MeLeSco

LOCOMOTIVE SUPERHEATERS

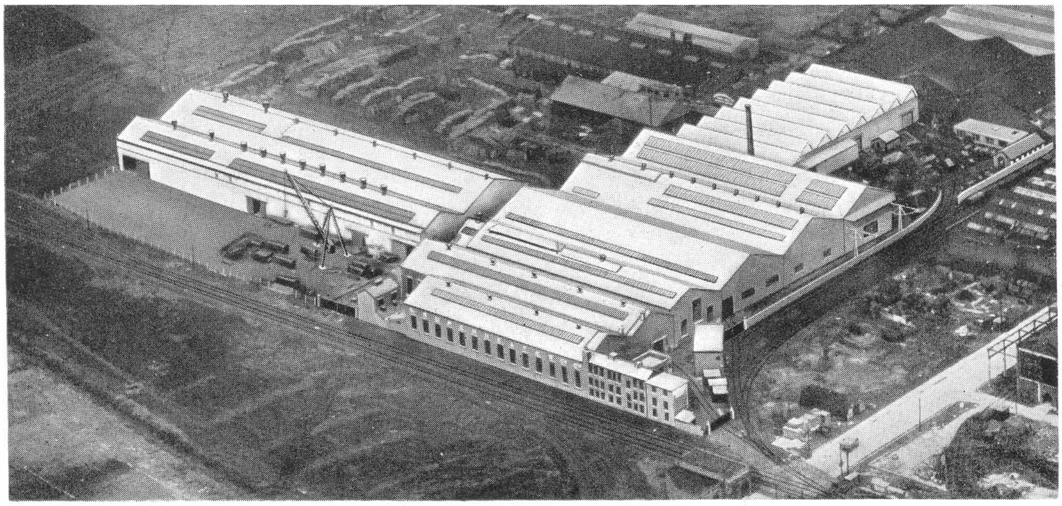
★

THE SUPERHEATER COMPANY LTD.

THE SUPERHEATER COMPANY LIMITED

Designers and Manufacturers of

SUPERHEATERS FOR LOCOMOTIVES



Works :

TRAFFORD PARK, MANCHESTER

Telegraphic Address : Supertemp, 'Phone, Manchester. *Telephone :* Trafford Park 0628 (2 lines)

Head Office :

53, HAYMARKET, LONDON, S.W. 1

Telegraphic Address : Supertemp, 'Phone, London. *Telephone :* Whitehall 8225 (5 lines)

Scottish Office :

143, WEST REGENT STREET, GLASGOW, C. 2

Telegraphic Address : " Localise " Glasgow *Telephone :* Douglas 2093

Registered Trade Mark

World Wide Superheating Service

THE Superheater Company Ltd. design and manufacture superheating equipment for every class of service. " MeLeSco " superheaters are the product of unique specialisation in design, exclusive methods of construction and over 40 years experience and progressive development in superheaters for marine, locomotive and stationary boilers ; they comply with standard specifications, boiler codes and insurance requirements as applied in all countries.

The vast majority of the locomotives of the world are now superheated and it is only in the very rare cases where special duty engines are concerned, such as shunters on intermittent duty, that saturated locomotives are still used.

In the stationary power plant field, " MeLeSco " Superheaters are installed in water tube boilers of every well known make, for all methods of firing and conditions of load, pressure and temperature, in many public utility and industrial plants in Great Britain and overseas. This wide diversity of application and the specialised knowledge and experience required for its successful realisation has established world leadership in superheated steam engineering.

The Superheater Company Ltd., with its associated organisations—The Superheater Company Ltd., of Canada, The Superheater Company (Australia) Pty. Ltd. and agencies in India, the Union of South Africa, Dominion of New Zealand and elsewhere—serves the British Commonwealth and other territories, thus, together with The Superheater Company of New York and the Compagnie des Surchauffeurs of Paris, providing world wide superheating service.

THE

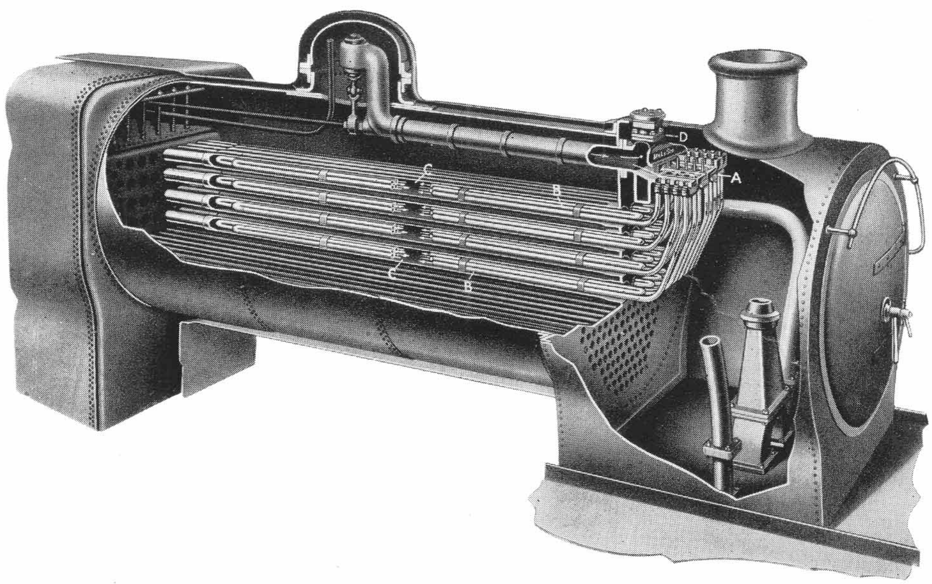
LOCOMOTIVE SUPERHEATER

The use of superheated steam is universally acknowledged as indispensable to the efficiency and economic operation of locomotives.

Superheating is carried out by passing the boiler steam through a series of pipes called superheater elements before it reaches the cylinder steam chest. These superheater elements are placed in flues of the boiler and thus are swept by the hot gases passing through the flues on their way from the firebox to the smokebox.

As the steam delivered by the boiler contains a certain amount of moisture this must first be evaporated in the superheater before superheating proper can take place. Subsequently the heat absorbed by the steam in the superheater elements from the hot gases acts to superheat the steam, that is, it raises the temperature of the steam above that associated with the prevailing steam pressure. This superheating effect is produced without any increase in the steam pressure, and the rise in steam temperature effected is expressed in *degree superheat*. Thus if steam supplied by the boiler at 250 lbs. per sq. in. gauge pressure (which corresponds to a saturation temperature of 406°F.), is superheated to 700°F. then the superheat added is (700 – 406) = 294°F.

The amount of moisture or carry-over contained in the saturated steam delivered by the



Cross Section Through Boiler, showing MeLeSco Superheater.

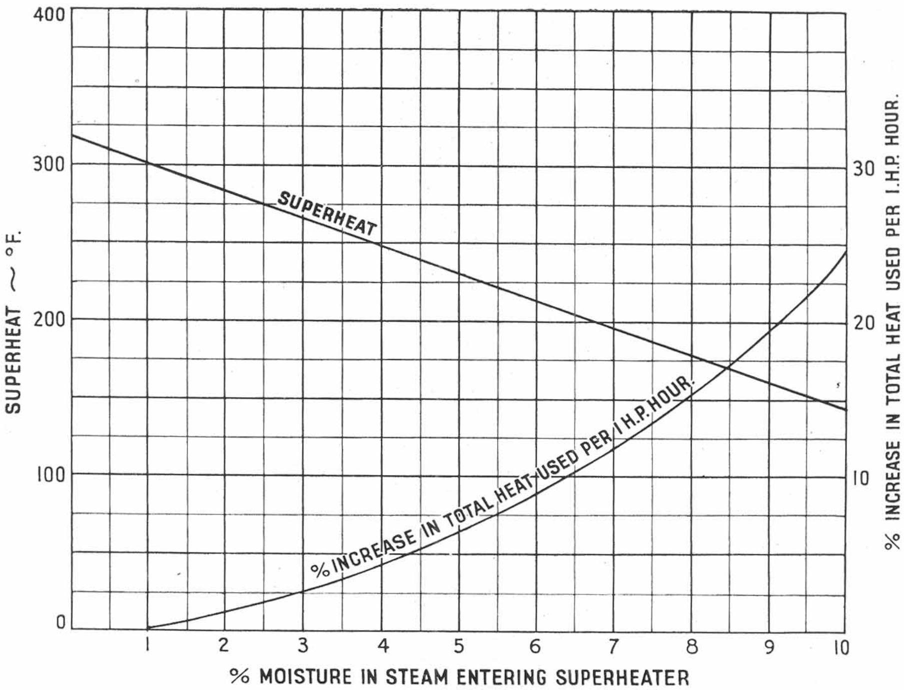


Fig. 1.

boiler is expressed in terms of percent moisture, the actual percentage prevailing depending upon both boiler design and operational factors. This moisture content, if allowed to asssume excessive proportions, is undesirable from the aspect of steam economy as well as of superheater operation. The extent to which moisture affects engine economy is shown by the graph Fig. 1.

Percentages of Excess Reflected in the Capacity of Superheater Locomotives over that of Saturated Locomotives

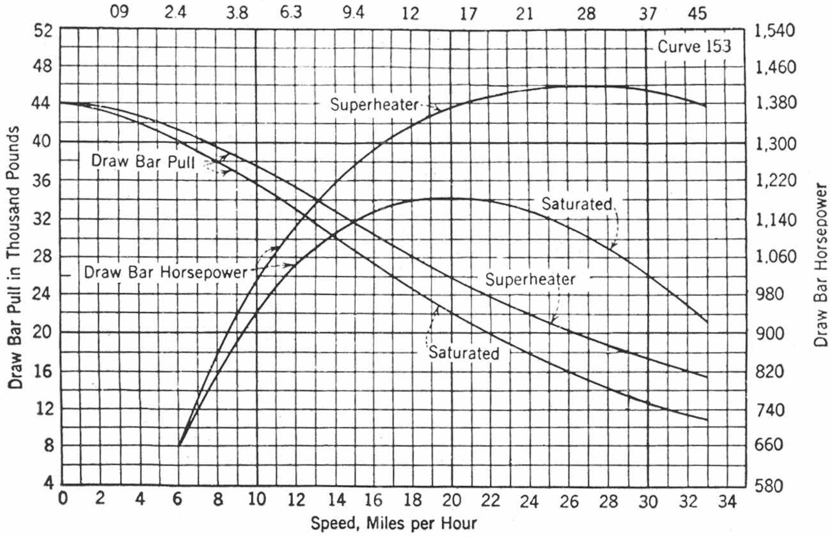


Fig. 2. Increase in Capacity due to using Superheated Steam in Locomotives.

These data are based upon a case in which a superheater is designed to deliver 300°F. superheat when being supplied with saturated steam containing 1% moisture. Assuming by way of example a moisture content of 5%, it will be seen that the decrease in superheat from 300°F. to 232°F. caused by an increase in moisture from 1% to 5% results in an increase of some 6% in total heat consumed per I.H.P. hour. Furthermore, the passage of steam of high moisture content into the superheater is undesirable as impurities such as solids and salts contained in the moisture will tend to form incrustations in the superheater tubing and impair its heat absorbing efficiency and also to shorten superheater service life. Thus, while the superheater possesses the important advantage of eliminating the moisture, the presence of an excessive percentage of moisture should be avoided. To ensure that the moisture content is as low as possible, it is recommended that a MeLeSco internal steam dryer is installed, which removes the moisture from the saturated steam before it reaches the superheater.

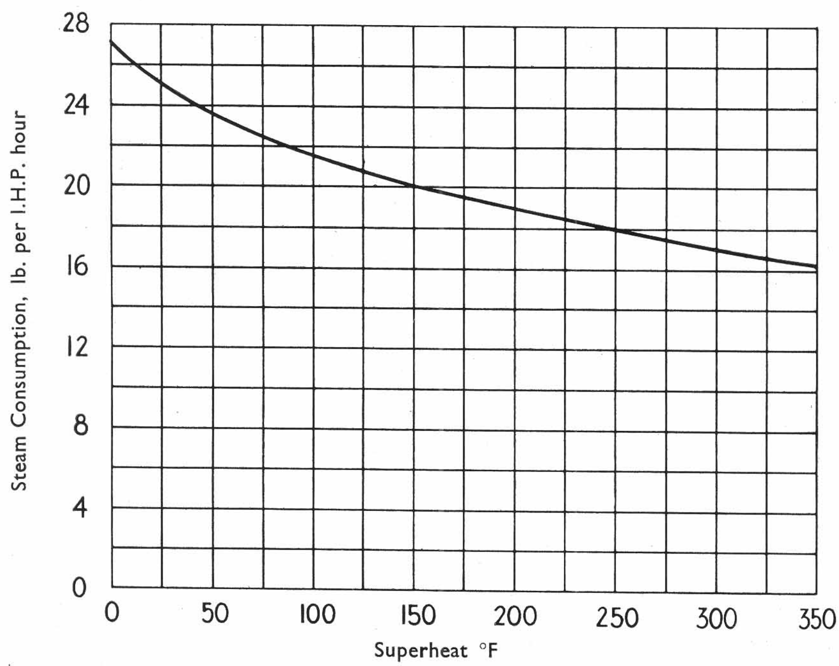


Fig. 3. Decrease in steam consumption with superheat.

ADVANTAGES AND ECONOMIES

The outstanding and decisive advantage secured by the employment of the superheater is that as compared with saturated operation a saving in water from 35% to 40% and fuel savings ranging from 25% to 35% are effected, while the hauling capacity of the locomotive is increased by approximately 33%. This increase in hauling power is due to the fact that superheat operation enables a larger horsepower output to be maintained although the superheater adds little or nothing to the starting power of the engine. This increase in capacity due to the employment of superheat is illustrated in Fig. 2.

The reduction in steam consumption per I.H.P. hour with the degree of superheat employed is shown in Fig. 3, which is based upon actual road tests. Here it is seen that the steam consumption of 27 lbs. per I.H.P. hour in the case of a saturated engine compares with a rate of

18 lbs. per I.H.P. hour with steam of 250°F. superheat corresponding to 656°F. total steam temperature ; while the use of 300°F. superheat, or 706°F. total steam temperature, reduces the steam consumption still further to some 17 lbs. per I.H.P. hour.

When steam is admitted to the engine cylinders a certain amount of heat is immediately abstracted from the steam by the relatively cool cylinder walls. If saturated steam is used then this transfer of heat to the cylinder walls is unavoidably accompanied by condensation of a certain amount of steam as saturated steam cannot lose heat without corresponding condensation. The result is a condensation loss of 20-30 per cent or even more, depending upon the cut-off employed (Fig. 4). However if superheated steam is used the loss of heat to the cylinder walls will merely result in a fall in steam temperature, a drop in superheat of about 7½°F. corresponding to each 1% of condensate which would be contained in the cylinder at the time of cut-off if the engine were operated with saturated steam.

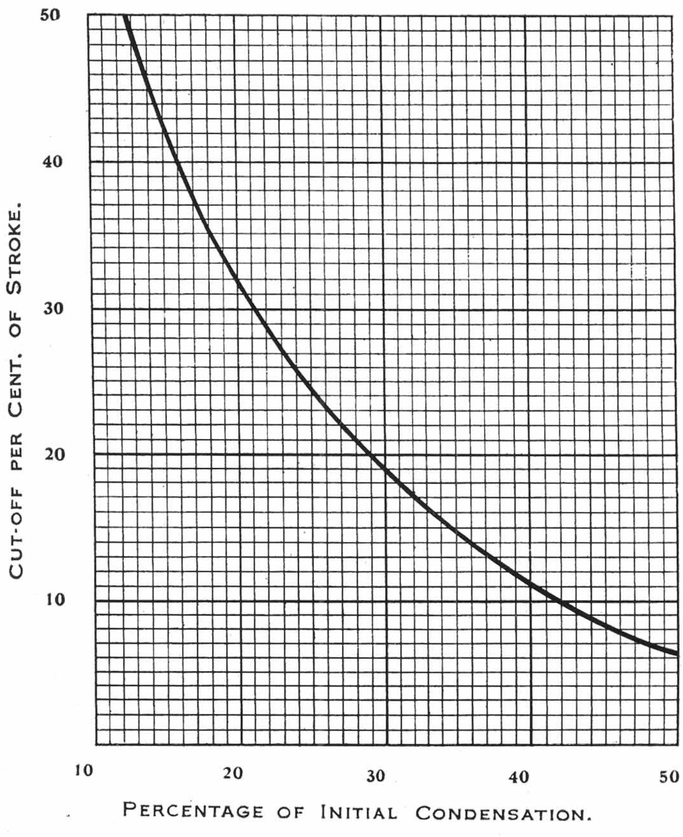


Fig. 4.

The actual reduction in superheat before the cut-off will also depend upon the engine speed as the lower the piston speed the longer will be the time the steam is allowed to remain in the cylinder, and the more heat will correspondingly be lost to the cylinder walls. The amount of superheat required to supress initial condensation with varying cut-off percentages is charted in Fig. 5.

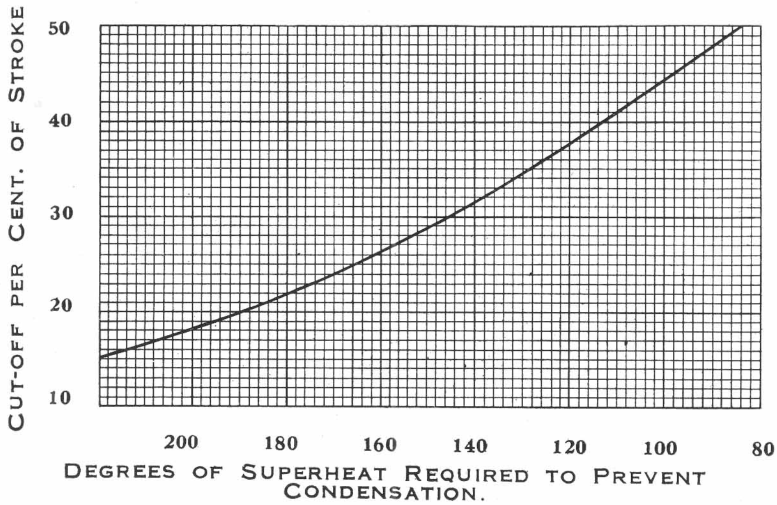


Fig. 5.

The expansion line of indicator diagrams taken from cylinders using superheated steam shows a more rapid drop of pressure than with saturated steam, but, on the other hand, the compression line is lower, showing less back pressure. The result therefore is that there is little

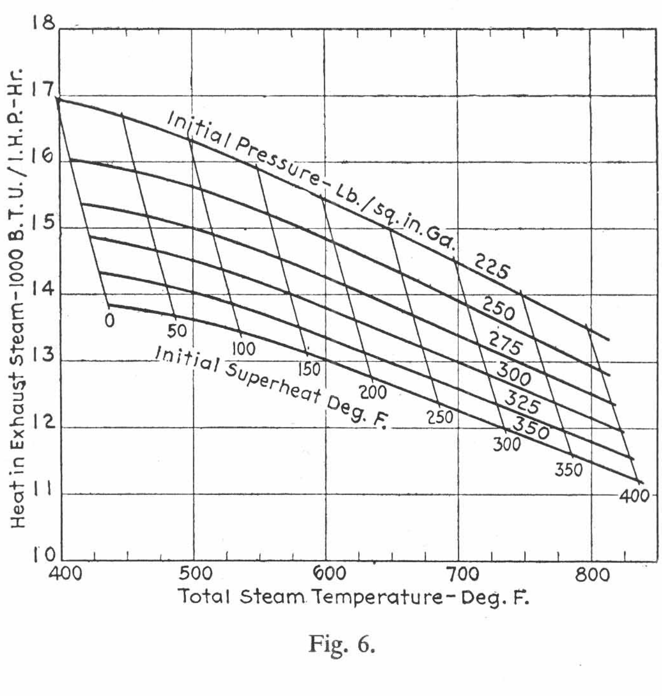


Fig. 6.

difference in the main effective pressure between superheated and saturated steam at the same initial pressure and cut-off. The orifice of the blast pipe with an engine operating with superheat should be about $\frac{1}{8}$ in. smaller in diameter, as the weight of steam discharged in a given time is less than that with saturated engines.

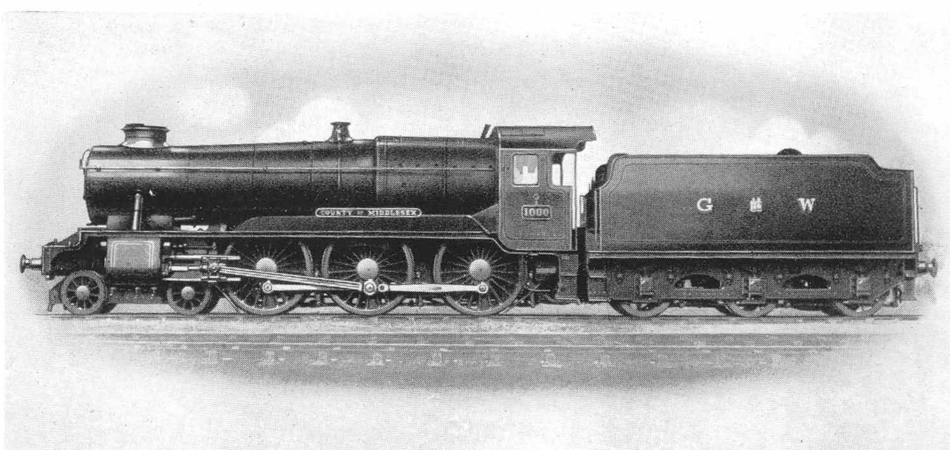
From time to time the question has been asked why it is that the presence of superheat in the exhaust does not adversely affect operating economy—a fact which is quite obvious from Fig. 3 showing a consistent increase in steam economy with the degree of superheat employed. The explanation is supplied by Fig. 6 which shows the relationship obtaining between the initial total steam temperature and the heat content of the exhaust steam as computed from the temperature of the latter. As will be seen from this chart the amount of heat contained in the exhaust steam decreases steadily with the initial steam temperature, and incidentally also with the initial steam pressure. This phenomenon is simply due to the fact that the real measure of cylinder performance is the amount of heat converted into work in relation to the total heat supplied to the cylinder, and this holds true no matter how high the initial steam temperature may be chosen. No theoretical temperature limit from the aspect of engine economy therefore exists.

FURTHER ADVANTAGES OF SUPERHEAT

The employment of superheat secures additional advantages such as reduction in boiler repairs because of the smaller demand for steam, and lower rate of combustion. Larger cylinders are employed on account of the increase in steam volume produced by superheating. Moreover superheating makes locomotives much more lively and flexible in service. Owing to the lower fuel and water consumption of engines fitted with superheaters, such engines can run longer distances without replenishment of water and fuel supply. This is of particular advantage in the case of tank engines where the amount of fuel that can be carried is limited and in districts where the water is scarce or of poor quality.

All new superheated engines are built with piston or poppet valves and equipped with some means of forced feed lubrication, either of the sight feed hydrostatic or mechanical types. With regard to the cost factor, it is important to note that the cost of the superheater is less than 5% of the cost of the entire locomotive. It is well-known that superheated engines haul considerably greater loads than saturated ; and it is but natural that for this reason greater maintenance is to be expected, although boiler repairs will be less. In order therefore to arrive at the true cost of maintenance it is necessary to view this on the ton-mile basis, and when this is done the result will be found to be greatly in favour of superheated locomotives.

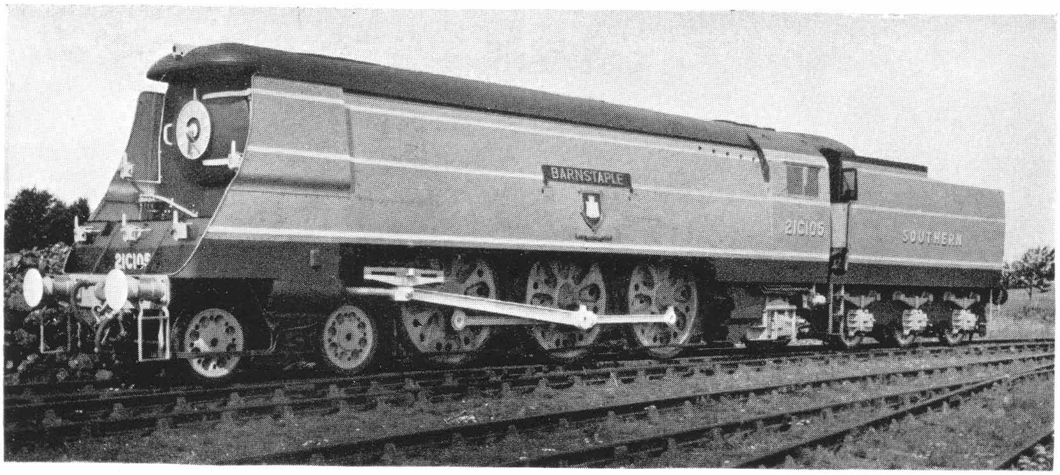
The following pages describe in detail the MeLeSco Superheater as applied to locomotives.



Photograph by courtesy of C.M.E.

Great Western Railway. 4 ft. 8½ in. Gauge.

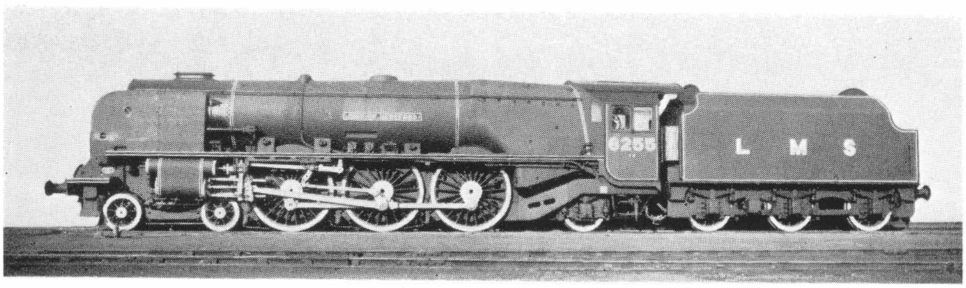
4-6-0 Locomotive "County" Class. Built at Swindon and fitted with "MeLeSco" Superheater elements.



Photograph by courtesy of C.M.E.

Southern Railway. 4 ft. 8½ in. Gauge.

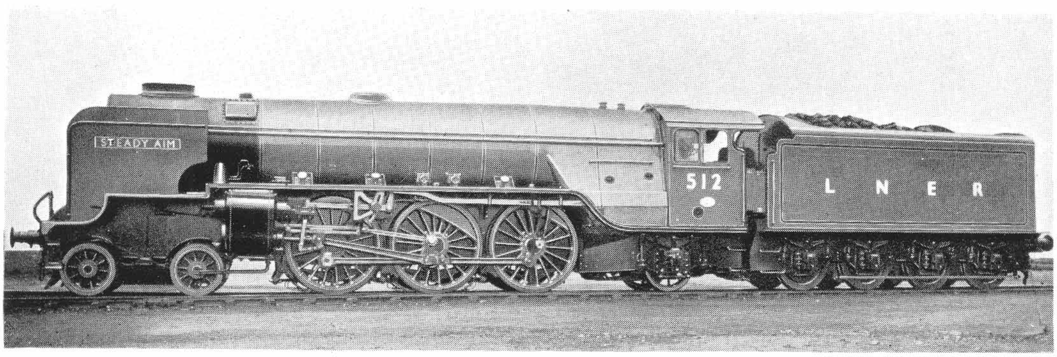
4-6-2 Locomotive " West Country " Class. Built at Brighton and fitted with " MeLeSco " Superheater.



Photograph by courtesy of C.M.E.

London Midland and Scottish Railway. 4 ft. 8½ in. Gauge.

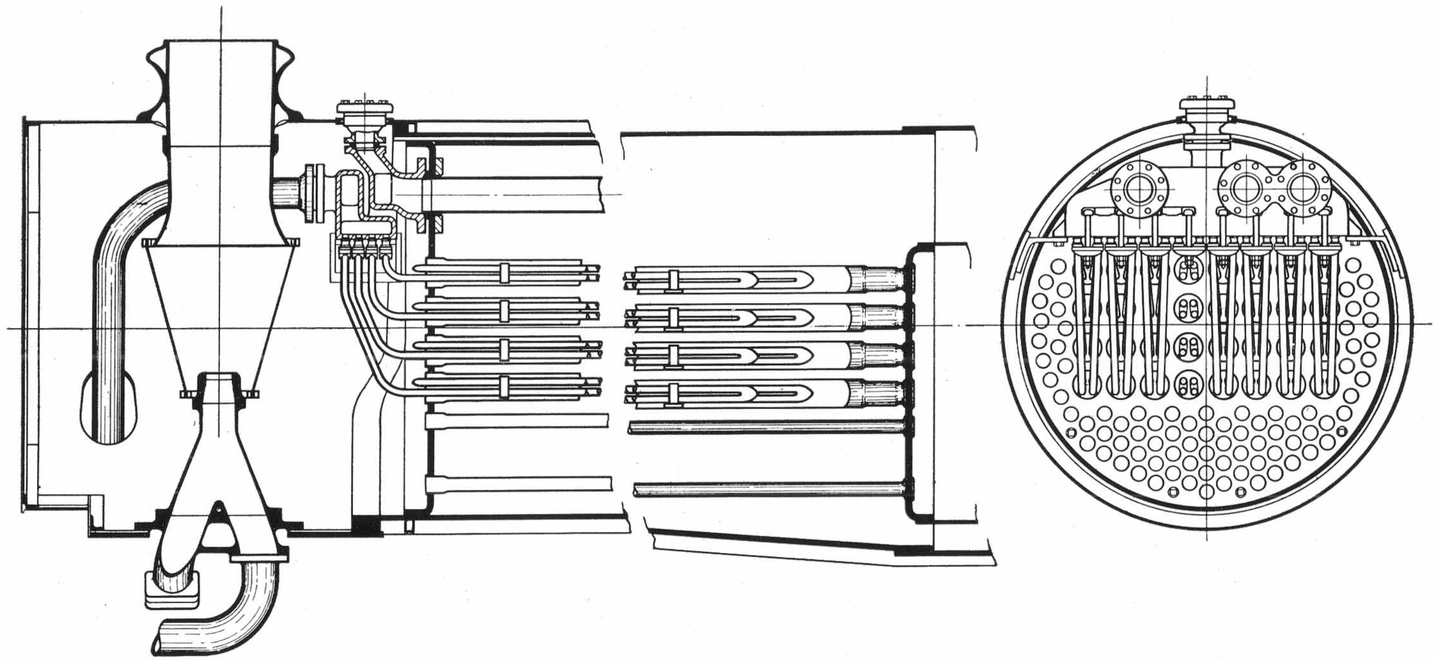
4-6-2 Locomotive " 7P " Class. Built at Crewe and fitted with " MeLeSco " Superheater.



Photograph by courtesy of C.M.E.

London and North Eastern Railway, 4 ft. 8½ in. Gauge.

4-6-2 Locomotive " A2 " Class. Built at Doncaster and fitted with " MeLeSco " Superheater.



Section through boiler showing disposition of " MeLeSco " Superheater Header, Elements and Anti-Vacuum Valve.

LOCOMOTIVE SUPERHEATER ELEMENTS

High temperature superheated steam can only be obtained by properly positioning the superheating elements in the hot zone of the gases passing through the flue tubes, and this necessitates that part of the element piping be situated very near the firebox and be exposed not only to a very high temperature but also to the erosive and corrosive action of the furnace gases.

The material from which the superheating elements are made must therefore be of the highest quality, and the methods of manufacture must be such that the completed elements are in every way efficient and able to withstand the severe service conditions to which they are subjected.

It was not until the introduction of the arrangement of superheater evolved by the late Dr. Wilhelm Schmidt, at the beginning of this century that comparatively high temperature locomotive superheating could be obtained on an economical basis ; and since that date The Superheater Company, Ltd., have specialised in the design, supply and manufacture of all types of superheaters. The experience gained, together with the improvements in methods of manufacture and the introduction of specially designed machinery has been such that the Company are now not only in a position to design the most efficient superheater equipment for any type of boiler, but the apparatus which they manufacture ensures maximum service life and greatest economies in results.

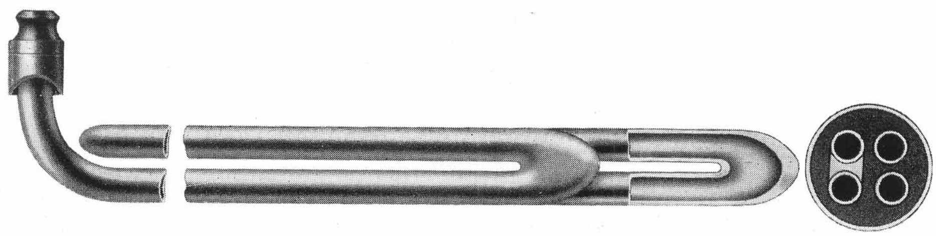


Fig. 7. MeLeSco Superheater Element.

" MeLeSco " Superheater Elements are manufactured from cold drawn weldless steel tubing of the best quality, to conform with a Specification prepared by the Company. This Specification will be forwarded upon request.

The most vulnerable parts of a superheater element are the return bends situated at the firebox end of the flue tubes. Not only do these return bends have to withstand the severity of the high temperature and high draught of the furnace gases, but they must be so shaped that their exterior surfaces offer the minimum obstruction to gas flow ; while interior steam flow resistance must also be reduced to the minimum. Return bend construction must therefore be such that the steam flow area in the bend is not less than that in the element tubing itself, so that the velocity of the steam is maintained without eddying, with its consequent pressure drop. The thickness of the bend must be sufficient to resist the erosive and corrosive action of the furnace gases and also to preclude the possibility of deformation due to insufficient strength of material at this point—and this under the most severe operating conditions.

THE MeLeSco FORGED RETURN BEND

Experience has shown that these extremely exacting operating requirements can be successfully met only by the MeLeSco Return Bend ; while all makeshift designs jeopardize safety of operation and require frequent replacement. This applies in particular to cast steel ends screwed or welded, or both, to the element tubing, and to oxy-acetylene welded ends. The unreliability of welding is also present in the forged caps end type butt welded to the tubing. Deterioration of the parent material adjacent to the weld, corrosion attack of the deposited weld material and the formation of steam flow obstructing fins on the inside of the tube are typical features of such designs.

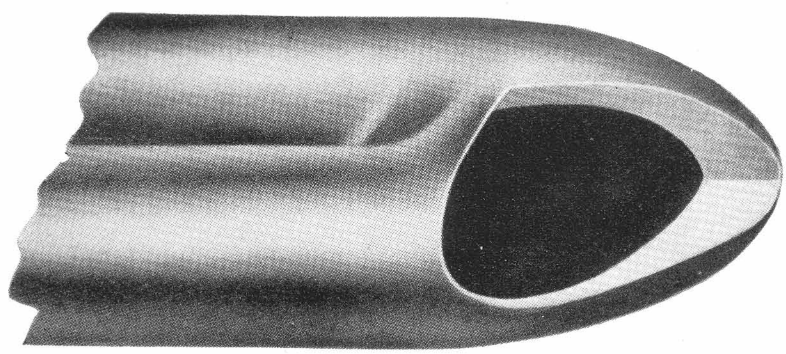


Fig. 8. Sectioned View of MeLeSco Forged Return Bend.

The ideal return bend is therefore one which is integrally formed from the tubing itself. Fig. 7 illustrates an element, the return bends and ball ends of which are manufactured by the latest " MeLeSco " process.

Fig. 8 illustrates a completed end, sectioned. By varying the dies used in this process any desired cross section, contour or thickness of wall can be obtained.

Special forging and swaging machines have been designed and installed at the Trafford Park Works of The Superheater Company. The illustrations in Fig. 9 show the various steps in the manufacture of a return bend produced from the actual material of the tubes, the product being standard and homogeneous in all respects because it is mechanically produced, each operation being performed by means of special dies in forging and swaging machines.

As a first step in this manufacture the two long element tubes are clamped together at fixed centres, as shown in Fig. 9 (*a*), the ends after being heated in a furnace are placed in a special machine, where the tube ends are split simultaneously and forged together, giving the results as shown at (*b*). The end is re-heated and closed in a rotary swaging machine by split dies, producing the respective steps, as shown at (*c*) and (*d*), wherein the end, still hot, is shaped and given the proper contour. In Fig. 9 (*e*) the final press operation is illustrated in which the excess metal in the tip has been cut off and the end smoothly finished.

The MeLeSco Return Bend thereby produced gives the following distinctive features which cannot be realised by any other process and may be summarised as follows :—

1. Strict uniformity and unvarying dimensions ; the manufacture being effected throughout by automatic machinery.

2. The dies which control the dimensions of the ends are so constructed as to ensure :—
   (*a*) Standard thickness of wall.
   (*b*) Standard cross sectional steam area.
   (*c*) Standard internal and external dimensions.
   (*d*) Standard reinforced thickness at top of end.

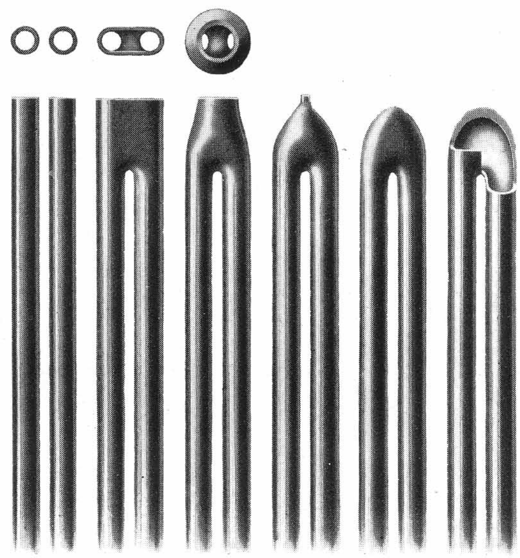


Fig. 9. Steps in the manufacture of the " MeLeSco " Integrally Machine Forged Return Bend.

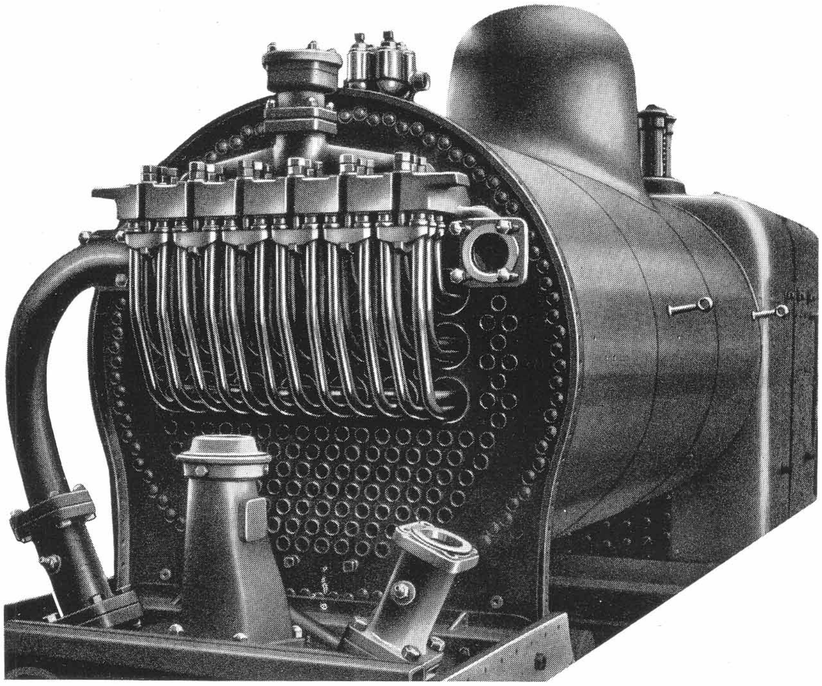
Thus a constant maximum steam area is provided and pressure drop across superheater reduced to minimum.

3. The end is a component and integral part of the element tubing. The element and its end constitute one solid forging all parts of which have been subjected during the entire process of manufacture to the same uniform temperature. Consequently, risk of crystallisation due to burning of the metal or any other defects possible in acetylene welding or in any other known method of joint are entirely eliminated.

4. Clean, smooth surface finish, thus preventing the accumulation of dirt, ashes, or other foreign matter, with resultant minimum constriction of gas flow and reduction of draught pressure.

5. *Numerous destruction tests have been made on the completed element with this type of end, and in every case the tubing has fractured before the end itself, thus showing that the forged end has a greater strength than any other part of the tubing.*

This machine forged return bend is protected by the registered Trade Mark " MeLeSco," and customers desiring to ensure that the elements supplied to them are manufactured by this special process should specify that they be made with " MeLeSco " Machine Forged Return Bends, and thus avail themselves of the opportunity thereby afforded to secure highest efficiency with minimum maintenance costs.



Locomotive under construction for Indian Government Railways, showing Superheater Header, Elements, and Anti-Vacuum Valve erected in position.

"MeLeSco" SUPERHEATER ELEMENTS

The most usual method of applying a superheater to a locomotive boiler is to provide a number of flue tubes of from 5 in. to $5\frac{1}{2}$ in. external diameter which are fitted in place of a number of the ordinary size fire tubes. The bore of the flue tubes is sufficiently large to contain four runs of $1\frac{3}{8}$ in. or $1\frac{1}{2}$ in. outside diamenter element tubing without causing undue obstruction to the flow of furnace gases through them. The number of flue tubes fitted varies from eight to forty-eight or more, according to the size of boiler and the degree of superheat required.

Fig. 10 shows a standard type of superheater element in position in the flue tube. It will be observed that the element consists of four lengths of tubing connected by two return bends at the firebox end and one at the smokebox end in such a manner that the steam in its course from the inlet to the outlet ends has to traverse four times the length of the element lying in the path of the gases from the firebox to the smokebox. The element ends nearest the furnace are

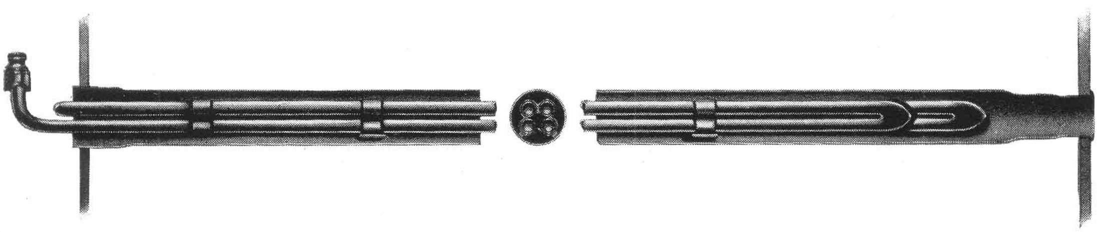


Fig. 10. Standard " MeLeSco " Ball Joint Element shown in position in Flue Tube.

positioned about 20 inches from the firebox tube-plate. The element shown in Fig. 10 is made with MeLeSco Ball Joints forged integrally with the inlet and outlet ends of the element, as described below.

THE " MeLeSco " BALL JOINT

There are several methods of making the connection between the superheater element and the header, and of these it has been found that the metal-to-metal joint obtained by seating a ground ball on a conical seat,is superior to any other type.

The MeLeSco Ball Joint, metal-to-metal connection, offers the following advantages :—

(*a*) Perfect steam tightness under all conditions.

(*b*) Free movement of the element in the flue tube without imposing strain on the joint connection.

(*c*) Ease and facility of erection and removal.

(*d*) Absence of special tools for installation or dismantling.

(*e*) Minimum maintenance cost.

This type of joint is exclusively adopted in the United States, Canada, South Africa, India, Australia, Argentine and in many railways in other parts of the world.

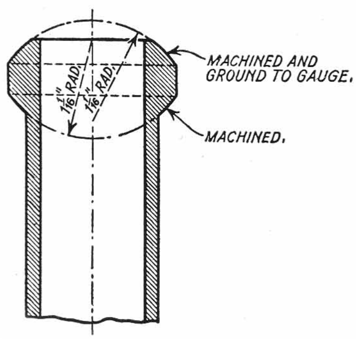


Fig. 11.
" Short " Ball.

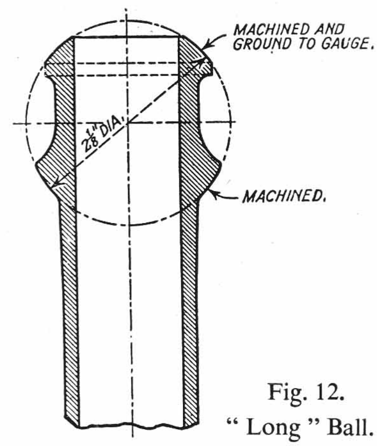


Fig. 12.
" Long " Ball.

In the " MeLeSco " process the ball ends are made from the tube itself by means of machinery specially designed for the purpose. The ends of the tubes are " jumped up " or " upset " in a forging press so as to provide sufficient material to form the ball. They are machined to the correct dimensions and the spherical surfaces at the extreme ends, on which the steam tight joints are made, are ground to a radius of $1\frac{1}{16}$ in., a cup gauge being employed to test the accuracy of the curvature. The gauge itself is checked by a steel ball $2\frac{1}{8}$ in. diameter. Full details of the tools for maintaining the ball joint are to be found in a separate Instruction Book which will be furnished on request.

The illustrations Figs. 11 and 12, show " Short " and " Long " ball ends, the type to be used being governed by the requirements of the particular design of superheater. The lower spherical surfaces of the "ball" are formed to the same radius as the upper and seat in loose washers, which are cupped out to provide spherical seats on the one side and flat surfaces on the under side which bear against a flange block, made from a drop forging.

ELEMENT BOLTS

Element bolts for the " Through bolt " type of headers can be used either with the nuts below the flange block or, if desired, on the top of the header as shown in Fig. 13. These bolts are

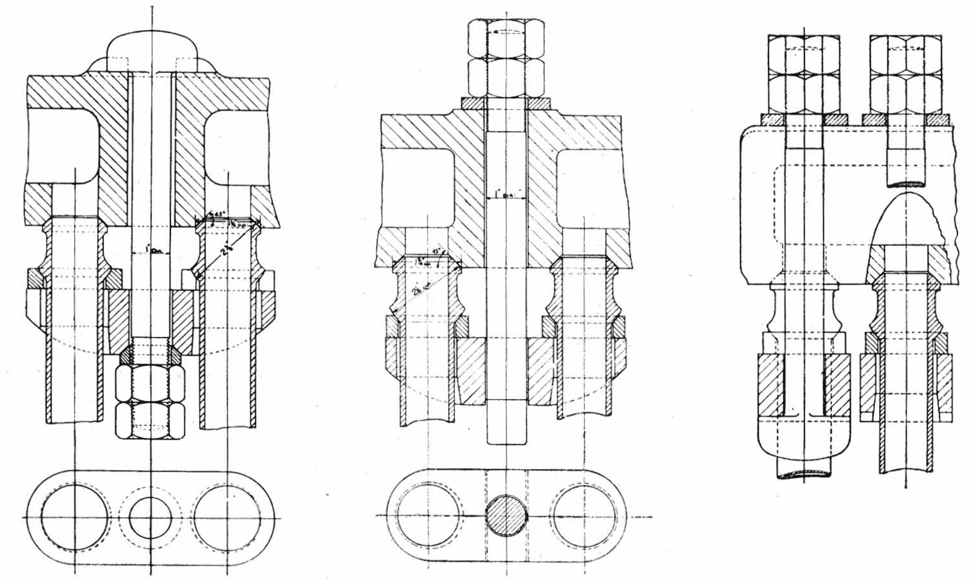


Fig. 13. Typical applications of the MeLeSco " Long " Ball Joint.

manufactured from special steel having a tensile strength of not less than 50 tons per square inch, a yield point of not less than 35 tons per square inch, and an elongation of not less than 16 per cent in 2 inches. The nuts are also made from similar special material. It is essential that attention be paid to these bolts and nuts to ensure their being to the correct specification, as otherwise the use of ordinary mild steel will result in elongation when screwing up and it will be impossible to obtain a sound steam tight joint. All bolts supplied are made to conform with The Superheater Company's specially prepared Specification copy of which will be forwarded on request.

It will be seen from Fig. 14 that two nuts are used with each bolt. The second serves both as a lock nut and to provide protection to the thread of the bolt, preventing its corrosion and ensuring ease of removal when necessary. For the latter reason the length of bolt should be such that its end does not protrude beyond the second nut, but should be about $\frac{1}{8}$ in. within it.

As will be gathered from the foregoing, the " MeLeSco " ball joint provides an attachment giving maximum efficiency with considerable flexibility. No setting of tubes is required in the shops or running sheds, and the element joints are easily and quickly assembled and disconnected. An application of colloidal graphite on the threads of the bolt will prove beneficial when the joint has to be broken.

MeLeSco BOX SPANNER

Fig. 15 shows a specially designed box spanner of robust construction for use in breaking the element joint. The box spanner is shown reflected in a mirror, from which it will be observed that one hexagon is at an angle of 90° to the other. Both hexagons fit the 1 inch Whitworth element bolt nuts. It will be appreciated that the hexagons being at 90° to one another in conjunction with the three positions for the cast steel tommy bar afford a very wide range of application and facilitate access to nuts in restricted positions. The box spanner and tommy bar are supplied as part of the standard maintenance equipment to which reference is made on page 21.

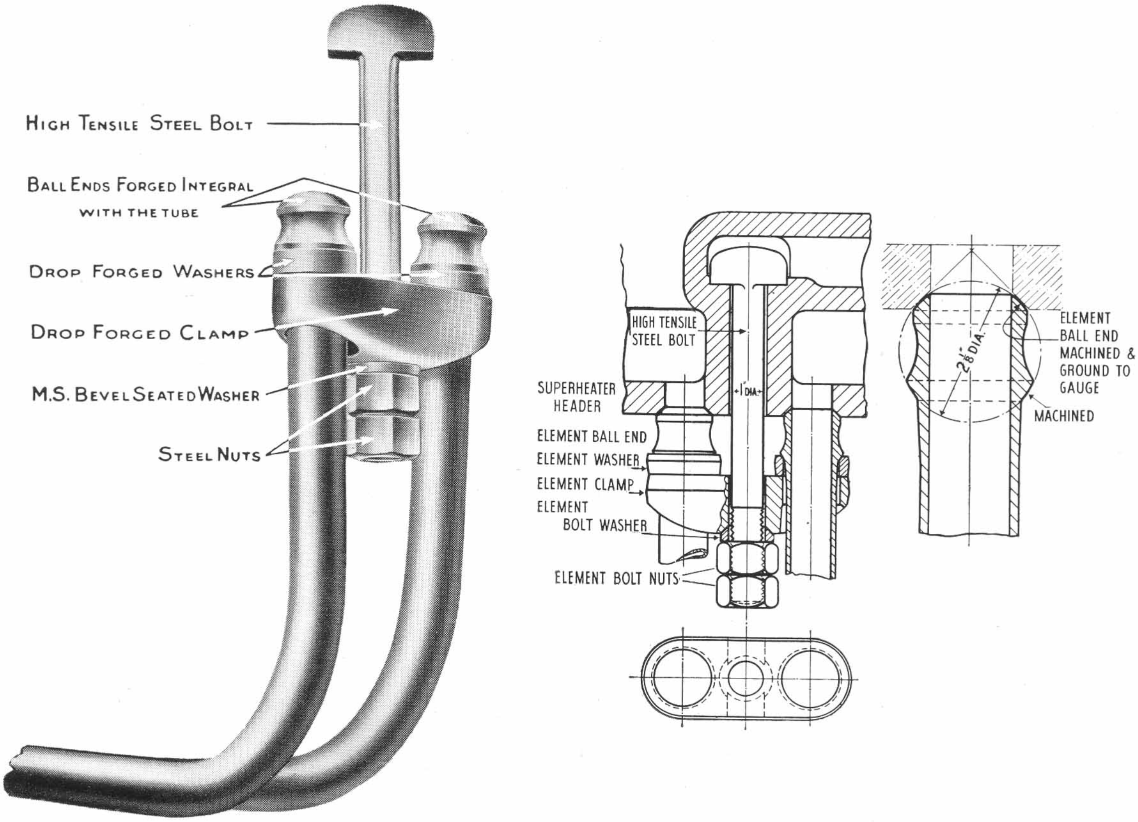


Fig. 14. " MeLeSco " Ball Joint connection of Element to Header.

CONVERSION OF HEADERS TO BALL JOINTS

Existing headers can generally be cheaply converted to the " ball " joint, coning of the element holes being the only alteration required. Designs will be readily submitted by The Superheater Co., whose staff is at the service of customers.

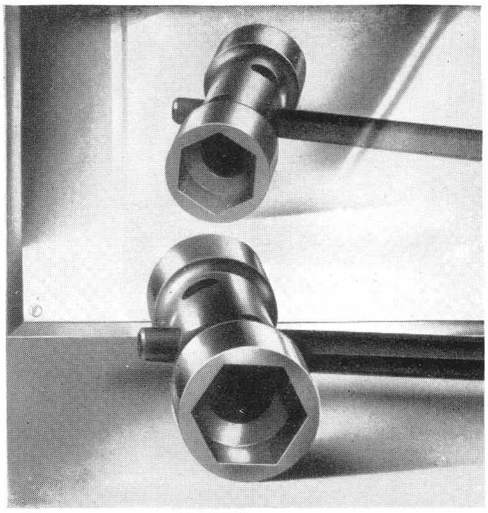


Fig. 15. MeLeSco Box Spanner for making and breaking the Ball Joint.

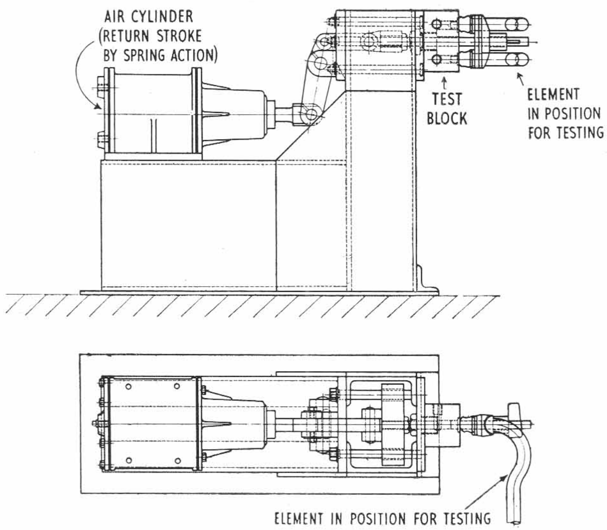


Fig. 16. Hydraulic Testing of Ball Joint Elements. Test Pressure 1250 lbs./sq. in.

TESTING AND DESPATCH

After completion of manufacture and before despatch, all elements are tested by hydraulic pressure to 1250 lbs. per square inch. The testing equipment is shown in Fig. 16. After test the elements are blown out thoroughly with steam to expel all test water and finally dried with hot air. They are then dipped in tar to ensure protection against rust in transit and store. The ball ends or flanges are fitted with specially designed wooden protecting blocks, as shown in Fig. 17, thus ensuring that no damage to joints can result in handling. It is strongly recommended that these protecting blocks are not removed until the elements are about to be fitted to the headers. Elements of the expanded joint type are protected by means of wooden plugs which are driven into the tube ends.

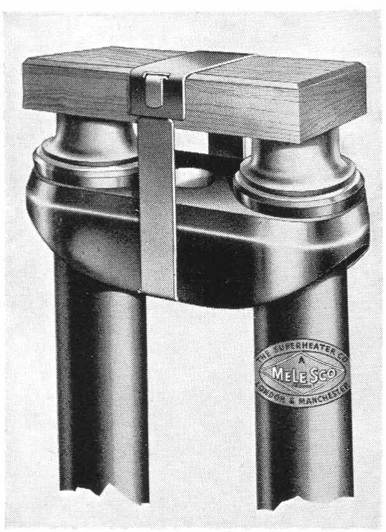


Fig. 17.

Method of securing Wooden Protection Block as fitted to all Ball Joint Elements.

BANDS AND SUPPORTS

Attention must be paid to the design of bands for holding the runs of element tubing in their correct relation to one another, and to the method of supporting the elements in the flue tubes.

Many cases have occurred in which the flue tubes have become pitted and grooved, due to the rubbing action of small bearing surfaces against them, assisted by the vibration set up when the locomotives were in service. This wear occurred at points where the supports for the elements were in contact with the tubes and was principally due to insufficient and sharp bearing surface. With some types of element supports the bearing surface consisted only of the edges of two 16 w.g. strips of narrow width and in others the support consisted of small pieces of metal spot-welded to the elements.

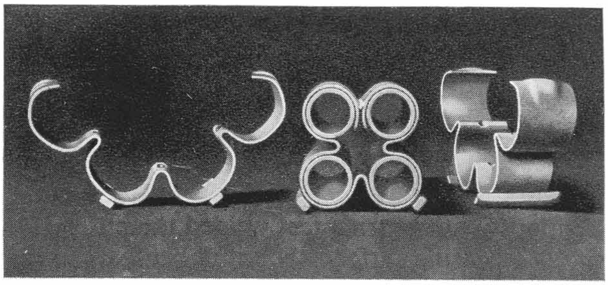


Fig. 18. " MeLeSco " pre-formed Element Support.

Furthermore the element bands were generally too frail to withstand the working conditions and the corrosive action of the furnace gases. This resulted in collapse of the bands and hence the elements themselves rested on the flue tubes, causing a considerable loss of superheat, due to the impaired heat transfer from the flue gases to the steam in the elements. Obviously, the loss of efficiency due to this factor alone was very high, added to which soot accumulation around the elements made proper cleaning impossible. The absence of bands and supports due to collapse rendered elements liable to distortion and bending in service and in handling when dismantled.

The Superheater Company have now evolved and standardised bands and supports which overcome these troubles. Maintaining correct centres in the four pipes comprising the elements, ensures :—

1. Maximum area of gas-swept surface of superheater element exposed to hot gases, thus ensuring attainment of the designed superheat temperature.
2. Predetermined area for gas flow through the flue tubes,
3. Reduced ash accumulation owing to minimum obstruction of band and support and more easy flue cleaning.
4. Maximum metal surface contact between support and element which promotes increased heat transfer, and thereby prevents excessive temperature building up in band material and consequently reduces wastage.

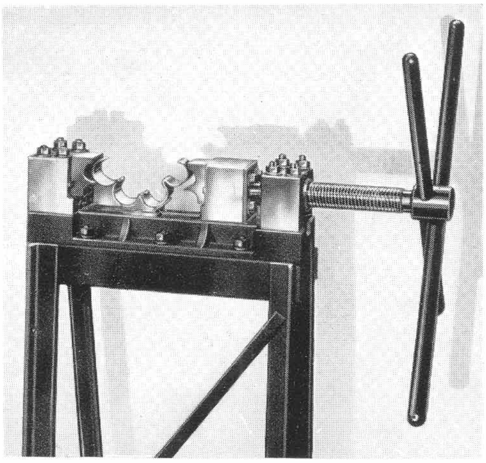


Fig. 19. " MeLeSco " Press in open position with pre-formed band in position.

Fig. 18 illustrates the support with bearing feet welded thereto. These feet consist of strips of steel which provide adequate bearing surface, the result being that pitting and grooving of the flue tubes due to vibration and rubbing of the elements is avoided. The bearing feet are seen to be bent slightly upwards at each end ; this prevents damage being done to the tube surface when sliding the elements into position. Also, there is no sharp edge that can rub against the flue tube during operation.

The element band is constructed similarly to the element support, except that there are no bearing strips. These bands bind the four tubes comprising the superheater element securely together. Elements not exceeding 11 feet in length should have one support placed not more than 30 inches from the end of the element, and one band at a distance of about 22 inches from the front end. Elements exceeding this length, up to 16 ft. 6 in. should have two supports and one band ; over 16 ft. 6 in. in length, three supports and one band.

Care has been taken in the design to ensure a robust construction without causing obstruction to the cleaning of the flues. Both the band and the support are made of stout material, 12 w.g. strip metal being used.

MeLeSco PRESS

A portable screw-operated clipping machine, as shown in Figs. 19 and 20, is manufactured by the Company, to facilitate the fitting of new bands and/or supports to elements.

The machine consists of two sliding dies which close the band or support around the four pipes of the element against the stationary die when the screw is actuated, the horizontal and vertical centres being automatically registered by the design of the dies. The Press, including Preformed Bands and Supports, can be obtained readily from The Superheater Company. Full details of the MeLeSco Press are to be found in an instruction book which will be furnished upon request.

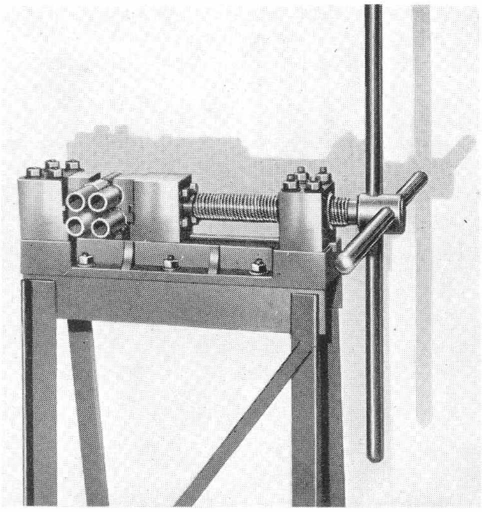
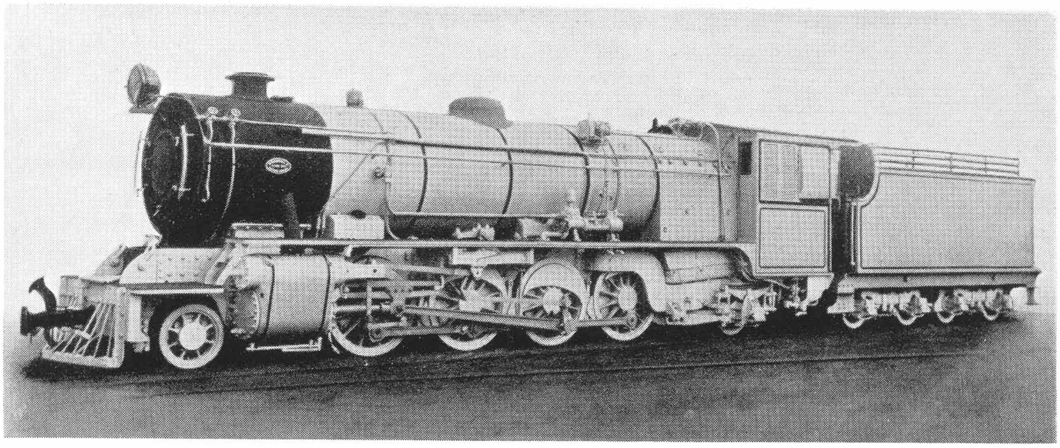


Fig. 20. " MeLeSco " Press in closed position with pre-formed support ready for welding.

MAINTENANCE TOOLS

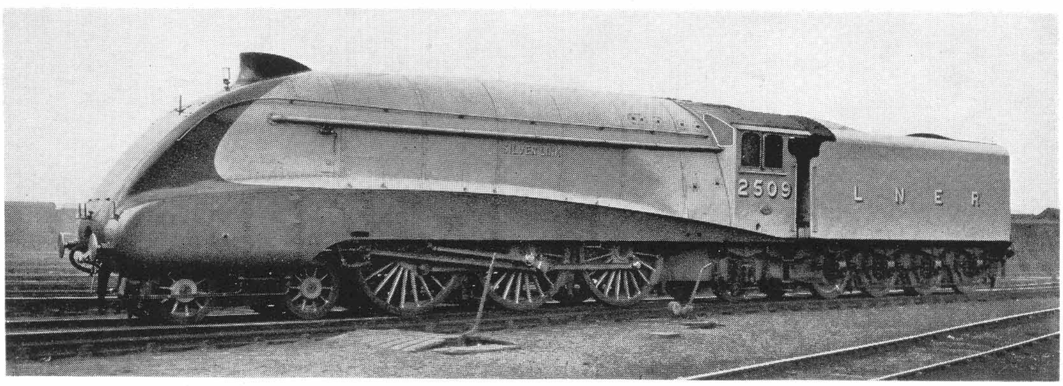
The Superheater Company manufacture and supply from stock a strongly constructed metal case containing specially designed tools for maintaining superheater headers and elements in first class condition.

As mentioned earlier in this pamphlet, full particulars and working instructions are contained in a separate publication—entitled " MeLeSco Superheaters—Installation, Maintenance and Operation "—which booklet will be furnished on request. This booklet contains useful information for works and running shed staffs and is also invaluable to footplate personnel.



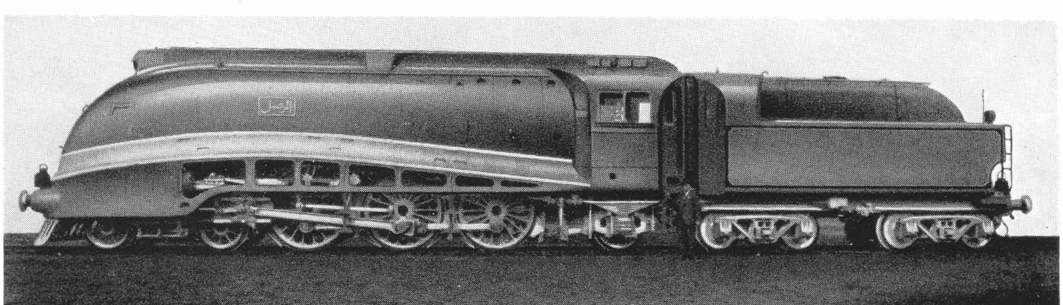
Bombay, Baroda and Central India Railway. Metre Gauge.

2-8-2 Locomotive. Built by W. G. Bagnall, Ltd. for Ministry of Supply and fitted with " MeLeSco " Superheater.



London & North Eastern Railway. 4 ft. 8½ in. Gauge.

4-6-2 Pacific Locomotive. Built in Company's Workshops. Fitted with " MeLeSco " Superheater. " Mallard " of this class holds the World's Speed Record of 125 m.p.h.



Iraqi State Railway. 4 ft. 8½ in. Gauge.

4-6-2 Locomotive. Built by Robert Stephenson and Hawthorns Ltd. and fitted with " MeLeSco " Superheater.

SUPERHEATER HEADERS

Locomotive Superheater Headers, or Steam Collectors as they are sometimes called, are usually placed horizontally in the upper part of the smoke-box. They are subdivided internally into two separate series of compartments or chambers, one of which receives saturated steam from the boiler and distributes it to the superheater elements, the other receiving the steam after it has been superheated. The castings are consequently subjected to the unequal stresses set up by the different temperatures prevailing in the compartments and on the inner and outer surfaces of the header walls.

These temperature variations are accounted for by the location of the header in the smoke-box, as the outer surfaces of the castings are exposed to flue gas temperatures of from 550°F. to 750°F. depending on the vacuum in the smoke-box, while the interior walls are in contact with saturated and superheated steam, which may have temperatures of 380°F. and 750°F. respectively. The temperature difference, therefore, may range up to 370°F. across adjacent walls, and, moreover, this temperature difference occurs at several places in one and the same casting, due to the necessary internal subdivisions.

The above temperature variations apply to normal conditions of steady steam and gas flow, but in actual operation they may be greater, owing to the fact that while the saturated steam temperature is practically constant, the temperatures of the flue gases, and of the superheated

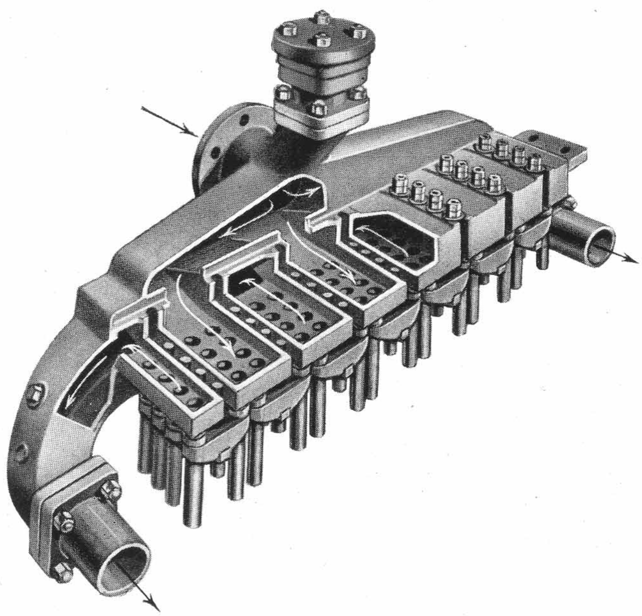
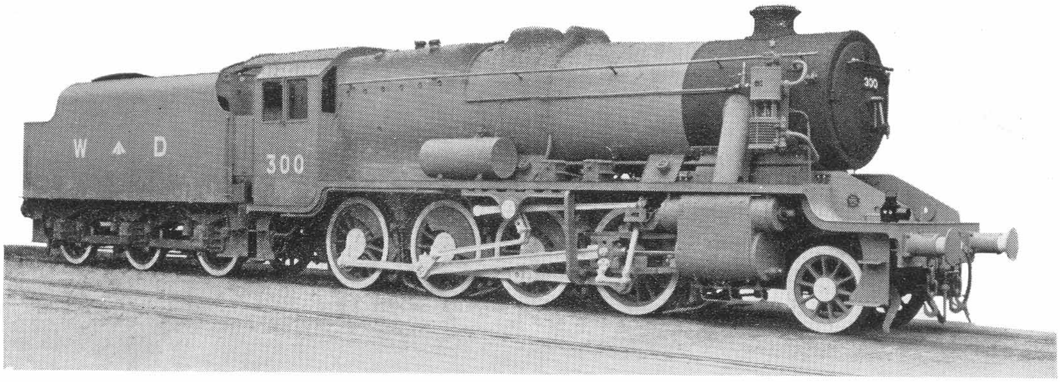


Fig. 21. Locomotive Header fitted with Anti-Vacuum Valve, showing path of steam from saturated inlet to superheated outlets via the superheater elements.



Ministry of Supply. 4 ft. 8½ in. Gauge.
2-8-0 W.D. Locomotive (L.M.S. type). Built by the North British Locomotive Co. Ltd. and fitted with " MeLeSco " Superheater.

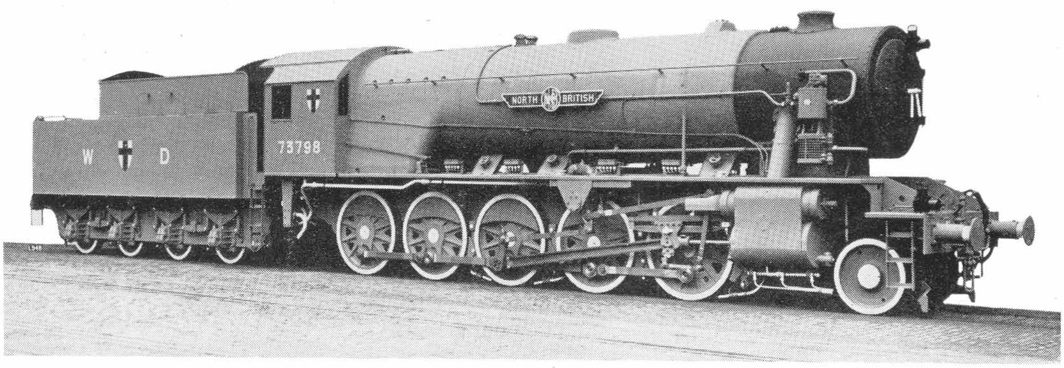
steam are subject to fluctuation because of the continually varying vacuum or strength of blast in the smoke-box. Moreover, the variation in steam velocity through the passages in accordance with the movement of the piston of the engine in different position of its stroke, causes continuous fluctuation of the steam temperature.

The difficulties in designing suitable Headers for locomotive superheaters are further increased by the actual conditions obtaining on the various railway systems, and they vary with the class of engine and the service to be performed.

SPECIAL DESIGN FEATURES

The large variations in temperature induce thermal stresses of no mean magnitude, which must be considered in the design, and are entirely apart from any static pressure stresses.

The Superheater Company has a large and varied experience in successfully dealing with the application of superheated steam to locomotives, and the " MeLeSco " Headers, illustrated on the following pages, have been so designed that notwithstanding the essential subdivision into separate passages for saturated and superheated steam, the areas of the surfaces and the thicknesses of the walls are so proportioned that the rate of heat transmission is maintained at predetermined rates through the whole structure. This is of great importance since, as the time factor is constant, the thickness of metal forming the wall of any chamber must have a definite relationship to the surface of that wall and to the temperature and relative velocity of the steam and/or gas passing across that surface.



Ministry of Supply. 4 ft. 8½ Gauge.
2-10-0 Locomotive. Built by the North British Locomotive Co. Ltd. and fitted with " MeLeSco " Superheater.

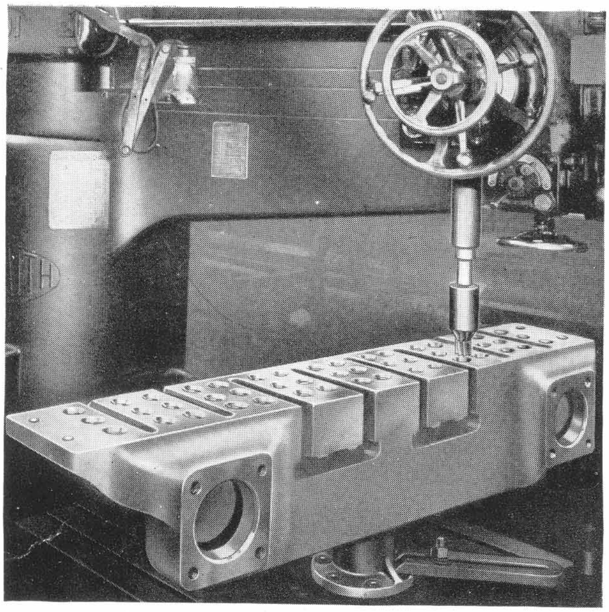


Fig. 22. Header cone seats being machined after the element holes have been jig drilled. In the special combined reaming and countersinking tool the setting of an adjustable sleeve ensures that all element holes and seats are identical. (From photographs taken in the works of The Superheater Company at Trafford Park, Manchester.)

Due consideration has also been given to the areas of the various steam passages and the contours of the casting so as to provide ample and unobstructed steam flow ; sharp corners and pockets likely to cause eddying of the steam are avoided, thus ensuring that the steam velocity is maintained with a minimum loss of pressure through the apparatus.

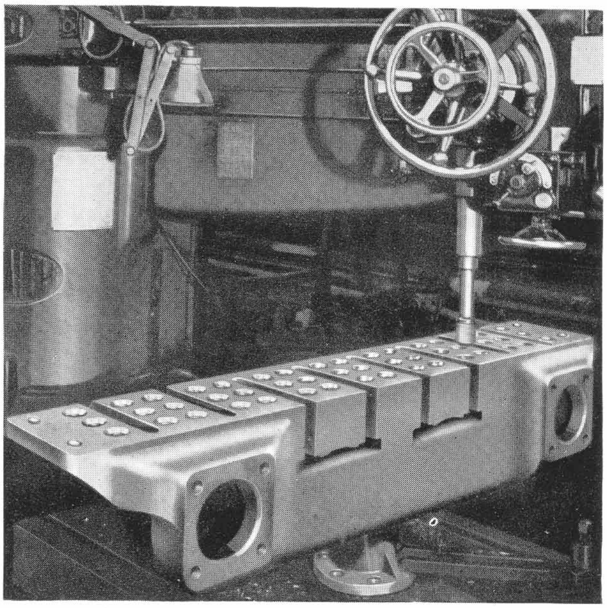


Fig. 23. Header cone seats being finally ground after machining. A high grade polished cone seating is produced, the line contact for the element ball end being checked for each individual cone by means of a hardened ball.

As a result of these precautions there have been few failures of " MeLeSco " Headers resulting from thermal or static stresses. This successful performance, while in great part due to the correctness of design in principle, is also explained by the care exercised in the preparation of the patterns and core-boxes for the foundry.

When locomotive superheating was first adopted the headers or collectors were made of cast steel, but the difficulty of producing sound castings free from porosity—owing to the intricate design—eventually led to the adoption of cast iron. Numerous experiments were made to evolve the most suitable mixture, with the result that The Superheater Company now

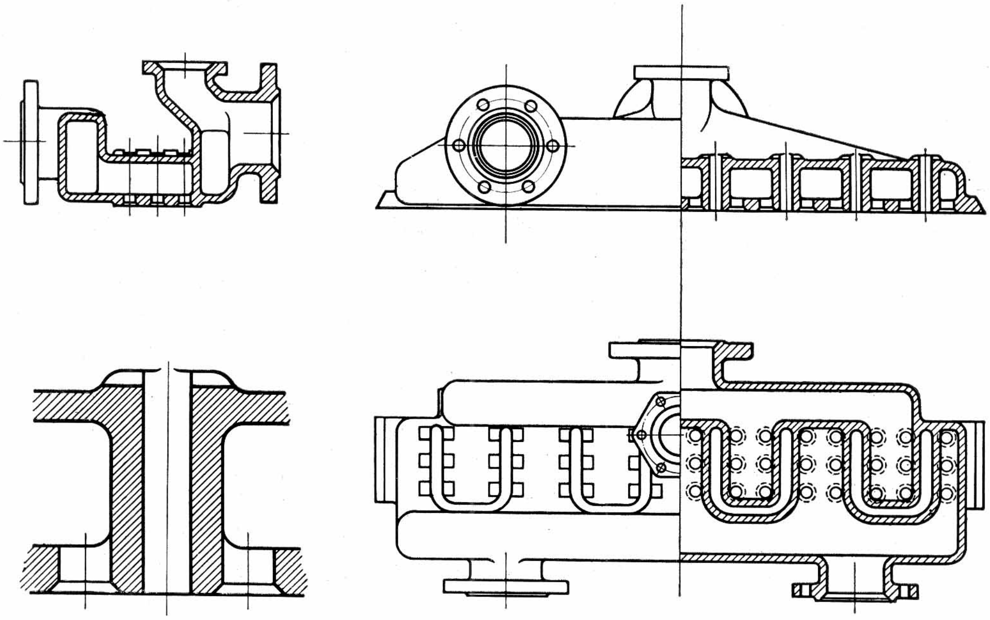


Fig. 24. " A.M. " Type Header.

use a special grade of cast iron known as "Melescoloy," and strictly conforming to specified composition, for all their superheater header castings. The Specification, to which all " MeLeSco " Headers are made, will gladly be furnished on request.

The castings thus produced are of excellent quality, having the necessary strength to resist the thermal and static stresses, and at the same time are easy to machine and finish to a fine surface.

HEADER TYPES

All the header types described below are machined at the works of the Company at Trafford Park, Manchester ; and before despatch are hydraulically tested to 360 lb. per square inch, in addition to any such tests as may be required by the Consulting or Inspecting Engineers.

Every " MeLeSco " Header bears a serial number cast on, reference to which gives a complete history of the Header, and this number should be quoted in communications.

HEADER TYPE " A.M."

In the design of header shown in Fig. 24 the possibility of cracking of the compartment walls has been precluded by providing air-insulating spaces between the different compartments. The casting is divided into transverse compartments or pockets communicating alternatively with the saturated and superheated steam passages, which are situated longitudinally at the back and front of the headers respectively. Air passages which act as insulating spaces between these compartments are utilised for housing the element clamp bolts, the T-heads of which lie in a horizontal plane along the header, the nuts being below. If desired, however, the bolts may be used with their heads bearing upon the element clamps and the nuts on the top of the header. With this design two or more superheated steam outlets with large flanges can be easily arranged. The ball joint attachment is universally fitted with this type of header.

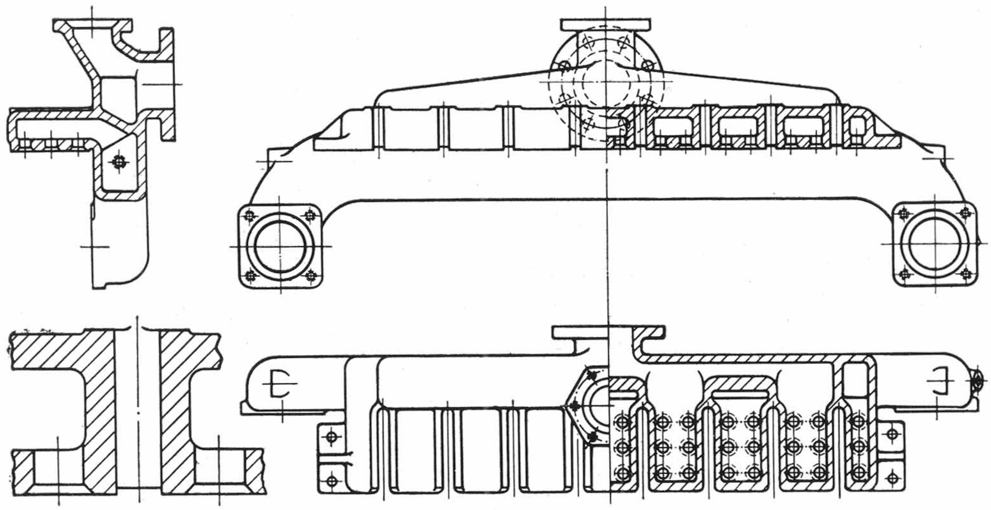


Fig. 25. " A.S." Type Header.

HEADER TYPE " A.S."

This header has similar insulating passages between the compartments or pockets, as shown in Figs. 21 and 25. However in this design the saturated and superheated passages are arranged one above the other at the back of the header with communicating compartments or pockets at right angles. The slots or insulating passages, in addition to allowing for independent expansion of the compartment walls, are utilised for housing the clamp bolts, with nuts either on top of the pockets or below the clamps as desired.

To withdraw an element it is merely necessary to slacken the nuts, after which the bolt will slide out of the insulating space as the element is withdrawn without having to remove it from the clamp.

Any form of ball joint attachment can be adopted for this header, the one illustrated actually being the long ball type with bolt nuts and washer on top. This header occupies small space and consequently is particularly suitable for engines having short smoke boxes.

HEADER TYPE " A.S.B."

This type of header is a modification of the " A.S." design, and although the saturated and superheated passages are similarly situated longitudinally, instead of being one on top of the other, they are one in front of the other *i.e.* side by side. This type is generally known from its shape as the " Boot " Type. In other respects it is similar to the " A.S." Header previously described, having insulating spaces between the compartments. The ball joint attachment is also employed with this design.

HEADER TYPE " A.X."

In the foregoing designs the depth of the header is comparatively large, and on many of the older locomotives, which are still worth converting from saturated to superheated steam, the space in the smokebox is restricted ; consequently the chimney would have to be moved forward to accommodate these headers. To overcome this difficulty the " A.X." type of header has been evolved, which is illustrated in Fig. 26.

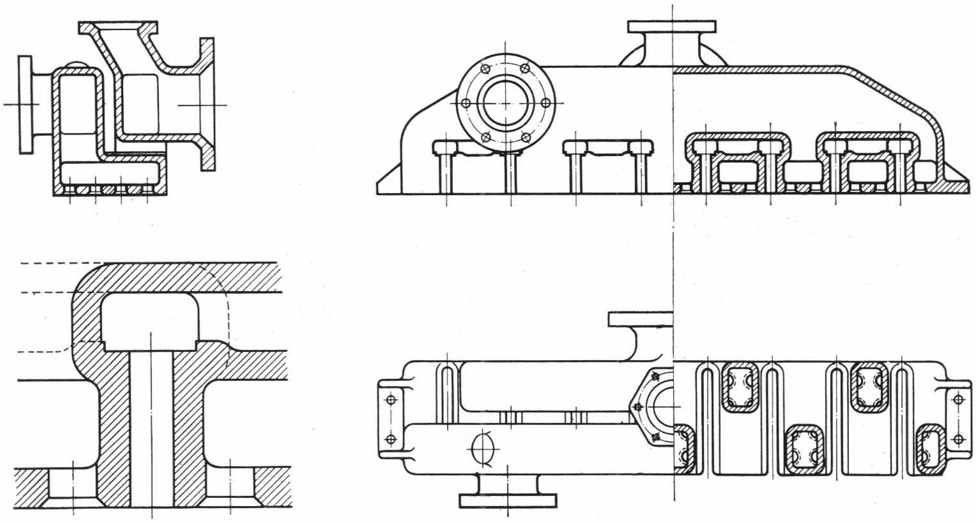
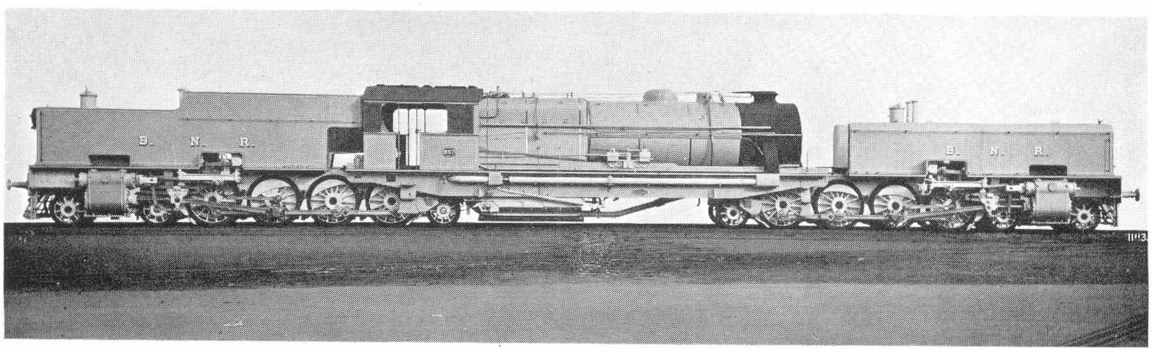


Fig. 26. " A.X." Type Header.

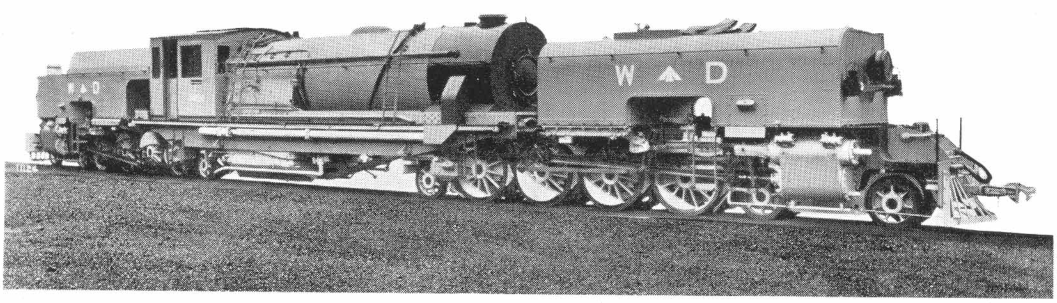
This header design combines the important features of the types previously described, but has the additional advantage of compactness. It can be designed to replace headers such as the Underneath " T " Bolt and Expanded Types without alteration to tube plates, smokebox or steam pipes—a feature which will be readily appreciated.

Further particulars will be readily furnished, and designs will be willingly submitted for headers of the type selected.

Rhodesia Railways. 3 ft. 6 in. Gauge.
4-6-4+4-6-4 Passenger Type " Beyer-Garratt " Locomotive for 60 lb. Rail.
Built by Beyer, Peacock and Co. Ltd., and fitted with " MeLeSco " Superheater.



Bengal-Nagpur Railway. 5 ft. 6 in. Gauge.
4-8-2+2-8-4 " Beyer-Garratt " Locomotive. Built by Beyer, Peacock and Co. Ltd. and fitted with " MeLeSco " Superheater.



Far Eastern Railways. Metre Gauge.
4-8-2+2-8-4 W.D. " Beyer-Garratt " Locomotive for 50 lb. Rail. Built by Beyer, Peacock and Co. Ltd. for Ministry of Supply and fitted with " MeLeSco " Superheater.

" MeLeSco " ANTI-VACUUM VALVE

Fig. 27 shows the anti-vacuum valve designed and manufactured by The Superheater Company, the purpose of which is to permit air to be drawn through the superheater elements and steam pipe into the cylinder when the engine is running with a closed regulator. The air has a cooling effect on the elements and also minimises vacuum formed within the cylinder,

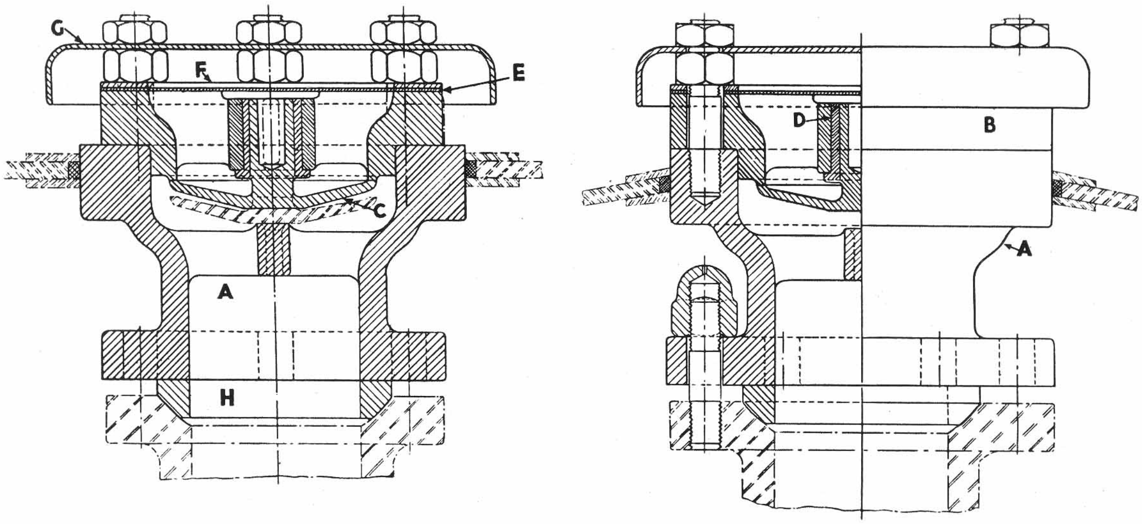


Fig. 27. " MeLeSco " Anti-Vacuum Valve.

which would cause ashes from the smokebox to be drawn down the blast pipe at the point of opening of the exhaust valve. The principal component parts of the anti-vacuum valve are shown in Fig. 27 and are :—

(*A*) Valve Body.

(*B*) Valve Seat.

(*C*) Valve.

(*D*) Valve Bush.

(*E*) Gauze.

(*F*) Plate Washer.

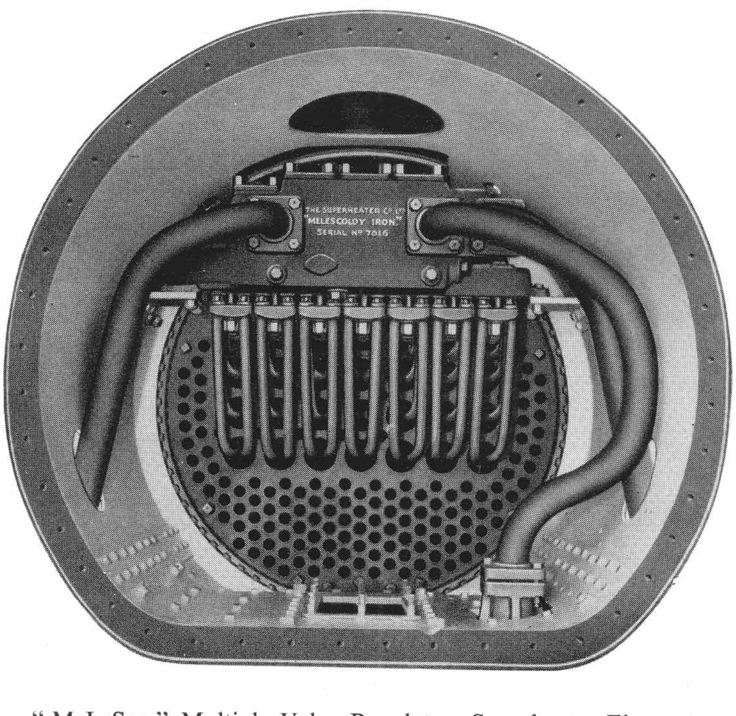
(*G*) Cover Plate.

The anti-vacuum valve is fitted direct on to the saturated chamber of the superheater header, and is arranged in such a way that the valve is closed by steam pressure when the regulator is open and the steam is passing through the elements. On closing the regulator to shut off steam the valve opens and admits air to the elements, thereby reducing their metal temperature and thus obviating the risk of burning.

MULTIPLE VALVE REGULATOR

THE SUPERHEATER AND THE REGULATOR

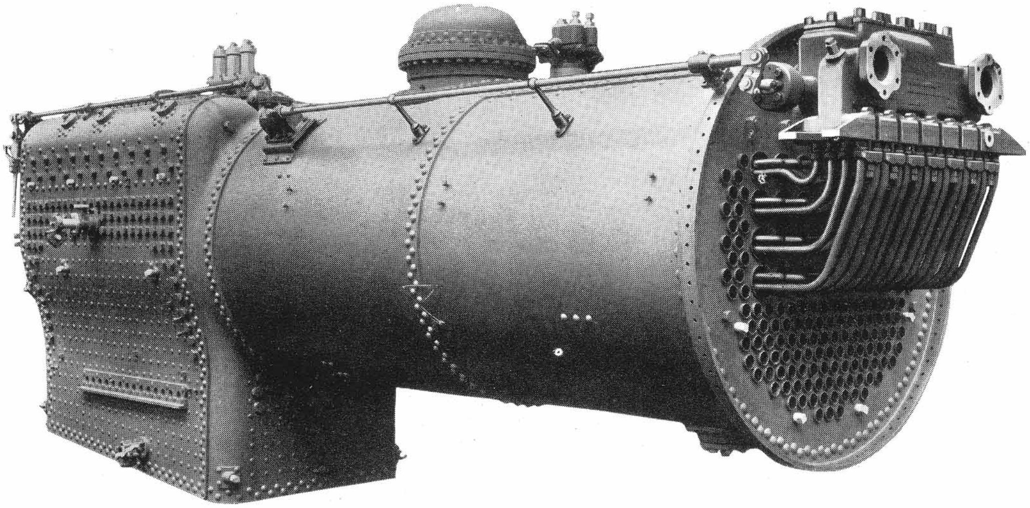
It may not be strictly accurate to say that designers of modern locomotives have cut themselves entirely free from precedent, but it is true that they no longer do things simply because they have been done in the past. If the methods of predecessors involve inconvenience or expense they are altered. The position of the regulator is a case in point. In old locomotives having boilers with comparatively low steam pressure the unbalanced regulator valve was conveniently placed in the dome and, by removing the dome-cover, it was reasonably accessible for regrinding and repair. With the advent of higher steam pressures and larger boilers, consequent on the increased size of locomotives, the balanced regulator has become a necessity, and difficulty is experienced in efficiently placing this in a dome which is so restricted in size due to limitations in loading gauge. The space in the boiler occupied by the main steam pipe is valuable as steam space and it is found that by placing the regulator nearer the cylinders, as in modern practice, a better handling of the locomotive is made possible. This can be achieved by either positioning the regulator (1) between the superheater and the cylinder or (2) between the main steam pipe outlet and the superheater. Owing to the many advantages possessed by this arrrangement an ever increasing number of locomotives are being fitted with the regulator in the smoke-box.



" McLeSco " Multiple Valve Regulator, Superheater Elements and Steam Pipes assembled in position.

When viewed in its entirety, there are many reasons for placing the regulator in the smokebox and but few for retaining it in its old position in the dome. There is no doubt that locomotive engineers would long ago have utilised the smokebox location for the regulator had it been made practicable to do so. Indeed many attempts, more or less satisfactory, have been made to place the regulator in the smokebox, but generally owing to the size of the regulator valve and the difficulty of keeping a valve of large area tight on its seating the arrangement has not heretofore sufficiently appealed to engineers for them to adopt it as standard.

The Multiple Valve Regulator overcomes these difficulties and in support of this it may be mentioned that the majority of new locomotives built within recent years have been fitted with a regulator located in the smokebox.



View of Locomotive Boiler equipped with " MeLeSco " Multiple Valve Regulator Superheater.

DETAILS OF THE MULTIPLE VALVE REGULATOR

Fig. 28 shows a general arrangement and Fig. 29 a perspective view of the " MeLeSco " Multiple Valve Regulator. It consists of three chambers in the forward part of the superheater header, each extending transversely across the front and arranged one above the other. When the regulator is fitted between the superheater and the cylinders the upper chamber is part of the superheated steam compartment of the header, and has a flanged connection at one end for supplying superheated steam to the auxiliaries. The middle chamber is in direct connection with the main cylinder steam pipes, whilst the third or lowest chamber is employed for balancing purposes and has no outside connection other than that for draining the chamber.

When, however, the regulator is fitted before the superheater, the top chamber becomes part of the boiler steam space. The middle chamber connects with the saturated steam pockets in the base of the superheater header and thence by way of the superheater elements to the superheated steam outlets. The bottom chamber again serves for balancing purposes.

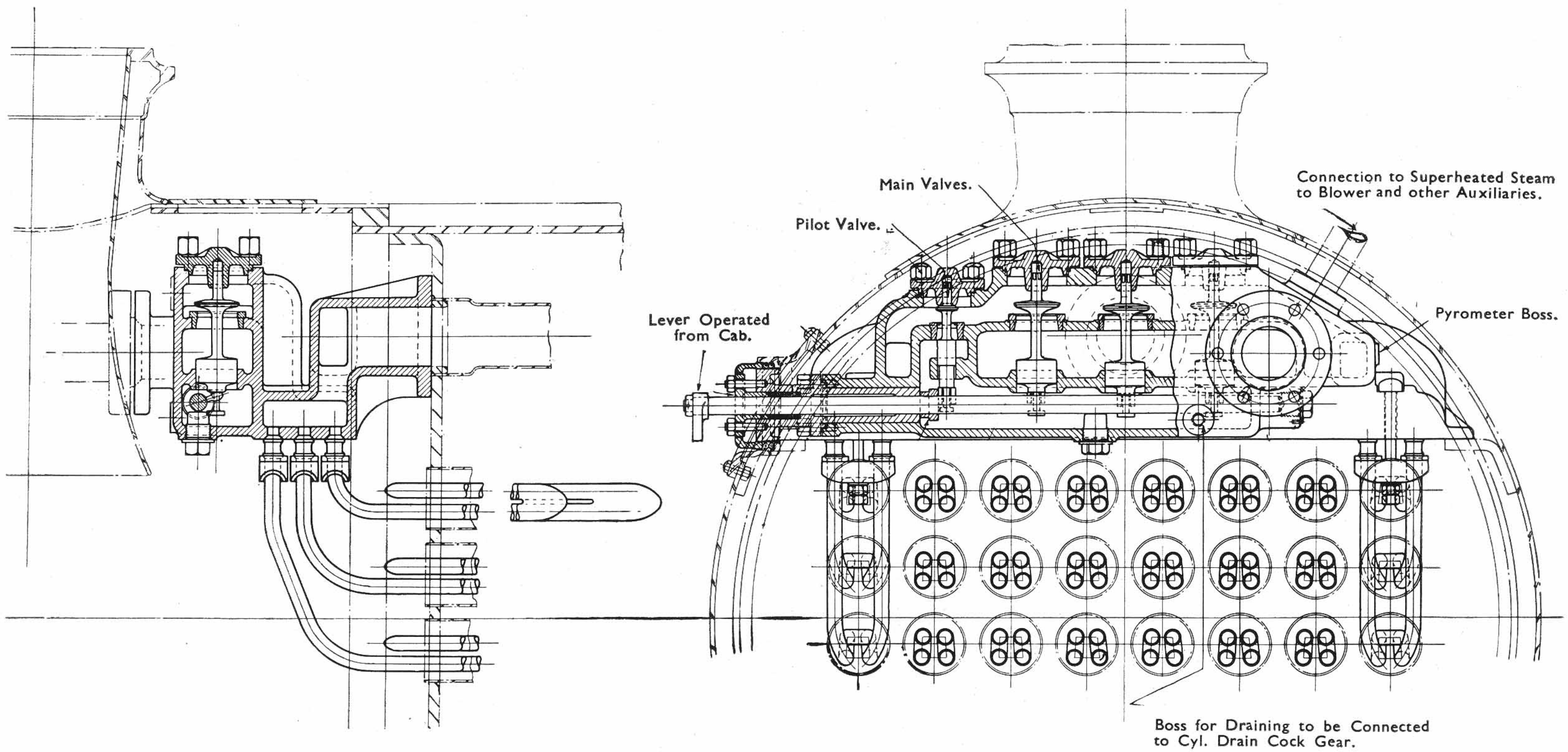


Fig. 28. General Arrangement showing Superheater Header with Multiple Valve Regulator.

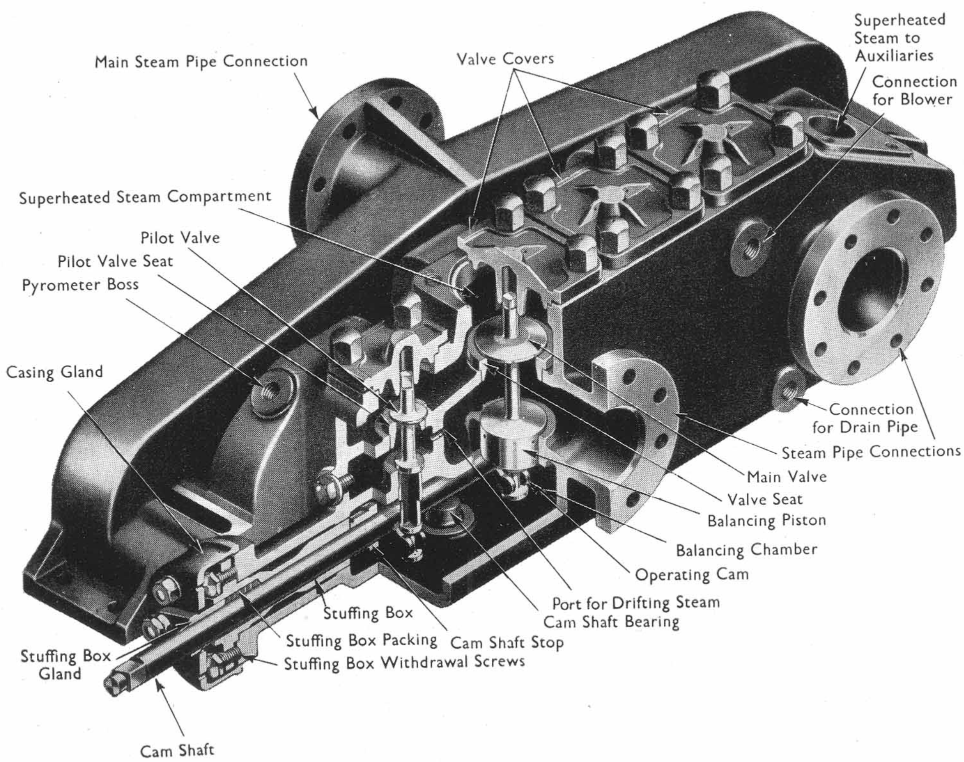
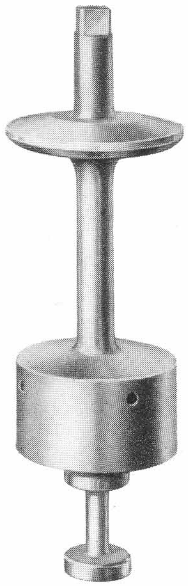
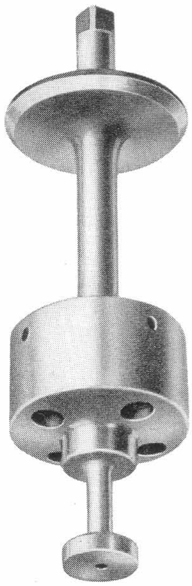


Fig. 29. Perspective view of Superheater Header with Multiple Valve Regulator shown designed for fitting between the Superheater and the Cylinders.

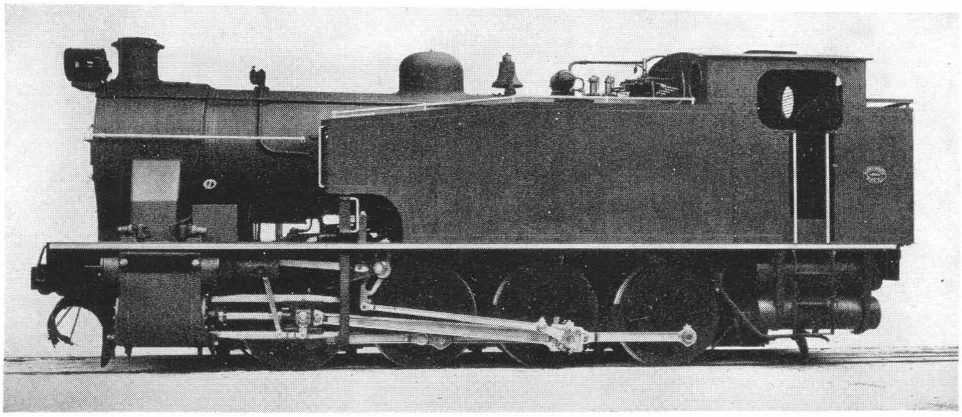


Main Valve.



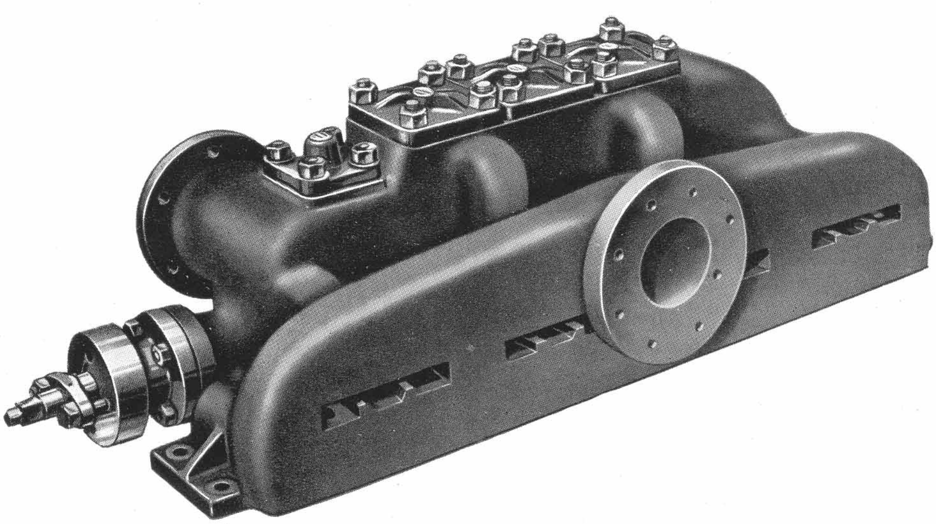
Main Valve showing pressure equalising ports.

The valves, which are of comparatively small diameter, are operated by a camshaft and closing is effected by positive mechanical action of the cams. The valves are so well balanced that only a minimum effort is needed to move them. This balancing is accomplished by providing a small pilot valve, which, on moving the regulator handle, lifts first, admitting steam to the balancing chamber preliminary to lifting the main valves. The main valves follow in succession, the first to lift being that adjacent to the pilot valve, whilst the end valve on the right hand side is next, followed by the centre valve, so that the passage of steam through the superheater and regulator is uniform, providing a perfect graduation in the supply of steam to the locomotive cylinders.

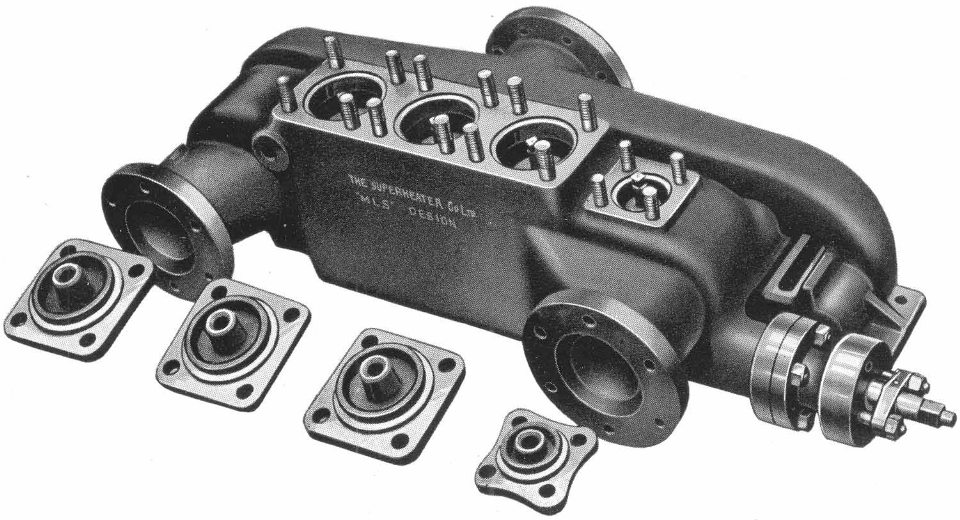


Tientsin-Pukow Railway. 4 ft. 8½ in. Gauge.

0-8-0 Tank Engine for Train Ferry Service. Built by The Hunslet Engine Co. Ltd.
Fitted with " MeLeSco " Superheater and Multiple Valve Regulator.



Rear view of Multiple Valve Regulator Header.



Front view of Multiple Valve Regulator Header, with valve covers removed.

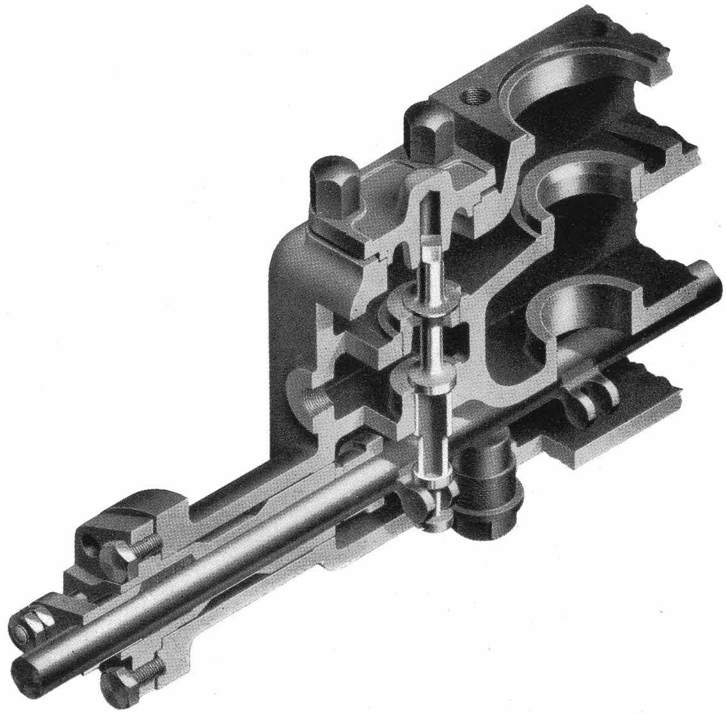


Fig. 30. Sectional view of the Automatic Drifting Arrangement.

AUTOMATIC DRIFTING VALVE

Fig. 30 shows a sectional view of the "MeLeSco" automatic drifting arrangement incorporated in the pilot valve (illustrated in its closed position), for supplying steam to the cylinders when the locomotive is coasting. It will be observed that a drifting chamber is cast integrally with the header, immediately below the pilot valve seat. A tapped boss is provided at the side of the drifting chamber through which a communicating hole is drilled in the wall connecting to the outlet chamber.

The pilot valve is so arranged that on the first small movement of the regulator, steam is admitted past the pilot valve to the drifting chamber, and thence by way of the aforementioned port to the main steam pipes and cylinders.

The drifting position is just prior to the shut position and is marked on the regulator handle sector plate. On a further movement of the regulator handle steam communication is established between the drifting and balancing chambers, i.e. when the lower face of the piston immediately above the guiding vanes on the pilot valve has been lifted clear of the top face of its guide in the header. Steam pressure in the balancing chamber is thus built up, causing the main valves to be put in a state of balance preparatory to their being opened.

OPERATION OF THE MULTIPLE VALVE REGULATOR

The pull-and-push movement of the regulator handle is transmitted to the camshaft lever at the smokebox through a rod attached to either end of a compensating lever which nullifies any effect the contraction or expansion of the boiler may have on the rods. (See illustration on page 32).

The first movement of the lever lifts the pilot valve and permits (according to the design) superheated or saturated steam from the header to enter the balancing chamber building up pressure under the balancing piston equal to that in the header. Further movement of the lever lifts the first valve. The cams on the operating shaft are so placed that when the first valve is partially lifted the second valve starts to lift and so on until all the valves have lifted when the regulator lever is in the full open position.

The closing of the valves is accomplished by mechanical action of the cams and is assisted by the weight of the valve plus the pressure of the steam on top of the valve due to this area being slightly greater than that of the balancing piston.

Closing takes place in reverse order, the valve which lifted last being first, and each valve successively seating until the pilot valve is the last valve to close.

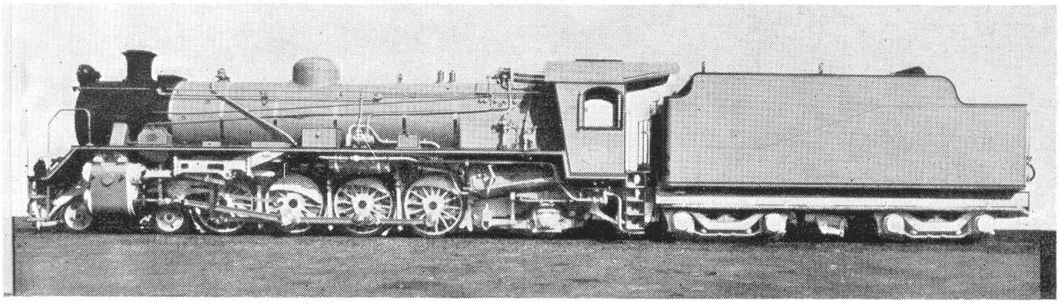
The small amount of steam remaining in the balancing chamber when the regulator is closed leaks past the balancing pistons into the steam pipes.

Drain connection is provided in the bottom of the balancing chamber in order to draw off any condensation which may occur. The draining is accomplished by way of a pipe leading to a cock fitted below the cylinders operated by the drain cock gear.

ADVANTAGES OF THE MULTIPLE VALVE REGULATOR

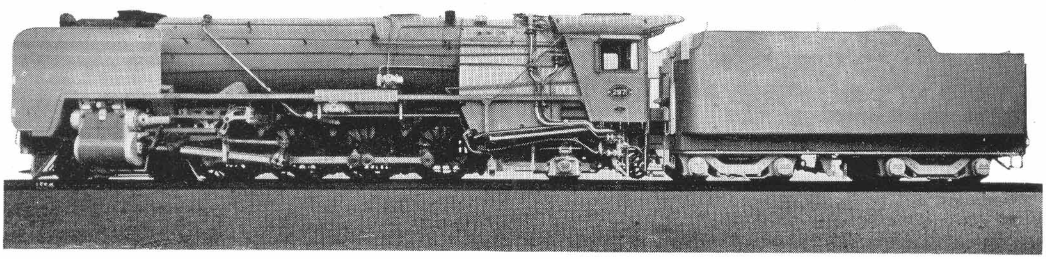
The "MeLeSco" Multiple Valve Regulator has the following advantages which are inherent to the special design :—

1. **Ample regulator valve area.** With this regulator, the required steam area determines the number of valves necessary. Multiple Valve Regulators are built with two or more valves as required, giving ample steam supply under maximum requirements with minimum pressure drop.
2. **Instant and fine regulation of the steam supply to the locomotive cylinders.** Owing to the regulator valves opening and closing consecutively with instant response to control from the cab, smoother starting and stopping are obtained. This point is particularly appreciated by drivers as it facilitates control of the locomotive.
3. **Positively steam tight.** The small sized valves employed in the " MeLeSco " Multiple Valve Regulator are not affected by high temperatures as is the larger dome valve, and experience has shown that the small valves remain positively steam tight.
4. **Simplicity.** There are no piston rings, bolts, nuts, pins, rods, cotters or links to wear or work loose inside the regulator and cause trouble.
5. **Accessibility.** All parts may be readily inspected without entering the smoke-box. By removing a plate from the smoke-box immediately over the header, access to the valve covers is obtained. There is no dome joint to break in order to dismantle the regulator, and no overhead tackle is required. Inspection or dismantling of the regulator can therefore be effected on any side line adjacent to the shed, thereby conserving shop or shed space.
6. Repacking the camshaft stuffing box while steaming may, when required, be done when the boiler is under steam, since it is accessible outside the smoke-box ; and there is no steam when the regulator is shut in the balancing chamber where the camshaft is located.
7. **Minimum number of joints in the smoke-box.** Since the regulator is contained in the superheater header, only the usual steam pipes direct from the header to the cylinders are required.
8. **Low Weight.** It is lighter than a smoke-box regulator separate from the header.
9. **Minimum installation expense and ease of application.**



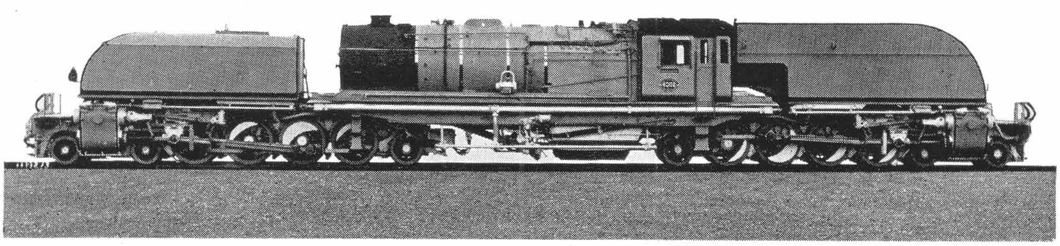
South African Railways. 3 ft. 6 in. Gauge.

4-8-2 Locomotive " 19D" Class. Built by Robert Stephenson and Hawthorns Ltd. and fitted with " MeLeSco " Superheater and Multiple Valve Regulator.



South African Railways. 3 ft. 6 in. Gauge.

4-8-2 Locomotive " 15F " Class. Built by the North British Locomotive Co. Ltd and fitted with " MeLeSco " Superheater and Multiple Valve Regulator.



South African Railway. 3 ft. 6 in. Gauge.

4-8-2+2-8-4 " Beyer-Garratt " Locomotive Class G.E.A. for 60 lb. Rail. Built by Beyer, Peacock and Co. Ltd. and fitted with " MeLeSco " Superheater and Multiple Valve Regulator.

10. **Automatic drifting valve.** This uses saturated or superheated steam according to design ; and it may be incorporated in the superheater header and eliminates the separately controlled valve with its attendant danger of being left open.

11. **Elimination of internal steam pipe failures.** Leaking joints in the Internal Steam Pipe will no longer require attention. These leaks are expensive to locate and repair, but with the regulator in the header such failures are of no consequence.

12. **Absence of regulator rod stuffing box on the fire-box back.** Leakage of steam at this point is eliminated.

13. **Accessibility and ease of operating the regulator handle.** This is the " pull and push " type employing an automatic springbox on the regulator quadrant, and enables the maximum track viligance to be maintained at all times. The gearing permits the regulator being operated from either side of the engine cab.

14. **Provision of Steam Dryer.** A MeLeSco Steam Dryer of adequate capacity may be housed in the dome.

Other Important Features.

15. Should the Regulator be located between the Superheater and Cylinders an additional steam space is afforded by the Superheater Elements, and superheated steam can be used for operating auxiliaries such as headlight turbine, air pump, feed water pump, blower and other devices. The amount of steam used by auxiliaries can be around 10% of the boiler output and the relative saving effected by supplying them with superheated steam is appreciable, their steam consumption being reduced by 40%, which is equivalent to a saving of 4% of the total fuel burned.

MAINTENANCE

Instructions on the maintenance of the " MeLeSco " Multiple Valve Regulator are contained in our Instruction Book, which will be supplied on application.

Full details and working instructions are given therein.

COMPONENT PARTS OF THE MULTIPLE VALVE REGULATOR

The component parts are listed hereunder and are illustrated in Fig. 31.

Letter.	Name of Part.	Letter.	Name of Part.
C	Regulator Main Valve	P	Packing
D	,, Pilot Valve	Q	Casing (*not supplied by The Superheater Co. Ltd.*)
E	,, Main Valve Cover	R	Joint Rings for Main Valve Cover
F	,, Pilot Valve Cover	S	Joint Rings for Pilot Valve Cover
G	,, Main Valve Seat	T	Joint Ring for Stuffing Box
H	,, Pilot Valve Seat	V	Cam Shaft Stop
J	,, Cam Shaft	W1	Studs and Nuts for Main Valve Cover
K	,, Cam Shaft Stuffing Box	W2	,, ,, ,, Pilot Valve Cover
L	,, Cam Shaft Stuffing Box Gland	W3	,, ,, ,, Stuffing Box Gland
M	,, Cam Shaft Bearing	W4	Bolts and Nuts for Stuffing Box
N	,, Cam Shaft Bushing	W5	Stuffing Box Withdrawal Screws
O	,, Cam Shaft Casing Gland		

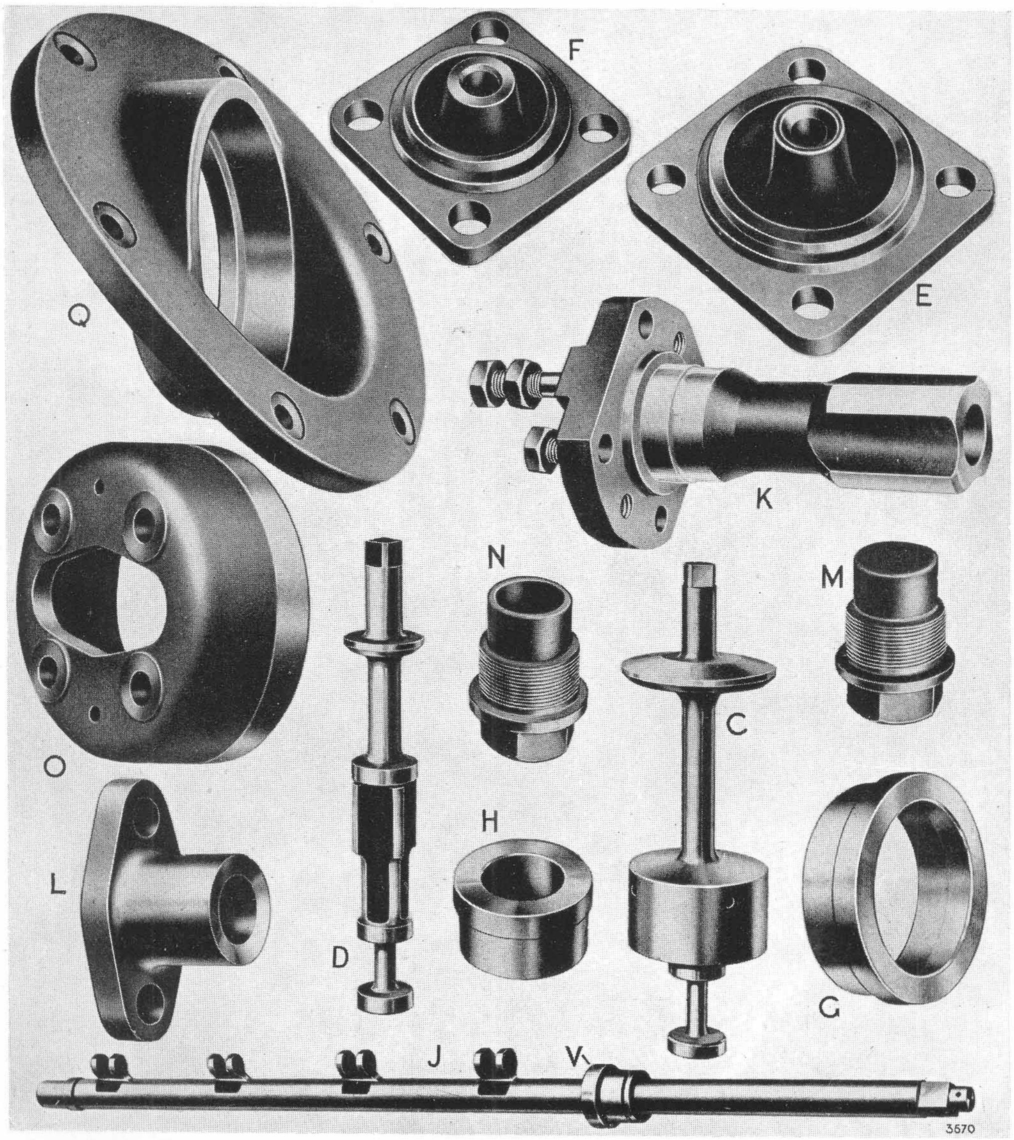
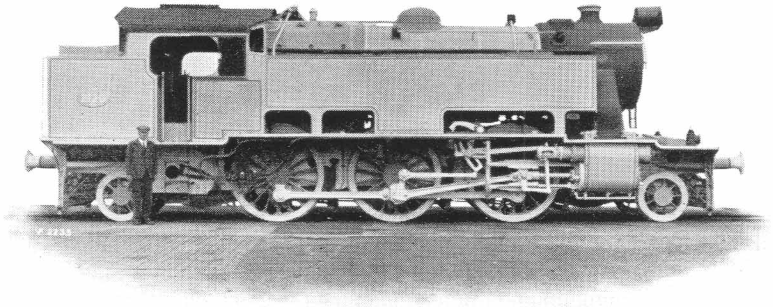


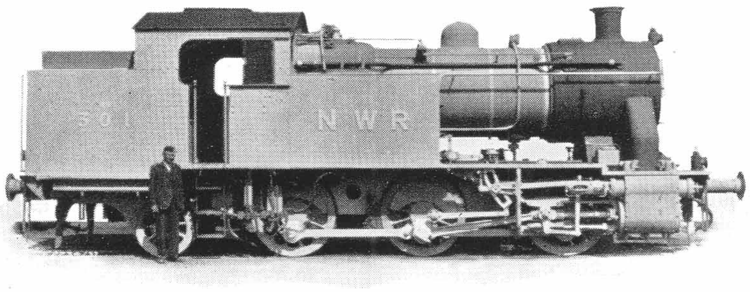
Fig. 31.

COMPONENT PARTS OF THE MULTIPLE VALVE REGULATOR



East Indian Railway. 5 ft. 6 in. Gauge.

2-6-2 Passenger Tank Locomotive " WV " Class. Built by The Vulcan Foundry Ltd. and fitted with " MeLeSco " Superheater and Multiple Valve Regulator.



North Western Railway. 5 ft. 6 in. Gauge.

0-6-2 Shunting Locomotive " WW " Class. Built by The Vulcan Foundry Ltd. and fitted with " MeLeSco "Superheater and Multiple Valve Regulator.

TECHNICAL SERVICE

The services of the Company's staff are at the disposal of all desiring advice as to the application of superheaters to new or existing locomotives, and designs and recommendations will be willingly submitted.

SAND GUN

Dirty and obstructed tubes give rise to retarded gas flow, low heat transmission and high fuel consumption with consequent lowering of final steam temperature and reduced boiler evaporation.

Shed cleaning of tubes and flues entails heavy expenditure and undoubtedly the best time to carry out this work is when the locomotive is operating, so that the boiler and superheater are maintained at their highest efficiency throughout the run. Even a thin layer of soot adversely affects heat transference, and if cleaning can be carried out as and when required, economy of fuel, increased evaporation and lighter firing will result.

The nature and quality of the fuel used and operating conditions will have a bearing on the intervals between cleaning periods. With some classes of fuel, it is necessary to be continually cleaning the tubes and flues, whilst with others days may elapse without harmful results. With wood and oil fuel, heavy deposits of gummy soot form which are more difficult to remove than those from good quality coal, whilst wood fuel and poor quality coal render a large quantity of ash which is carried over into the flues, "nesting" round the superheater return bends. Deposits of this nature cannot be removed by steam blowing only.

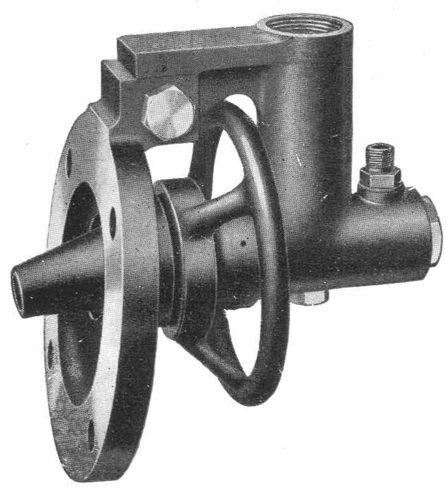


Fig. 32. " MeLeSco " Sand Gun.

Sand thrown into the firebox on a shovel when steaming hard has long been used by drivers and firemen as a means for scouring dirty tubes. The simultaneous use of steam and sand in an easily controlled manner offers the advantages of both methods.

The " MeLeSco " Sand Gun illustrated in Figs. 32 and 33 is of rigid construction, simple to operate, readily applied, and has no parts which are liable to give trouble. On opening the

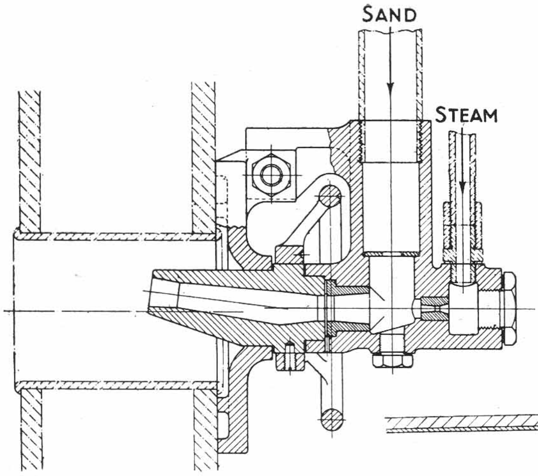


Fig. 33.
Section through " MeLeSco " Sand Gun.

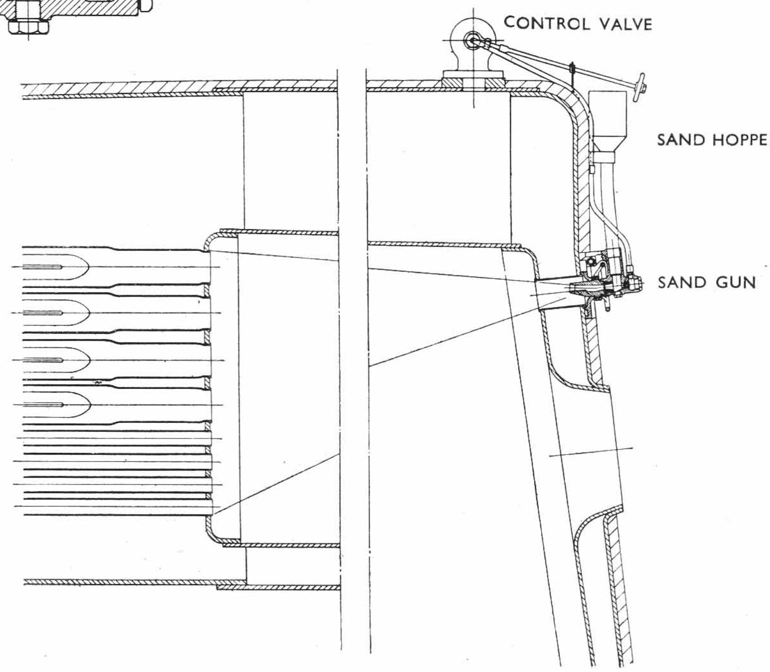
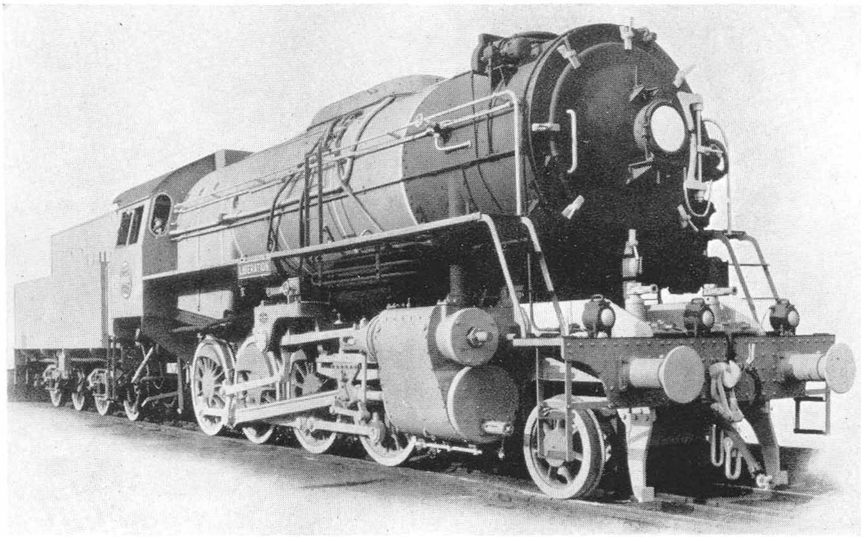


Fig. 34.
Arrangement of Sand Gun on Fire Box Backplate.

control valve shown in Fig. 34, steam passes through a system of nozzles housed in the gun, causing a combined jet of sand and steam to be ejected from the revolving blast nozzle at high velocity across the firebox, and thence through the tubes. The radius described by the blast nozzle when rotated by means of the hand wheel, is such that the whole of the firebox tubeplate area is swept.

The Sand Gun should only be operated when the locomotive is steaming hard as, if it is used when coasting with the regulator closed, there is danger of the dirty deposits which are driven into the smoke-box being drawn down the blast pipe. The operating time will be about half a minute, and a visual indication of effectiveness in the dense black smoke, which issues from the chimney immediately the blower is operated ; when this clears, the tubes are properly cleaned.

The gun should be operated every hour or more often if fuel conditions are bad, the last application being made immediately before the end of a run so that cleaning of tubes in the sheds is entirely obviated. It will be found that about 2 lbs. of sand is used at each operation. A sufficient supply of coarse, sharp sand for the trip is carried in a suitable receptacle within easy reach on the footplate so that the hopper, which is located in a convenient position above the gun (thereby affording gravity feed to the sand) can be charged as and when necessary.



Ministry of Supply. 4 ft. 8½ in. Gauge.
2-8-0 " Liberation " Locomotive. Built by The Vulcan Foundry Ltd. for U.N.R.R.A.
Fitted with " Melesco " Superheater.

CONCLUSION

Until about thirty-five years ago steam locomotives were the only source of railway motive power. Then electrically driven motive power was introduced and subsequently motive power driven by internal combustion engines in conjunction with electric traction.

This competition acted as a spur to the further development of the steam locomotive and today it is still the generally preferred and logical motive power. Its initial cost is lower . . . high speeds are an everyday accomplishment . . . and it has an incomparable capacity for hauling overloads.

Thirty years ago, at the time when the locomotive had reached its limit of power with saturated steam, the " MeLeSco " superheater gave the locomotive one-third more hauling power with a more economical fuel and water rate.

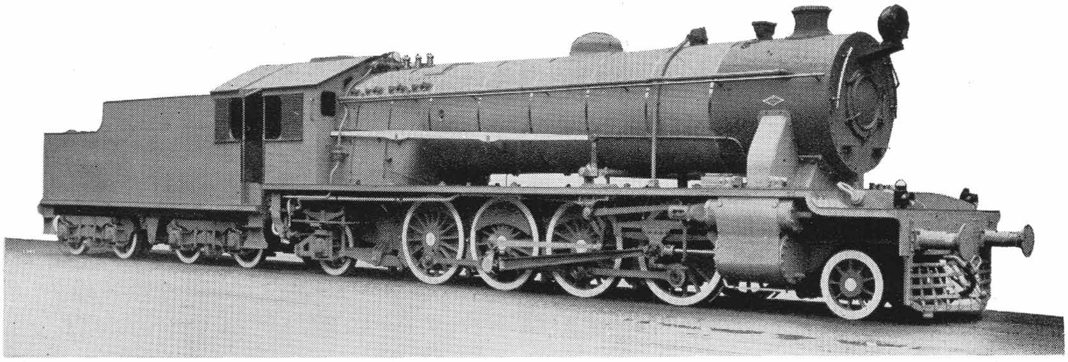
The Research Staff of the Superheater Company is continually investigating new problems in connection with locomotive superheating with a view to introducing designs which overcome the problems revealed by experience. Representative examples of today's modern locomotives are illustrated in this catalogue ; and it will be noted that all are fitted with " MeLeSco " Superheaters designed and manufactured by The Superheater Company.

SOME RAILWAYS USING

MeLeSco

SUPERHEATERS

Antofagasta (Chile) & Bolivia.
Argentine North Eastern.
Argentine State.
Baroda State.
Barsi Light.
Bas Congo-Katanga.
Bengal & Assam.
Bengal & North Western.
Bengal Dooars.
Bengal Nagpur.
Benguela.
Bhavnagar State.
Bikaner State.
Bombay, Baroda & Central India.
British Guiana.
Buenos Aires Central.
,, ,, Great Southern.
,, ,, Midland.
,, ,, Pacific.
,, ,, Western.
Burma.
Canton—Hankow.
Central Argentine.
Central Uruguay.
Ceylon Government.
Chinese National.
Commonwealth Government (Australia).
Cordoba Central.
Darjeelling-Himalayan.
Dorada.
East Indian.
Egyptian State.
Eireann.
Entre Rios.
Gold Coast.
Gondal.
Great Indian Peninsula.
Great Northern of Ireland.
Great Western.
Great Western of Brazil.
Gwalior Light.
Hong Kong Government.
Indian Government.
Iranian State.
Iraqi State.
Jaipur State.
Jamaica Government.
Jamnagar & Dwarka.
Jodhpur.
Kenya & Uganda.
Leopoldina.
London & North Eastern.
London, Midland & Scottish.
Madras and Southern Mahratta.
Malayan.
Manila.
Mauritius Government.
Metropolitan.
Mewar State.
Midland of Western Australia.
Morvi.
Mysore.
Newfoundland.
New South Wales Government.
New Zealand Government.
Nigerian.
Nitrate.
H. E. H. Nizam's State.
North Western (India).
Nyasaland.
Oudh & Rohilkund.
Oudh & Tirhut.
Palestine.
Peruvian Central.
Peruvian Southern.
Queensland Government.
Rhodesia.
San Paulo.
Sierra Leone Government.
South African.
South Australian Government.
Southern.
South Indian.
Sudan.
Taltal.
Tanganyika.
Tasmania Government.
Trans-Zambesia.
Trinidad Government.
Turkish State.
Victorian Government.
Western Australian Government.



Indian Government Railways. 5 ft. 6 in. Gauge.

2-8-2 " XD " Locomotive. Built by the North British Locomotive Co. Ltd. and fitted with " MeLeSco "Superheater.

ENQUIRIES.—To facilitate the design of a locomotive superheater the following information should be given wherever possible.

DIMENSIONS

Boiler Press.—lbs. per sq. in. ... ...
Internal Steam Pipe Area—sq. in. ... ...
Smokebox Steam Pipe Area—sq. in. ... ...
No. and Size of Cylinders ... ...
Area per Cylinder—sq. in. ... ...
Vol. per Cylinder—cu. ft. ... ...
Dia. of Driving Wheels—ins. ... ...

RUNNING CONDITIONS

Speed— m.p.h. ... ...
Revs. per minute ... ...
Cut-off ... ...
Piston Speed—ft. per minute ... ...

BOILER

Length between Tube-plates ... ...
No., dia. and Gauge—Flues ... ...
No., dia. and Gauge—Tubes ... ...
Heating Surface Firebox, C.C. and Syphons—sq. ft. ...
Heating Surface Flues—sq. ft. ... ...
Heating Surface Tubes—sq. ft. ... ...
Heating Surface Total Evaporative—sq. ft. ... ...
Grate Area ... ...
Class of Fuel ... ...

The Designs of Superheaters and Accessories illustrated in this Catalogue form the subject of numerous British, Colonial and Foreign Letters Patent, owned or controlled by The Superheater Company, Ltd., London.

ASSOCIATED COMPANIES

THE SUPERHEATER COMPANY (Australia) PTY. LTD.
185, Elizabeth Street, Sydney, N.S.W., Australia.

THE SUPERHEATER COMPANY
60 East 42nd Street, New York 17, N.Y., U.S.A.

THE SUPERHEATER COMPANY, LTD.
Dominion Square Building, Montreal, Canada.

COMPAGNIE DES SURCHAUFFEURS
Rue de Berri, 29, Paris, France.

INDIA, BURMA AND CEYLON

J. STONE & CO. (India) LTD.,
P.O. Box 10605, 5, Hide Road, Kidderpore, Calcutta.
P.O. Box 494, Yaffi Building, Goa Street, Ballard Estate, Bombay.

SOUTH AFRICA AND RHODESIA

J. STONE & CO. AFRICA (PTY.) LTD.,
Box 1189, Maritime House, Loveday Street, Johannesburg.

SOUTH AMERICA

EVANS, THORNTON & CIA., S.A.,
Calle Defensa 465, Buenos Aires.

Cheney & Sons, Banbury