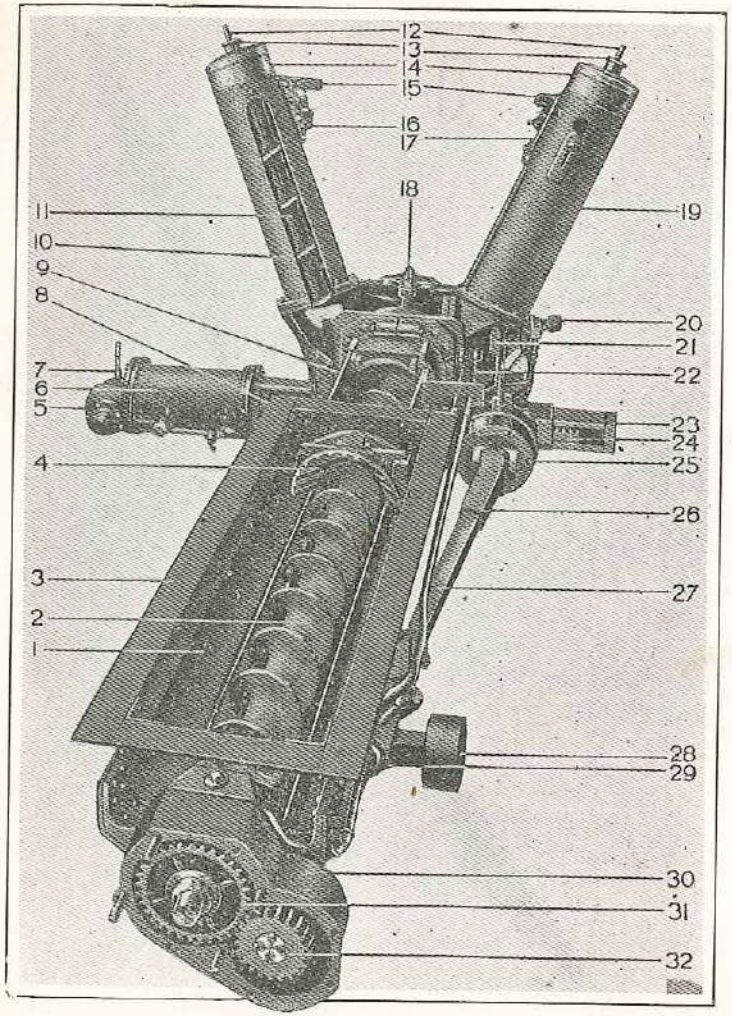


FIG. 39.

Duplex Stoker.

DRIVING ENGINE

Fig. 40 shows the driving engine which consists of a cylinder of eleven-inch bore and a stroke of seventeen and three- quarter inches, with piston and reverse head. It is operated by steam taken from the locomotive turret reduced in pressure by throttling through a one-half inch globe valve.

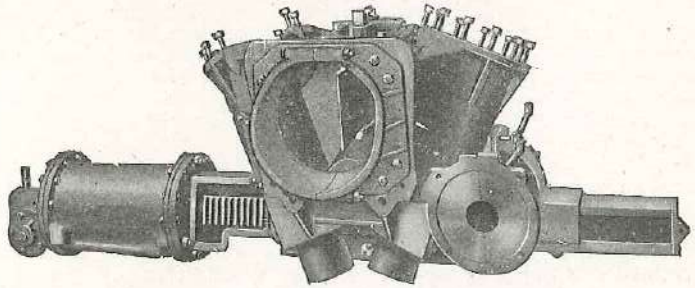


FIG. 40.

Stoker Engine and Transfer Hopper.

The pressure of the steam used by this engine varies from eight to eighty pounds, according to the work required by the quality and size of the coal, and its pressure is indicated by a special driving engine steam gauge located on the boiler head, connected in this line between globe valve and cylinder. In normal operation, the piston has a power stroke in one direction only. This is when the piston is traveling in toward the center line of the locomotive and the entire stoker mechanism is in normal operation, since on the return stroke of the piston the conveying mechanism is stationary; but when any one or all of the three screws—two elevator and one conveyor—are reversed by means of their individual reverse mechanisms, the return stroke of the piston becomes temporarily a power stroke. By this it can be seen that only a very small percentage of the full boiler pressure is required for the return stroke except when the reversing of any of the screws is necessary.

The operation of this cylinder is controlled by a reverse head, to which is connected by proper ports and passages, almost identical with the reverse head used on the Westinghouse eleven inch air pump, although not interchangeable. The piston rod screws into the rack or stoker main driver, hereinafter described. The reverse head is bolted to the outer end of the driving engine cylinder, and the admission ports to the cylinder are so arranged that if the piston makes a sudden movement, such as might be the case if a clog occurred in the conveyor or elevators, and then broke loose, a small percentage of the steam is

trapped in either end of the cylinder which forms a cushion to prevent breaking the piston or knocking off the reversing head.

The reverse head is operated by means of a small reverse rod which operates in the hollow piston rod, in a manner identical with the reversing rod used on Westinghouse air pumps.

In case the stoker becomes clogged on any foreign material, or it is desired to reverse it for any reason, the operating rod located on the back head of the locomotive boiler, if the piston is making a power stroke, is moved to its lower position, and if the piston is making a return stroke, to its upper position. This moves a small valve in the auxiliary head bolted to the reverse head, so that the reverse head valve throws steam into the opposite end of the cylinder and causes the piston to change its direction. The return of the operating rod handle to a central position causes the driving engine to resume its normal operation.

It is always necessary to reverse the driving engine whenever a clog occurs and it is desired to reverse either of the elevator screws or the conveyor screw. The reason for this is that in case of a clog the pawls in the elevator or conveyor screw reverses are held so tightly against the ratchet wheels that it is impossible to lift them from the teeth unless the pressure is relieved by reversing the driving engine.

Unlike the ordinary high speed engine, there is in this driving engine an enormous reserve power, which is absolutely necessary for the work to be performed, i. e., the crushing of coal with its varying physical properties. With the low steam pressure needed by this engine for normal operation, and the great differences between it and main steam line pressure, it can be seen that when the task to be performed increases it is merely a question of the steam pressure building up in the cylinder to the point required for that task.

DISTRIBUTION OR SPREADING SYSTEM

The starting of the coal towards the two firing zones or areas in the firebox is done by the elevators, as explained, but the actual spreading of the coal over the two overlapping zones, or areas, is accomplished through the means of the two firing points at the two stoker openings through the back-head of the locomotive boiler. The fire door is left undisturbed so that it can be used for hand firing at roundhouse and on sidings, or when drifting.

Two elbows, Fig. 41, in the back bottom portion of which firing nozzles are secured by means of set screws, are bolted to the elevator casings. Distributors and tubes combined are attached to these elbows, the tube extending through the openings in the back-head and the distributor being on the inside of the firebox.

The distributor tubes serve as a firing plate and the coal is blown through the tubes on the under side of the distributors by the jets of steam admitted to the firing nozzle, an intermittent action being secured through the constant steam jet and the

stopping of coal elevation during the return stroke of the driving engine piston and rack.

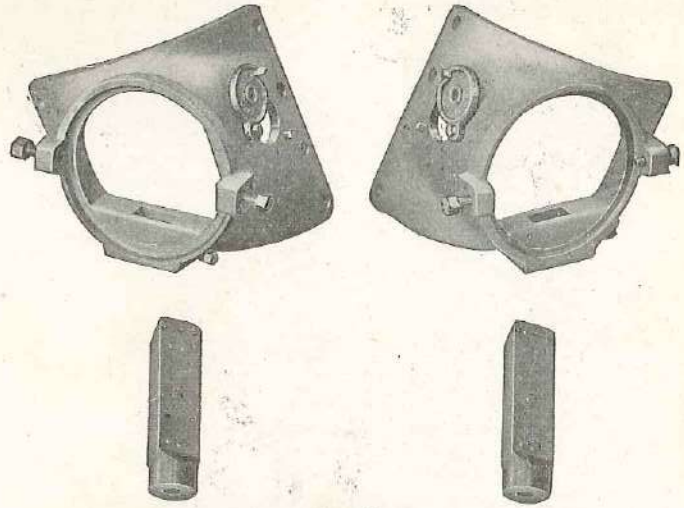


FIG. 41.

Stoker Elevator Elbows and Firing Nozzles.

The elbows are provided with peep holes with swinging covers through which the coal supply can be observed, and the condition of the fire can be seen through peep holes in the tops of the elevator casings.

The deflecting ribs on the distributors are so arranged as to distribute the coal in such a manner that all parts of the grate area will be served to the best advantage, the two firing zones, or areas, overlapping along the center where the combustion area is greatest.

The distributor tubes are made of cast steel and are of the design shown in Fig. 42. They are secured to the elbows by means of bolts and it is but a moment's work to replace them when necessary.

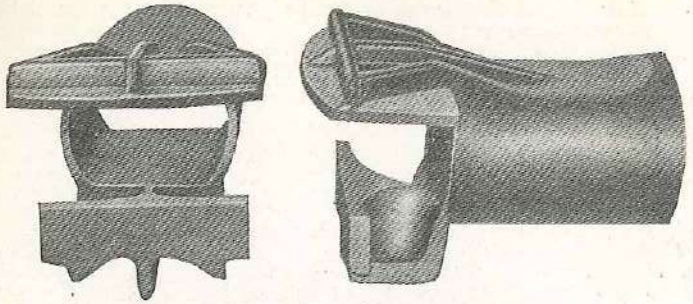


FIG. 42.
Stoker Distributor Tubes.

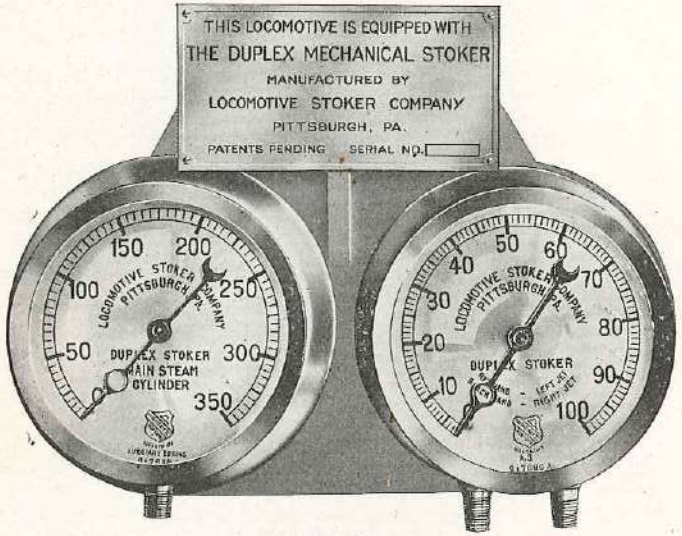


FIG. 43.
Stoker Operating Gauges.

GAUGES

Fig. 43 shows the two steam gauges which are set in a bracket, secured to the back-head of the locomotive boiler in a position where they can be easily read by the fireman.

The driving engine gauge on the left indicates the pressure of steam used by the driving engine. The one on the right has two indicators, the red indicator showing the steam pressure on the jet in the left elbow, and the black indicator, the pressure on the jet in the right elbow.

OILING

All stokers should be oiled before leaving terminal, and on long divisions oil holes should be filled between terminals. The points of oiling are as follows:

The driving engine is oiled by tapping into the driving engine steam inlet line an individual small lubricator. The valve to which should be turned on before starting stoker.

Before the locomotive is put in service either new or after an overhauling in the shop, the rack in the rack housing should receive an initial mixture of one quart of black engine oil. There is a one-inch elbow tapped into the separator cover on the left back side of the rack housing provided for this purpose.

Left and right elevator drivers and reverses are lubricated by lifting the pawl shifters on top of the elevators. When first putting stoker into service about one quart of oil should be poured into each reverse in this manner.

Small holes are located in elevator drive and reverse casings each of which leads to a cored passage in casing provided to lubricate bearing on which elevator drive and reverse rotates.

The left elevator driving shaft bearing in bottom of transfer hopper is lubricated by a special tap on the left side of transfer hopper under locomotive deck.

The right elevator driving shaft bearing and the conveyor drive and reverse receive their lubrication through an oil box, usually stuffed with curled hair, with four outlets. This box should be filled every trip. This oil box should be cleaned out occasionally, particularly when considerable dust and dirt has accumulated.

The conveyor driving shaft bearings in the slide support and gear casing are oiled by cups secured to the trough under the apron between locomotive and tender. These should be filled once each trip.

The grease boxes in the gear casing and gear casing cover on the rear of the conveyor should be filled at least once a month with soft grease and once in three months the gear casing cover should be removed and the gears packed in grease.

Universal joints, slip joints and conveyor slide support rollers should be oiled once each trip with engine oil.

Use valve oil in the lubricator for the driving engine. Use engine oil for other parts, except the conveyor gear casing. See that the lubricator is feeding when the stoker driving engine is running. When the stoker engine is shut off, such as in standing or drifting, shut the lubricator off.

TO START AND OPERATE STOKER

Referring to Fig. 44. First open main valve No. 1 at the

fountain, then open valve No. 2, next open valve No. 3, which allows the steam to flow to the distributor jet line. Valves Nos. 4 and 5 should then be opened sufficiently to register about 15 pounds upon the jet steam gauge. Always see that steam is blowing through the jets before starting the stoker engine.

To start the stoker engine place the operating lever No. 10 in its central or running position. Place conveyor reversing lever No. 12 in forward position. See that valve No. 8 to the exhaust line is open. Valve No. 9 should be kept closed except when it is desired to moisten the coal with exhaust steam. See that the lubricator to the stoker engine is feeding properly. Valve No. 6 should be opened slightly and allowed to remain in that position until the stoker engine has made several strokes slowly, if the stoker engine has been standing some time, in order to work the condensation out of the stoker engine cylinder. Valve No. 7 should be kept closed except when necessary to obtain more power to crush a particular hard lump of coal. When this valve is open steam pressure increases very rapidly in the stoker engine cylinder. As soon as the heavy duty crushing is performed valve No. 7 should be closed, and the stoker operated with steam through valve No. 6.

Open the first slide plate No. 29, in the floor of the coal pit of the tender by pulling it ahead with a hook. This allows coal to feed into the stoker conveyor. The slide plate should not be opened full length, but just far enough to feed coal at the proper rate to the conveyor. When lump coal is used the slide plate must, of course, be opened wider than with slack coal.

The stoker should be run slowly at first, feeding just sufficient coal to supply the fire for the work being done by the locomotive. On extra light runs the stoker will have to be shut off frequently for short intervals. Do not feed too much coal, carry a light fire. In firing with the stoker the fire should be lighter than is the case in hand firing.

To reverse the conveyor screw in the tank lower handle No. 10 to bottom position. Move screw conveyor reverse lever No. 12 to rear or reverse position. Raise handle No. 10 to center position. This reverses the screw in the tank.

To stop conveyor screw in tank place conveyor reverse lever No. 12 in center position. If reverse lever No. 12 does not move freely lower handle No. 10 to bottom position and then to center before attempting to move the reverse lever.

CAUTION

Return stoker piston to dead position against cylinder head by lowering handle No. 10 and shut off steam to stoker engine by closing valves in steam line before trying to remove obstructions in stoker or doing any work on stoker.

Keep hands out of stoker elevators and conveyors unless steam is shut off to stoker engine and handle No. 10 moved to its lowest position.

Do not put a bar, rod or lever in stoker unless the above precaution is observed.

Do not step in the stoker conveyor.

To reverse the right or left elevator screw raise the pawl shifter No. 26 on top of vertical shaft to upper position. Stop the conveyor screw before reversing the elevator screws or the stoker will be jammed with coal.

To stop the right or left elevator screw raise elevator pawl shifter No. 26 on top of elevator to middle position. Stop the conveyor before stopping the elevators or the stoker will be jammed with coal.

TO LOCATE CLOGS

In case the stoker stalls due to iron, slate or other foreign matter getting into the stoker machinery, first shut off steam pressure to the stoker engine cylinder by closing valves Nos. 6 and 7, move operating lever No. 10 to its lowest position, place the tender conveyor reverse lever No. 12 in center position, then place the right elevator pawl shifter No. 26 in its neutral or middle position. Now raise the operating valve lever No. 10 to its central position and open the steam valve No. 6 sufficiently to turn the left elevator to determine whether the obstruction is in the left elevator. If the left elevator operates properly cut in the right elevator by lowering pawl shifter No. 26, without increasing the steam pressure. If the stoker stops, evidently the obstruction is in the right elevator. If the stoker continues to operate properly the obstruction is in the tank conveyor.

With the D-2 stoker the conveyor screw and left elevator operate on the forward stroke of the driving engine, and the right elevator operates on the return stroke.

TO REMOVE CLOGS

DO NOT FORGET TO SHUT OFF THE STEAM TO THE STOKER ENGINE CYLINDER, BY CLOSING VALVES NOS. 6 AND 7, BEFORE ATTEMPTING TO REMOVE OBSTRUCTIONS OR WORK UPON THE STOKER.

The clogs in the upright elevators usually occur at the bottom of the elevator casing doors, catching between the flight of the conveyor and the bottom of the door.

To remove these clogs, raise the door in the engine deck and the obstruction can usually be seen and removed. However, if it is in the elevator, reverse the elevator screw forcing the obstruction back down into the transfer hopper. In case the obstruction is not located at this point it may be a small mine spike or other piece of metal which has gotten above this point. In that case remove the nut at the top of the elevator casing door, remove the door and the obstruction may be located and removed.

A clog in the tank conveyor will usually be found in the crusher zone. To remove a clog at this point reverse the tank conveyor screw in the manner described, forcing the obstruction out of the crusher when it can be removed from the trough.

Do not run the conveyor screw backward more than three revolutions.

COAL DISTRIBUTION IN FIREBOX

The distribution of coal is regulated by two separate attachments as follows:

Steam jets in elevator elbows.

Dividing rib in transfer hopper.

The steam jets fitted into the elevator elbows blow the coal over the grate area and are regulated according to the quality of coal. For coarse coal it requires about 18 pounds of steam, and for slack about 9 pounds of steam, on these jets to get an even distribution. The coarser the coal the more steam, and the finer the slack the less steam will be required. If, after running for some distance, it is found that too much coal is going to the flues, the steam pressure on the elbow jets should be reduced, and if not enough is going to the flues, it should be increased.

The dividing rib in starting out should be in the center of the transfer hopper. If it is found that too much coal is feeding to the right side of the firebox, the dividing rib should be turned to the right, and if too much is feeding to the left, the dividing rib should be turned to the left.

The amount of coal distributed over the firebox is regulated by the speed of the driving engine and the plates over the trough in the tender. To vary the amount of coal, the steam pressure should be increased or decreased by regulating the controller valve 6, Fig. 44. When it is seen that not enough coal is feeding into the trough another slide over the trough should be pulled back.

Before leaving terminal, see that fire is clean and in good condition. Build up a good level fire with shovel. After starting stoker as hereinbefore explained, open one or more slides in tank and be sure coal is getting to conveyor screw.

Do not feed iron, rock, slate or waste through the conveyor.

When train is standing on siding for a short period, shut stoker off by throwing operating rod on back-head of locomotive boiler out of running position. When train is to stand for a longer time, the driving engine should be cut out entirely by closing main steam line inlet and main lubricator connection and in winter time drain cocks should be opened.

If sufficient coal cannot be supplied front grates see if the distributors are warped out of shape and point too low. If such is the case, report should be made at terminal so that proper adjustment may be made. See that the steam jets are blowing freely, and are not plugged with pipe scale. It may be necessary to increase the pressure on these jets.

METHOD OF OPERATION

In firing with the stoker the practice is to build up a light even fire by hand and get up full steam pressure before leaving a terminal, and not bring the stoker into use until the locomotive is working steam. The fireman then opens distributor jets and starts driving engine, then opens first coal slide plate over conveyor trough, which starts the delivery of the coal to the firebox.

The screw conveyor is designed to furnish the amount of coal required under average conditions with stoker engine running at or below medium speed.

When the first of the slide plates is pulled forward, the coal, falling into the conveyor beneath, is carried by the heavy cast steel conveyor screw through the crushing zone at the forward end of the trough. Through this zone the slack and coal of a size suitable for efficient firing passes in a loose and free state without being crushed, while the large coal is broken and reduced to the best size for efficient firing. After passing through this zone the coal is delivered to the transfer hopper beneath the cab deck, where it is divided, equally or unequally, according to the position of the dividing rib, between the right and left elevators, and dropped into distributor elbows. Into these elbows are fitted distributor tubes which extend through the openings in the back-head on each side of the fire door, the distributor portion of each tube being located on the inside of the firebox over the grate area.

The distribution of coal over the grate area is accomplished by means of a low pressure constant steam jet located in the back and bottom portion of each distributor elbow. The pressure of the steam supplying the right and left jets is reduced from boiler pressure by throttling it through half inch globe valves, and this reduced pressure is indicated by a steam gauge connected to each jet line between globe valve in that line and elbow jet nozzle. The pressure of steam at these jets under working conditions varies from ten to twenty-five pounds. Interposed between the jet valves and the main steam line is a three-quarter inch globe valve, by which the steam may be cut off from the jet main line without disturbing the setting of the jet valves.

The distribution of coal over the grate area is regulated by varying the pressure of the elbow jets, as indicated by its individual pointer on steam gauge fastened to the back-head in full view of the fireman. The distributors have deflecting ribs especially designed for their function of spreading the coal, and this variation of jet pressure affects sufficient flexibility in firing different areas of the grate. The distribution overlaps the two areas or zones fired from the two elbows, which overlapping insures ample coal being supplied to center of firebox in heavier combustion area. By increasing the jet pressure on the right or left side more coal will be carried to the flues on that side, or by decreasing the jet pressure less coal will be carried to the flues and more to the middle and back portion of the grate area on that particular side.

The deflecting ribs on the distributors, as shown in Fig. 42, place some of the slack coal in right and left corners of firebox, thus preventing loss through stack. The fireman can direct more or less coal to each side of the firebox by changing position of the dividing rib, as shown in back view of transfer hopper, Fig. 40, by moving lever to either side.

By means of the elevator reverses and conveyor reverse, which as hereinafter described are an arrangement of ratchets and pawls, the two elevator screws and conveyor screw turn in one direction only, and coal is therefore conveyed and elevated only on the forward stroke of the engine. In this manner constant steam and intermittent supply of coal is secured.

The sliding plates at the bottom of the tank are located so that there will be a supply of coal at all times on top of the screw.

As coal is used from tender so that it no longer flows freely through first slide opening, the fireman opens next slide and so on until supply is again taken at coal chute, when slides are all pushed back and first slide opening used as in starting out.

With the distribution as described, a level white fire can be carried and perfect combustion secured. This level thin fire usually results in the firebox temperature being higher than with hand firing. Maintain a white, level fire, and if the locomotive has been steaming well for some distance and steam begins to reduce, do not materially increase the amount of coal being fed to the firebox, unless there has been a change in the working of the locomotive or an increase in the amount of water being supplied to the boiler. Observe if the fire needs attention. Forcing the stoker under such conditions causes clinkers to form which shuts off the supply of air through the grates, causes the fire to bank and become heavy and contributes to heavy losses of fuel.

Before taking coal close the tank opening with the slide cover plates. This should be done before any coal is put in the tender.

When it is desired to separate the locomotive and tender, the conveyor unit of the stoker should be left with the tender. This can be done by loosening the bolts on the left ball joint clamp and sliding the clamp to the left enough to free the conveyor ball joint and disconnecting pin connecting the block and universal joint jaw on the conveyor drive and reverse cover.

Do not leave the tank openings uncovered when coaling the tender.

Do not let coal stand in the conveyor trough between trips.

Do not allow coal to accumulate in the tank cut-out and become packed around the outside of the conveyor trough. This will break the trough when the locomotive is rounding a curve.

Never place a hand or foot in the trough while stoker is in motion.

Do not run the stoker without distributors. The distributors are designed to spread and save coal. Leaving them off means unnecessary waste of coal.

Leave a pressure of at least four pounds on stoker jets at all

times when locomotive is fired up to prevent distributors being over-heated and damaged.

When approaching a terminal yard where locomotive is to be taken to roundhouse the slides should be closed and the conveyor and elevators should be emptied of coal. This operation should be started in sufficient time so that coal will be consumed in getting train into yard without creating black smoke. If, then, additional coal is required, it should be handled with the scoop.

The conveyor, hopper and elevators hold between 500 and 600 pounds of coal, and if this amount is placed in firebox after locomotive is detached from train or after arriving at roundhouse, most of it is wasted.

Before leaving a stoker locomotive at fire track, fireman should close driving engine throttle valve and steam jet main line valve tight, open drain cock on bottom of engine cylinder to eliminate any possibility of stoker engine freezing in extremely cold weather, and shut off the stoker lubricator.

DESCRIPTION OF THE STANDARD TYPE B AND MB STOKERS

As the Standard B and MB Stokers are generally same in principle and design, the operating instructions outlined in this book apply to both stokers. However, there is a difference in the construction of the two stokers, principally in the conveying systems, as illustrated in Fig. 46. The clevises and paddles connecting the screws, and the two hanging bearings supporting the front and tender screws used with the B Stoker are eliminated in the MB. Thus the conveying system of the MB is comprised of a continuous screw divided into three sections connected by universal joints.

The main units of the stokers are:

A tender trough located beneath the coal supply and rigidly secured to the tender frame.

A two-piece, telescopic intermediate unit with a ball joint at each end to provide the necessary element of flexibility between locomotive and tender.

A front unit consisting of a horizontal trough casting and an elbow-shaped conduit fastened to the locomotive frame, together with a vertical housing, protecting grates and firing table.

A distributor jet fastened to the back wall of the vertical housing just inside the firedoor and controlled through a manifold and valves located on the boiler backhead.

A separate, double-acting, two-cylinder, variable-speed, reversible steam engine which may be located either on the locomotive or tender.

On both the type B and type MB stokers the coal is conveyed through conduits beneath the locomotive deck and mudring, and thence upward through an elbow in vertical conduit

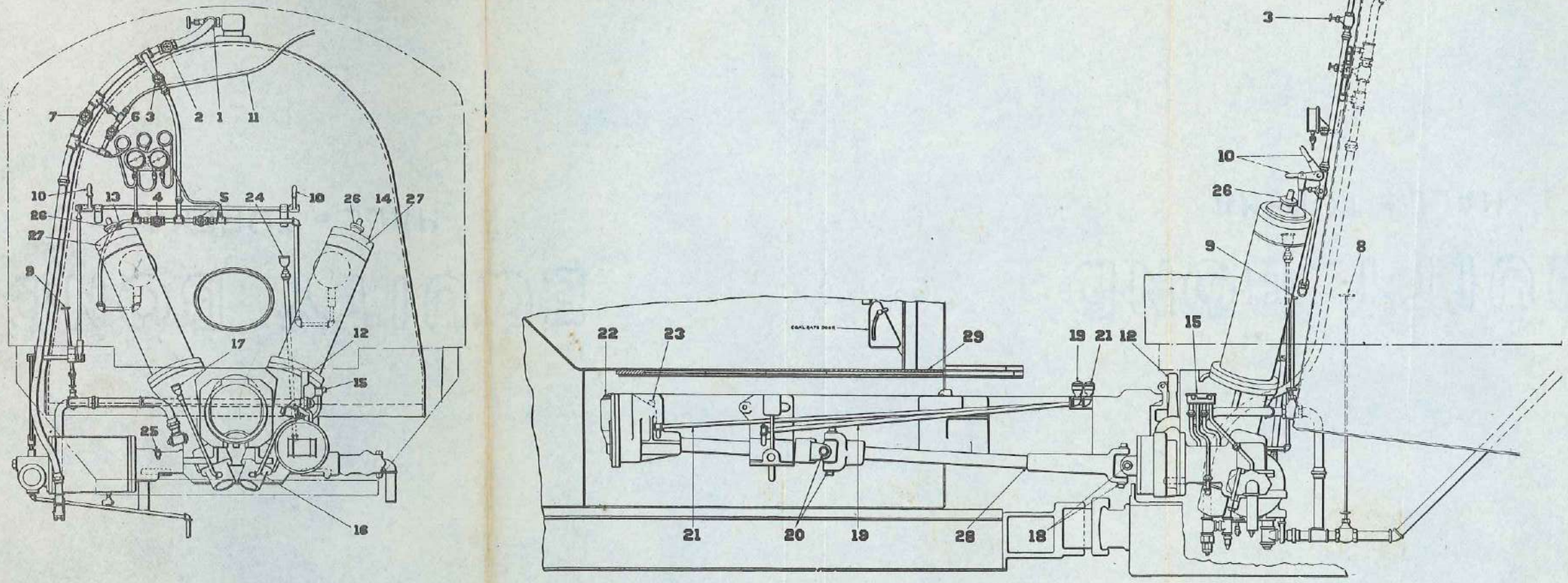


FIG. 44.
Duplex Stoker Arrangement.

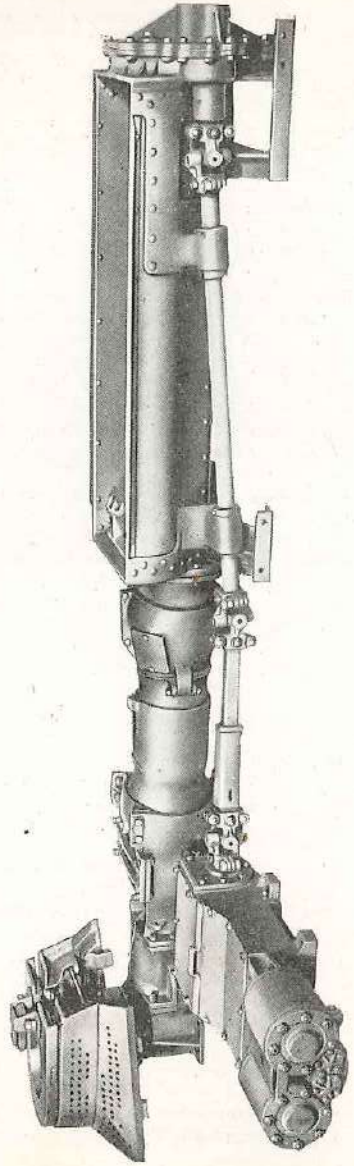


FIG. 45 Type MB Stoker.

which extends through the rear portion of the grates and terminating just below the firedoor opening. From this point the coal is distributed by steam jets. The only parts of the stoker in the locomotive cab are the jet manifold and valves and steam gauge, all located on the boiler backhead.

OPERATING INSTRUCTIONS

When a locomotive is placed on outgoing track to be turned over to the engine crew, the fire should be in good condition, free from banks, clinkers and excessive ash accumulation on the grates. The preparation of the fire before starting the stoker, which should not be used before locomotive is coupled to the train, should be done by hand and the fire should be heavy enough to withstand the high draft created when starting the train.

Before leaving terminal the fireman should check the oil level in the stoker engine bed. If oil appears when pet cock No. 7 is opened, there is a sufficient amount to insure proper lubrication of all parts within the engine bed. When additional oil is necessary, supply through filler pipe No. 8, using a good grade of engine oil.

A compartment oil box, No. 9, and in many instances a grease gun connection, No. 52, located at the front of the tender, supplies the lubricant necessary for the various conveyor trough bearings. The oil box also provides lubrication for the universal joints when the stoker engine is located on the tender. Fill each compartment with car or engine oil (do not use valve oil) at the beginning of the trip. When stoker engine is located on the locomotive the universal and slip joints between engine and tender should be oiled with other locomotive parts.

Adjust lubricator for stoker engine cylinders to feed three drops per minute.

To start the stoker, first open turret valves admitting steam to engine and jet lines, Nos. 1 and 2, respectively; next open main jet valve, No. 3; then open each of the manifold jet valves separately to see that jet holes are free from obstruction.

Place operating lever, No. 4, for stoker engine reverse valve in forward position. There are two designs of reverse valves as will be noted in Fig. 48, the principal difference being in the location of the internal valve when in forward or reverse position. The neutral or central position remains the same for both valves.

Open stoker engine valve, No. 5, slowly to permit cylinders to heat up and condensation to exhaust through automatic drain valve, No. 12. This valve will close when condensate has been released. The stoker engine valve can now be regulated for the desired speed.

Booster valve, No. 6, should be kept closed except in cases where it is necessary to increase the steam pressure to stoker

engine rapidly in order to crush an exceptionally hard lump of coal. As soon as possible, valve No. 6 should be closed and stoker operated with steam through valve No. 5.

Pull the first slide plate forward to admit coal to the conveyor. Open firedoor for observation and as the coal reaches the top vertical housing, No. 17, adjust the five manifold jet valves to get an even distribution of coal over the entire grate area. On locomotives having exceptionally large fireboxes there are two additional jet valves, or a total of seven.

The valves for the "Left Front" and "Right Front" jet lines, Fig. 47, control the distribution of coal to the left and right front corners and adjacent sides of the firebox, through the holes in the left right top center portions of the distributor jet.

The valves for the "Left Back" and "Right Back" jet lines control the distribution of coal to the left and right back corners and adjacent sides of the firebox, through the holes in the extreme left and right sides of the distributor jet.

The valve for the center jet line controls the distribution of coal over the front and center of the firebox, through the holes in the center of the distributor jet.

For the average grade of coal 30 to 45 pounds manifold jet pressure should be sufficient to obtain proper distribution. However, these pressures are only approximate and a difference in coal size may necessitate a change. Any fluctuation in boiler pressure should be compensated for by adjusting main jet valve.

The speed of the stoker can be determined by observation of the front conveyor screw (No. 19 or 53) (see Fig. 46), through the vision box grating in the firing deck or by the stoker engine steam gauge, No. 31, which will vary between 15 and 25 pounds during normal operation. If a hard lump of coal or piece of foreign matter should check the speed of the stoker, the pressure in the engine cylinders will gradually increase until the engine has sufficient power to move the obstruction. If, however, the pressure rises to nearly boiler pressure and remains there it indicates that the stoker has stalled.

The stoker of today will fire a locomotive under all circumstances if properly manipulated. It is, however, not automatic; it depends upon human hands and intelligence for proper and efficient operation. The stoker will convey the coal fast or slow, depending upon the adjustment of the operating valve in the steam line to the stoker engine, and will distribute the coal to any part of the grates at the will of the fireman, depending upon his judgment in the manipulation of the distributing valves.

Light firing with constant distribution of the coal to cover entire surface of the fire bed will produce the highest combustion efficiency. Heavy firing or racing the stoker intermittently leads to improper and incomplete combustion, clinkered fires, excessive black smoke and waste of coal.

Handling of the grates in connection with stoker firing is an important factor. Grates should not be moved violently

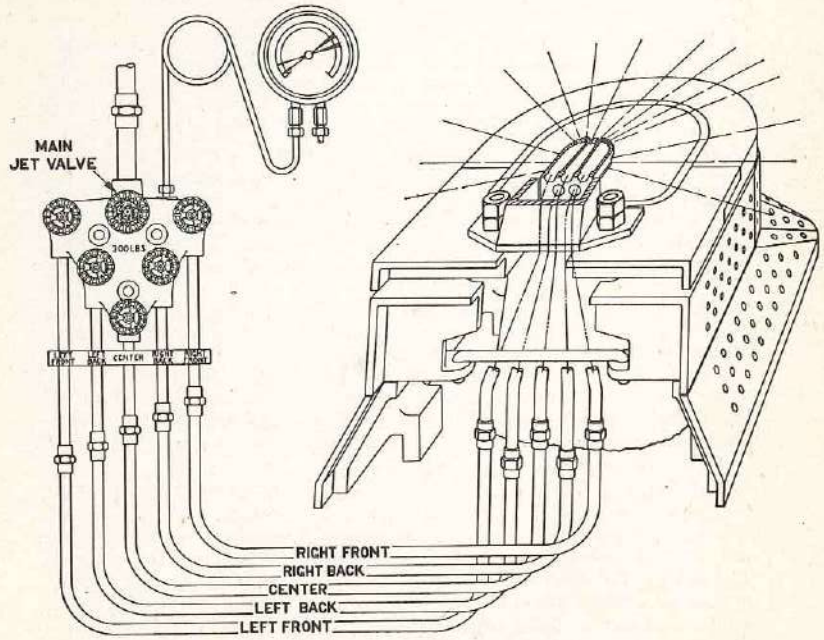
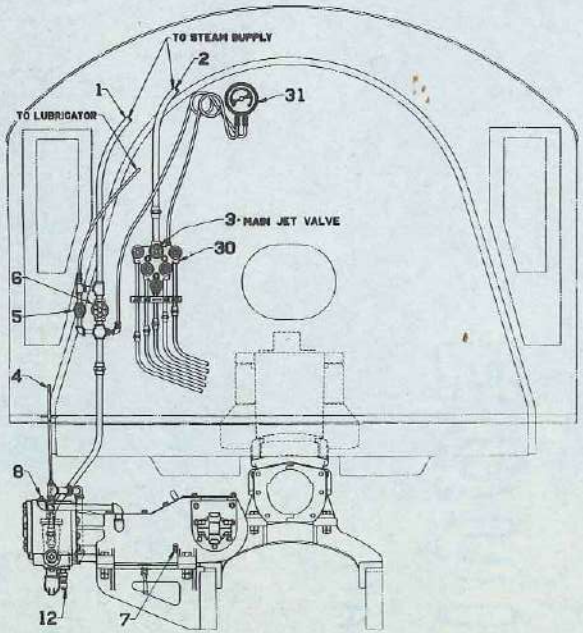
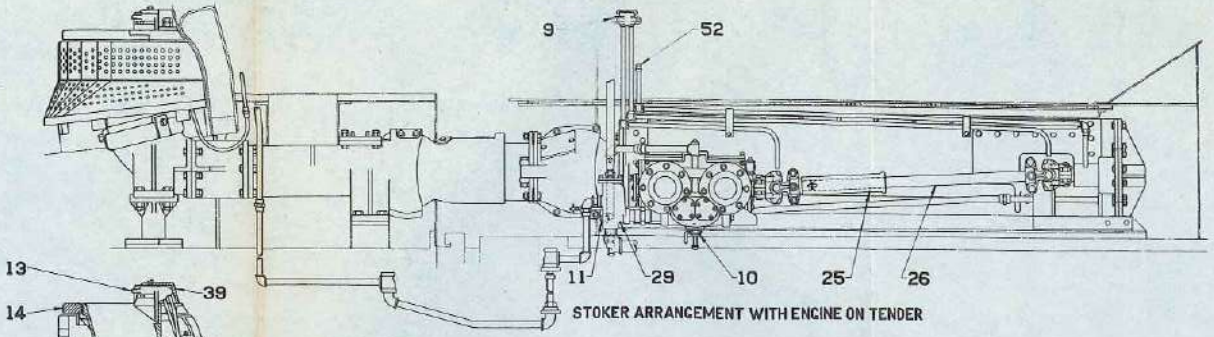
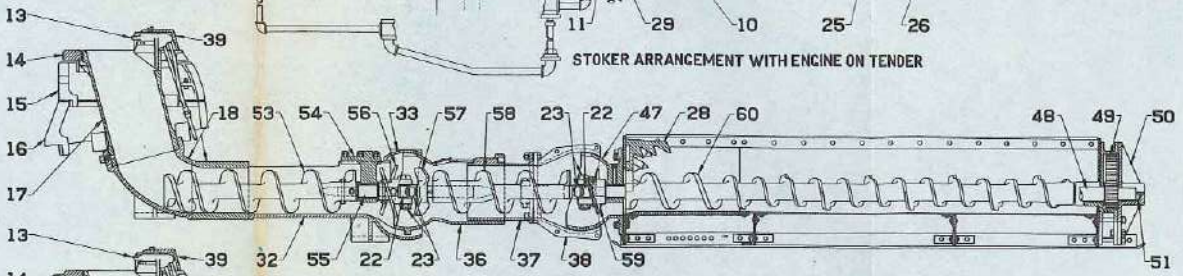


FIG. 47. Diagrammatic View of B or MB Stoker Distributor Jet and Manifold Piping Showing Location of Jet Holes.

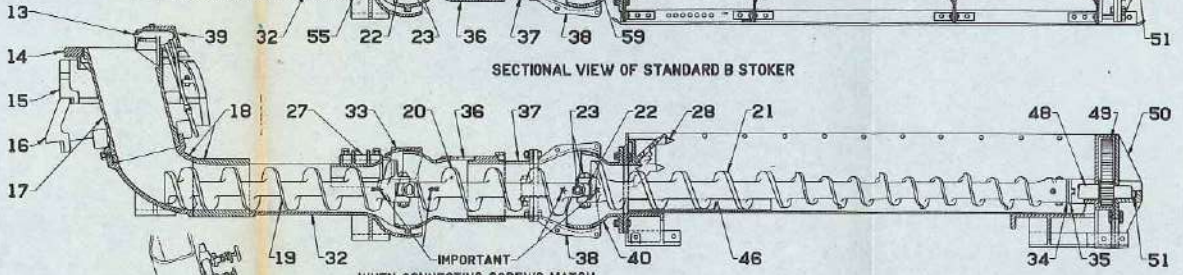




STOKER ARRANGEMENT WITH ENGINE ON TENDER

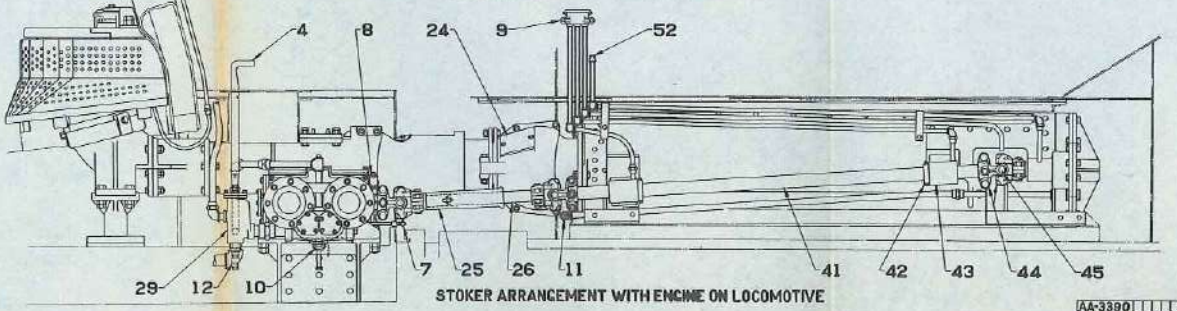


SECTIONAL VIEW OF STANDARD B STOKER



IMPORTANT
WHEN CONNECTING SCREWS MATCH
MARKERS AT RESPECTIVE ENDS

SECTIONAL VIEW OF STANDARD MB STOKER



STOKER ARRANGEMENT WITH ENGINE ON LOCOMOTIVE

AA-3390
B + MB STOKERS
REFERENCE DIAGRAM
THE STANDARD STOKER CO. INC.
ERIE, PA.

FIG. 46.

while locomotive is working, on account of the light fire bed carried with the stoker. They should be moved lightly and as frequently as may be necessary, depending upon the type of grate in use, in order to keep the ash accumulation underneath the fire bed down to a point where it will not interfere with the uniform flow of air necessary to complete combustion. If it is necessary to shake the grates heavily to dispose of excessive accumulation of ash and clinker formation, it should be done while locomotive is standing or drifting, or at places where locomotive is worked light and the maximum boiler pressure is not required to handle the train. Holes in the fire are very apt to form from too heavy shaking of the grates while locomotive is working hard, and in many instances are the cause of steam failures before the fireman can locate the hole and stop the inrush of cold air.

Occasionally, conditions are encountered which necessitate readjustment of the distributing devices in order to maintain proper distribution of the coal. Some of these are: grade and weight of coal furnished, condition of coal, wet or dry; thickness of fire bed; change in the combustion rate or draft caused by change of cut-off. Irregular draft conditions through the grates caused by grates not being properly spaced and adjusted, improper setting of the brick arch and holes in the arch all have their influence on draft action and affect distribution. Therefore, occasional inspection of fire conditions and distribution is advisable. This will enable the fireman to take timely action to correct improper conditions that may be in the formative state and can be corrected by a slight readjustment of the distributing valves. Generally, if one adheres to the principles embodied in good hand firing, success in stoker firing will likewise prevail.

The engineer's handling of throttle and cut-off, which control the admission of steam to the cylinders, has its effect on successful performance of stoker-fired locomotives. Close cooperation between the engineer and fireman is very important. The fireman should be informed as to any movement out of the ordinary which imposes extra heavy work on the locomotive and requires special attention, particularly if he is not familiar with the road and operating conditions. The engineer should not start without asking the fireman if the fire is ready, as a light stoker fire is easy to upset when starting a heavy train. The locomotive should not be worked at longer cut-off just because the stoker will deliver coal and the pointer on the steam gauge registers the maximum pressure, but should be handled in the shortest cut-off possible to haul the tonnage and maintain the scehdule. Whenever the maximum output of the locomotive is needed, it can be had at all times, as all stoker-fired locomotives can be worked to capacity, the physical limitation of the fireman having no bearing on the efficient performance of the locomotive.

REMOVING OBSTRUCTIONS

If the stoker stalls, in nearly all instances an obstruction will be found at the crusher zone (located in the tender trough). To relieve it, reverse the stoker by placing the operating lever in reverse position. If, after repeated reversal, the stoker will not operate normally, it is an indication that the obstruction is too large to pass through the crusher.

IMPORTANT: When removing an obstruction from the conveying system be certain that steam valves are shut off tight and that the operating lever for the stoker engine is in neutral position.

To remove a clog at the crusher, reverse the stoker in the manner previously described, forcing the obstruction out where it can be removed from the conveyor. Should the clog be wedged so tightly that the stoker cannot be reversed, the crusher can be taken out by removing the two bolts which fasten it to the tender trough.

REVERSING VALVE

The reversing valve is an ordinary piston valve with inside admission and in normal operation steam passes from the boiler around the valve to the cylinder of the engine. In exhausting, steam passes out at the end of the valve to the atmosphere. In reverse position the reversing valve is pushed down (Fig. 48), permitting live steam to enter the exhaust steam chamber of the engine through the exhaust passage, the engine exhausting through the reversing valve to the atmosphere. It will be readily understood that this change of position of the reversing valve changes the engine valves from inside admission in normal operation to outside admission in reverse. Oil in the exhaust steam from the cylinders furnishes sufficient lubrication at all times for the reversing valve.

GENERAL SUGGESTIONS TO FIREMEN

The same general principles that pertain to fire conditions under hand firing apply to stoker firing, that is, to maintain a thin, level, bright fire and uniform distribution of fuel over the entire grate surface.

See that fire is clean and in good condition before leaving terminal.

Do not feed too much coal—carry a light fire. The stoker should be regulated to deliver a constant supply of coal to the firebox, but only enough to meet the demand on the boiler for steam.

Do not allow rock, iron, wood, or other foreign matter to be fed into the stoker if it can be detected in the coal and removed before it enters the conveyor.

Before taking coal, while en route or at terminal, see that all tank slides are closed.

See that the stoker is lubricated at recommended intervals.

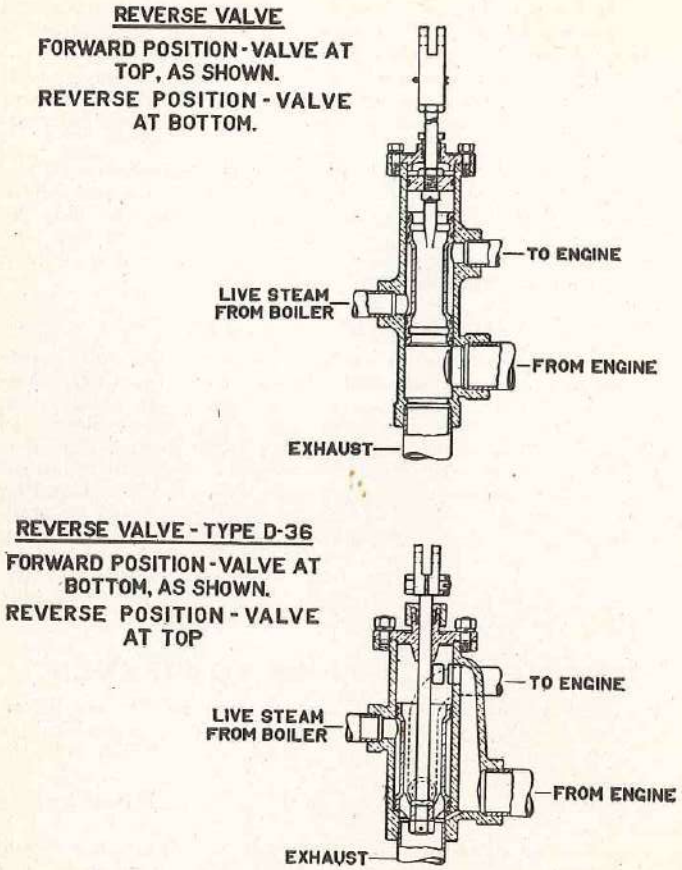


FIG. 48 Stoker Engine Reverse Valves.

TAKING COAL AND TERMINATION OF TRIP

Before taking coal en route all tender trough slides should be closed. They should also be closed before arriving at terminal and the stoker kept in operation for a short time thereafter, so that the conveyor may be empty on arrival. This is to prevent wet coal from freezing in the winter, also to permit roundhouse forces to make proper inspection.

Arriving at terminal, close stoker engine valve, and main jet valve. If the latter valve has not been provided with a bleed hole, it should be left slightly cracked until the fire has been dumped to guard against overheating of the firing table and to prevent the coal on top of vertical housing from catching fire. This same precaution should be taken when lying on sidings or drifting on long grades or at any other time when the stoker is not in operation.

Note condition of firing table, if burned or warped so as to affect distribution, report for replacement at terminal.

Report any other defect in stoker mechanism.

DESCRIPTION OF THE STANDARD TYPE FD STOKER

The Standard FD stoker introduces coal at the front end of the locomotive firebox immediately beneath the arch. The general construction of this stoker is shown in Figs. 49 and 50.

Like all Standard Stokers the tender unit of the FD Stoker consists of a trough rigidly secured to the tender underframe in a position to receive coal from the coal compartment. A gear reduction unit is carried by the rearward end of the trough and this reduction unit is connected by suitable flexible shafting to stoker engine. The usual telescopically flexible conveyor housing extends between the trough on the tender and conveyor housing on the rear part of the locomotive.

Instead of delivering coal into the firebox through that portion of the grates adjacent to the backhead, the FD Stoker employs a conveyor tube which passes beneath the grates and into the ash pan to a point short of the front waterleg of the firebox. An elevator housing is secured to the front waterleg and projects through the plane of the grates so as to open upwardly within the firebox. Thus, the coal delivery end of the FD Stoker is positioned adjacent the lower end of the arch.

The foremost end of the inclined elevator housing carries the distributor jet which directs radial jets of steam toward the sides, center and rear portions of the firebox grates.

A protecting grate surrounds that portion of the inclined elevator housing which is above the firebox grates. Air holes through the protecting grate serve to cool the latter and also provide secondary air over the fire bed.

Coal is conveyed forwardly from the tender by a conveyor screw consisting of a series of flexibly connected sections extending from the rear of the trough on the tender to a point

within the inclined elevator housing at the front end of the firebox. The forwardmost screw section delivers the coal into the zone of action of the distributor jets which propel the coal across a firing table to all parts of the firebox grates. The upper surface of the firing table is inclined in rearward extent so as to compensate for the forward slope of the grates and to aid even distribution of coal over the firebed.

OPERATION OF TYPE FD STOKER

Instructions covering the operation of the type B and MB stokers apply to the type FD stoker, with exception that the operation is exactly the reverse from the rear delivery stoker, i.e., coal is delivered from the firing table towards the rear of the firebox, while with the rear delivery stoker the coal is delivered from the firing table towards the front of the firebox. This necessitates that steam jets should always be closed before the fire door is opened to read the fire, or for any other purpose, to avoid any possibility of hot burning coals being thrown out of the fire door and striking men in the cab.

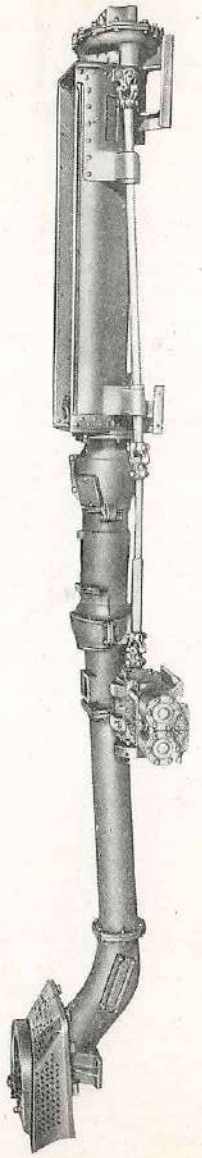


FIG. 49.
Type FD Stoker

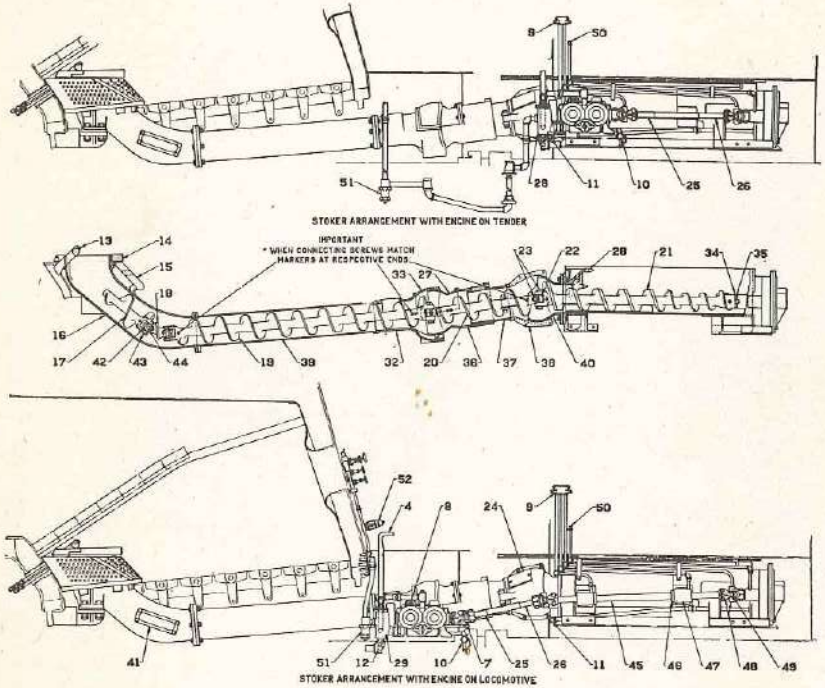


FIG. 50. Type FD Stoker.

POWER REVERSE GEAR

Modern locomotives are equipped with a power reverse gear which replaces the ordinary reverse lever for reversing the locomotive and controlling the valve gear.

The Ragonnet power reverse gear consists of a cylinder and piston connected by means of a reach rod to the valve motion. The reverse lever in cab operates the control valve which is located on top of the cylinder and is connected to the valve with a rod and a system of levers.

Pressure for operating the reversing piston may be taken from the main air reservoir, or steam pressure from the boiler may be used. When the reverse lever in the cab is moved into forward gear, a floating lever moves a control valve located in a valve chamber on top of the cylinder, admitting air to the proper end of the cylinder to move the piston in the proper direction to cause the valve gear to move to forward position. At the same time any pressure on the opposite side of the cylinder piston is exhausted to the atmosphere. As the piston moves the valve gear as described above, a connecting link which is attached to the piston rod crosshead, operates a combination lever which automatically carries the control valve to its central position, at which time the supply of pressure to the cylinder is cut off and the exhaust to the opposite end of the cylinder is also closed, thus stopping the piston if it has moved an amount corresponding to the movement of the reverse lever in the cab.

When the reverse lever in the cab is moved to the backward motion, the gear operates as described to set the valve gear for a backward movement of the locomotive. When the reverse lever in the cab is placed in its central position the piston in the reverse gear cylinder moves to the center of the cylinder, at which time the control valve cuts off the pressure, causing it to remain in that position.

It can be seen that a movement of the reverse lever either slightly forward or backward of its central position, causes a slight movement of the piston in the reverse gear cylinder, thus providing for moving the valve gear to a position corresponding to that of the reverse lever in the cab from full forward to full backward positions.

Before attempting to operate the reverse gear it should be known that ample air pressure is in the main reservoir and that the main reservoir valve, admitting air to the reverse gear valve chamber is open.

The cylinder is oiled through a lubricator or oil cup, located on the top of the reverse gear valve chamber, and all moving parts should be lubricated from the oil holes provided for that purpose.

A fountain valve is provided for shutting off steam from the boiler to the reverse gear. There is also a three-way valve in steam pipe located in the cab between fountain valve and reverse gear. When this three-way valve is sealed in closed position,

steam is shut off to power reverse gear and drain is opened to atmosphere, to prevent steam or water passing to the reverse gear in case the fountain valve leaks.

If no air pressure is available, steam should be used to operate power reverse gear by opening the three-way valve and fountain valve located in cab. Steam should only be used in cases of emergency. Always report having turned steam on reverse gear so that cylinder packing may be given attention, and new seal applied to three-way valve in cab, because of breaking the seal when steam is applied to reverse gear.

Leakage from the cylinder around the piston rod causes a loss of pressure which is a continual drain on the main reservoir when the locomotive is working steam, and also tends to cause the gear to creep forward after the control valve has cut off the supply of air to the cylinder.

Leakage by the cylinder piston packing rings causes the air to leak from one end of the cylinder to the other, which, when the locomotive is working, causes a continual drain on the main reservoir and also causes the gear to creep after the control valve has cut off the supply to the cylinder.

Lost motion in the pins connecting the combination lever and also lost motion in the valve stem, either where connected to the slide valve or at the combination lever, requires additional movement of the combination lever to cause the control valve to close the ports after the reverse lever is placed in any position. Such lost motion causes the gear to creep without a loss of air pressure, unless there is excessive lost motion in which case the gear may creep far enough so that when the control valve opens a return movement to its original position may cause the control valve to open the exhaust port.

Locomotives equipped with power reverse gear must not be moved under their own power unless air or steam is applied to the reverse gear under sufficient pressure to insure proper operation of the gear.

Locomotives with valve gears connected, that are to be moved by power other than their own, where air or steam is not supplied to the reverse gear under sufficient pressure to insure proper operation of the gear, must have valve gears of reverse gear blocked so that crosshead of reverse gear cannot move. This rule applies to locomotives moved at shop and terminals as well as on the road.

Fig. 51 shows a sectional view of the type "A" gear and ports leading from each end of the control valve directly to ends of cylinder. Some types of the gear have these ports crossed so that the port from one end of the valve leads to the opposite end of cylinder.

The type "B" gear, works on the same principle, as the type "A" the slide valve being operated by a rocker arm passing through the side of the valve chamber.

The names of parts corresponding with numbers in Fig. 51 are as follows:

3. Crosshead
4. Crosshead Pin
5. Cylinder
6. Guides
7. Combination lever and Rocker Arm Pins
8. Piston Bullring
9. Piston Packing
10. Piston and Rod
11. Piston Rod Gland & Ring
19. Control Valve & Stem
20. Valve Stem Gland Ring
21. Valve Stem & Guide

This company has in service other types of power reverse gears which operate on practically the same principle as the Ragonnet Gear.

The Baldwin power reversing gear operates on the same principle as the Ragonnet type A or B, except that air or steam is delivered to either end of cylinder through a rotary valve instead of a slide valve as shown on Fig. 52.

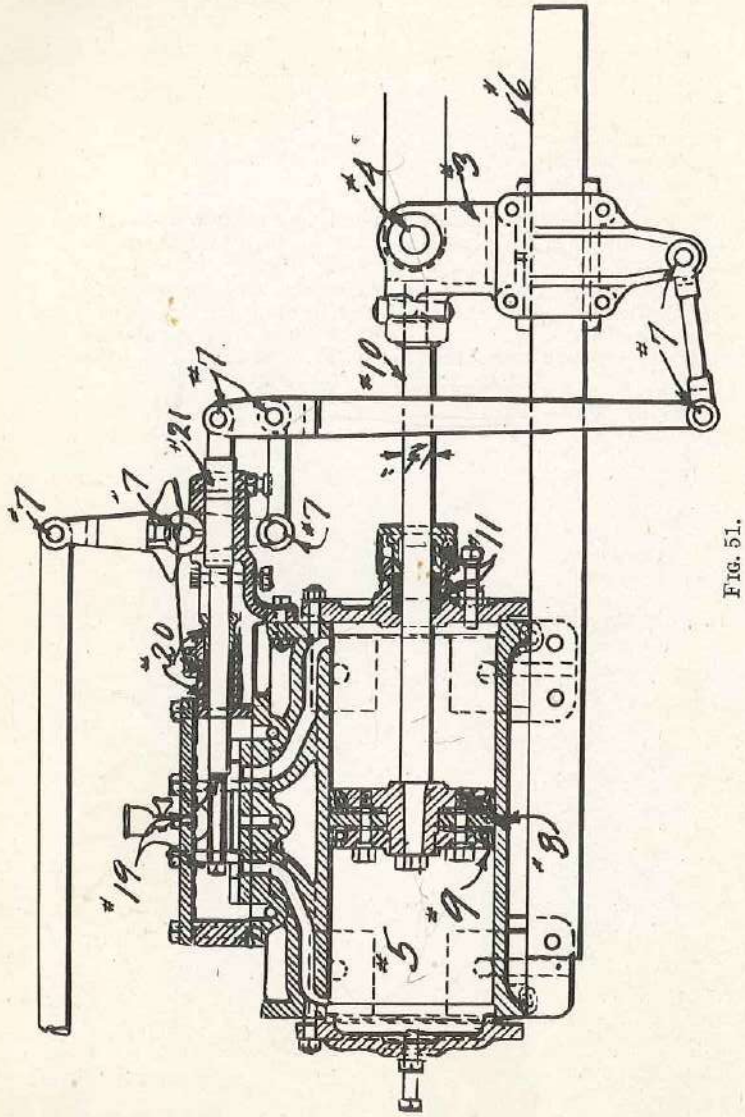


FIG. 51.

Type "A" Reverse Gear Cylinder and Valve Arrangement.

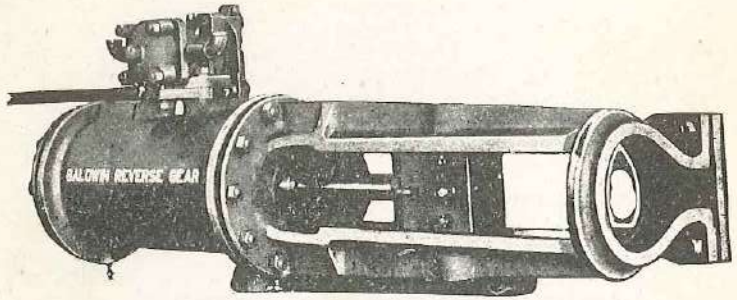


FIG. 52.

Baldwin Reverse Gear Cylinder and Valve.

CAB STEAM HEAT SYSTEM

In order to provide for the comfort of the engineer and fireman during cold weather, locomotive cabs are equipped with an independent system of steam heating pipes or coils. The steam heat pipes or coils are located on the running board under the engineer's and fireman's seat boxes. Connected into the blower steam pipe is a branch pipe leading to a small reducing valve which controls the pressure admitted to the heating coils. A globe valve is located in this branch pipe between the blower pipe connection and the reducing valve to enable the steam to be closed off from the steam heat system.

Leading from the reducing valve is a steam pipe connected to the steam heat pipes or coils on each side of the cab. These two connecting pipes are equipped with globe valves in order that steam may be used in the coils at one or both sides of the cab, as desired, or that the steam may be closed off from the coils on both sides. After the steam passes through the heating coils it is admitted into a steam trap or condensor, in order that the steam will be condensed into water, to prevent as far as possible any steam being passed to the atmosphere which might tend to cause steam clouds around the cab.

A small steam gauge, located in the cab, indicates the pres-

sure carried in the steam heat coils. This pressure should not exceed twenty-five to thirty pounds. To increase the pressure loosen the jam nut and screw down on the adjusting stem located at the top of the reducing valve. To reduce the pressure screw upward on the stem. After the proper adjustments have been made the jam nut should be tightened.

If a heavy flow of steam is had at the steam trap under the cab, the steam trap is not working properly and should be reported for repairs. There should be a very little or no steam showing at the trap when it is operating properly.

For instructions on steam heat for trains see "Instructions for the Operation of Passenger Car Heating and Water Distribution," issued by this Company.

POWER GRATE SHAKER

The power grate shaker, which is provided to reduce the labor of the fireman, consists of an operating valve and cylinders. The operating valve is located on the boiler head at the left side of the cab. A steam pipe connection supplies steam from the boiler to the operating valve. A globe valve is applied in this steam pipe to close off the steam supply from the boiler. The cylinders for shaking the grates are located under the cab deck; the pistons are connected to suitable levers extending inside the cab for the purpose of connecting the cylinders to the grate shaker levers. Steam pipe connections lead from the operating valve in the cab to each end of each cylinder, for the purpose of supplying steam for moving the pistons in such cylinders. A small lubricator is mounted on the operating valve body, or in the steam supply pipe leading from the boiler to the operating valve, for the purpose of lubricating the operating valve and cylinders. The lubricator should be filled each trip and opened when steam is supplied to the operating valve.

To operate the grate shaker see that the shaker bar is removed from the shaker post which operates the section of grates to be moved, throw back the lock holding such shaker posts, throw in the lock on the center post to connect the shaker post at either side to the center post, turn on steam in the supply pipe to the operating valve and open the lubricator; then move the handle on the right side of the operating valve, if the grates on the right side of the firebox, or on the left side of the operating valve, if the grates on the left side of the firebox are to be shaken. Moving the handle forward causes the shaker post to also be moved forward, the same as when using the shaker bar. Moving the handle backward causes a backward movement of the shaker post. Moving the operating valve to its central position shuts off steam to both ends of the shaker cylinders.

Do not move the handles on the operating valve back and forth too quickly. Move the handle to either the forward or backward position and watch the shaker post, to note whether the cylinder has moved the shaker post to a position corresponding to that of the handle on the operating valve, which it should do. If no movement is observed, the handle should be reversed to the opposite position, allowing the shaker cylinder to move the grate shaker post in the opposite direction. Move the handle of the operating valve back and forth only as fast as the cylinder is able to move the shaker posts. If the handle is reversed too quickly no movement will be had from the cylinders.

There are two cylinders, one for the section of grates on the left and one for the section of grates on the right. The operating valve has two handles, the handle on the right operates the cylinder and grates on the right side of the firebox, and the handle on the left operates the cylinder and grates on the left side of the firebox.

After using the power grate shaker, see that locks for holding the shaker posts in central position are in place and the shaker posts are locked. The locks for holding the shaker posts in position are composed of two parts. If it is desired to move the grates slightly throw out the center part of the lock, this will provide for a slight back and forth movement of the shaker post. When full movement of the grates is desired, throw out both parts of the lock, thus providing for full travel of the shaker posts.

Never attempt to operate the power grate shaker and the shaker bar at the same time. To do so may cause injury to the person attempting to handle the shaker bar.

After using the power grate shaker, shut off the valve in the steam supply pipe to the operating valve and the lubricator. Do not have steam supply valve to operating valve open when shaking grates by hand with the shaker bar.

DESCRIPTION AND INSTRUCTIONS FOR OPERATING THE STEAM COAL PUSHER

The steam coal pusher, designed to eliminate the necessity for the fireman shoveling the coal forward in the tender is shown in Fig. 53, located in the coal pit of an ordinary tender. It will be noted that a steam cylinder is fastened at the top of the slope sheet of the coal pit. Attached to the piston of this cylinder are two crossheads which act to push the coal forward. These crossheads rest at the bottom of the coal pit and when steam is used, the cylinder forces the crossheads forward toward the coal gates, thus pushing the coal forward at the bottom of the pit. This tends to mix the fine coal with the lumps and prevents an accumulation of very fine coal at the bottom of the coal pit.

Before starting on trip the coal pusher lubricator, located in the steam supply pipe in the cab, should be filled with valve oil. Do not use engine oil in this lubricator.

The pusher should be allowed to make a couple of strokes before lubricator is opened up. This in order that the piping and cylinder may be warmed up. To open the feed on lubricator, close globe valve in steam line from turret, then open the small globe valve above and below the lubricator, then reopen the main steam valve. When pusher is not in use the lubricator should be shut off.

Open globe valve in steam line slowly to allow condensation to work out through the drain valve. Then move operating handle to place the operating valve in its lower or back position, holding this position of the handle until the pusher completes its upstroke this movement loosening the coal around the pusher member as it rises, after which let go of the handle and the operating valve automatically returns to its upward or forward position causing the pusher to make its downward or pushing stroke. The main steam valve should be closed when pusher is not in use in order to allow the drains to remain open and free the piping from condensation.

Coal pushers are to be tested at terminal after each trip. Enginemen should test the coal pusher by operating it before leaving locomotives on arrival at terminals. If the coal pusher fails to work properly, make necessary report so that repairs can be made before tender is filled with coal.

PNEUMATIC SANDERS

The pneumatic sander is designed to provide for placing a continuous stream of sand upon the rail to prevent locomotives slipping. A system of pneumatic sanders is installed to each side of the locomotive. A sand dome is applied on top of the boiler to carry the sand supply. Some locomotives have two sand domes. The location of sand dome is such that the heat from the boiler tends to keep the sand dry after the sand dome is filled.

Suitable pipe connections at each side of sand dome lead to the rail for the purpose of delivering sand to the driving wheels for either forward or backward motion of the locomotive.

Installed in the sand delivery pipes leading to the rails, is what is called a "sand trap." These sand traps are equipped with small nozzles, and pipe connections lead from the main reservoir, through the cab, and connect to the sand traps in such a manner that as air pressure is passed from the main reservoir to the sand traps the air passes through the small nozzle, blowing a jet of air into the sand delivery pipes. The sand from the sand box flows to the sand traps by gravity and is then blown into the delivery pipes by the air passing through these nozzles. As long as air is admitted to the nozzles and sand flows from the sand box, a continuous stream of sand will be spread upon the rails.

Various types of engineer's valves are used for the purpose of admitting air from the main reservoir to the sand traps. Some of these valves are so arranged that when they are open air is allowed to blow through a small hole in the valve body, which makes sufficient noise to attract the engineer's attention when the valve is in open position. Such openings are called "warning ports," and are provided for the purpose of attracting the engineer's attention, so that he will not leave the operating valve open unintentionally.

In some cases the sand operating valves are of such construction that moving the handle forward operates the sanders leading to the go ahead sand pipes and moving the handle backward operates the sanders leading to the back-up sand pipes.

Some of these valves are designed along the lines of the ordinary plug cock, while others are of the rotary valve type. Leaving the valve open unnecessarily causes a waste of air and also a waste of sand, in addition it increases the difficulty of pulling a train if a heavy layer of sand is spread upon the rails continuously.

In the "Graham-White Sander," an additional air connection is made from the engineer's operating valve to the sand trap. This additional air supply pipe is for the purpose of blowing a current of air through the sand delivery pipes through a much larger opening than provided in the sanding nozzles. The object being to clear the delivery pipes of wet sand or other obstructions, in case such obstructions exist. When sand becomes wet it packs and will not flow freely. Sometimes moisture accumulates inside the sand pipes near the bottom, and when using the sanders the sand tends to stick to the inside of the pipes at this point. If this condition continues, the sand will gradually pack in the pipe until the pipe is stopped up, when it is necessary to tap the pipe sufficiently to dislodge the wet sand and cause it to fall out of the pipe. If, however, a large volume of air under heavy pressure is admitted to the sand trap, the wet sand can usually be blown clear of the pipe, permittting proper operation of the sander when air is admitted to the sanding nozzles.

The improved Graham White sander operating valve shown in Fig. 54 is of the poppet valve type and that the one valve handle operates both the forward and backward motion sanders, and the blow out.

When the handle is moved about midway of its travel in either direction it opens the valve to admit air to the blow out pipes as well as the operating pipes. When moved to its extreme or operating position, the port leading to the blow-out pipe is closed by the piston section of the valve stem and in this position air is allowed to flow through the operating pipe only.

When moved to its extreme position, either forward or backward, the handle latches in open position. To unlatch the valve it is necessary to push down on latch rod in upper end of handle when the spring beneath the valve will return handle to closed position.

In using the sanders move the valve to the blow-out position momentarily, or for just a few seconds, then move the handle to its sanding position. Do not leave the handle in the cleaning or blow-out position except momentarily. The pipes and passages leading from the main reservoir are quite large and if the handle is left in cleaning position too long, the main reservoir pressure will be reduced, which might cause a loss of excess pressure, which would cause the brakes upon the locomotive or train to apply.

Report all leaks observed in the air pipes leading to the sanders, and also any leaks which will permit moisture to enter

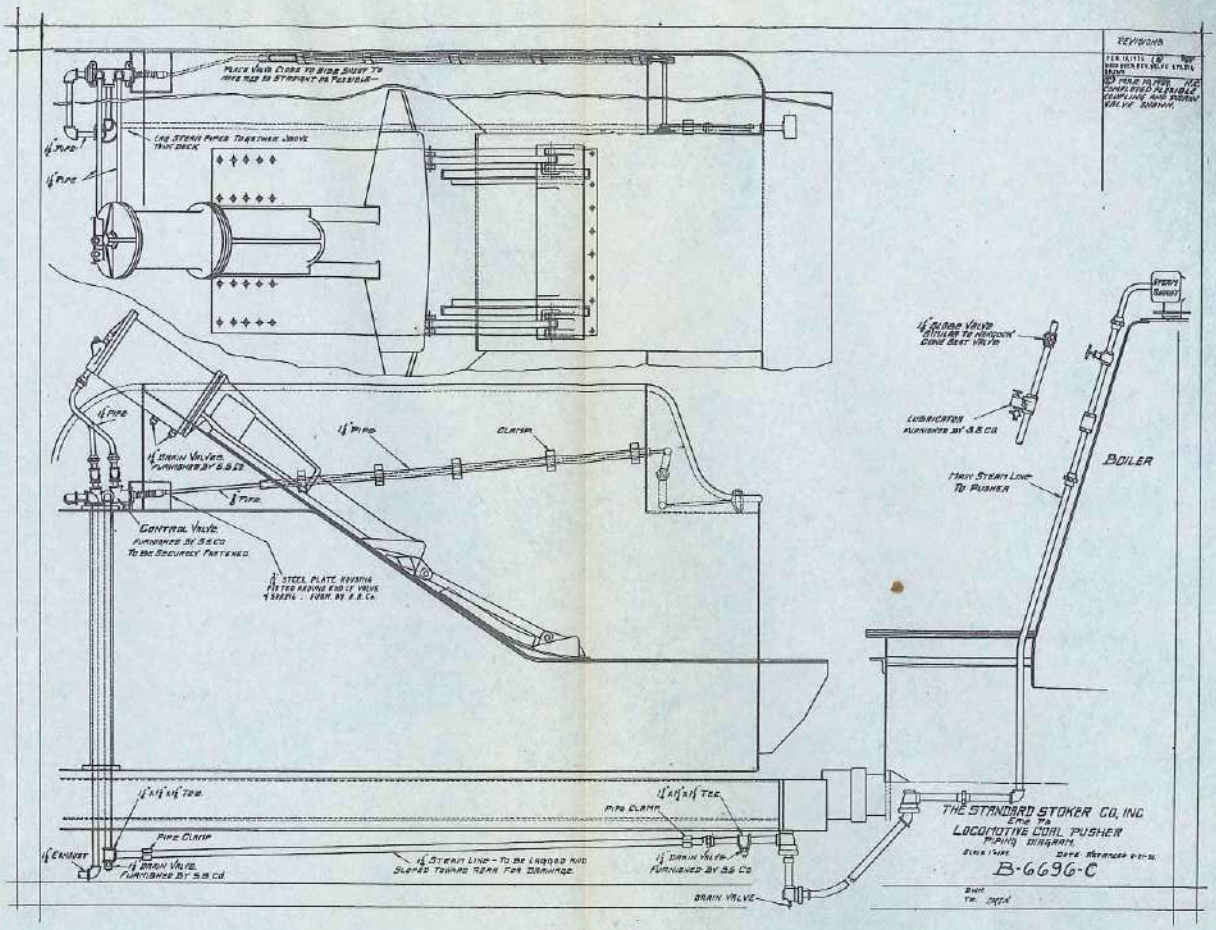


FIG. 53. Type D-A.

the sand box or the sand traps. Usually leaks around the sand box and sand traps will be evidenced by signs of sand or sand dust at such places. When this is observed report promptly, so that repairs can be made to prevent moisture entering the traps or sand box, which might cause the sand to become wet and packed, interfering with the proper operation of the sanding devices.

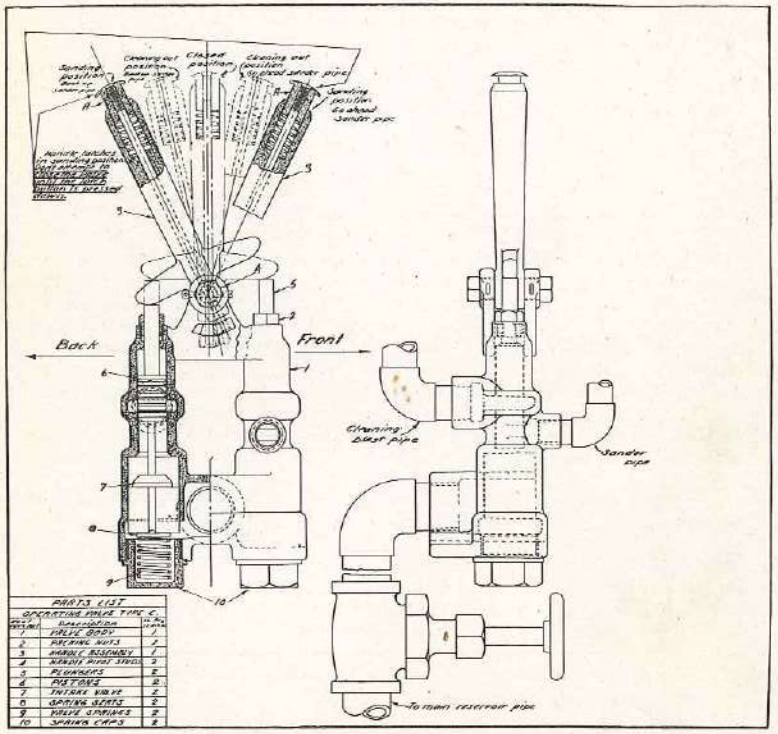


FIG. 54. Sander Operating Valve.

PNEUMATIC FIRE DOORS

To relieve the fireman of the labor of opening and closing the swinging fire door, automatic fire doors are applied, the doors are operated by compressed air. A small cylinder is provided to operate the door, the piston of such cylinder transmits motion to the fire door by means of a link or lever. In most cases the fire door consists of two parts, and a link or lever connects to each section of the door, which provides for both sections opening in unison.

A foot pedal, located so as to just clear the cab floor, is placed in such position as to be convenient for the fireman to operate with his foot, when standing in his usual position for firing the locomotive. To operate the door press down on the foot pedal, which raises a valve from its seat, admitting air from the main reservoir to the operating cylinder. This moves the piston in the cylinder, causing the door to open. To close the door release the foot pedal, the supply of air from the main reservoir is then cut off from the cylinder and the air in the cylinder is exhausted allowing the door to close.

The door should be closed after each scoop of coal is applied to the firebox.

Oil the various pins connecting the rods and levers once each trip. The cylinder should be oiled through the oil cup, and the pins and levers oiled through oil holes provided for that purpose.

Provision is made by applying an adjustable choke in the exhaust passage leading from the operating cylinder so that the pressure will be exhausted from the cylinder at such a rate as will prevent the doors closing suddenly and striking each other with considerable force. When it is noticed that the doors do operate in this manner report should be made so that proper adjustment of the choke can be made to provide for the doors closing gently.

FLANGE LUBRICATOR MANUAL

Since the flanges upon the wheels are the only means of maintaining; a locomotive or car in place on the track, or guiding same around curves, it is obvious that they and the rails are both subject to wear when these two surfaces come into contact with each other.

The main frames of a locomotive are not permitted to turn under the boiler in the same manner as is common to the ordinary two, four or six wheel truck, and it therefore requires a greater effort on the part of the flanges on the driving wheels to guide the locomotive, than is the case with the truck wheels at either end.

A large per cent of the guiding effort is produced by the leading trucks and trailing trucks upon the locomotive, but notwithstanding this, such trucks are free to turn or move from side to side, while any side movement of the driving wheels cannot be transmitted to the main frames, in the same manner as is common to the leading and trailing trucks. The flange wear is therefore greater than is common to the smaller size wheels used in the ordinary truck.

To reduce the wear of the driving wheel flanges and also the inside edges of the rails, flange oilers are applied. The flange

oiler is constructed on the same principle as the hydrostatic lubricator which is used to lubricate the main valves in the steam chests or valve chambers. This flange oiler is located in the cab, on the left side of the boiler head. Suitable pipe connections lead from the flange oiler to the driving wheels that are to have the flanges lubricated. Nozzles are applied at the end of these pipes to direct the oil to the throat of the flange. This provides for placing a coating of oil on the flange as the driving wheels revolve.

The flange oiler consists of an oil bowl, which holds about one quart of oil. Above the oil bowl is a condensing coil. Steam is admitted from the boiler into the condensing coil, and at the same time passes around the condensing coil to each side of the lubricator, where it connects to the delivery pipe connection leading to the driving wheels at each side of the locomotive. Above the point where the oil delivery pipe connects to the lubricator, is a sight glass, and just above this point is located a feed valve. The connection to the feed valve leads inside of the lubricator bowl and is piped to the top of the bowl. At the bottom of the condensing coil a valve is located, which permits water from the condensing coil to pass to the bottom of the oil bowl.

As steam enters the condensing coil it has no means of circulating through the lubricator. It consequently condenses into water. This water is passed beneath the oil in the oil bowl, causing the oil to raise on top of the water, where the oil flows into the pipe which conducts the oil to the feed valves. When the feed valves are opened the oil is permitted to flow through the feed valve, where it drops past the sight feed glasses into the current of steam flowing through the oil delivery pipes. The current of steam which is flowing out through the delivery pipes carries the oil with it to the nozzles located close to the flanges, where the oil is blown upon the flange by the current of steam The nozzles should be located close to the flanges and directed so that the oil will be blown upon the flange and not upon the tread of the wheel.

A steam valve, located in the steam pipe leading from the foundation to the condenser, permits of shutting off steam to the flange oiler. The valve located below the condenser permits of shutting off the flow of water from the condenser to the oil bowl. The feed valves located above the sight feed glasses permits of shutting off oil from the flange oilers to the delivery pipes. A drain valve located in the bottom of the lubricator provides for draining the water out when it is desired to refill the oil bowl, and a filling plug at the top is provided for refilling the bowl.

The flange oiler is illustrated in Fig. 55.

LIST OF PARTS MANUALLY OPERATED FLANGE OILER

34. Drain valve for oil bowl
35. Steam connection
69. Packing nut for glass
70. Follower ring and washer for glasses
80. Solid glass for sight feed
89. Gaskets for solid glasses
185. Oil bowl
189. Feed Valve
191. Condenser valve complete
193. Filler plug
194. Feed tips
197. Flange nozzle
198. Steam pipe choke
201. Choke for oil delivery pipe
292. Steam valve