THE

ELVIN

MECHANICAL STOKER

"Saves as it serves"

ROAD SERVICE HAND BOOK

This book covers road operation only. For additional information see complete edition containing shop manual, parts lists and instructions for repairs.

THE ELVIN MECHANICAL STOKER CO.

50 CHURCH STREET NEW YORK, N. Y.

Made in U. S. A.

FOREWORD

LOCOMOTIVE FUEL is the second largest item of expense in the operation of our railroads. In 1920 it amounted to the amazing total of $763,158,000. or about $2,090,000. for every day in the year.*

It is needless to point out the importance of economy in the use of such costly material, and that even small individual savings per locomotive amount in the aggregate to a very large sum for any railroad.

As the greatest portion of the fuel passes through the fireman's hands, he can use it economically (depending on his ability, skill and good judgment coupled with the co-operation of the engineer in handling the locomotive), or he can waste it through lack of knowledge or inattention to his duties.

Elvin Mechanical Stokers are extremely simple to operate and are designed to assist in obtaining the utmost efficiency from every pound of coal fired, but they must, of course, receive the hearty co-operation of engine crews in order to accomplish such savings. Given such co-operation, the results are assured.

* Interstate Commerce Report, 1920.

The Elvin Mechanical Stoker

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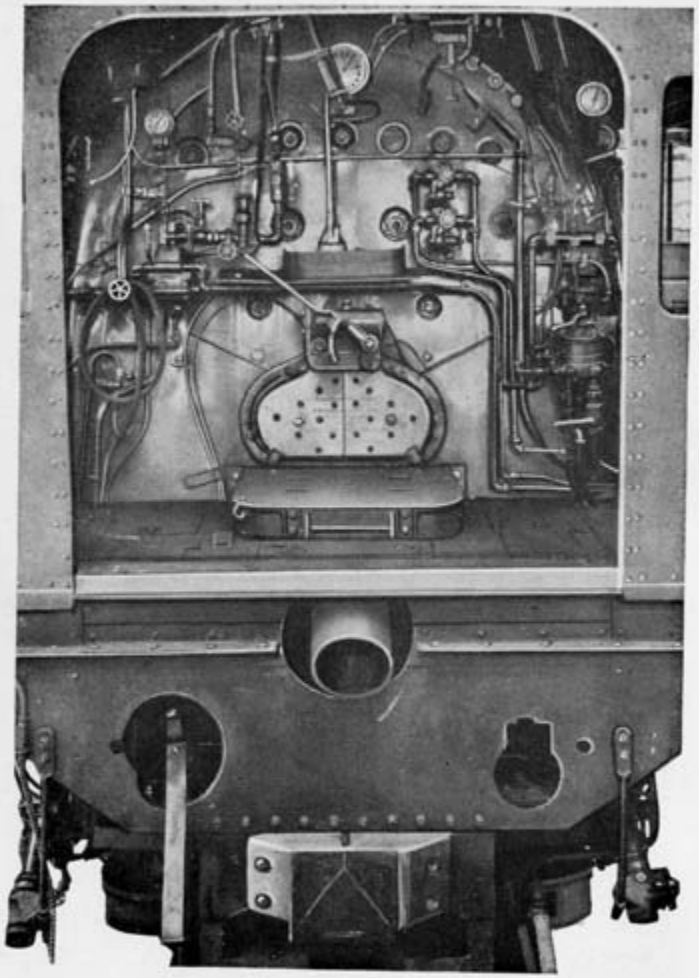

Fig. 1—Showing excellent and roomy cab arrangement where Elvin Stokers are used

GENERAL DESCRIPTION

When considering the Elvin Mechanical Stoker all previous conceptions based on knowledge of other stoker apparatus should be placed out of mind for the reason that the Elvin Stoker operates on principles radically different from other existing types.

When the development of the Elvin Mechanical Stoker was undertaken, Mr. A. G. Elvin and associates had before them all previous knowledge and experience with locomotive stokers. It was the purpose of the designers to construct a stoker which would overcome the disadvantages of the stokers then in use, be mechanical in its operation, economical in the use of fuel, and so well built that the maintenance would be practically negligible requiring only periodical overhauling when the locomotive was shopped for general repairs.

The weakness of existing types of coal crushing arrangements was recognized and overcome in the Elvin coal feeding and breaking device, which is also radically different from other existing locomotive stoker practice.

The Elvin Mechanical Stoker consists essentially of two separate units: i.e., the stoker unit on the locomotive and the feeder and coal breaker unit on the tender. Both

of these units are self-contained and are easily applied or removed when overhauling becomes necessary.

The Stoker Unit

The stoker unit consists of the driving engine, the elevator, and a pair of mechanically operated firing shovels for distributing the coal in the firebox.

The regulation of the coal feeder on the tender determines the amount of coal fed to the separator and breaker from where it falls to a hopper at the base of the inclined screw conveyor which carries the coal forward to the stoker unit. This conveyor runs only about one-half full when the stoker is working at full capacity, and this is one of the contributing reasons why the operation of the Elvin Mechanical Stoker requires so little power. The screw conveyor delivers the coal to the rectangular elevator of the stoker, which in turn raises the fuel directly to the firing shovels located about fourteen inches above the grate.

The shovels, working alternately in proper time with the elevator, pick up the coal and distribute it correctly over the grates by means of the accelerated and retarded motion imparted to them and also by reason of their shape and contour. The action of

Fig. 2—Stoker Unit—Right Side
Weight as shown, 2800 lbs.
(Type A)

the shovels and placing of fuel is independent of the amount of coal being used, which can be regulated for amounts varying from a fraction of a pound to about six pounds per shovel which is fired at the rate of from thirty-six to forty shovels per minute.

It will be noted from Figure 4 that each shovel distributes coal over an area of about

The Elvin Mechanical Stoker

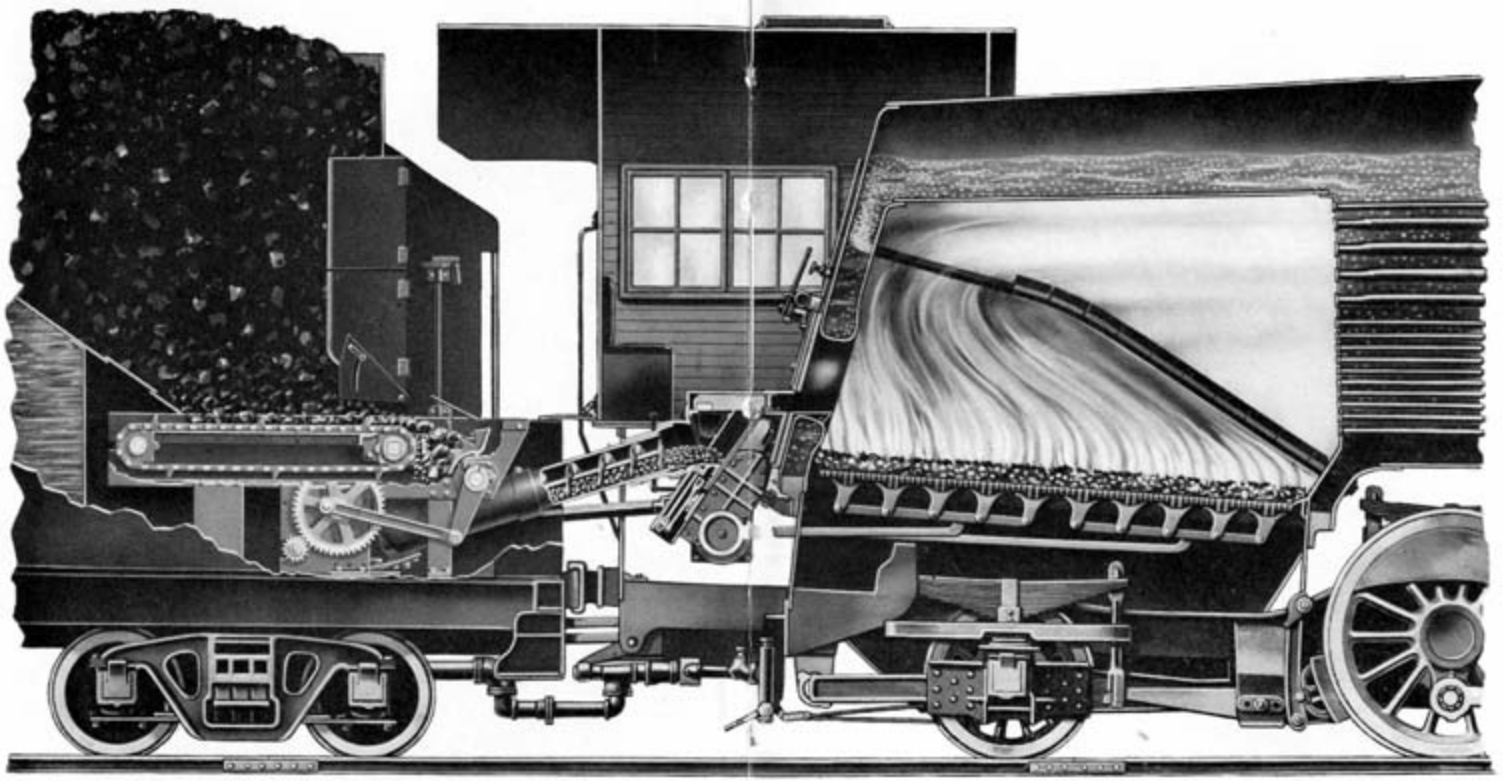

Fig. 3—General Elevation showing Elvin Mechanical Stoker installation. The feeder chains can be operated at any rate desired to serve the stoker with coal in amounts required. The speed of the stoker is not increased when more coal is needed. The elevator is shown in its lowest position receiving a charge of coal which will be lifted to the shovelbox and distributed over the fire by one firing shovel. The elevator then will drop for another charge of coal for firing by the opposite shovel.

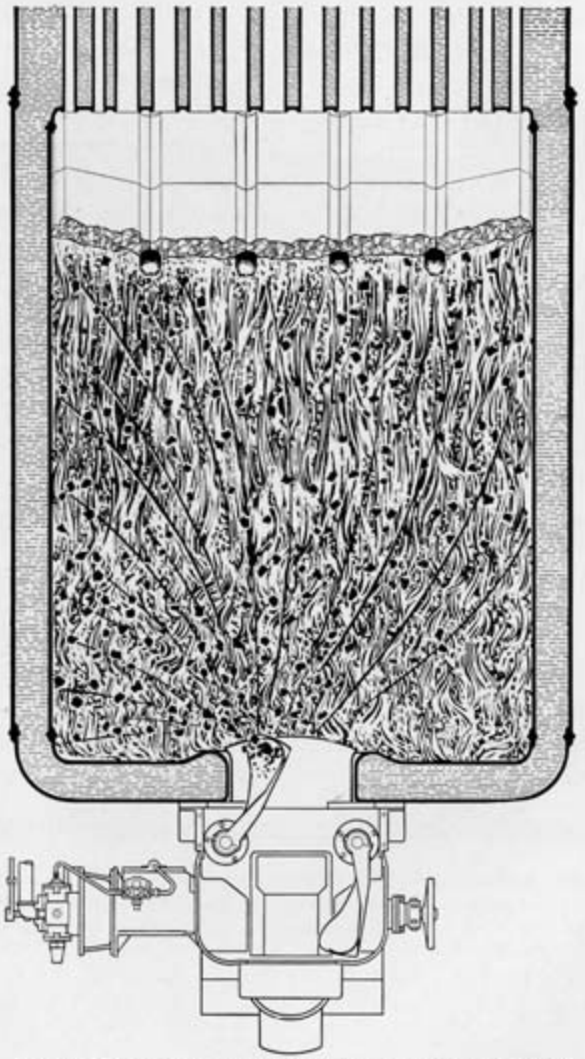

Fig. 4—Plan view showing the distribution effected by one shovel

85% of the firebox on each stroke, the rear corners of the firebox being the only part served exclusively by one shovel.

The distribution of coal in the firebox is rapid and even, a uniformly thin fire being maintained over the grate area except at the sides and ends of the firebox where the fire is slightly heavier—an ideal condition. The maintenance of a thin fire and the placing of coal close to the grates, by many correctly distributed charges per minute, burns coal most economically, gives a fire noticeably free from smoke and reduces stack losses to a minimum. The advantages of the Elvin Stoker with respect to stack losses are particularly noticeable when compared with stokers of the steam jet type.

The Stoker Engine

The problem of providing a simple, compact, efficient and economical engine for driving the Elvin Mechanical Stoker was met by the use of a novel double reciprocating square piston engine. This engine is rated at approximately 6 H.P. under 100 pounds of steam, but the stoker in normal operation only requires from 30 to 40 pounds even when handling and crushing lump coal, from which it will be seen that only from 2 to 3 H.P. is required for the operation of the

stoker and all its appurtenances in the tender. This engine has no dead center and can be started, stopped or reversed instantly. There are no eccentrics, and there is not a bolt, nut, or piston ring inside the casing. It requires less space than any other engine of equal power, and stands the strain of long and strenuous use, a feature of obvious importance in the present instance. The engine casing is bolted direct to the stoker frame and the crank mounted directly on the end of the stoker drive shaft, thus applying the power direct without any intervening chains or trains of gears between the engine and stoker.

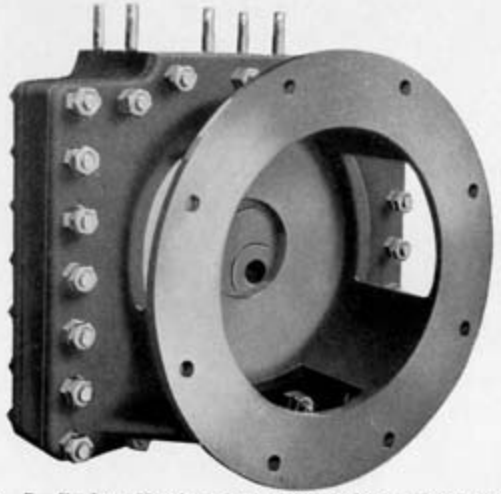

Fig. 5—Stoker Engine and Crank Case, Rear View showing hole in inner piston which receives the crank pin.

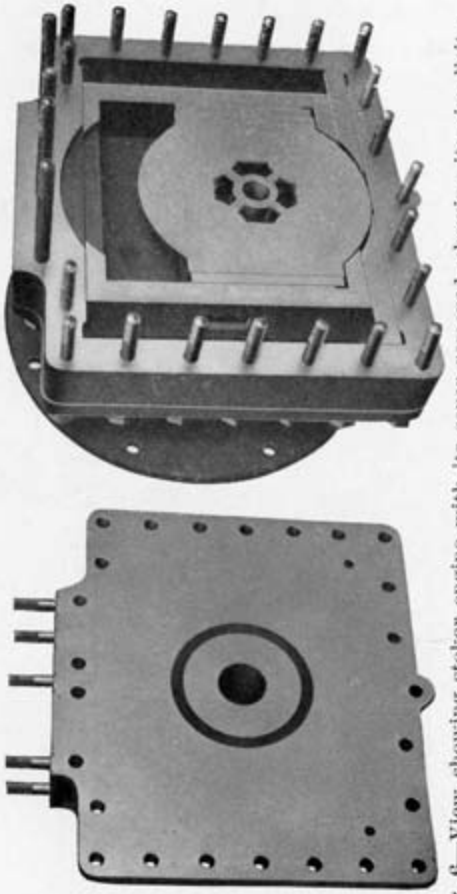

Fig. 6—View showing stoker engine with its cover removed, showing its simplicity.

The stoker engine consists of a casing and two pistons,—one working within the other. The outer piston moves horizontally and takes steam at its ends;—the inner piston, which is connected to the crank pin, moves in a circle and takes steam at top and bottom. Thus the inner piston reciprocates vertically within the outer piston which reciprocates horizontally.

Steam is distributed to and exhausted from the ends of the pistons through the four ports in the inner piston as the ports travel over the steam and exhaust ports in the cover which fits closely to the faces of the pistons. This is shown clearly by Figures 6 and 8.

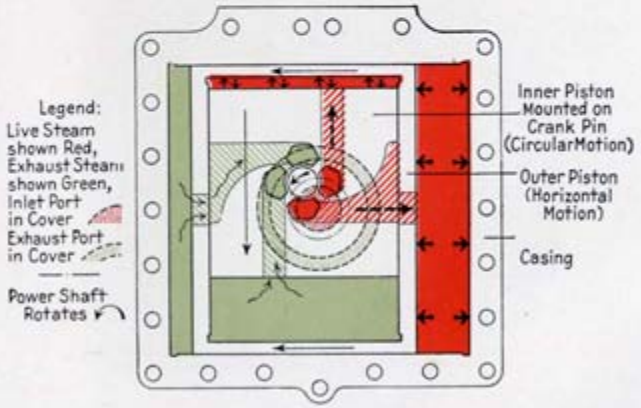

Fig. 7—Diagram showing ports and pistons, stoker engine

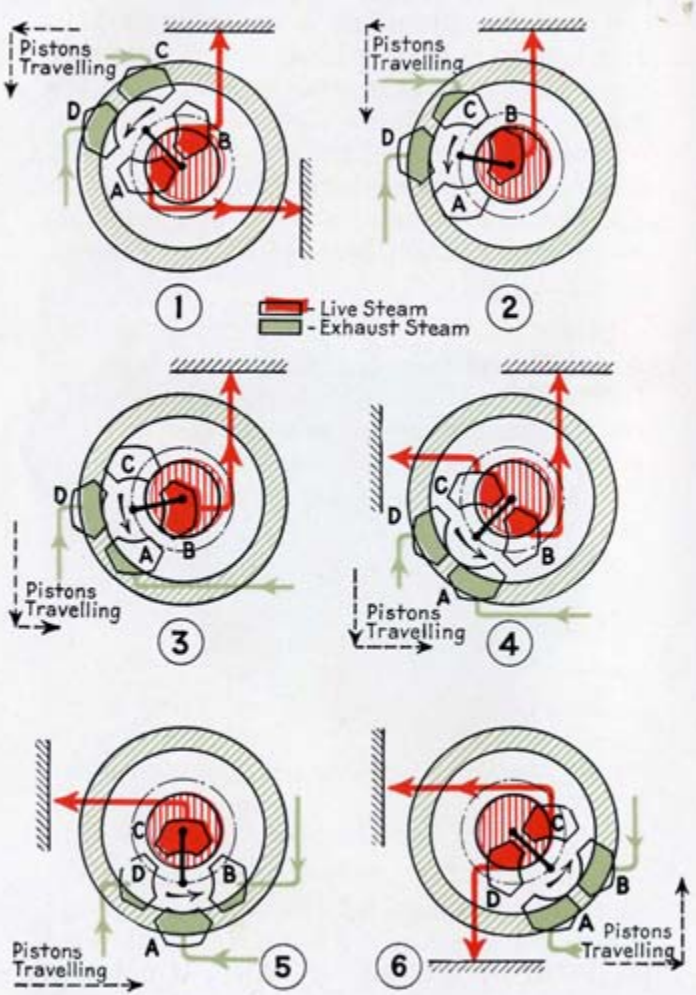

Fig. 8—Diagram showing steam distribution of stoker engine during one-half revolution

By referring to Figure 8, diagrams 1 to 6 inclusive, it will be clearly seen how the steam is admitted to and exhausted from the engine during half a revolution.

Reversal of the engine is accomplished by means of a valve which turns live steam into the normal exhaust port and connects the normal steam port with the exhaust pipe.

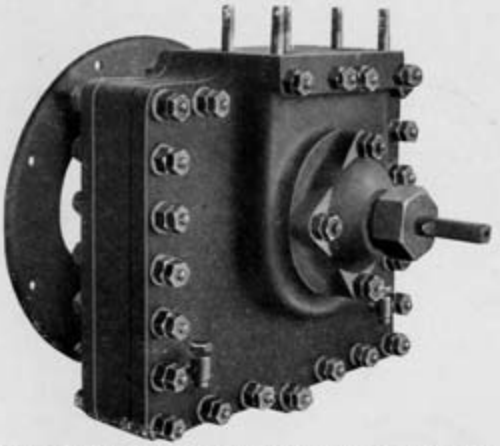

Fig. 9—Stoker Engine and Crank Case, Front View

The Governor

A governor of unusual and compact design has been provided to control the stoker engine and compensate for the variable load presented by the crusher which, if not provided for, would tend to disturb the uni-

formity of speed of the stoking shovels. The governor is provided with a variable speed control through which the operator is enabled to run the stoker uniformly at any operating speed desired.

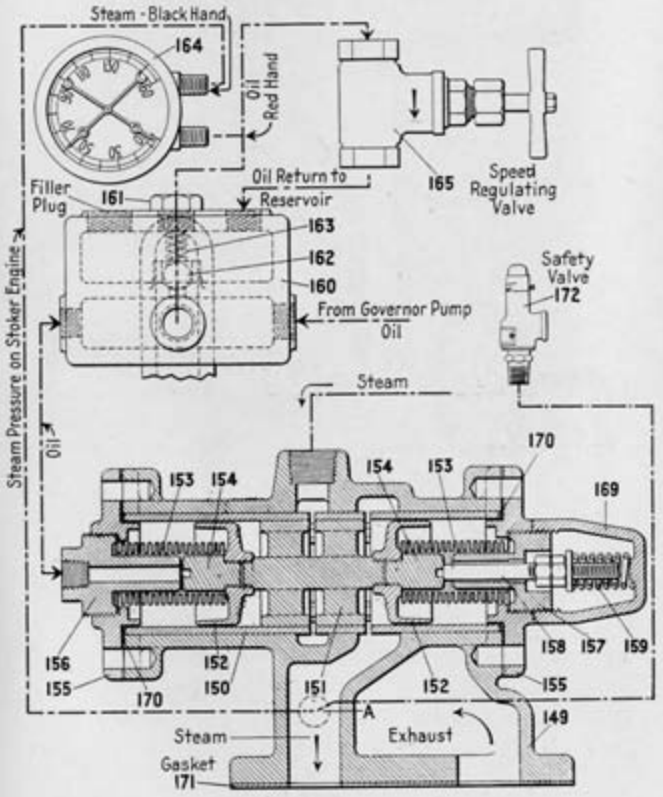

Fig. 10—The Governor Valve and Appurtenances

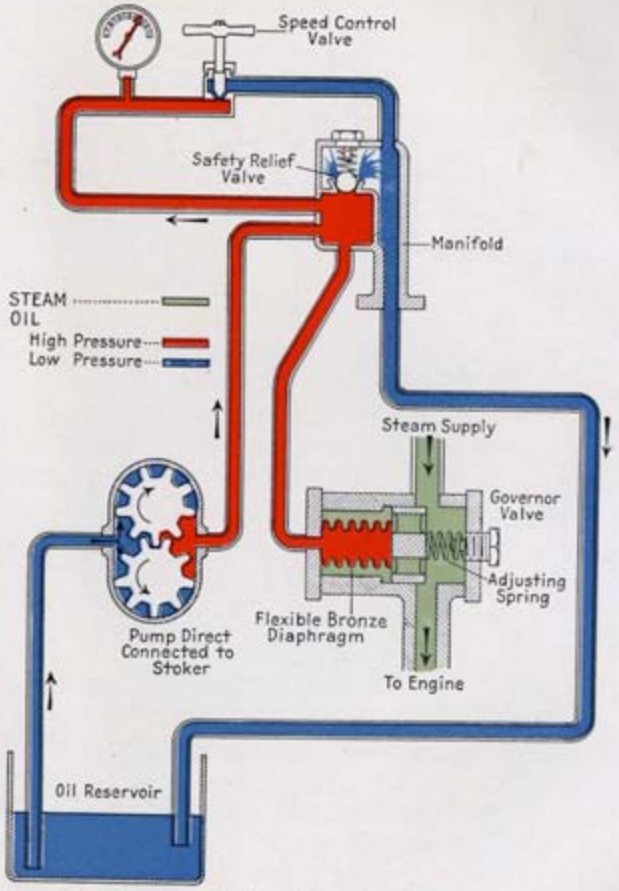

Fig. 11—Diagram showing the principle of the governor mechanism. For details as actually constructed, see Figure 10.

Principle of Governor Operation

The governor valve is actuated by the changing pressures set up in a column of oil by the changing speeds of a gear pump directly connected to the stoker. Figure 11 is arranged to show only the **principle of operation,** the actual details of the valve being shown by Figure 10.

Referring to Figure 11 it is clear that if the stoker and pump were running and the Speed Regulating Valve were **wide open,** the oil would be pumped from the oil reservoir up through the manifold and back to the reservoir **without any pressure being developed.** Under such conditions the adjusting spring of the governor valve would keep the valve in a fully open position, allowing steam to pass freely to the stoker engine.

If, under such a condition, the Speed Regulating Valve be gradually closed, a point will soon be reached where the discharge from the pump cannot easily pass the valve seat which will result in setting up pressure as indicated in red on Figure 11. As soon as pressure develops, the flexible bronze diaphragm stretches until the compression of the adjusting spring just balances the pressure on the diaphragm thus throttling down the steam to the engine. If the Speed Regulating Valve be closed still further, more

pressure will be set up in the lines colored red in Figure 11 and the valve be closed further and steam cut down again.

It is now clear that as long as the Speed Regulating Valve is left in one position and the pump continues to run at the same speed, that the governor valve will remain in one position with the pressure in the flexible bronze diaphragm constantly balanced by the opposing spring. Under such a balanced arrangement the steam supply to the engine is constant and the speed remains uniform.

However, as soon as the pump slows down (or in other words, if the stoker slows down) then the pressure relaxes in the red lines of Figure 11 and the spring in the governor valve immediately acts to push the valve open and admit more steam to the engine. The engine at once increases its speed but cannot increase beyond the desired rate for as it increases speed, the pump again raises the oil pressure which acts to move the governor valve against the spring and gradually cut down the steam.

In the manifold will be noted a safety relief valve which is merely a safety valve to prevent damage to piping should the speed regulating valve be shut and the stoker still run slightly due to a small leakage of steam purposely let through the valve.

While the description above is lengthy, the

operation of the valve and its response to a decrease or increase in speed is almost instantaneous resulting in close control of the stoker's speed under the widely and rapidly changing loads imposed by the crusher.

The manifold plays no part other than to afford a convenient means for connecting pipes and refilling the oil reservoir with light oil which remains liquid in cold weather.

Plate 10 shows the valve as actually constructed. The governor valve has two diaphragms but the one on the same end as the adjusting spring plays no part other than to make the governor valve perfectly balanced. A leak in this empty diaphragm will not affect working of the governor but will cause leakage of steam at the cap over the spring.

The spring (159) should be adjusted so that the valve will be forced to its open position as illustrated by Figure 10, but only such pressure as is necessary to accomplish this result should be used. If the spring is set up to a higher compression it requires just that much unnecessary additional oil pressure to move the valve against the spring for control of the steam when the stoker is in operation.

The Coal Feeder

Since the Elvin Stoker operates at the same uniform speed when firing large or small quantities of coal, it follows that the amounts of coal required are regulated by the measure of coal permitted to reach the stoker. The feeder which serves the coal consists of four suitable endless drag chains in a wide shallow trough. These chains work forward intermittently at any rate required by the operator giving a discharge of coal up to a maximum capacity of about eight tons per hour with the flow of coal under complete control at all rates of delivery.

When coal is already sufficiently fine for stoker use, it is inadvisable to crush it further and for this reason, coal which does not require reduction in size passes through four slots just back of the breaker jaws. This relieves the breaker of any work except reduction of the lumps. Particular attention is called to the absence of slide plates in the tank deck and the method by which the feeder carries the coal the full length of the feeder trough from the front of the slope sheet to the breaker. The safety features are particularly apparent. There is no possibility of injury to any one walking back in the tank, as the maximum forward movement of the chains at any one impulse is only 1½ inches.

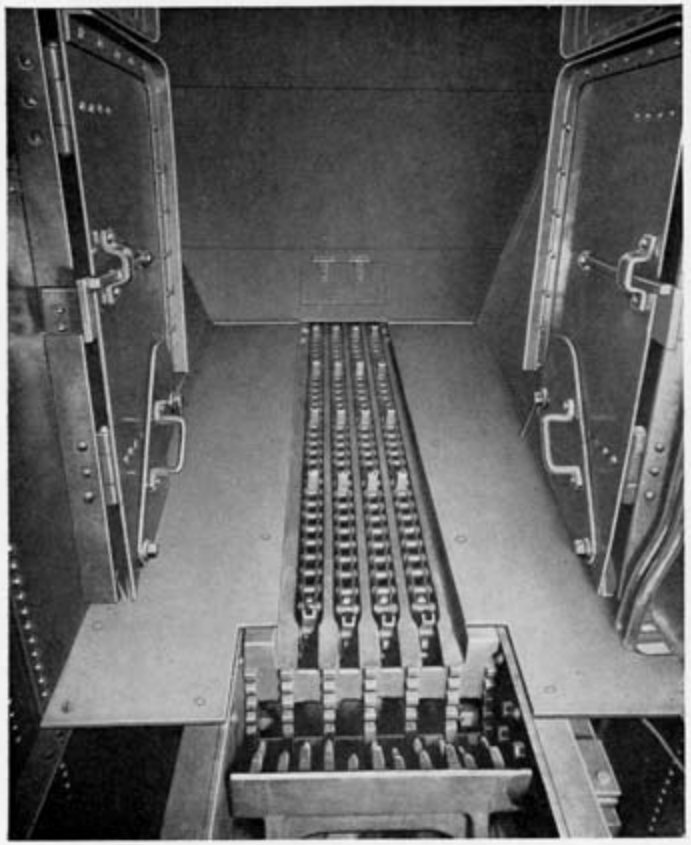

Fig. 12—View in tank with front deck plate removed to more clearly show the crusher

The Coal Breaker

A reciprocating breaker is employed of a type which is successfully used in different forms by various industries the world over. Since the breaker is ahead of the coal gates it is not covered when the tank is full of coal and is in plain view at all times during operation, an arrangement of obvious advantage.

It is essentially a single roll breaker differing only from this well-known type in not having a completely revolving breaker roll. A cover plate is provided, which when latched in position at an angle over the crusher forms a guard and when laid flat forms a shovel plate for shoveling coal by hand as when on sidings or in yards and terminals.

A foreign obstruction, such as a brake-shoe, will stop the entire machine and thus make its presence quickly known. A simple reversing of the stoker for about one shovel stroke will open up the breaker jaws, relieving the pressure thereon, and permitting ready removal of the offending object. This is a particular advantage over other types of stoker apparatus having the crushing zone back of the coal gates where it is buried under the coal, except at such times

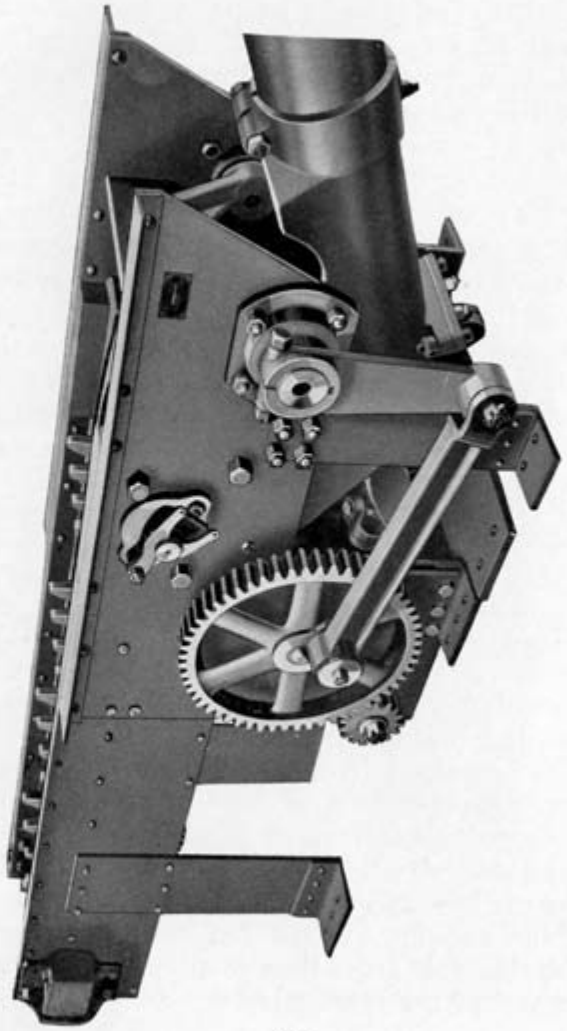

Fig. 13—Crusher and feeder, showing crusher arm and driving gear

as when the tank is partially empty, and where all coal is passed through the crushing zone, even when already sufficiently small for stoker use.

OPERATION

It is believed that instructions for the use of the Elvin Mechanical Stoker can best be given in the form of questions and answers and for that reason the catechisms which follow have been prepared. Many of the questions may be used for examination purposes by the road foremen of engines or other examining officials.

While at first glance the instructions given in this form may appear somewhat lengthy, it was necessary to cover all possible phases of the stoker performance. Familiarity with the Elvin Mechanical Stoker will soon serve to show the extreme simplicity of its operation and the excellent results which are so easily obtained if the stoker is given the proper co-operation of the fireman. With the speed control valve set for the shovel speed desired after starting the stoker, the fireman has only one duty—the regulation of the amount of coal fed to the stoker, changing this from time to time to suit the demand of the locomotive.

A light thin fire should be built up by hand and full steam pressure attained before leaving the terminal. It is best not to bring the stoker into use until the locomotive is working steam.

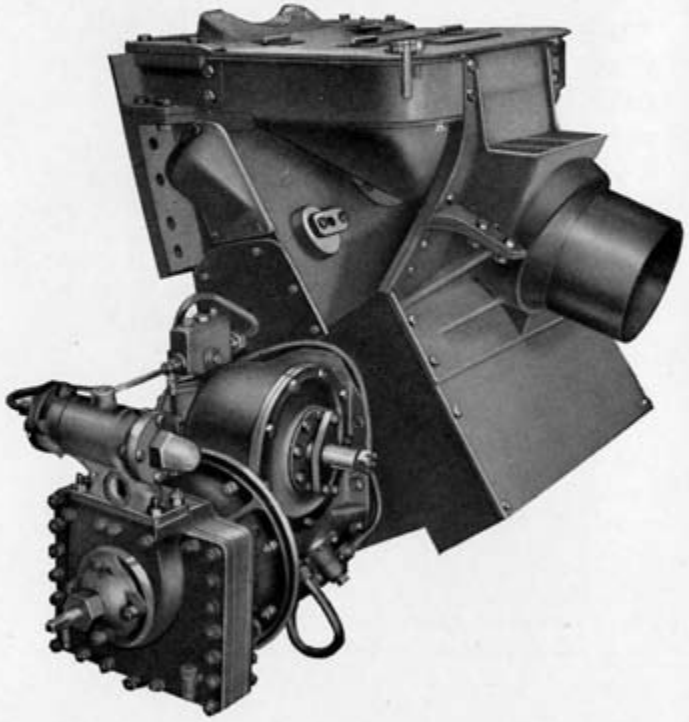

Fig. 14—Stoker unit from left side, showing driving engine, gear case and governor valve

The joint committee on fuel conservation of the American Railway Association publishes a very excellent booklet "Fuel Economy on Locomotives", copies of which may be obtained from the association by addressing 75 Church Street, New York. Before proceeding with detailed instructions for the operation of the stoker it might be well to quote some pertinent sections from the pamphlet referred to:

"33. The waste of steam through safety valves must be avoided. Frequent blowing off of safety valves shows poor judgment, and implies that economy is not being practiced. Use the injector to prevent popping if conditions permit. Careful attention must be given to the use of the injector and to the height of the water level in the boiler. The proper handling of the injector is a very important matter in fuel economy."

* * * * *

"65. Leaks in front end of superheater units, steam pipes, and exhaust column, flues stopped up, and derangement of draft appliances not only interfere with the proper steaming of the locomotive, but reduce the degree of superheat. Blows in cylinder and valve packing will cause scoring, due to removal of oil from the wearing surfaces. All leaks such as those mentioned above should be reported promptly by the engineer, because if neglected, they seriously affect the economical operation of the locomotive."

"70. The draft plate and diaphragm are put in to control the flow of gases through the flues and to distribute the draft over the grate surface as desired."

"71. The draft plate has, however, another function, namely, to give the direction to the gases in their passage from the flues to the stack, and in doing this, to aid in keeping the front end clear of cinders. While the draft plate does not create draft, it is sometimes so adjusted as to restrict it, and in this way becomes a hindrance to the free steaming of a locomotive instead of a help."

"72. All front-end appliances should be maintained according to the blue-print standards as furnished by the mechanical department, keeping them in first-class repair and adjustment. Records should be kept of front-end adjustments so that when the locomotive is reported not steaming, the man in charge of front ends will be able to determine whether the nozzle or any other adjustable parts have been changed, or whether the defect is in the locomotive. If the setting is on record and the locomotive has steamed for months, or years possibly, and is reported 'not steaming' no changes should be made in the front end, but the real trouble should be found and corrected. If such practice is followed, front ends can be set standard and so maintained."

* * * * *

"79. As a rule, poor time and excessive fuel consumption go hand in hand, therefore, the engineer should report everything that tends to decrease the efficiency of the locomotive."

"80. Under the head of 'draft efficiency' would come anything that in any manner interferes with or reduces the draft. The worst offender in this direction is the front-end air leak, especially in superheater locomotives with steam pipes extending through the smoke arch. As a rule, in order to permit of their easy application and removal, the hole through the arch is cut large enough to accommodate the flange of the pipe. This opening is then partially closed by means of a split collar or bushing. In practically all of the locomotives built prior to 1918, this collar or bushing still left an opening around each pipe equal to a round hole 5¾ in. in diameter, consequently, when the exhaust creates a partial vacuum in the front end, some air moving along the line of least resistance will be drawn in through these openings instead of through the fuel bed, thereby decreasing the draft by that amount, making it necessary to reduce the nozzle in order to maintain the necessary vacuum. Tests have proven that sealing these openings permitted an increase of from ¼ in. to ⅜ in. in the diameter of the nozzle, resulting in *a decrease of from 14 to 21 per cent. in fuel required* with a corresponding increase in engine efficiency, at the same time very materially improving the locomotive's steaming qualities."

"81. Another draft inefficiency found in superheater locomotives is improper position of the superheater damper. The superheater damper should always be set at an angle of 60 deg. when open, the top of the damper leaning back; if set vertical, it obstructs the draft through the bottom flues."

"82. Among other draft inefficiencies can be mentioned steam leaks in front end either at steam pipe or nozzle joints or at the connections between the superheater units and header. Any steam thus escaping into the front end tends to fill the vacuum being created by the exhaust jet and so reduces the draft."

"83. All flues clogged with cinders should be thoroughly bored out. Tests show that with one-half of the large smoke tubes stopped up, the performance of a superheater locomotive was reduced to practically that of a saturated locomotive, and the fuel consumption was *increased 24 per cent.;* a lesser number of these tubes stopped up affected the fuel consumption proportionately. Other tests proved that with 100 small tubes stopped up and the grate openings partially obstructed with clinkers the fuel consumption was *increased 47 per cent.* This shows that cleaning flues, grates, etc., should receive the same careful attention accorded any other work."

OPERATING INSTRUCTIONS

Prepare your fire and have it clean and level before leaving the terminal so the stoker can do its best work when you start out with your train.

Do not run the stoker at speeds higher than about 40 shovels per minute. (20 on each shovel.) High speed throws all the coal up under the arch.

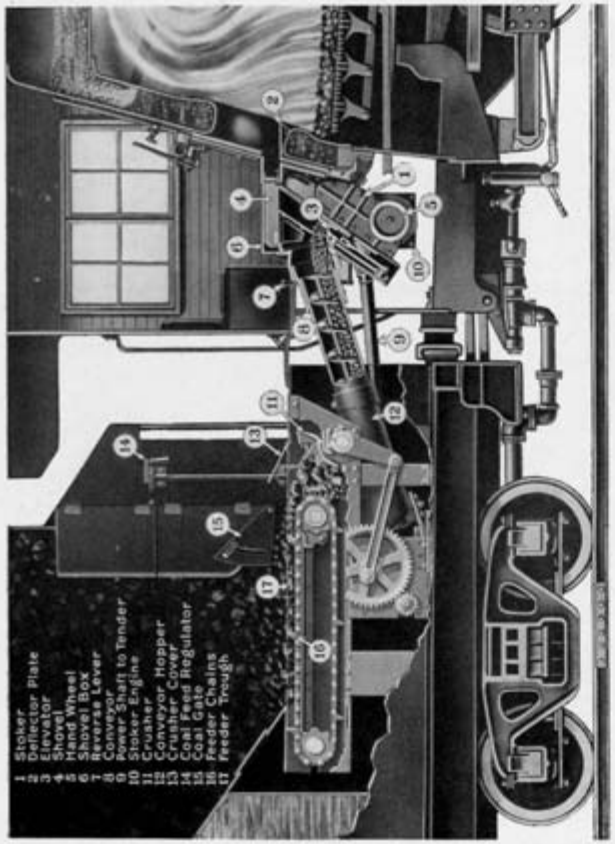

Fig. 15—Descriptive elevation naming parts mentioned in instructions for road crews

Keep the coal gates raised sufficiently to allow the lumps to pass to the coal breaker.

Always stop the stoker with the shovels back in the shovelbox and keep the cover shut and latched. Stop the stoker when using the rake.

Do not shovel coal into the shovelbox as shovels will catch such coal on backward stroke and pack it against sides of shovelbox. Any coal fired by scoop should be through the regular fire door.

Start and stop the stoker by use of main valve—*not the speed regulating valve* Keep main valve well open after starting and adjust speed by means of speed control valve.

Be sure your stoker engine lubricator is working properly to avoid engine damage.

Do not run stoker in reverse for more than one shovel stroke.

If stoker becomes jammed due to foreign matter in conveyor or shovelbox, *never attempt removal until steam is shut off,* as a matter of personal safety.

Incompetent or unauthorized parties at ashpits, coal docks, etc., should not operate stokers.

When reaching the terminal always run the stoker with coal feed shut off until coal is cleaned out of conveyor hopper and screw, especially in cold weather and *close breaker hopper cover* and coal gates when taking coal.

1.—What should road crew do in taking over engine?

Stoker engine lubricator should be filled and tested to see that it is in working order or if the stoker engine is lubricated by a pipe from the main locomotive lubricator, the tap leading to the stoker engine should be inspected. Where grease cups are provided on either side of stoker or tank unit, turn down each.

The stoker casing is partly filled with oil and a gauge will be found on the right side near the hand wheel which should be inspected to make sure that casing is filled up to proper level, if not, additional oil should be added at the terminal before operating stoker. Use a half-and-half mixture of valve and engine oil in summer and one-third valve and two-thirds engine oil in winter.

2.—What should be done before starting the stoker?

The trap door over the coal breaker hopper on the front of the tender should be lifted to the latched position and the coal gates raised to permit coal to enter hopper when feeder chains are started. There should be no coal in the coal breaker or conveyor hopper and if any, it should be run out before starting the coal feeder.

3.—How is the stoker started?

Before starting see that the stoker engine lubricator is feeding at the rate of not less than one and one-half or two drops per minute. The stoker engine is a high-speed steam engine and must receive adequate lubrication the same as a locomotive. See that the speed regulating valve is open about half a turn and the reverse lever clear down, then open the main steam valve **slowly**, allowing the stoker to start **gradually** and work out water from the engine through the automatic cylinder cocks, which will close when steam is dry. As soon as the stoker is warmed up, open the main valve about three full turns and adjust the speed of the stoker by means of the speed control valve which controls the governor. *Never run the stoker above about 40 shovels per minute (20 on each shovel).*

After the stoker is operating smoothly, the coal feed control lever can be set to feed coal forward from the tank.

Care should be exercised to avoid bringing coal over to the stoker too fast to avoid overloading.

4.—If the coal feed lever sticks and cannot be moved from notch to notch, what should be done?

The lever can be moved easily as soon as the stoker is running. Never hammer this lever or damage to the feed control will result.

5.—When stoker is running, how should coal feed be started?

The feed control lever on the tank should be gradually advanced to the notch which will provide just sufficient fuel for the work the engine is doing at the time. *Feed your fire lightly.* The coal gates should be sufficiently raised to allow lumps brought forward by the chains to pass under freely.

6.—How fast should the stoker run to properly distribute coal over the entire firebox?

The proper operating speed will depend on size of firebox and the working of the locomotive, but will be found to be between 15 and 20 strokes *per shovel* per minute, or a total of 30 to 40 shovels per minute. Running the stoker too fast will throw the coal too far forward and pile coal under the arch, while running the stoker too slowly will starve the front portion of the firebox by dropping it too far to the rear.

Experience will quickly show an intermediate speed between these limits which will give a correct distribution over all parts of the firebox, and this distribution is the same *regardless of the quantity* of coal fired. When a locomotive is working hard with the resulting heavy draft, the speed of the stoker can be cut down slightly, as the draft will pull the coal into the forward part of the box more than normally. On the contrary, when the locomotive is working light, the stoker must be run slightly faster to make up for the loss of heavy draft, and in order to take care of the forward part of the firebox. The top of the shovel shaft shows through the shovelbox and a small marker will be found thereon from which the movements of the shovel can be noted as well as their position.

Never stop the stoker with a shovel in the firebox.

7.—How can the speed of the stoker be controlled?

The speed of the stoker is controlled by a governor described on page 16. This governor can be set for any desired speed by means of a speed regulating valve in the cab by which the stoker speed can be

Note—Turret valve controlling high pressure steam leading to Reducing Valve must be kept wide open at all times when Stoker is in operation.

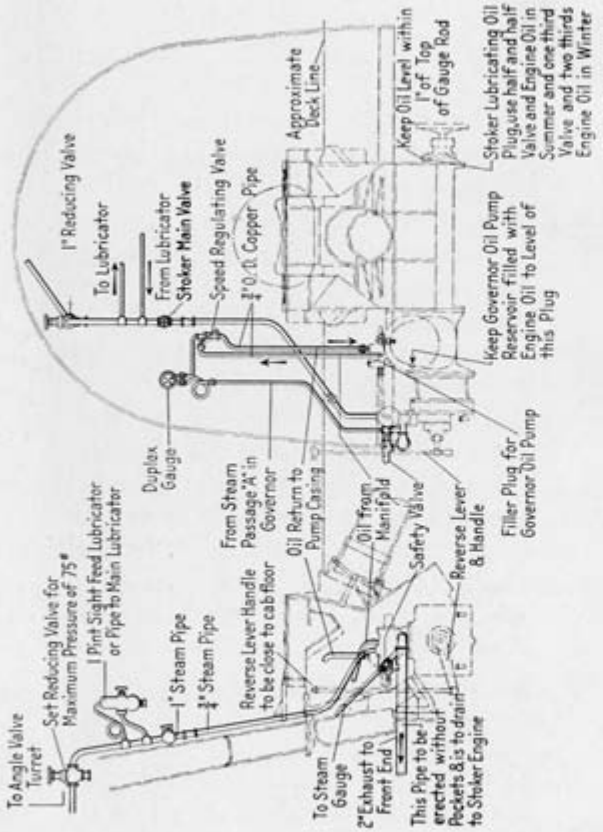

Fig. 16—Piping diagram and cab arrangement

increased or decreased at will, the governor, however, maintaining this speed uniformly until a change is again made.

When your speed regulating valve is set for the desired speed it should not be disturbed until a change in speed is again desired. *Do not stop the stoker by use of the speed regulating valve,* but use the main steam valve. When starting the stoker again, the opening of the main valve will cause the stoker to resume and maintain the same speed as it had before stopping, if the speed regulating valve has not been disturbed.

The red hand on the stoker gauge indicates oil pressure acting on governor valve which fluctuates with the load on the stoker. The black hand indicates steam pressure on the stoker engine.

8.—If the governor should for any reason become inoperative, can the stoker be operated?

Yes. In such a case open the speed control valve wide and control the stoker by means of the main steam valve. This will require closer attention than ordinary, but good results can be obtained. If the valve should stick in the closed position, it may be pushed open by removing cap (169) Figure 10 and blocking valve (151)

toward front of locomotive until steam will pass through.

9.—What kind of fire should be carried?

A thin fire from three to four inches deep in the center should be maintained. The stoker will take care of the sides, ends and back corners where the fire will be found to be about six inches deep, which is desired. **A heavy deep fire should not be built up at any time. Starve the fire for best results. Don't think you should show black smoke.**

10.—If fire should be heavier than four inches in the center of firebox when leaving terminal, what should be done?

Fire should be raked even and permitted to burn down without additional coal being placed until it reaches a depth of about three to four inches in the center; the stoker can then be started and coal fed only in sufficient amounts to take care of the work the engine is then doing and no more. *Stop the stoker if using the rake.*

11.—Is it necessary to look into the firebox to ascertain how much coal is being fired?

No. The amount of coal being fed through the stoker can be directly observed from the fireman's seat by noting

the amount being brought forward at each movement of the feeder chain. The fireman will quickly learn by experience how much coal is required for the different conditions of load and grade along the road. Close attention should be paid to the amount of fuel being fired, adjusting this amount so as to maintain a thin fire at all times.

12.—What should be done if the steam reaches popping pressure?

Plainly, too much coal is being fed for the work being performed. The stoker should be shut off at the main valve, *without touching the speed control valve,* until the steam drops and then the coal feed should be reduced until only the required amount of coal is being fired to maintain full boiler pressure.

Remember that a pop valve can blow off steam at the rate of $5.00 an hour, all of which is sheer waste that can never be recovered for any useful purpose. **Starve your fire! Don't forget** that too heavy a fire can cause steam failure and clinkers.

13.—When a stop is made with a thin fire that gets "gray" and apparently dead in the center, what should be done?

Do not become alarmed, for if you have

been keeping a thin fire as advised this will usually be the case. If the stop is to be a long one, it is preferable to hand-fire the locomotive, keeping a very light fire. If only a short stop is to be made and if the fire at the sides and ends is in good condition, it will be found by practice that it will only require one or two minutes after locomotive is started to build the fire out from the sides.

14.—If coal does not burn properly in spots or certain sections of the firebox, what can be done?

Since both of the shovels operate exactly alike, it is plain that the distribution effected by both of them is the same, unless they are damaged. Therefore, if improper distribution is being secured on one side or the other the fault will usually be found to lie in imperfect grate conditions, clinkers, leaks in the firebox, superheater leaks or improper front end adjustments. If the condition persists after you have made sure that the fire is clean reports should be made at the end of the trip so the locomotive may be examined and conditions corrected. To continue a locomotive in service with any of the conditions mentioned above wastes coal and seriously lowers the locomotive efficiency.

Remember that the stoker does not burn the coal, it only places it where it should burn. If the stoker is undamaged and continuing to work at its proper speed and the fire burns improperly, look for the trouble elsewhere than in the stoker.

15.—Should the shovelbox cover be open when running?

No. This should never be allowed. If it is left open it permits too much air to enter the firebox. The cover should be latched down at all times when stoker is in operation.

16.—Should coal be placed in the stoker shovelbox by hand?

No. This should never be done. To do so when stoker is in operation would probably result in damaged shovels due to overloading or catching lumps behind the shovels on their back stroke. Any coal fired by hand should be through the regular fire door above the shovelbox.

17.—If the tank end of the stoker should be damaged and stoker unit still operative, can stoker be used?

In such a case the feeder and coal breaker can be uncoupled by unbolting the slip shaft and universal joints connecting engine and tender. The stoker

unit can then be run and coal conveyed to it by hand through the small trap door in the middle of the deck just back of the shovelbox. It will be necessary to break lumps which will not pass through the grating of this opening. A locomotive can be fired in this manner to capacity since it is not necessary for the fireman to handle the distribution.

18.—What should be done if the stoker stops?

This will usually be the result of foreign material in the coal getting into the coal breaker, conveyor screw or under a shovel. If inspection of the coal breaker hopper shows this to be the case, the stoker engine may be reversed for not more than one shovel stroke, which will release the pressure in the jaws of the coal breaker and permit the obstruction to be easily removed. If the stopping of the stoker is not caused by an obstruction in the coal breaker, investigation should be made of the shovelbox and conveyor screw hopper below coal breaker, where obstructions may be found. Before attempting to remove any obstructions be sure that the stoker engine main valve is closed. Remember that if the reverse lever is only half way between forward and reverse, no steam can reach

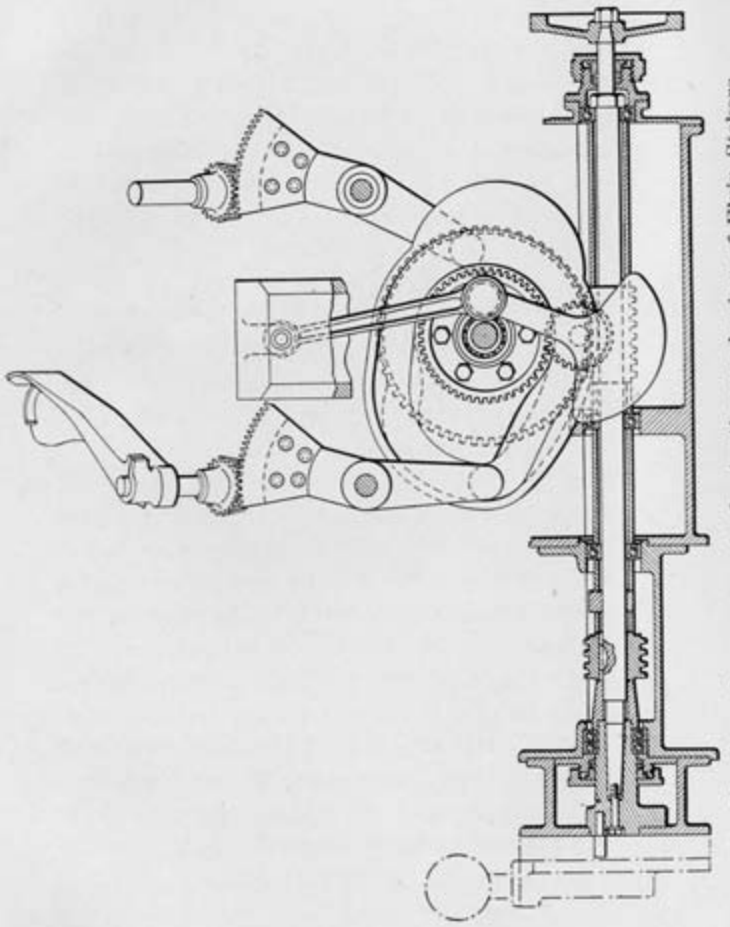

Fig. 17—General arrangement of actuating mechanism of Elvin Stokers

the stoker engine pistons. When stoker is idle, it should be stopped with both shovels back in the shovelbox. If shovels are allowed to remain idle on the inner stroke, there is a possibility of warping.

19.—Should the stoker be permitted to run reversed?

Not more than one shovel stroke. If so coal will be forced back by the screw conveyor and out of the conveyor screw hopper. The feeder chains always feed forward without regard to the direction of the stoker operation.

20.—If coal is taken on the road, what precaution should be taken?

Coal gates should be closed and the cover over the breaker hopper should be dropped to prevent the hopper from being filled. When the stoker is first started a small amount of coal may appear in the shovelbox even though the feed lever be in the zero position. This will be the result of coal being permitted to fall through the grating of the feeder trough to the screw conveyor when coaling a locomotive, and will soon cease. There are no slide plates to push back.

21.—What happens when some very large lumps of coal are taken on the tender?

An excessively large lump of coal, when

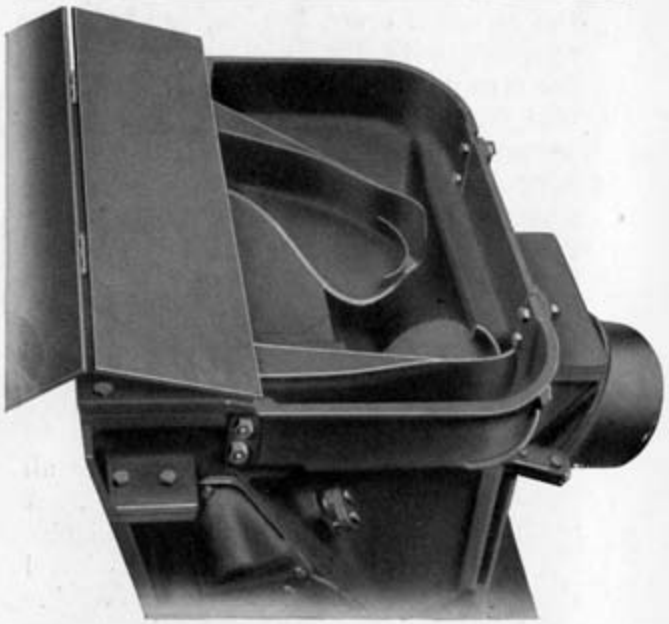

Fig. 18—View of shovelbox showing shovel just passing over elevator

feeding forward will be forced against the coal gates or if it passes under them, will force the cover over the breaker hopper to an upright position. When such a case is observed, the lump should be broken to permit it to pass through the coal breaker.

22.—What should be done at the end of the trip?

Before turning the locomotive over to

the terminal crew, **the stoker should be operated with the coal feed control in the zero position in order to clean out all coal from the breaker hopper and screw conveyor. The cover over the breaker hopper should be closed down so that when engine is coaled up, coal will not run down and fill up the breaker and conveyor hoppers.** The stoker steam line should be cut out at the turret to avoid stoker being used at ashpit and coal docks by unauthorized parties.

23.—How does the stoker receive oil?

The internal parts of the stoker are all enclosed and run in a bath of oil. A pump furnishes oil through internal piping to the gear segments of the shovel shaft. No oiling is necessary by engine crews except as mentioned in the answer to question 1. If leaks should be noticed around casing sides or at glands at each end of main shaft, they should be reported promptly.

24.—Does Tank unit require lubrication?

On crushers and feeders provided with grease cups, a full turn should be given each cup. Only the softest grease about the consistency of vaseline should be used. *Do not use hard yellow grease or rod cup compound.*

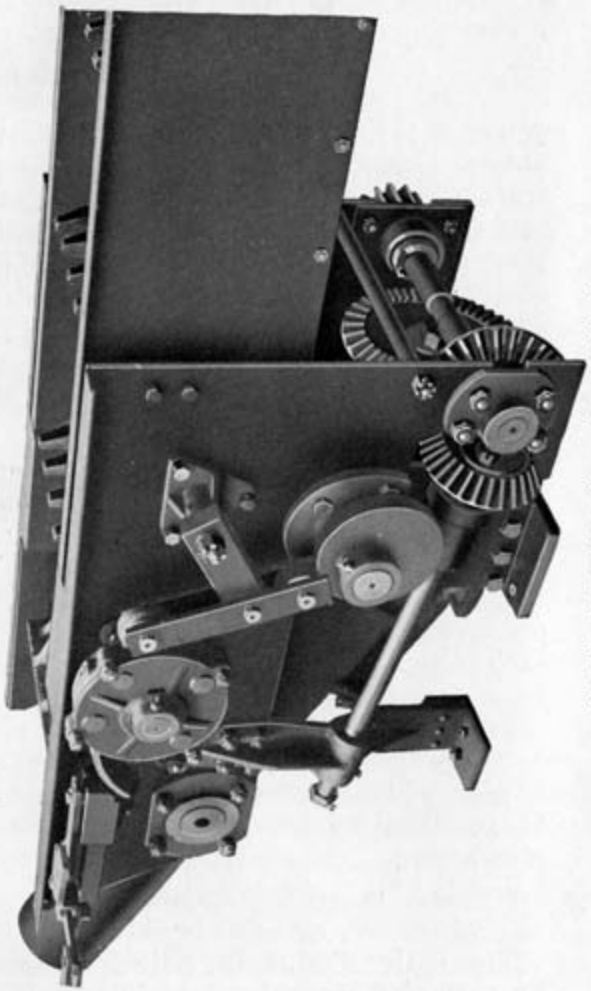

Fig. 19—Rear view of crusher and feeder

Bearings not provided with grease cups do not require lubrication.

25.—Can the stoker be moved or turned over by hand?

A small hand wheel on the right hand side is mounted on end of main shaft.

The stoker can be moved in forward motion by turning wheel clockwise in direction of arrow thereon, unless the conveyor hopper or crusher is packed with coal or the feeder regulator handle is in feeding position.

26.—What should be done if a feeder chain is broken?

The four feeder chains are pulled forward by four sprockets at the front which are mounted on a square shaft and rotate together but the four corresponding sprockets at the rear of the trough are separate and rotate independently of each other. If a chain breaks, it will not be necessary to pull it entirely out to finish the trip. See that the lower end is kept up and out of the conveyor screw hopper and continue with three chains. If possible, however, pull chain completely out.

27.—If feeder chains stop feeding forward where may cause be found?

The feeder chains are pulled forward by means of an enclosed variable travel

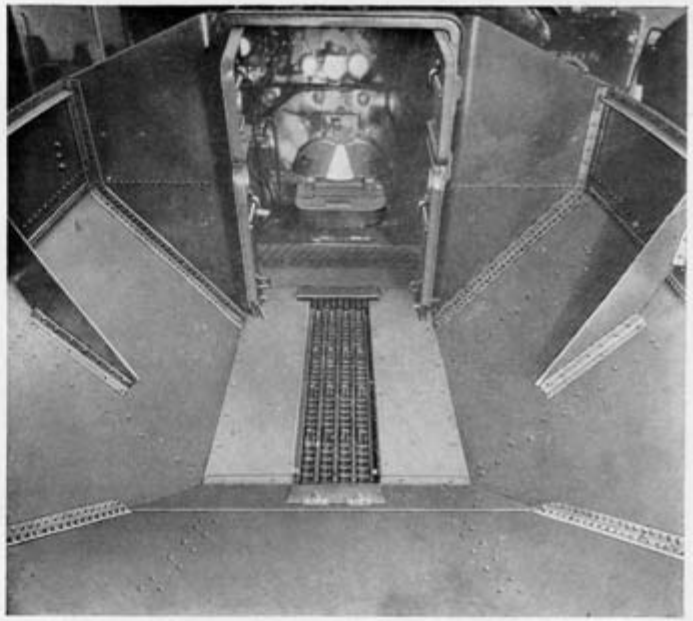

Fig. 20—Tank arrangement looking forward to the crusher

ratchet illustrated by Figure 19. This ratchet should rotate on its backward stroke by gravity and if this is damaged and fails to drop back, the feeder chains will not move forward.

Under no circumstances should the feeder chains be hammered in an endeavor to start them.

28.—Why is reducing valve used on steam line to stoker engine and how is it operated?

The stoker engine is intended for operation at steam pressures not exceeding 75 lbs., making necessary the use of a reducing valve between the boiler and stoker engine and a 75 lb. pop valve protects the engine against pressure in excess of this amount as shown by Figure 16. While the reducing valve is not part of the stoker equipment, the proper operation of the stoker is dependent somewhat on the proper functioning of such valves. Complete detailed instructions cannot be given for the reason that various roads use different makes of reducing valves, but the following general instructions will apply to all valves regardless of type:

1.—When setting reducing valve put reverse lever of stoker engine in middle position, cutting off flow of steam at engine. With reverse lever in this position, the stoker steam gauge will indicate the pressure in the low pressure line leading from the reducing valve to the engine. Before the reducing valve can be set, boiler pressure **must be raised to maximum pressure normally carried.**

2.—Adjustment: First unscrew adjusting cap until all tension is off the adjusting spring. Then open the turret valve slowly, allowing steam to come to the inlet side of the reducing valve, which will allow the valve to heat through gradually. Screw down adjusting cap slowly until the desired pressure has been reached on the delivery side of the reducing valve and lock the adjusting cap in position by use of the lock nut. **The turret valve leading to the reducing valve must be fully open when this adjustment is completed.**

3.—If increased pressure is desired on the outlet side of the reducing valve, screw down the adjusting cap until the desired pressure is obtained or until the pressure ceases to increase. Screwing down any further would injure the diaphragm without obtaining any increased pressure. To reduce the pressure on the outlet side, unscrew the adjusting cap and lock in desired position.

4.—**Important: If the reducing valve is to function properly, it is absolutely necessary that the turret valve feeding high pressure steam to the reducing valve must be kept wide open at all times when the reducing valve is in service. It should be closed at the end of the trip when the stoker engine is no longer being operated.**

5.—When reducing valves are installed, it is imperative that inlet pipes leading

to the valve be thoroughly cleaned or dirt will collect in the inlet or outlet ports of the reducing valve and impair its operation. Red or white lead or other kinds of cement should not be used in making up joints between the boiler and the reducing valve. Reducing valve should be installed in an upright vertical position as shown by Figure 16, Page 38.

29.—How may best results be obtained with the Elvin Mechanical Stoker?

By thoroughly familiarizing yourself with its principles and operation. The commonest error made by firemen not familiar with mechanical stokers is a tendency to overload their fire. If the steam should for any reason drop back, care should be taken not to feed a large amount of coal to the fire in a short space of time, which will only result in making conditions worse. Forcing any stoker under such conditions causes heavy banks of coal in the firebox, dirty and clinkered fires and heavy losses of fuel. The proper procedure is to increase the amount of coal being fed very gradually so that the fire can absorb the additional fuel and burn it without choking the grates. If this course of action be followed it will be found that the steam pressure will be regained within a very

short time whereas if a large blanket of green coal is fired the steam pressure will continue to drop instead of climbing back to normal. The stoker will do all the work and do it well and economically, but it must have the whole-hearted co-operation of the engine crew.

Starve the Fire!