offer considerable advantages. Henschel turbo-generators are manufactured for an output of 250—1300 watts. For outputs up to 500 watts a 25 or 32 volt system is generally preferred, whereas for higher outputs 32 or 110 volts are recommended.

As is well known, such low-powered impulse turbines have a comparatively high steam consumption. The consumption of 127 lbs. of steam per hour in our turbines with a dynamo output of 500 watts must be considered a very good performance for so small a machine. In relation to the total steam production of the boiler, however, this consumption is exceedingly small, in fact only $\frac{1}{2}$ —2% of the total steam consumed by the locomotive.

The Henschel turbo-generator is of compact design and all moving parts are placed on one center line.

The turbine rotor is made of special bronze. The blades are cut from the solid wheel by a special process. The very sensitive governor is completely enclosed in the rotor. There is a double axial steam admission, by which steam passes through one direct and one reverse nozzle. The sturdy steel shaft is carried in two ball bearings and is grease lubricated, thus requiring practically no attention. The bearing housing on the turbine side is so designed as to form a steam-tight partition between the turbine and generator. (German Patent No. 433184.) The turbine cover is ingeniously designed to comprise the inlet and exhaust steam passages, the nozzle and to house the governor gear. The governor spindle and guide bush are made of non-rusting material, viz. Monel metal and phosphor bronze, so that even after a long period of idleness no rusting-up occurs. The live steam can be taken from the dome, from the pump piping or steam turret and in the case of ships, from the live steam pipes. The exhaust is allowed to escape



550 WATT TURBO-GENERATOR

into the atmosphere direct or by way of the chimney, or passed through the feed water heater.

The generator which is made in collaboration with Messrs. Pöge Elektrizitäts A.G. of Chemnitz, is in one casing with the turbine, totally enclosed and efficiently cooled by a powerful fan. The field winding comprises a shunt, compound and commutator pole winding which are so calculated in relation one with the other as to keep the tension practically constant even with the maximum load fluctuations, i. e. between no-load and full load.

The armature winding is hand-wound, the wire passing through slots which are closed with wedges, and has short coil ends which are bound with steel wire. The commutator is strongly designed and of ample dimensions. The whole shaft with rotor and armature is statically and dynamically balanced in order to prevent vibration. The collector brushes are carried on the ball bearing housing and radially adjustable with a view to eliminating sparking. The openings giving access to the commutator are fitted with hinged covers which clamp down on a rubber joint ring, thus rendering the machine water-tight. The generators conform in every respect to the "Regeln für die Bewertung und Prüfung elektrischer Maschinen" (R.E.M.)—"Regulations for the Classification and Testing of Electrical Machines".

Before leaving the works, every generator is tested on a special test bench which permits of testing with all steam pressures and commonly used voltages, special attention being given to the steam consumption.

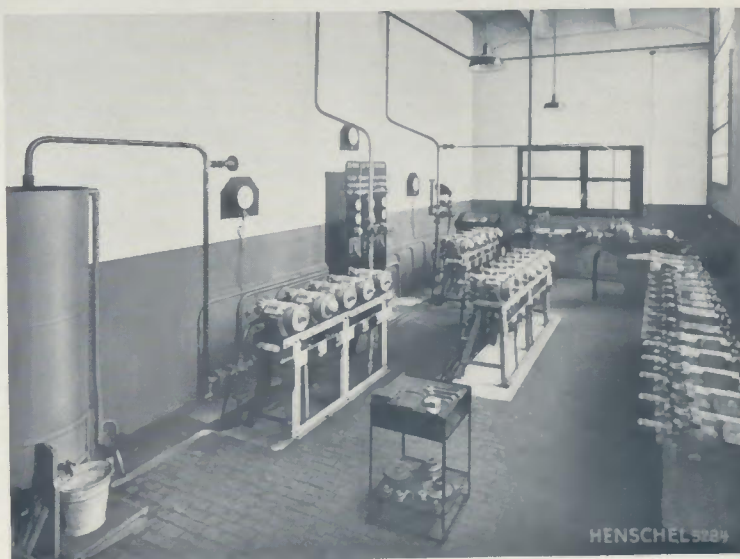
In special cases, i. e. for the German State Railways, a high frequency generator for automatic train signalling can be fitted to the commutator end.

The dismantling of the turbo-generator is exceedingly simple.

After removing the casing cover, the whole rotating part can be withdrawn at the turbine end by removing only four bolts.

Because of the numerous advantages which electric lighting by turbo-generators offers, such as uniform light, absolute working safety, ease of operation, low running costs, absence of danger from fire or explosion, this system is recommended not only for steam locomotives of every type and size, but also for small and medium-sized steamboats, dredgers and small stationary plants.

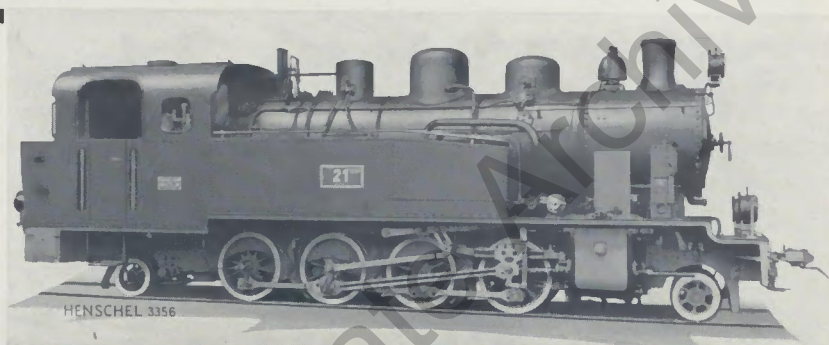
Messrs. Henschel & Sohn A.G. also undertake the erection and installation of the complete electric light system.



TURBO-GENERATOR TEST ROOM

NEW HENSCHEL LOCOMOTIVES

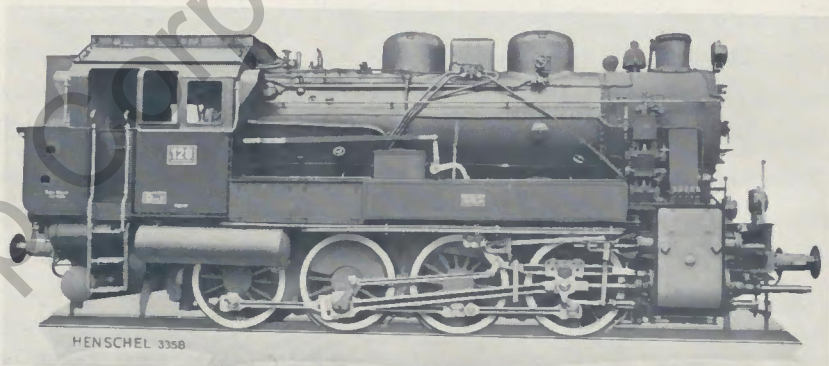
GERMANY



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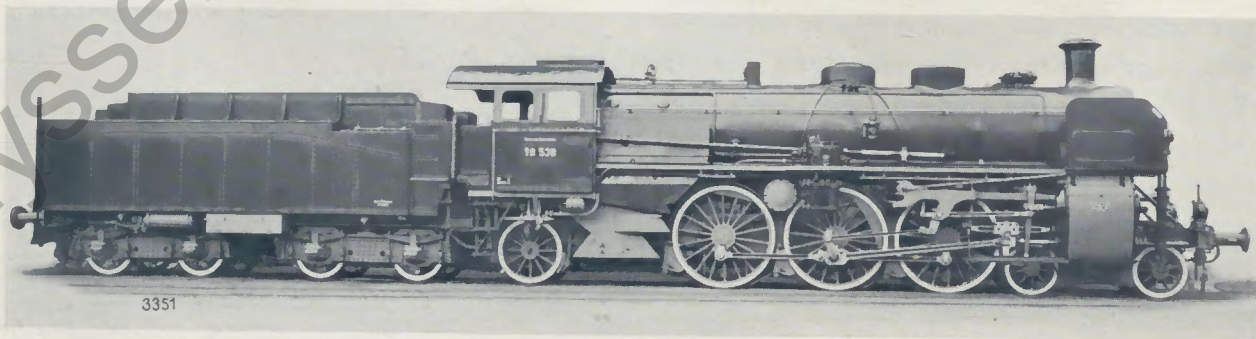
NARROW-GAUGE 2 : 8 : 2 SUPERHEATED TWIN TANK-LOCOMOTIVE OF THE MITTELPOMMERSCHE KLEINBAHNEN, RUNNING ON THE CASEKOW-PENKUN-ORDER SECTION
- 750 mm (2'6 1/2") GAUGE - 7 TONS AXLELOAD



21 757

73

0 : 8 : 0 SUPERHEATED TWIN GOODS TANK-LOCOMOTIVE, GT 44.17 CLASS OF THE LÜBECK-BÜCHEN RAILWAY COMPANY



21 738

74

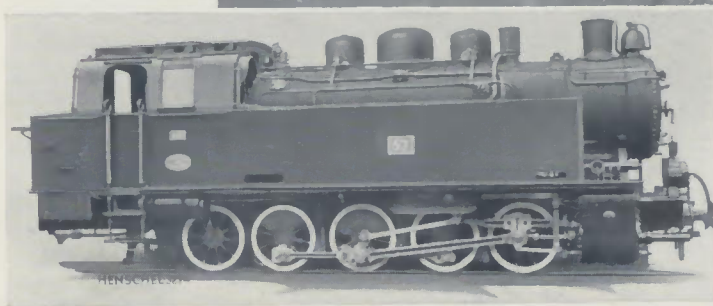
4 : 6 : 2 SUPERHEATED FOUR-CYLINDER COMPOUND EXPRESS-LOCOMOTIVE, S 36.18 CLASS OF THE GERMAN STATE RAILWAYS (SERIES 18^a)

18 engines supplied



20 573

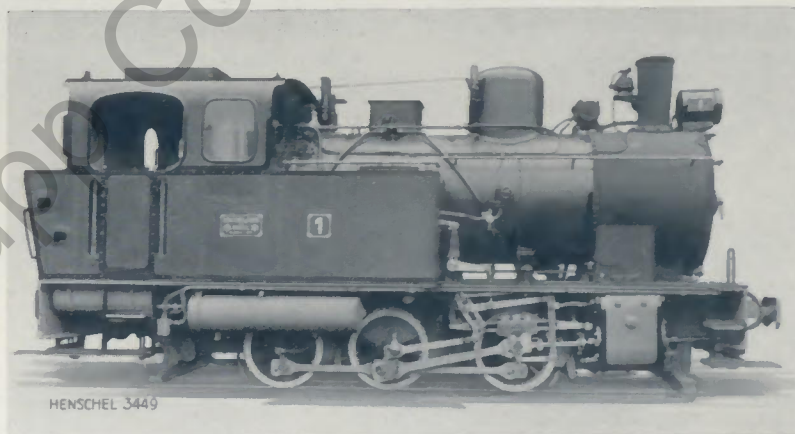
75



NARROW-GAUGE SUPERHEATED TWIN TANK-LOCOMOTIVE OF THE SÜDHARZ RAILWAY + METER GAUGE (3' 3³/₈")

76

Plate-frame (main plates 1" thick)—Schmidt flue tube superheater—Valve regulator—Nicolai piston valves with automatic bye-pass—Leading and trailing axles have $\frac{3}{4}$ " free side play and are cog-wheel driven from intermediate axles, intermediate and driving axles rigid, driving wheels flangeless—Coale safety valves—Lückhoff sander operated by water pressure—Strube injector—Friedmann exhaust steam injector—Standard lubricating pump—Steam tube cleaner—Latowsky steam bell—Acetylene head-lights—Water lifter of 88 gal. p. m. capacity—Hand brake—Körting vacuum brake with Hardy ejector—Le Chatelier counter-pressure brake—Central draw and buffing gear.



HENSCHEL 3449

21 918

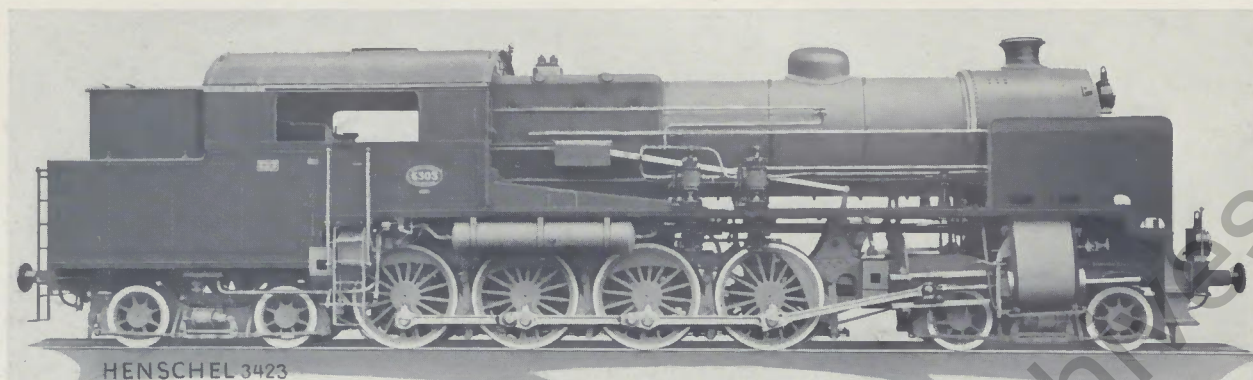
77

NARROW GAUGE 0:6:0 SUPER-HEATED TWIN TANK-LOCOMOTIVE SUPPLIED TO A CEMENT FACTORY

Plate-frame (main plates $\frac{3}{8}$ " thick)—Valve regulator—Piston valves—Automatic bye-passes—Pyrometer—Bosch lubricating pump—Latowsky steam bell—Henschel soot blower—Knorr compressed air sander—Hand brake—Hand bell—Knorr air brake—Henschel electric lighting equipment—Deuta speed indicator—Central draw and buffing gear—Driving wheels without flanges; connecting and coupling rod bearings grease-lubricated.

LEADING DIMENSIONS:

	0:10:0	0:6:0		0:10:0	0:6:0
Gauge	3' 3 ³ / ₈ "	2' 9 ⁷ / ₈ "	Superheater surface, ext. sq. ft.	274,5	290,6
Diameter of cylinders	19 ¹¹ / ₁₆ "	16 ⁹ / ₁₆ "	Weight on drivers t.	52,1	34,4
Piston stroke	19 ¹³ / ₁₆ "	15 ³ / ₄ "	Weight empty t.	42,2	27,6
Diameter of drivers	3' 3 ³ / ₈ "	2' 9 ⁷ / ₈ "	Weight in running order t.	52,1	34,4
Wheel base, rigid	7'10 ¹ / ₂ "	8' 2 ¹ / ₈ "	Tractive force (.75 p) lbs.	28800	17530
Wheel base, total	15' 1 ¹ / ₈ "	8' 2 ³ / ₈ "	Water capacity Imp. gal.	1100	660
Boiler pressure lbs. p. sq. in.	200	184,9	Coal capacity t.	2	0,98
Grate area sq. ft.	19,66	14	Max. speed m. p. h.	18,6	18,6
Evaporative heating surface, in contact with fire sq. ft.	824,5	626,4	Smallest radius of curves ft.	197	262



21782

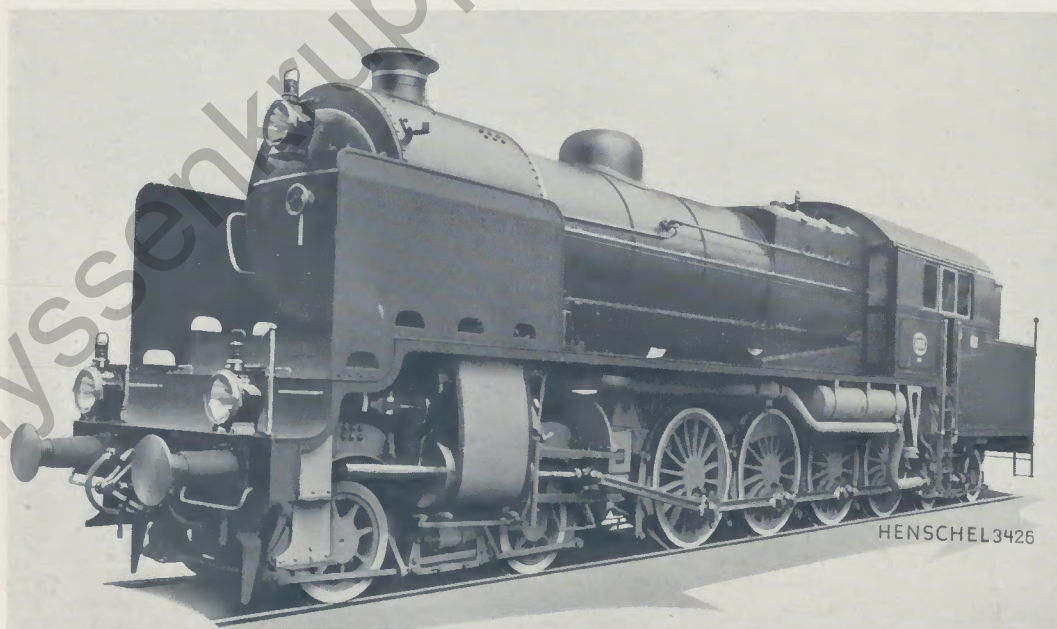
78

THE HEAVIEST 4:8:4 TANK-LOCOMOTIVE IN THE WORLD

4:8:4 SUPERHEATED 4-CYLINDER TANK-LOCOMOTIVE GTO³ CLASS, SERIES 6300, OF THE DUTCH RAILWAYS, FOR FAST GOODS-TRAINS

Bar frames ($3\frac{13}{16}$ " thick)—Belpaire firebox—Schmidt flue tube superheater—Inside cylinders with Walschaert valve gears, piston valves of outside cylinders controlled by transmission levers from inside cylinder valve rods—Automatic bye-pass of the standard Dutch type, Hasler speed indicator—Hand brake—Knorr air brake—Gresham injector—Metcalf exhaust steam injector—Ackermann safety valves—Friedmann lubricating pump—Steam heating—Knorr steam sander with Borsig nozzles—Dump grate—Crank axle solid forged—Flange thickness of 4th and 5th pairs of wheels reduced by $\frac{3}{8}$ "; bogies free to slide 4" to either side.—The boiler, cylinders, valve motion and driving gear, with the exception of the diameter of the driving wheels, are completely in accordance with the 4:6:0 class PO⁴ express locomotive, series 3900 (see Henschel Review 1930, page 24). Of this type we have supplied 10 engines.

Gauge	4' 8 $\frac{1}{2}$ "	Boiler pressure	199 lbs./sq.in.	Weight in running order	124,4 t.
Diameter of cylinders	4' 16 $\frac{1}{2}$ "	Grate area	34,01 sq. in.	Tractive force (2 x .75 p)	34760 lbs.
Piston stroke	26"	Evaporative heating surface,		Water capacity	3000 Imp. gal.
Diameter of drivers	5' 1"	in contact with fire	1797,6 sq. in.	Coal capacity	4,5 t.
Diameter of running wheels	3' 5 $\frac{3}{8}$ "	Superheater surface, ext.	538,2 sq. in.	Max. speed	56 m. p. h.
Wheel base, rigid	17' 2 $\frac{13}{16}$ "	Weight on drivers	70,8 t.	Smallest radius of curves	656 ft.
Wheel base, total	46' 1 $\frac{3}{16}$ "	Weight empty	100 t.		



Literature:

Labrijn: "Spoor-en-Tramwegen" 1930, p. 194

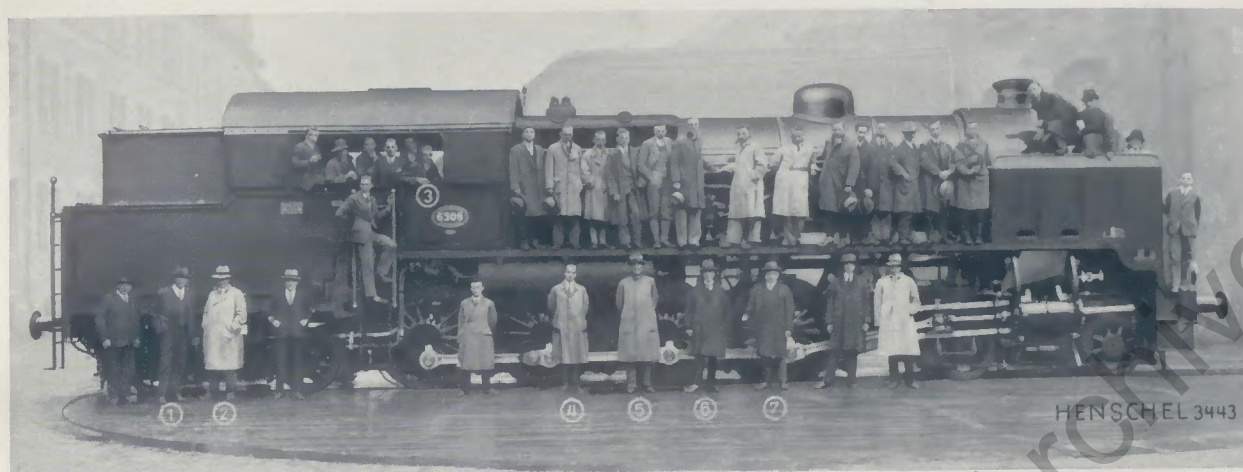
"Technisch Maandblad" 1930, p. 41

"The Locomotive" 1930, p. 361

"The Railway Engineer" 1930, p. 473

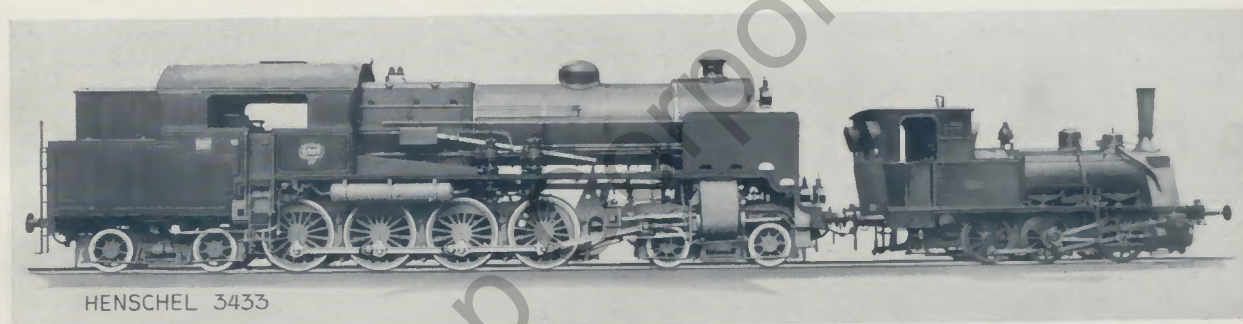
"The Railway Gazette" 1930 II, p. 753

79

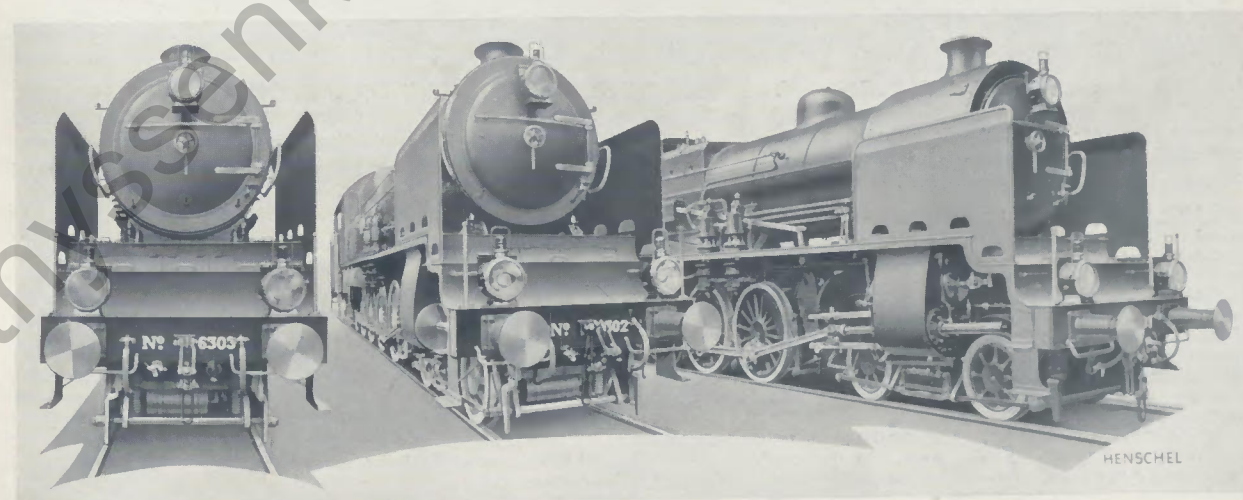


PROFESSORS AND STUDENTS OF THE DELFT TECHNICAL HIGH SCHOOL INSPECTING THE NEW 4:8:4 LOCOMOTIVE IN THE HENSCHEL WORKS AT KASSEL

Left to right: (1) Director von Gontard, (2) Director Imfeld, (3) H. M. L. van Berkel, Member of the Committee, Association of Delft Students of Machine Building, (4) G. P. de Haas, Engineer of the Dutch State Railways who supervised the construction of the engines in the works of Messrs. Henschel & Sohn A. G., (5) Professor P. Landberg, (6) Professor J. C. Dyxhoorn, (7) Professor P. Meyer.



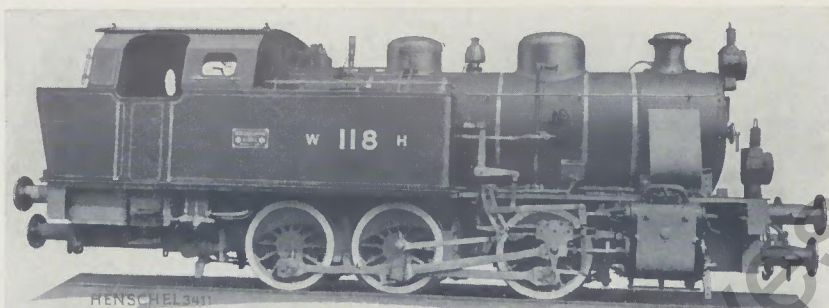
A CONTRAST
THE DUTCH 4:8:4 LOCOMOTIVE — 124 tons
AND AN OLD PRUSSIAN STATE RAILWAYS' CLASS T3 ENGINE — 29,5 tons.



FRANCE

NORMAL GAUGE 0:6:0 SATURATED TWIN TANK WORKS LOCOMOTIVE

LOW-BUILT: MAX. HEIGHT 3200 mm (10'6")



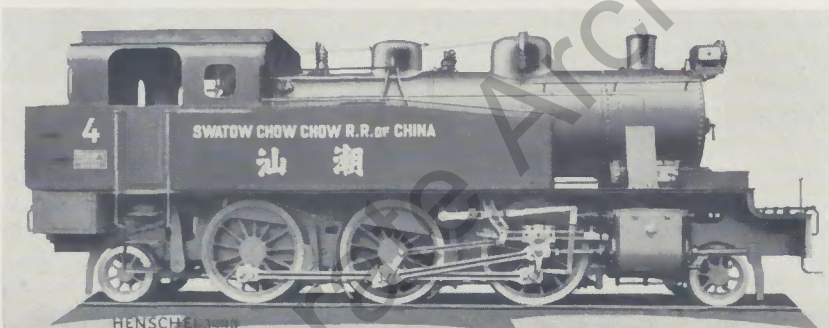
21 843

83

Plate-frame (18 mm = $\frac{11}{16}$ " thick)—Coale safety valves—Valve regulator—Piston valves—Automatic by-pass valves—Bosch lubricating pump—Latowsky steam bell—Hand sander—Hand brake—Steam brake—Double buffers.

CHINA

NORMAL GAUGE 2:6:2 SUPER-HEATED TWIN PASSENGER TANK LOCOMOTIVE OF THE SWATOW CHOW CHOW RAILWAY

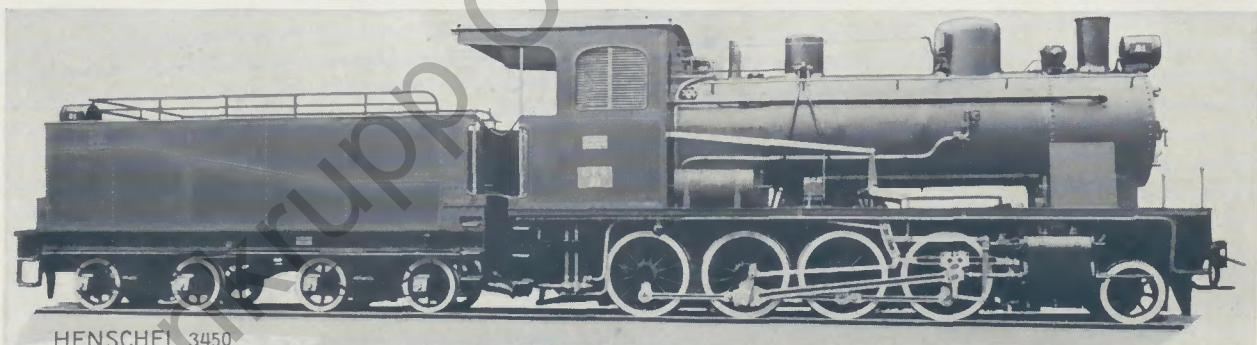


21 849

84

Plate-frame (20 mm = $\frac{13}{16}$ " thick)—Coale safety valves—Valve regulator—Piston valves—Automatic by-pass valves—Bosch lubricating pump—Hand sander—Hand brake—Steam brake—Henschel electric lighting equipment—Henricot central couplers—Tube cleaner—Rocking grate—Leading bissel axle with 86 mm ($3\frac{3}{8}$ "), trailing bissel axle with 62 mm ($2\frac{7}{16}$ ") free play to either side.

PORTUGUESE EAST-AFRICA



HENSCHEL 3450

21 775

85

NARROW GAUGE 2:8:0 SATURATED STEAM TWIN GOODS LOCOMOTIVE OF THE QUELIMANE RAILWAY

1067 mm (3' 6") GAUGE—WOOD-FIRED

Plate-frame (22 mm = $\frac{7}{8}$ " thick)—Coale safety valves—Valve regulator—Titan dump grate—Piston valves—Automatic by-pass valves—Bosch lubricator—Hand sander—Screw brake on tender—Hardy vacuum brake—Henschel electric lighting equipment—Central couplers—Leading bissel axle sliding 75 mm ($\frac{15}{16}$ ") to either side.

LEADING DIMENSIONS:

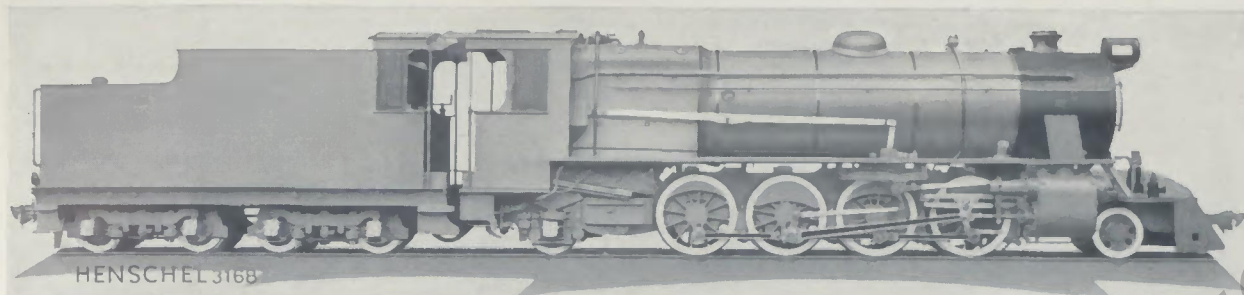
	0:6:0	2:6:2	2:8:0
Gauge	4' 8 $\frac{1}{2}$ "	4' 8 $\frac{1}{2}$ "	3' 6"
Diameter of cylinders	16 $\frac{15}{16}$ "	17 $\frac{11}{16}$ "	14 $\frac{13}{16}$ "
Piston stroke	21 $\frac{5}{8}$ "	24"	21 $\frac{5}{8}$ "
Diameter of drivers	3' 7 $\frac{1}{16}$ "	4' 6"	3' 7 $\frac{1}{16}$ "
Diameter of running wheels	—	2' 5 $\frac{1}{8}$ "	2' 5 $\frac{1}{8}$ "
Wheelbase, rigid, of the locomotive	9' 10 $\frac{1}{8}$ "	12'	12' 4"
Wheelbase, total, of the locomotive	9' 10 $\frac{1}{8}$ "	25' 2"	19' 2 $\frac{5}{16}$ "
Boiler pressure	lbs. p. sq. in. 184,9	170	170
Grate area	sq. ft. 17,2	14	20,24
Evaporative heating surface, in contact with fire	sq. ft. 966,6	748,1	1053,8
Superheater surface, ext.	sq. ft. —	296,02	—
Weight on drivers	t. 46,2	38,4	32,5
Weight empty of the locomotive	t. 35,4	39	35,4

	0:6:0	2:6:2	2:8:0
Weight in running order of the locomotive	t. 46,2	50,7	38
Tractive force (.75 p)	lbs. 19850	17860	14330

	0:6:0	2:6:2	2:8:0
Water capacity	Imp. gal. 1100	1430	2420
Fuel capacity	cb. ft. 70,6	88,3	388
Diameter of tender wheels	—	—	27 $\frac{15}{16}$ "
Wheelbase of tender	—	—	15' 9"
Weight empty of tender	t. —	—	13,4
Weight in running order of tender	t. —	—	29,5

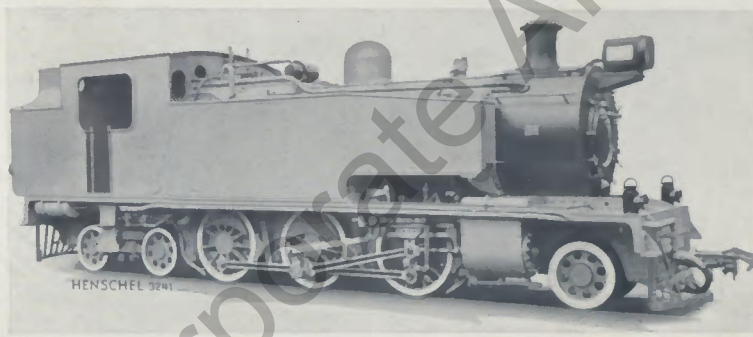
Total wheelbase of the locomotive and tender	—	—	44' 3"
Max. speed	m. p. h. 28	37,3	31
Smallest radius of curves	ft. 295	328	262

INDIA



21 544
2:8:2 SUPERHEATED TWIN GOODS LOCOMOTIVE, YD CLASS, OF THE BURMA RAILWAYS
INDIAN STANDARD TYPE + METER GAUGE

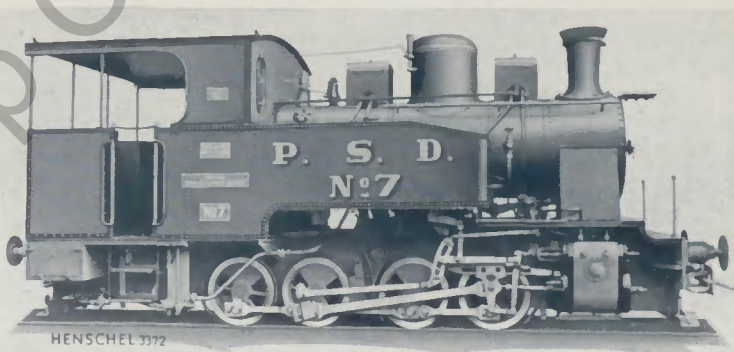
Built-up plate-frame—Flue tube superheater—Electric lighting equipment—Wota type piston valves—Automatic by-pass valves of the Indian Standard type—Leading bissel axle with 158 mm (6¹/₄"'), trailing bissel axle with 146 mm (5³/₄"') free play to either side—Ross safety valves—Rocking grate—Dump grate—Tube cleaner—Lambert hot water sander—Wakefield lubricator—Goodall central couplers—Steam and hand brake for the locomotive, vacuum brake for the train.—Of this type we supplied 29 engines, a few of which were equipped with Franklin axlebox grease lubrication.



21 632
2:6:4 SATURATED STEAM TWIN TANK-
LOCOMOTIVE, MODIFIED M CLASS, OF
THE BURMA RAILWAYS + METER GAUGE

Plate-frame (7/8" thick)—Bissel side play 79 mm (3¹/₈"'), bogie side play 89 mm (3⁵/₁₆"') to either side—Ross Pop safety valves—Balanced slide valves—Lambert hot water sander—Electric lighting equipment—Wakefield lubricator—Dump grate—ABC-central coupler—Hand brake—Steam brake for the locomotive, vacuum brake for the train.—Of this type we supplied 12 engines.

THE PHILIPPINE ISLANDS



21 841
0:8:0 SATURATED STEAM TWIN
TANK LOCOMOTIVE FOR A SUGAR
PLANTATION + 1067 mm (3' 6") GAUGE

Plate-frame (10 mm — 3/8" thick)—Coale safety valves—Piston valves—Hand sander—Electric lighting equipment—Michalk lubricator—Hand brake—Steam brake—Worthington feed pump—Hand bell—Three-chime whistle—Klinger water gauges—Double buffers with draw-hooks and central couplers—Intermediate and trailing coupled axles free to slide 10 mm (3/8") to either side.

LEADING DIMENSIONS:

	2:8:2	2:6:4	0:8:0		2:8:2	2:6:4	0:8:0
Gauge	meter	meter	3' 6"	Weight in running order of the locomotive . . . t.	56,78	53,84	25,2
Diameter of cylinders	17"	15"	12 ³ / ₈ "	Tractive force (.75 p) lbs.	19500	15541	11030
Piston stroke	24"	22"	14 ³ / ₁₆ "				
Diameter of drivers	4' 0"	3' 7"	2' 4 ³ / ₈ "	Water capacity Imp. gal.	3000	1550	1010
Diameter of running wheels	2' 6"	2' 6 ¹ / ₂ "	2' 4 ¹ / ₂ "	Coal capacity t.	7	3	1
Wheelbase, rigid, of the locomotive . . .	13' 5"	10' 0"	5' 10 ¹ / ₈ "	Diameter of tender wheels	2' 4 ¹ / ₂ "	—	—
Wheelbase, total, of the locomotive . . .	27' 9"	26' 1"	8' 6 ³ / ₈ "	Wheelbase of tender	14' 0"	—	—
Boiler pressure lbs. p. sq. in.	180	180	184,9	Weight empty of tender t.	16,82	—	—
Grate area sq. ft.	28	12,75	8,6	Weight in running order of tender . . . t.	37,30	—	—
Evaporative heating surface, in contact with fire sq. ft.	1260	893	366				
Superheater surface, ext. sq. ft.	383	—	—	Max. speed m. p. h.	35	35	15,5
Weight on drivers t.	39,56	29,95	25,2	Wheelbase of the locomotive and tender . .	50'5"	—	—
Weight empty of the locomotive . . . t.	51,04	40,30	17,9	Smallest radius of curves ft.	300	250	164

HENSCHEL ROTARY SNOW PLOUGHS

SWISS FEDERATED RAILWAYS (GOTTHARD RLY)

16 TONS AXLE LOAD



4309

89

PHOTO:
GENERAL MANAGE-
MENT OF THE SWISS
FEDERATED RLYS

AUSTRIAN FEDERATED
RAILWAYS

12.2 TONS AXLE LOAD

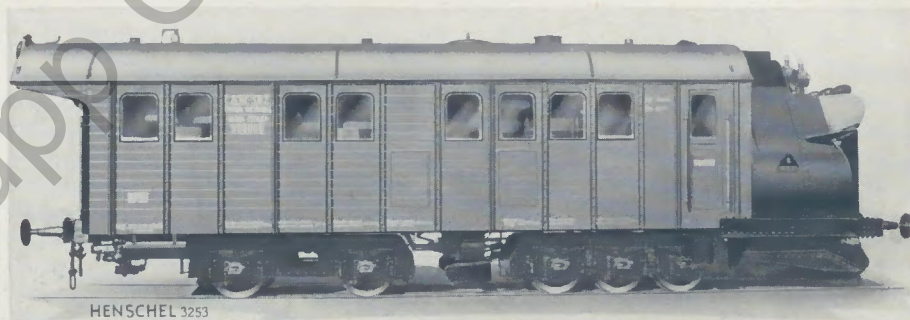


21 647

90

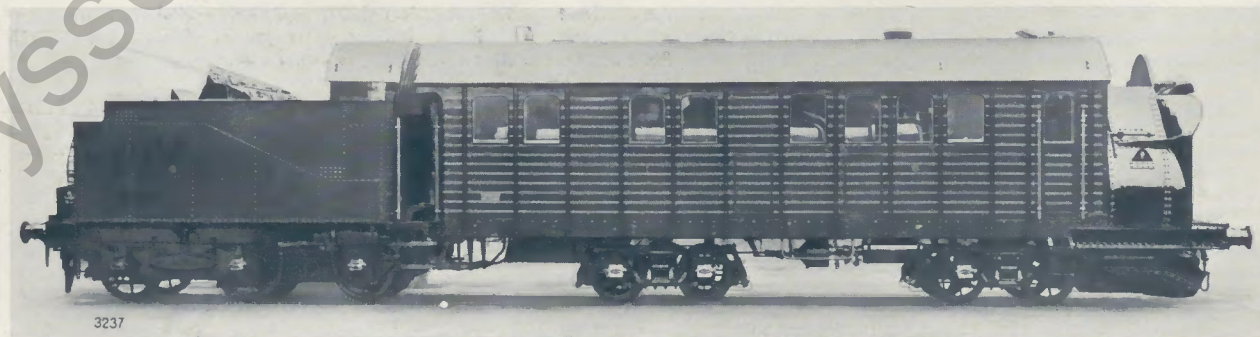
YUGO-SLAVIAN STATE
RAILWAYS

13.8 TONS AXLE LOAD



21 648

91

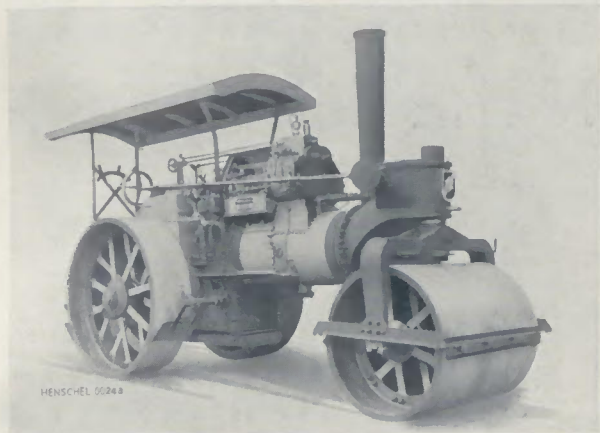


21 700

92

ORIENTAL RAILWAYS (TURKEY) 16,6 TONS AXLE LOAD

HENSCHEL ROAD-MAKING MACHINERY



93



94

TYPE H2 STEAM ROAD ROLLER

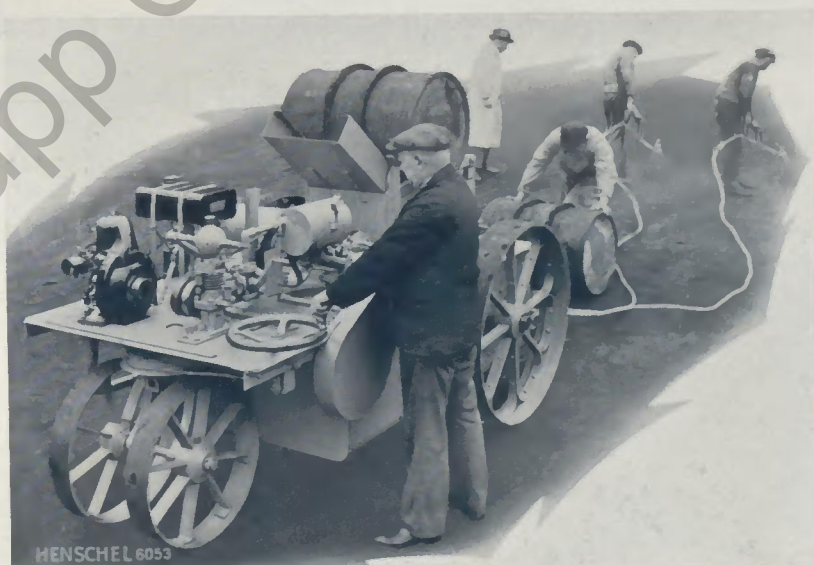
WEIGHT EMPTY 12,5 TONS
WEIGHT IN WORKING TRIM 13,7 TONS

LEADING DIMENSIONS:

Boiler:	Grate area	4,3 sq. ft.
	Heating surface in contact with water	96,8 sq. ft.
Engine:	Diameter of cylinders	5' 3 ³ / ₃₂ " and 10' 1 ¹ / ₃₂ "
	Piston stroke	9' 1 ¹ / ₁₆ "
	R. p. m.	175
	Working pressure	170 lbs. p. sq. in.
	Normal output	24,6/29,6 HP
	Diameter of fly wheel	3' 7 ⁵ / ₁₆ "
Rollers:	Width of fly wheel	4' 3 ¹ / ₄ "
	Diameter of front rollers	3' 11' 1 ¹ / ₄ "
	Width of front rollers	2' 2' 1 ¹ / ₈ "
	Working speed	1.25 m. p. h.

Rollers:	Travelling speed	3,10 m. p. h.
	Diameter of hind rollers	5' 5' 1 ¹ / ₃₂ "
	Width of hind rollers	1' 5' 2 ³ / ₃₂ "
	Track rolled	6' 9' 1 ¹ / ₃₂ "
Tender:	Water capacity	121 Imp. gal.
	Coal capacity	485 lbs.
General data:	Overall length of roller	19' 5' 1 ¹ / ₈ "
	Max. height	10' 7' 9' 1 ¹ / ₁₆ "
	Max. width	6' 10' 11' 1 ¹ / ₁₆ "
	Wheelbase	10' 11' 1 ¹ / ₂ "
	Distribution of weight: Front	2/5
	Rear	3/5

UNIVERSAL COMPRESSED-AIR BITUMEN SPRAYER, "SPREE" TYPE



The "Spree" in operation

95

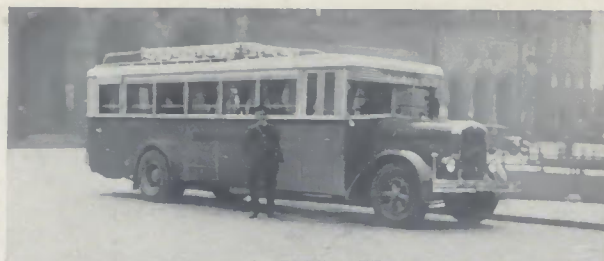
LEADING DIMENSIONS:

Capacity (two tanks holding 77,5 gal. each)	155 Imp. gal.
Weight without equipment	1 t. 4 cwt. 3 qrs.
Length without draw bar	9' 2"
Total height	4' 5"

Max. width	5' 7"
Output of petrol engine	6 HP
Working pressure	42-85 lbs. p. sq. in.
Lifting power of barrel hoist	8 qrs.

OUTPUT per day with good organization of work: up to 36000 lbs.

The machine is self-propelled and equipped with a shifting gear for forward and backward running. Travelling speed: 2,5-3 km/h = 1,5-1,9 m. p. h.

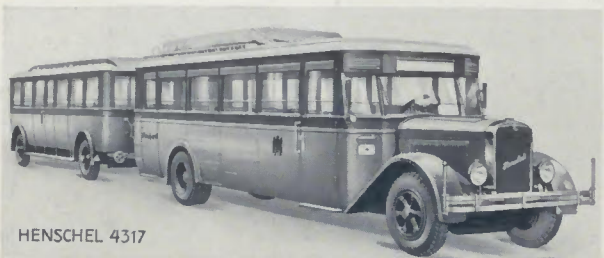


96



HENSCHEL 4406

97



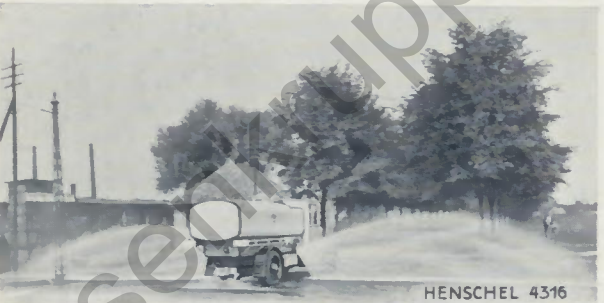
HENSCHEL 4317

98



HENSCHEL 4347a

99



HENSCHEL 4316

100



HENSCHEL 4359a

101

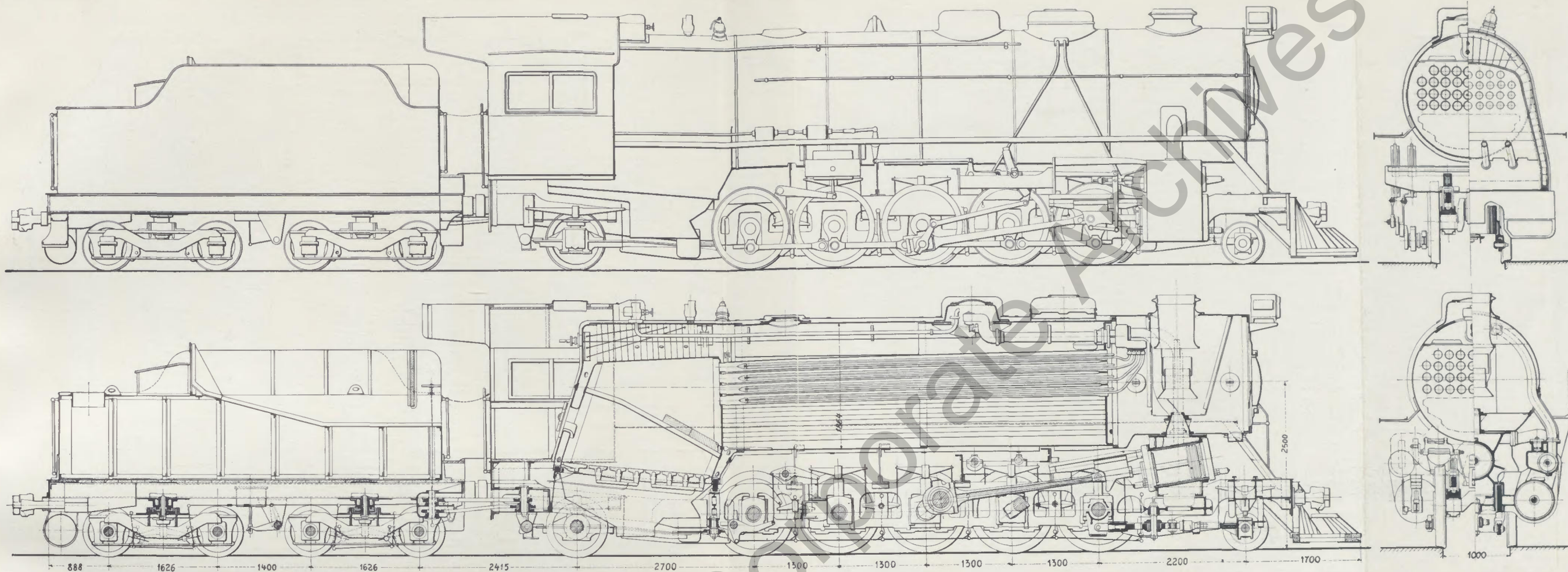
HENSCHEL MOTOR VEHICLES IN THE SERVICE OF

THE GERMAN STATE RAILWAYS

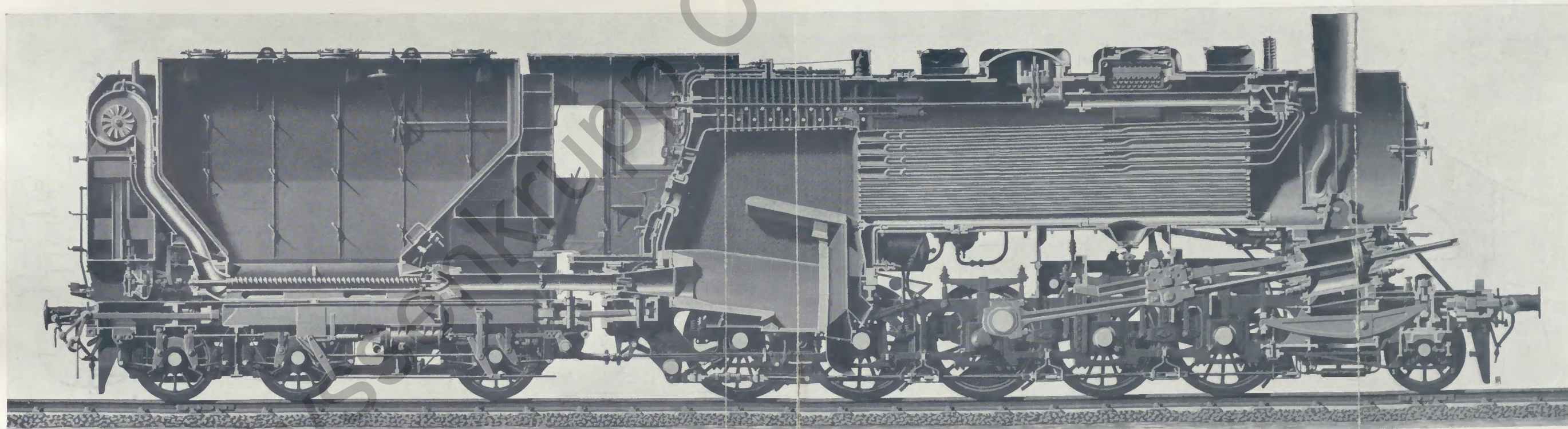
THE GERMAN POSTAL ADMINISTRATION

MUNICIPALITIES

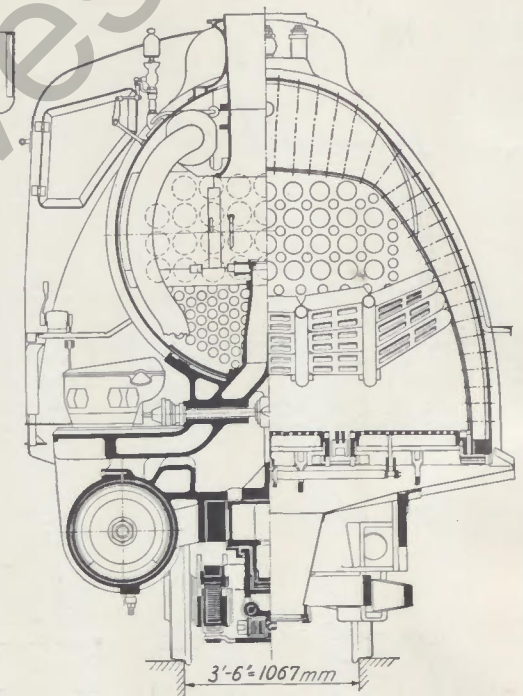
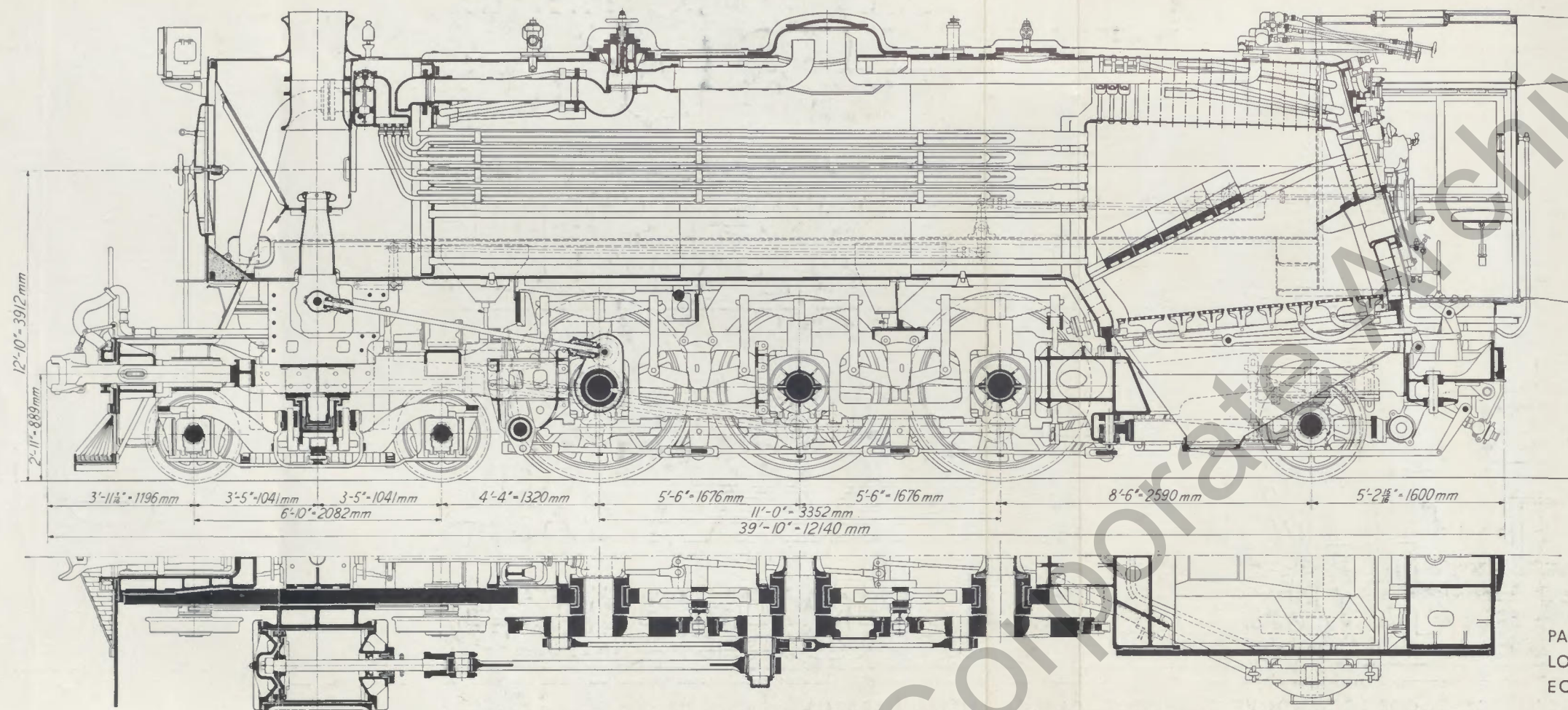
HENSCHEL - 2 - 1930



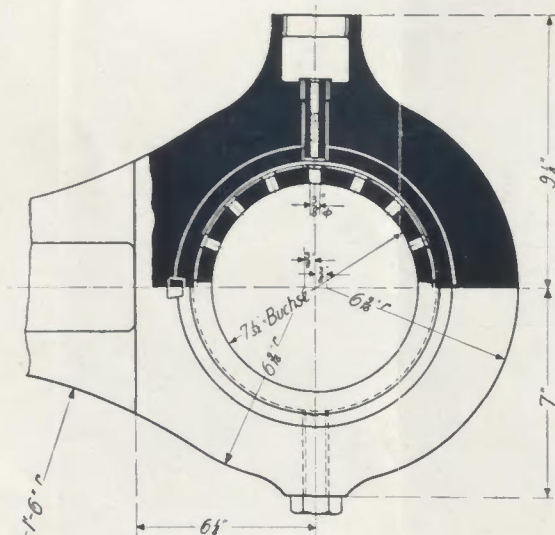
PAGE 29: 2:10:2 SUPERHEATED THREE-CYLINDER GOODS LOCOMOTIVE OF THE SOROCABANA RAILWAY (BRAZIL)



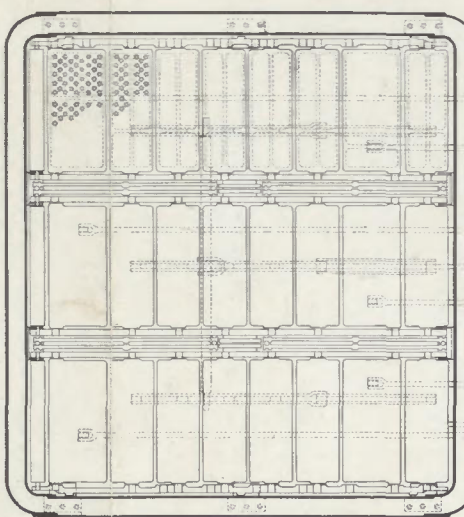
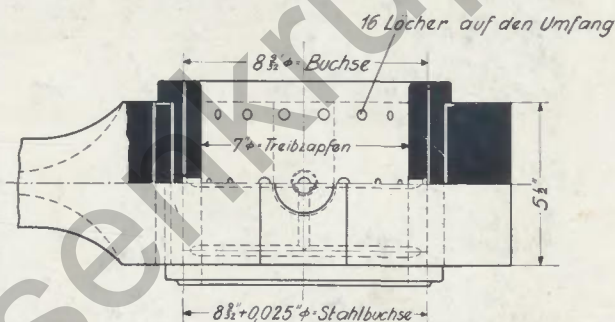
PAGE 55: THE LATEST "STUG" LOCOMOTIVE OF THE GERMAN STATE RAILWAYS



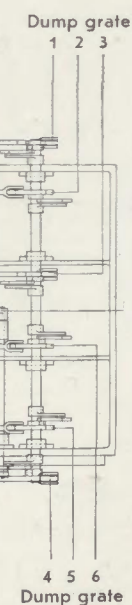
PAGE 51: THE LATEST 4:6:2 16 DA CLASS EXPRESS LOCOMOTIVE OF THE SOUTH AFRICAN RAILWAYS, EQUIPPED WITH CAPROTTI POPPET VALVE GEAR



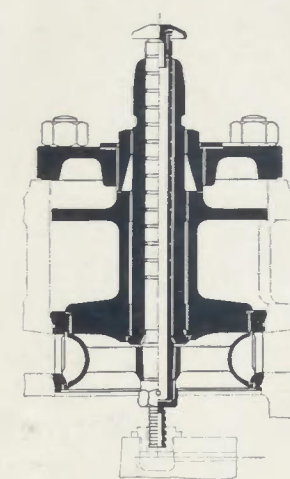
THE CONNECTING ROD BIG END



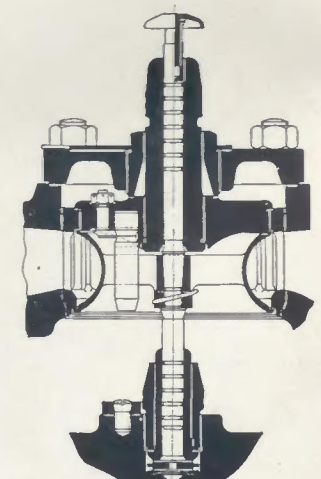
GRATE ARRANGEMENT



4 5 6 Dump grate



INLET AND EXHAUST VALVE OF CAPROTTI GEAR



Steam from superheater header