NEVADA STATE RAILROAD MUSEUM

CARSON CITY, NEVADA

ENGINEER HANDBOOK

2010

Engineer

Description: The Engineer is a volunteer who, without supervision, will be able to control the operation of a locomotive and handle a train, and respond to potential problems at any time. The Engineer is in charge of the Engine Crew for the shift to which he is assigned. The Engineer is responsible for the safe operation of the locomotive to which he is assigned and, with the Conductor, for the safety of the entire train. The Engineer is responsible to, and shall receive instructions from the Conductor relative to the overall operation of the train. The Engineer shall be responsible for the inspection of the engine's condition and shall assure the equipment is in a safe operating condition at all times. The Engineer shall oversee the performance of the Fireman and shall be responsible for assuring the safe and effective performance of duties by the Fireman. The Engineer shall be responsible for the safety of persons and property on or near the train and shall operate the train in a way that assures such safety. The Engineer serving the last shift of the day shall prepare an Equipment Report on the mechanical status of the engine and cars in his charge.

Engineer's duties include:

1. Attending the daily pre-operation Safety Briefing.
2. Following the instructions in the NSRM Engineer's Handbook.
3. Being responsible to and taking direction from the Conductor.
4. Safely operating the locomotive.
5. Assisting the Fireman with firing and boiler management as needed.
6. Protecting the locomotive under his charge from damage, carelessness, mishandling and any mechanical or safety failure.
7. Having final authority over persons riding in the cab of the locomotive.

Requirements: Thirty hours as a qualified Fireman, followed by thirty hours as an Engineer Trainee, recommendation by the Crew Chief and successful completion of the Engineer Qualification Test. This will be followed by a 'practical factors' demonstration with certification of competence by the Road Foreman [Chris DeWitt] (or his designee). An Engineer must be at least 21 years old.

All positions require that the Crew Member have passed the NSRM Rule Book / Safety Test. Attendance at the annual Safety Meeting is required to maintain status as a Crew Member.

In addition to the items described in this manual, a candidate for the position of Conductor, Fireman or Engineer must also demonstrate over time that he is always aware of the operating environment of the museum and that he consistently exercises good judgement about the needs of the public, the needs of the train crew, the operation of the train, and the importance of safety. The Road Foreman (or his designee) and the Crew Chief must make this subjective evaluation and both must agree to the promotion of a candidate to any of these positions.

1.0 INTRODUCTION

This Engineer's Handbook is intended to provide the basic information needed to perform the duties of a Engineer. Any update of the safety information will be noted in the text as a revision from the previous issue of the handbook.

Appearance is important. Engineers must be neatly dressed and groomed.
You should at all times wear your volunteer's name badge.
It is preferred, but not mandatory, that Engineers be dressed in the typical NSRM uniform: a museum logo shirt, jeans or overalls, a railroader's cap and jackets or coats when required by the weather.
Footwear is an important factor in safety. Wear work boots/shoes with soles and heels firmly attached and heels that are not excessively worn. Suitable footwear around shops, tracks, and moving equipment does NOT include high-heeled boots or shoes, sandals, low quarter slip-on shoes or tennis shoes.

You should carry your NSRM Rulebook at all times while on duty.

2.0 SUMMARY OF ENGINEER'S DUTIES

2.1 The engineer must have the ability and training to operate a locomotive in such a safe and sensible manner as to provide an environment that protects workers and passengers as well as offering minimal negative impact on the equipment in use. The engineer should verify that the equipment in his charge is in good operating condition and must conduct frequent inspections to ensure that these conditions are maintained.

2.2 INITIAL INSPECTION

The engineer must read log books and other bulletins or notices before the day's operation and inspect all items listed as needing attention to verify that they have been corrected and are in acceptable condition.

The first thing the engineer should do when getting on the locomotive is to inspect the boiler, paying particular attention to staybolts within and outside the firebox, leaky flues, and the general condition of the firebox. The engineer should make a general inspection of the exterior of the boiler to ensure there are no leaking fittings or appliances.

The engineer should inspect the injectors, lubricator, air pump, cylinder cocks, headlights and air brakes to ensure they are in working condition. Fill the sand box and sand dome and test the sander for proper operation. Blow down the water glass and verify the water level by using the try cocks.

The engineer should start an inspection of the locomotive forward from the right cab steps and inspect the engine on that side, then the front, and along the other side of the engine and tender, the back of the tender, and lastly inspect the tender on the side from which he started. He should inspect the main and side rods; look for loose, broken or worn brasses; wedges and crosshead keys; loose bolts or missing cotter pins; broken springs or defective rigging; and defects in brake gear, etc. He should verify that all the lubrication devices are in proper condition.

2.3 BEFORE ATTACHING LOCOMOTIVE TO TRAIN

The engineer must oil the parts of the engine not attended to by the hostler, hostler helper or fireman.

Fill the hydrostatic lubricator and adjust the feed rate.

The engineer should drain all condensation from the main air reservoir and before starting the air pump open its drain cocks to relieve condensation. Start the air pump slowly until sufficient pressure has been built up in the main reservoir to cushion it, and only then completely open the steam valve. Adjust the oil feed so as to feed oil to the steam cylinder before starting the air pump. Check the air pressure shown on the gauges to verify that the pump governor and feed valve are working properly. Test the brakes by applying them with each brake valve and note whether the air discharges freely and the gauges function properly.

The engineer should make sure that there is an adequate supply of fuel and water in the tender before leaving the terminal.

The engineer should warm the cylinders immediately prior to leaving the terminal by applying the brakes and, with the chain still in place, opening the throttle slightly with the reverse lever in both the forward and reverse positions. With the cylinder cocks open the throttle should remain open until there is no sign of condensate in the cylinders. Remove and store the chain on the hook provided when this is complete. Keep the cylinder cocks open during initial operations to ensure that any additional condensate is expelled.

Once he receives permission to proceed, the engineer must make a running brake test. Do this prior to reaching the turntable or coupling onto equipment.

2.4 LOCOMOTIVE HANDLING WITH A TRAIN

The engineer must stop the locomotive at least 15 feet from any train with passengers aboard. He must do this before proceeding to couple to the train.

If the locomotive has been uncoupled or when equipment has been changed, upon recoupling the engineer must conduct an air test to ensure proper brake operation. Have crewmembers verify that the brakes on each car set upon a reduction of train line pressure and release upon recharging.

As much as practicable, the engineer shall operate the brakes consistent with eliminating slack action to the train.

When starting, the engineer shall open the throttle slowly until he is certain that coupler slack has been taken up.

Use the automatic brake to control train speed when descending grades.

Before uncoupling from equipment, the engineer should make an automatic brake application to prevent movement of the cars prior to air line separation.

In the event that engine drivers slip, the engineer should never drop sand on the rail until the throttle has been closed enough to stop the slipping. Serious damage may result unless this is done. Close the throttle, operate the sander, and then open the throttle again.

Use sand as sparingly as possible, with only enough being used to give the drivers grip. Sand increases the rolling friction and makes the train harder to pull than on bare rail. Whenever possible, avoid the use of sand while traveling over switches.

The engineer should place the reverse lever in full gear when starting a train. When the driving wheels have made a few revolutions and the train has started to move, pull up the reverse lever several notches, and thereafter pull up one notch at a time until the required cut-off is obtained.

Whenever the train is stopped, place the reverse lever in full gear before starting.

Place the reverse lever in full gear when drifting downhill.

Use the try cocks regularly to verify the water level in the boiler.

Use the cylinder cocks when starting after long periods of standing except when their use might cause injury to crew or the public.

2.5 PREPARING THE LOCOMOTIVE FOR THE END OF THE DAY

When putting the train away following the last scheduled run the engineer should, in conjunction with the fireman, sand the boiler tubes. The engineer should operate the locomotive in a manner to produce maximum draft through the tubes, using locomotive or automatic brakes as necessary and the reverse lever in full gear.

1. **Before leaving the locomotive the Engineer must make sure that all appliances and valves that are his responsibility are secured.**

   a. **The valves that are specifically the fireman's responsibility are:**
      - i. **Firing manifold valve and firing valves**
      - ii. **Fireman's injector**
      - iii. **Squirt hose**
      - iv. **Tender water valves**
      - v. **Tender oil shut off, top and bottom**
      - vi. **Water glass valves**

   b. **The valves that are specifically the engineer's responsibility are:**
      - i. **Air pump steam valve**
      - ii. **Air pump drain**
      - iii. **Drifting valves**
      - iv. **Cylinder cocks**
      - v. **Main reservoir drain valve**
      - vi. **Lubricator steam valve**
      - vii. **Dynamo valve**
      - viii. **Engineer's injector**
      - ix. **Main manifold valve**
      - x. **Saddle drain**
      - xi. **Dynamo drain**
      - xii. **Air pump steam exhaust line drain**

2. **Check that the Conductor has called Simplex/Grinell (the fire alarm company) to report that a hot locomotive has been put into the building.**

3. **The stack cover must be put into place after the locomotive is in the building and the engine will not be moved again.**

4. **Remove chain from hook and place on both sides of driver nearest the engineer's cab window. Set tender hand brake.**

5. **The enginemen must keep clutter to a minimum and clean the cab at the end of the day.**

6. **Enginemen must be certain that an 'Engine Report' has been filled out. You should use the same form to report problems with cars or any other train equipment. Anyone can fill out a report. Enginemen must file a report for each day of operation even if no defects are noted. This assures the shop employees that a report was filed and not forgotten. Make all prudent entries in the logbook.**

7. **Record your volunteer hours for the museum's records.**

2.6 BUILDING SECURITY

All buildings on the NSRM property must be secure at the end of each day.

A) It is the responsibility of Museum Staff to lock the doors on the restrooms as well as to close and lock the doors and activate the alarm at the Interpretive Center.

B) Before the last run the Conductor will assign one Brakeman to ensure that the wheelchair lift is put away and that all doors and windows at the Wabuska Depot are securely fastened and locked before the train is returned to storage. Generally Museum Staff will be the last to leave the depot and will lock the doors but a member of the Train Crew must check that this has been done.

C) The Conductor will assure that the Annex Building is secure.

1. **The Turntable must be secured and padlocked when switching moves are complete.**
2. **All overhead doors must be closed and the chain which operates the door secured with a keeper.**
3. **The gate inside the building that separates the public area from the non-public area is to be closed, and if possible, latched.**
4. **Check that the doors to the Archive Office area are closed and locked.**

D) Because they are the last to leave the building, the Enginemen are responsible to ensure that all shop doors and the door behind which the locomotive is stored are closed and locked. In addition they must check that the compressor has been turned off and that the other doors of the building remain secure.

E) The last person to leave the Nelson House must ensure that trash has been removed, all of the windows are closed and latched, and the door is locked.

2.7 ELECTRONIC DEVICES

The Federal Railroad Administration has issued Emergency Order #26 regarding the use of electronic devices by train operating crews while on duty. Though our operation is not governed under rules of the FRA, adoption of this rule enhances safety of crews and passengers and as such is made part of our operating rules.

A) These rules are effective when on a moving train, when duty requires any crewmember to be on the ground, when a crewmember is riding rolling equipment during a switching operation and when any other employee of the railroad is assisting with the preparation of the train.

B) Hearing aids and digital watches are permitted.

C) Personal electronic/electrical devices must be turned off with any earpiece removed from the ear. This includes, but is not limited to, cell phones, audio players and video players. Any of these devices located in the locomotive cab must not only be turned off but also stored in the engineer's or fireman's seat box.

D) Exceptions:

1. In the event of an emergency or other problem the Conductor or his designee may use a cell phone to contact Emergency Services or museum staff. This cell phone should remain on but is for duty use only.

2. These devices may be used while on a designated lunch break.

3. As long as it does not interfere with the performance of their other duties crewmembers may take pictures using a digital camera.

4. These devices may be used if all crewmembers have been notified that operations have been suspended.

E) The Nevada State Railroad Museum does not supply any electronic/electrical devices for use during train operations.

F) The FRA has provided the attached flow-chart for your information.

FRA EO 26 – Electronic and Electrical Device Flow Chart

Use of Personal or RR supplied electronic/electrical devices may NOT interfere with RR operating employees performance of safety related duties

Use of RR supplied electronic/electrical devices *PROHIBITED* when:

Other RR Operating Employee*

On a moving train unless:

- Authorized for business purpose
- A safety briefing is held
- Crew agrees it is safe to do so

or

- Authorized business purpose within the body of a passenger train or RR business car

Outside the cab unless:

- Not fouling a track
- No Switching Operation is underway
- No other safety related duties
- All crew members have been briefed that operations are suspended

Locomotive Engineer/ RCO

- On a moving train

or

- When a duty requires any crew member to be on the ground

or

- When a crew member is riding rolling equipment during a switching operation

and

- During any period when another employee of the RR is assisting in preparation of the train

Personal electronic/electrical devices *MUST BE TURNED OFF* with earpiece removed when: (other than a hearing aid device)

All RR Operating Employees*

- On a moving train

or

- When a duty requires any crew member to be on the ground

or

- When a crew member is riding rolling equipment during a switching operation

and

- During any period when another employee of the RR is assisting in preparation of the train

Exceptions:

(1) May use digital storage and display function of personal or RR supplied device to refer to RR rule, SI, TT, other directive, if authorized by RR operating rule or instruction;

(2) May use Personal or RR supplied device as necessary to respond to an emergency involving the operation of the RR;

(3) Engineer/RCO may use electronic control systems and information displays presented within locomotive cab or on RCO transmitter including functions associated with controlling switches;

(4) Under authorized conditions of 49 CFR 220, may use a RR supplied/authorized device in lieu of RR radio, to conduct train or switching operations;

(5) May refer to a digital timepiece to ascertain time of day or verify accuracy of speed indicators.

Note:

WHILE ON DUTY use of personal electronic/electrical devices for other than voice communication is prohibited except as noted above

*Means a person performing duties subject to 49 U.S.C. 21103,"limitation on duty hours of train employees."

2.8 STANDARD CLOCK

The Standard Clock is in the Restoration Shop. This railroad runs on Pacific Time. The Standard Clock is set automatically via radio signal several times a day. You should adjust your watch to be within one minute of the Standard Clock. Compare your watch with that of the Conductor. Use of a digital watch is permitted.

2.9 EXCEPTIONS

All of the above describe the regular activities of an ordinary day's operation. **There is *never* an ordinary day's operation.** Be prepared for changes in your work necessitated by safety concerns, a different routine (such as Santa Train or night operation), differing equipment or the needs of the museum.

BE FLEXIBLE

BE SAFE

This appendix is strictly informational and does not necessarily pertain to operations at NSRM.

APPENDIX

The following material is from

The International Correspondence School

"Locomotive Lubricators"

Study Booklet

1941 Edition

Please note that the student who took the course has made underlines and notes on some of the pages. This is NOT emphasis made by the Nevada State Railroad Museum.

From the William Kohler collection.

This appendix is strictly informational and does not necessarily pertain to operations at NSRM.

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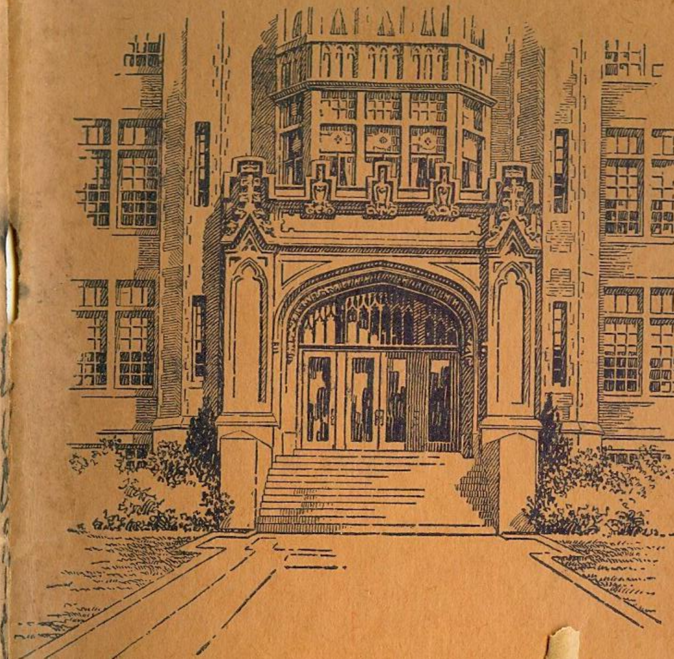


International Corr ondence Schools
Scran , Pa.

Rcd- 11-15-41
11-22-41

Locomotive Lubricators

PREPARED ESPECIALLY FOR HOME STUDY

By

J. W. HARDING

DIRECTOR, STEAM RAILROAD SCHOOL
INTERNATIONAL CORRESPONDENCE SCHOOLS

2358

EDITION 1

REVIEW NOTICE

Since this text was first printed little or no changes have been made in the development of locomotive lubricators. Under these conditions it is impossible to make any changes that would alter materially the make-up of this text.

However, a thorough review was made in 1940 by J. W. Harding, Director, School of Railroads, International Correspondence Schools, and the text was found to be fundamentally sound and in accordance with present day practice.

2358 Printed in U. S. A.

1941 Edition

LOCOMOTIVE LUBRICATORS

Serial 2358 Edition 1

DESCRIPTION, OPERATION, AND DISORDERS

PRINCIPLE OF OPERATION

1. Purpose.—The purpose of the locomotive lubricator is to supply oil to the steam chests and the cylinders and thereby lubricate the wearing surfaces of the valves and the pistons, as well as the surfaces with which they are in contact. Locomotive lubricators are of two types, hydrostatic and force-feed. As the name implies, the operation of the hydrostatic lubricator is due to the pressure caused by the weight of a body of water. With a force-feed lubricator, the oil is delivered to the required points by oil pumps.

2. Operation.—The operation of a hydrostatic locomotive lubricator will be explained from the conventional view shown in Fig. 1. The steam from the boiler passes through the pipe *a* to the condenser *b*, and there condenses, filling it up to the point shown. From the condenser, the water passes through the water pipe *c* to the oil reservoir *d* and fills all the space not occupied by the oil, which is here indicated by dark dash lines. The oil also fills the oil pipe *e* and the oil passage *f*, which terminates at the bottom of the feed nozzle *g*. The steam from the condenser passes through the equalizing tube *h* and condenses and fills the sight-feed chamber *i* with water up to the outlet through the choke *l* in the oil pipe *j*. The steam pressure in the condenser exerts a downward pressure on the water in the water pipe and causes an upward pressure to be exerted on the oil in the oil reservoir as indicated by the arrows. This pressure would force the oil through the feed nozzle were it not balanced by the steam pressure in the equalizing tube, exerting an equal downward pressure that is transmitted to the oil through the water in the sight-feed chamber and the opening through the

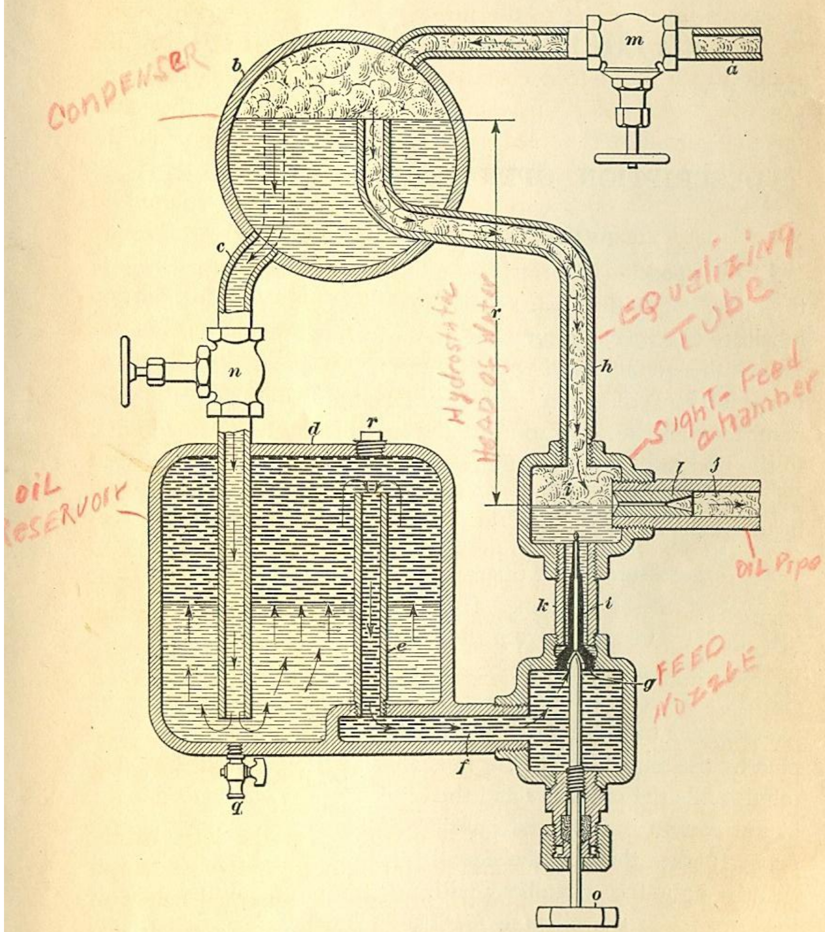


Fig. 1

feed nozzle. Therefore, the pressure of the steam does not enter into the forcing of the oil through the lubricator. The reason that the oil is forced through the feed nozzle can be understood from the following: It is a law of hydrostatics

that the pressure exerted by the weight of a column of water depends solely on its height and not on the diameter of the tube or vessel in which the water is contained. The oil in the oil reservoir is subjected to the pressure of two columns of water of unequal heights. A downward pressure is exerted by the water in the sight-feed chamber on the oil, and this pressure, according to the law just stated, is not affected by the small opening through the feed nozzle, but depends solely on the height of water in this chamber.

An upward pressure is exerted on the oil by a column of water that extends from the bottom of the reservoir through the water pipe to the top of the water in the condenser.

The upward pressure exerted by the weight of the portion of this column of water in the water pipe below the level of the choke balances the downward pressure exerted by the column of water in the sight-feed chamber, provided the water in the reservoir is on a level with the choke. Therefore, it is the pressure due to the weight of the remainder of the column of water in the water pipe and condenser, as measured from a point on a level with the choke to the surface of the water, that forces the oil through the feed nozzle. This height of water is indicated by the line *r* and is called the hydrostatic head. The pressure exerted per square inch by this height of water is about $\frac{9}{16}$ ounce for each inch of height.

The water pipe could be extended to the surface of the water in the condenser as shown by the dash lines, or such a pipe in the condenser could be made smaller, or omitted, as is the practice; but according to the law stated, the pressure exerted by the water would be the same.

With the water in the oil reservoir below the level of the choke as shown, the water and the oil in the reservoir below this level will exert a lesser upward pressure on an equal height of water in the water pipe than if the column in the reservoir was all water. A decrease in this upward pressure has the same effect as if the height of the hydrostatic head was increased. Therefore, the hydrostatic head is highest when the oil reservoir is full of oil as when the lubricator has just been filled, and the head lessens as the oil feeds out.

3. The oil, as it is forced through the feed nozzle, floats up in drops to the surface of the water in the sight-feed chamber, in which a glass *k*, Fig. 1, is set so that the rate of feed can be observed. The oil is caught by the steam that is flowing through the equalizing tube and is carried through the choke *l* into the oil pipe *j*. The oil, as it feeds out of the oil reservoir, is replaced by water, hence as the lubricator continues to operate, the height of the water in the oil reservoir increases, and the depth of the oil decreases. The oil reservoir will become empty of oil first, the oil pipe next, and the oil passage last. Before the lubricator can be refilled with oil, the water with which the oil reservoir, the oil pipe, and the oil passage are filled must be drained out by opening the drain valve *q*. The water cannot rise in the condenser above the end of the equalizing tube, because after this level is reached the water overflows into the tube and is carried through the choke to the oil pipe. Therefore, the equalizing tube determines the height of the water in the condenser and hence the height of the column of the water in the water pipe. As already stated, the choke limits the height of water in the sight-feed chamber.

4. The condenser is made large enough to furnish an abundant reserve supply of condensed water so that even an excessive amount can be withdrawn without materially affecting the height of the hydrostatic column. The fact that the pressure of a column of water is alone responsible for the oil being forced through the feed nozzle can be shown by closing the steam valve, thereby shutting off the steam pressure from the lubricator. The oil will continue to pass through the feed nozzle as usual until the water in the condenser and the water pipe, due to the absence of condensation with the steam valve closed, becomes about on a level with the water in the sight-feed chamber. The two columns of water are then balanced and the feeding of oil stops. The lubricator shown in Fig. 1 is of the single-feed type, whereas a locomotive lubricator has at least three feeds, one for each steam chest and one for the air compressor, and sometimes as many as seven. When more than one feed is used, the other feed nozzles are connected to the oil pas-

sage *f* and an equalizing pipe is provided for each sight-feed chamber to balance the steam pressure on the oil and to carry it to the oil delivery pipe. One water pipe or water passage is used, regardless of the number of the feed nozzles. Usually one oil pipe in the lubricator serves for all sight feeds, but sometimes an oil pipe is used for each feed. All hydrostatic lubricators contain the above essential parts and the only difference between the different makes is found in the details of construction. The foregoing shows that a lubricator consists primarily of a condenser for condensing the steam, an oil reservoir for holding the oil, a water pipe or water passage for conveying the water from the condenser to the bottom of the oil reservoir, an oil pipe and an oil passage to convey the oil from the reservoir to the feed nozzles, and an equalizing pipe or passage for each sight-feed chamber.

PURPOSE OF THE PARTS

5. Steam Valve.—The purpose of the steam valve *m*, Fig. 1, is to admit and shut off steam to the condenser when starting and stopping the lubricator.

6. Water Valve.—The purpose of the water valve *n*, Fig. 1, is to open and close the communication between the condenser and the oil reservoir. The valve is closed when filling or shutting off the lubricator or at other times as may be desired, and is kept open when the lubricator is in operation.

7. Regulating Valve.—The purpose of the regulating valve *o*, Fig. 1, is to prevent, when necessary, the passage of oil through the feed nozzle and also to regulate the rate at which the oil feeds. When the valve is opened wider, the rate of feed increases, and turning the valve toward closed position decreases the rate of feed.

8. Filling Plug.—The filling plug *r*, Fig. 1, is used to close the opening in the oil reservoir through which the reservoir is filled with oil.

9. Water Pipe.—The water pipe *c*, Fig. 1, is used to transmit the pressure of a column of water to the oil in the reservoir.

The lower end of the water pipe is brought as close as possible to the bottom of the oil reservoir so as to prevent the oil from floating up through the water in the pipe to the condenser immediately after the lubricator has been filled and put into operation. The oil is trapped in the oil reservoir as soon as the water in the reservoir comes above the end of the water pipe.

10. Oil Pipe.—The purpose of the oil pipe *e*, Fig. 1, is to convey the oil from the oil reservoir to the oil passage.

11. Equalizing Pipe.—The purpose of the equalizing pipe *h*, Fig. 1, is to transmit the same steam pressure to the oil by way of the sight-feed chamber as is transmitted to the oil by way of the water pipe. In other words, the equalizing pipe serves to balance the steam pressure in the lubricator, with the result that the lubricator is operated by water pressure. The steam from the equalizing tube also carries the oil through the choke.

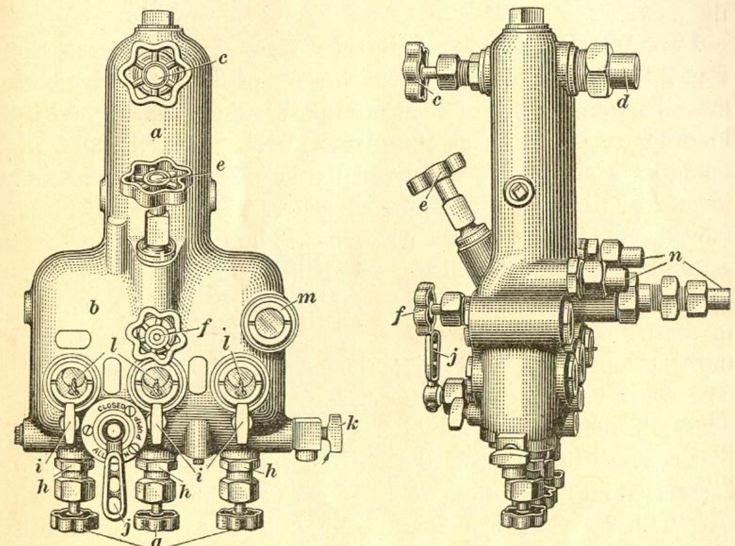
12. Choke.—The choke *l*, Fig. 1, is a metal plug that is placed in the end of the oil pipe, and has a small hole about $\frac{1}{32}$ inch in diameter drilled in it. The purpose of the choke is to restrict the flow of steam from the lubricator and maintain a pressure as nearly boiler pressure as possible in it so that it will feed evenly against the fluctuating pressure in the oil pipe. If a choke were not used the change in pressure in the oil pipe each time the reverse lever or the throttle was moved would affect the rate at which the oil would feed through the feed nozzle. With some lubricators, chokes are used at the steam chest only, whereas, with others, a choke is placed at the lubricator and also at the steam chest. When placed at the steam-chest end of the oil pipe, the choke is sometimes referred to as the steam-chest valve.

13. Drain Cock.—The drain cock *q*, Fig. 1, is used to drain the water from the oil reservoir preliminary to filling it with oil.

DETROIT LUBRICATORS

DESCRIPTION

14. Exterior View.—An exterior view of the front of a Detroit three-feed lubricator is shown in Fig. 2 (*a*) and a view of the side of the lubricator is shown in view (*b*). The number of feeds vary from three to eight, lubricators of the latter type being used with Mallet locomotives. The feed at the left supplies oil to the left steam chest, the center feed to the air compressor, and the other sight feed to the right steam chest.



(*a*) (*b*)

Fig. 2

The feeds are identified by letters on the bosses shown near them.

The names of the parts are as follows: *a*, condenser, cast in one piece with the oil reservoir *b*; *c*, steam valve; *d*, steam pipe; *e*, filler plug; *f*, water valve; *g*, regulating valves threaded through the centerpieces *h*; *i*, sight-feed drain valves; *j*, oil control valve; *k*, drain valve; *l*, sight-feed glasses with similar glasses opposite on the other side; *m*, glass for determining amount of oil in oil reservoir with an opposite glass on other side; *n*, oil pipes to steam chests and air compressor. The equalizing passages are cast with the condenser body, and their location is indicated by raised ribs on the back of the body. As indicated on the dial, the oil-control valve has three positions: *close*, *pump*, and *all open*. Formerly, it was necessary to close the regulating valves when it was desired to stop the feed of oil during temporary stops and they had to be reset again to give the desired number of drops per minute. With the oil-control valve, the permanent adjustment of the regulating valves is not disturbed.

15. Interior View.—An interior view of the lubricator in Fig. 2 is shown in Fig. 3, in which some of the parts have been moved somewhat out of their true position, and others omitted in order to make the arrangement clearer. For example, the oil pipes *a* are shown connected to the side of the lubricator instead of the back. Also, the equalizing passages *b* have been moved out of their correct positions. The equalizing passages communicate with the oil pipes and the sight-feed chambers *c*. The water pipe *d*, which conveys the water from the condenser to the bottom of the oil reservoir, is screwed at its upper end into the top of the reservoir, although here shown cast with it. The water valve *e* controls the passage of water from the condenser to the water pipe and the oil reservoir. The oil pipe *f* that conveys the oil from the oil reservoir to the oil passage *g* is screwed into the bottom of the reservoir, although here shown cast with it. The ball check-valve *h* is contained in a ball check-valve body that is screwed on to the end of the water pipe. The check is arranged in the body so that the water can discharge from the pipe into the reservoir, but cannot return from the reservoir to the pipe. This valve only comes into use when the valves of the lubricator are not closed in their proper order when shutting it off. When shutting off, the oil-control valve should be closed first, the water valve next, and the steam valve last. If the oil-control valve is closed first and the steam valve next, the pressure in the condenser, owing to its large radiating surface, will reduce quickly. In the absence of the

ball check, the hot oil in the oil reservoir would expand and back up through the water pipe into the condenser, where it would pass through the equalizing passages to the oil pipes. Therefore, the ball check prevents the loss of oil should the steam valve be closed before the water valve.

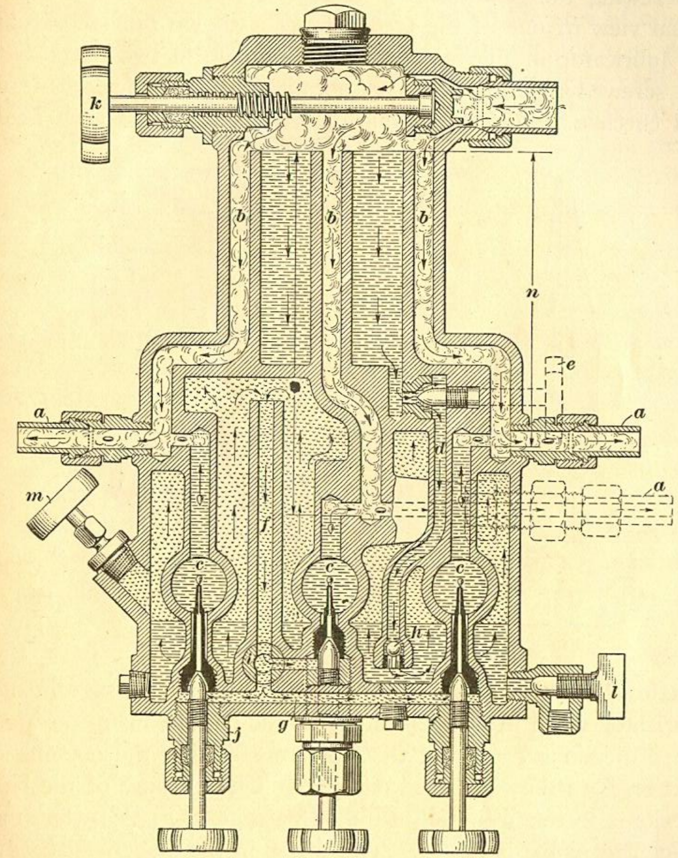


Fig. 3

16. The oil-control valve *i*, Fig. 3, is shown in all open position and oil is free to pass to the three feed nozzles. If the valve is now turned around the required amount, or to closed position, the passage of oil from the oil pipe is prevented. However, if the valve is turned one-quarter turn to the left, the passage of oil to the oil passage *g* and to the steam-chest feed nozzles will be stopped, but oil will continue to pass to the central feed nozzle that communicates with the compressor. Access to any of the feed nozzles can be obtained by unscrewing the centerpiece *j* from the oil reservoir. A sectional view of one of the feed nozzles is shown removed from the lubricator in Fig. 4; the nozzle is made in two parts that are screwed together so as to permit of the application of a ball check *a*. This check, one of which is used in each feed

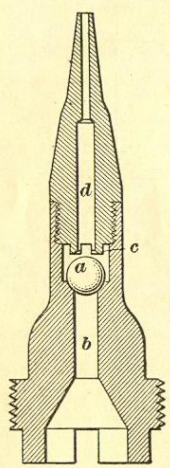


FIG. 4

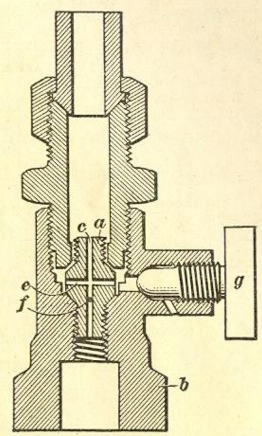


FIG. 5

nozzle, closes the opening *b* that leads to the oil passage in the lubricator when in down position as shown, but in up position the projections *c* prevent the ball from closing the opening *d* that leads to the sight-feed chamber. The purpose of the ball checks is to retain the oil in the oil passage *g*, Fig. 3, when the oil-control valve is closed. The water in the sight-feed chambers *c* is heavier than the oil in the oil passage and, with the regulating valves open and the control valve closed, the water and the oil would change places were the ball check not held closed, as in Fig. 4, by the weight of the water in the sight-feed chamber.

17. Choke.—A sectional view of the choke *a*, which is screwed into the plug *b*, is shown in Fig. 5. The choke has one straight passage *c* $\frac{1}{16}$ inch in diameter drilled through it as well as two cross-drilled passages *e* and *f*. These passages provide additional openings for the oil should the passage *c* become stopped up at the upper end. Both ends of the choke are threaded so that it can be reversed when the area of one of the openings increases to $\frac{3}{32}$ inch. The drain plug *g* is provided so that the choke can be blown out. The choke used for the air compressor is of the ball type and is placed next to the lubricator. From the plug, the oil is conducted into the steam pipe through a steam-chest oil plug, which will be described farther on. The purpose of the choke has already been explained.

OPERATION

18. Feeding Oil.—The operation of the lubricator in feeding oil is similar to the action of the conventional type of lubricator in Fig. 1. The pressure due to the weight of the water in the hydrostatic column, the height of which is indicated by the line *n*, Fig. 3, is transmitted through the water pipe *d* to the oil in the oil reservoir. This pressure forces the oil through the oil pipe *f*, the oil passage *g*, and the feed nozzles from which it floats up to the surface of the water in the sight-feed chambers *c*. The flow of steam through the equalizing passages *b* then carries the oil into the oil pipes *a*.

19. Filling.—Before starting to fill the lubricator, move the handle of the control valve, Fig. 3, to closed position so as to prevent the possibility of the steam from the steam chests passing through the oil pipes to the oil reservoir, then close the water valve *e* and the steam valve *k*. However, if the water valve is tight, it is not necessary to close the steam valve. Closing the water valve saves the water in the condenser, and permits the lubricator to be started sooner than if the condenser were drained and then allowed to condense full again. Next, open the drain valve *l* until the oil reservoir is emptied of water, then close the drain valve, remove the filler plug *m*, fill the oil reservoir with clear strained oil, and replace the plug. If there is not enough oil to fill the reservoir, use water to make up the required quantity. If the lubricator has been recently under pressure, remove the filler plug slowly, and do not close the drain cock entirely before the plug is removed. This precaution prevents the pressure in the oil reservoir from blowing the emulsified oil into the cab when the plug is removed. The oil-plug opening is below the top of the oil reservoir so that the reservoir cannot be completely filled with oil. The space in the reservoir between the highest oil level and the top of the reservoir is called the expansion chamber. Its purpose is to permit the oil to expand without damaging the reservoir when the lubricator is not in operation and all valves are closed.

20. Starting Lubricator.—The lubricator should be started about 15 minutes before leaving the terminal. To start the lubricator, open fully the steam valve and the water valve and move the handle of the oil-control valve to all open position. Then adjust the feeds to the maximum number of drops required by means of the regulating valves. For lighter service, the number of drops can be decreased by throttling the oil-control valve.

21. Stopping Lubricator.—To stop the lubricator, close the oil-control valve first, then the water valve, and the steam valve last. While the ball check-valve *h*, Fig. 3, would prevent the pressure in the oil reservoir from forcing the oil up the water pipe into the condenser should the steam valve be closed first, yet this check-valve should be regarded as a safeguard only, and the other valves should be closed in their proper order. With a locomotive that uses superheated steam, the steam valve should be allowed to remain open for at least 15 minutes after the water valve and the oil-control valve have been closed. The steam then carries all of the oil from the oil pipes into the steam chests. If the steam valve were closed at the same time as the other valves, the superheated steam that remains in the steam chests would cause the water in the sight-feed chambers to flash into steam, and the oil in the oil pipes that would be carried back with the steam would be deposited on the sight-feed glasses and nozzle tips.

DETROIT TRANSFER FILLER

22. Purpose.—The purpose of the Detroit transfer filler shown connected to the lubricator in Fig. 6 is to transfer a reserve supply of oil to the lubricator when it becomes empty. The transfer filler does away with the necessity of filling the lubricator in the ordinary manner on long runs.

23. Description.—In Fig. 6 the transfer filler and the lubricator are shown partly in section. The water pipe *a* is connected to the water space in the oil reservoir, and the oil pipe *b* is connected to the oil passage *c* in the oil reservoir; hence these pipes normally are filled with water and oil, respectively. To transfer the oil to the oil reservoir of the lubricator, it is merely necessary to open the valves *d* and *e*. As the water enters the transfer filler past the valve *d* from the pipe *a*, the oil in the transfer filler, being lighter, floats upwards past the valve *e*, through the oil pipe *b* to the oil reservoir and replaces the water that is passing from the reservoir of the lubricator to the transfer filler. Therefore, the water in the oil reservoir finally replaces the oil in the transfer filler, and the oil from the transfer filler takes the place of the oil in the oil reservoir. The transfer filler is provided with a filler plug *f*, a drain cock *g*, and a gauge glass *h*. Should the pressure of the oil in the transfer filler become excessive, owing to the heat from the boiler head, the valve *i* unseats against the pressure of the spring shown and permits some of the oil to pass through the water pipe to the lubricator.

NATHAN LUBRICATORS

24. Exterior Views.—An exterior view of the front of a Nathan three-feed lubricator is shown in Fig. 7, and an exterior view of a six-feed lubricator is shown in Fig. 8. With the three-feed lubricator, the center feed is for the air compressor and the left-hand and the right-hand feeds are for the left and the right steam chests, respectively. With the six-feed lubricator, and two end feeds at the left connect to the left steam chest and cylinder, and the two end feeds at the right

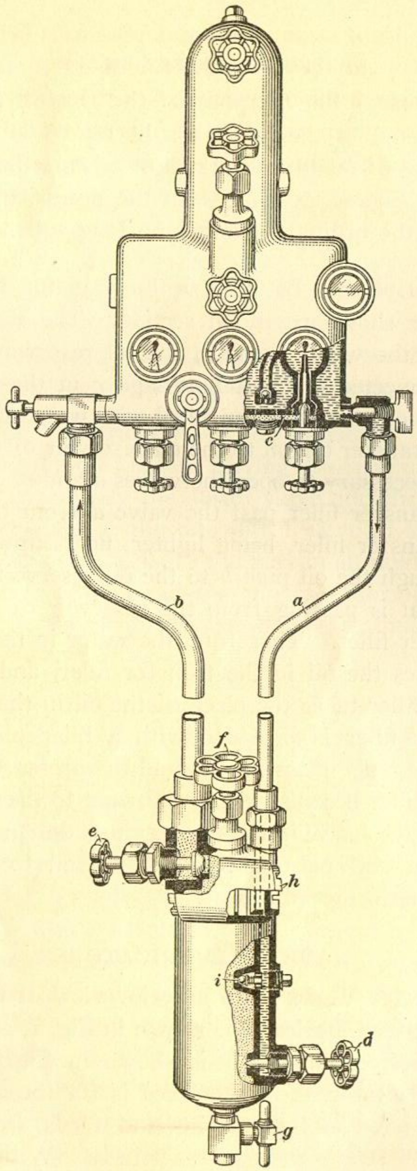


Fig. 6

connect to the right steam chest and cylinder. The two middle feeds supply oil to the two air compressors. If but one air compressor is used, the other feed is used for the stoker engine. The points to which the feeds connect are marked on the bosses above each sight-feed glass.

25. Names of Parts.—The names of the exterior parts of the lubricator shown in Fig. 7 are as follows: *a*, condenser,

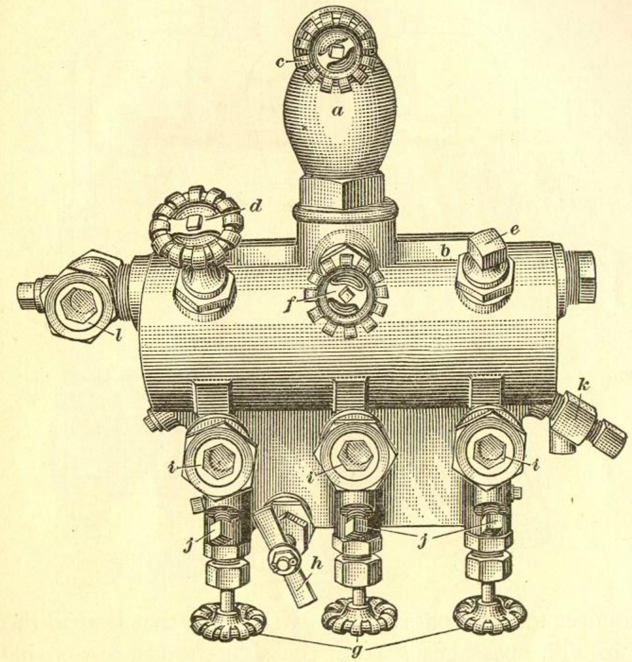


Fig. 7

screwed into the oil reservoir *b*; *c*, steam valve; *d*, filler plug, which may be transferred to the opening closed by the plug *e*, if necessary; *f*, water valve; *g*, regulating valves; *h*, oil cut-out valve; *i*, sight-feed glasses, with similar glasses directly opposite on the other side; *j*, sight-feed drain valves; *k*, oil-reservoir drain valve; and *l*, glasses for observing the depth of oil in the oil reservoir. The oil pipes are connected to the back of the lubricator and cannot be seen in Fig. 7. With the six-feed lubricator, Fig. 8, there is not enough room in the condenser for all of the equalizing pipes, and two are placed outside, as shown.

26. Interior View.—In Fig. 9, the three-feed lubricator is broken away so as to show the interior parts. The three equalizing tubes *m* are screwed into the top of the oil reservoir

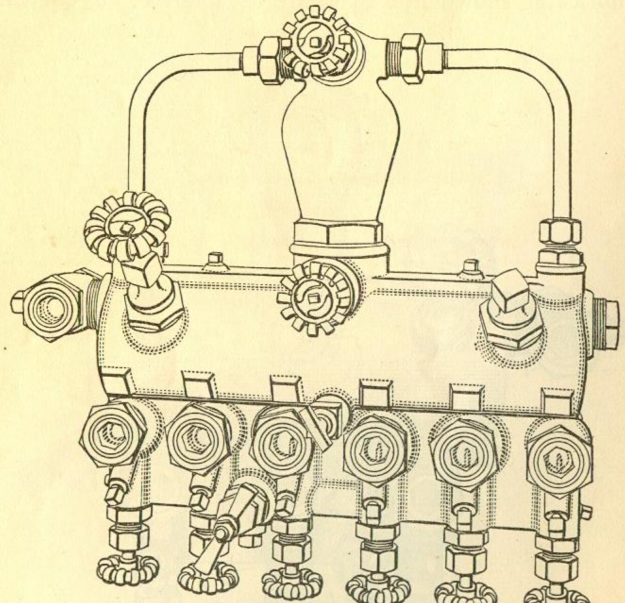


Fig. 8

and connect to three passages *n*, two shown, that lead to the oil pipes *o*. The passages *p* from the sight-feeds are cast in the body of the oil reservoir and open at their upper ends into the passages *n*. From the condenser *a*, the water passes by the water valve *f* to the water pipe *s*, which is screwed at its upper end into the oil reservoir. The oil pipe *t*, through which the passage of oil is controlled by the oil cut-out valve *h*, communicates with the oil passage *u* that leads to the feed nozzles *v*. The oil passage can be cleaned out by removing the plugs *w*. The oil pipe can be removed by taking out the plug *x*. The oil-control valve, when closed, stops the passage of oil through

all of the feed nozzles except the one that is connected to the compressor. This valve therefore permits the feeds to the steam chests to be started and stopped without operating the

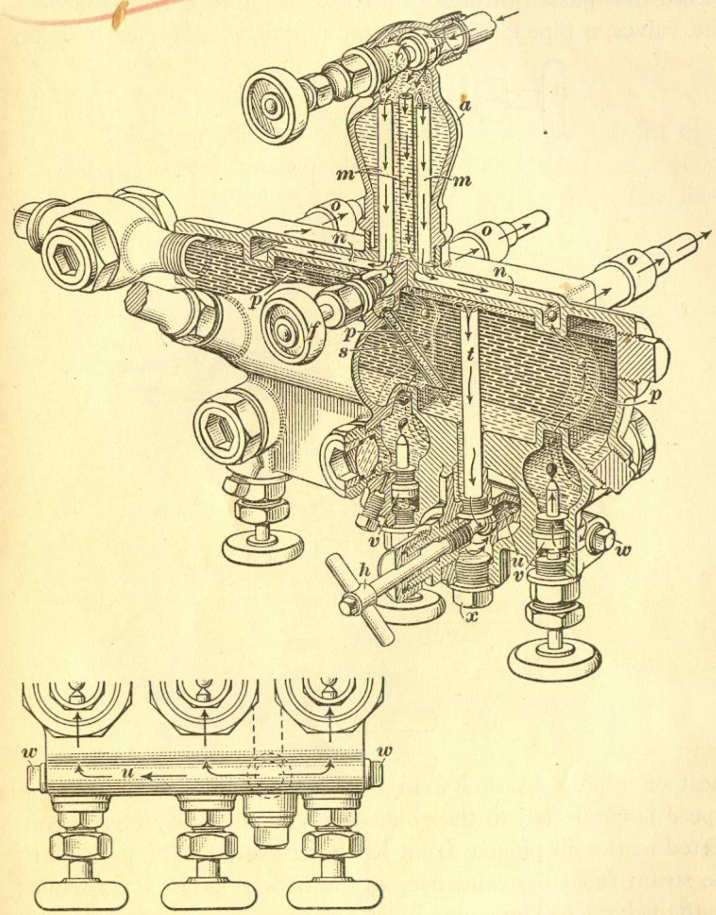


Fig. 9

regulating valves of these feeds and thereby changing their adjustment.

27. Lubricator With Booster Pipes.—It sometimes happens with superheated steam and with the locomotive operating under severe conditions that the feed of the lubricator is retarded by the back pressure from the steam chests and the locomotive does not obtain sufficient lubrication. To assist the steam that passes through the choke plugs to deliver the oil to the valves, a pipe called a booster pipe is used for each steam-

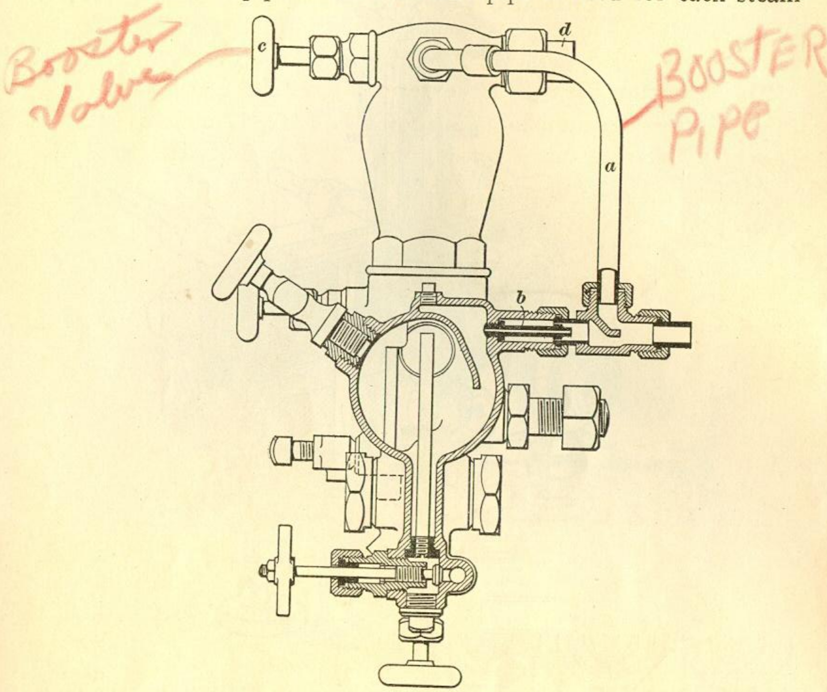


Fig. 10

chest oil pipe. As shown in Fig. 10, one end of the booster pipe *a* is connected to the condenser and the other end is connected to the oil pipe in front of the choke *b*. The passage of the steam from the condenser to the booster pipes is controlled by the valve *c*. This valve must not be confused with the main lubricator steam valve, which, with this arrangement, is located in the steam pipe *d*. The booster steam valve *c* should be opened wide and kept open while the engnie is in service.

28. Operation.—The operation of filling, starting, and stopping the Nathan lubricator does not differ materially from

the Detroit lubricator as already explained. However, when filling the Nathan lubricator the regulating valve of the compressor must be closed because this feed is not cut off when the oil cut-out valve is closed, as with the Detroit lubricator.

CHICAGO LUBRICATORS

DESCRIPTION

29. Exterior Views.—An exterior view of the front of a Chicago three-feed lubricator is shown in Fig. 11, and a front view of a five-feed lubricator is shown in Fig. 12. The five-

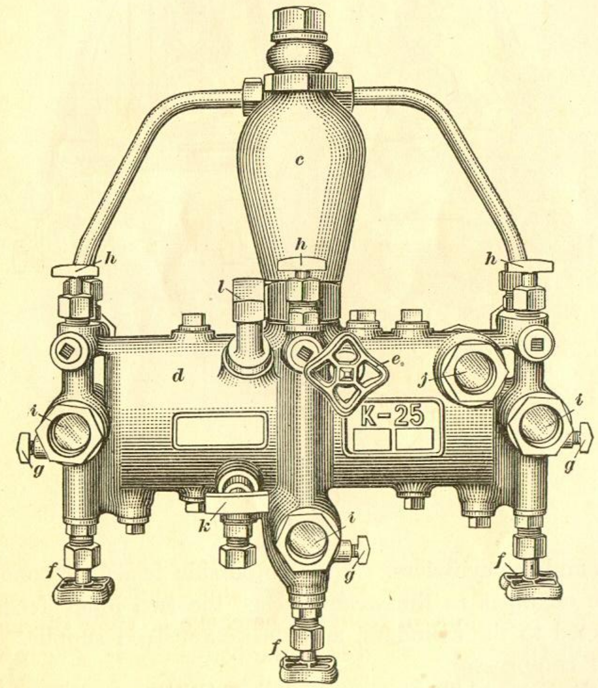


Fig. 11

feed lubricator requires two more equalizing tubes *a*, which are tapped into the other equalizing tubes *b*. In both views, the equalizing tube for the center feed comes directly behind the condenser and cannot be seen when the lubricators are viewed from the front. With the three-feed lubricator the center feed is for the air compressor and the left-hand and right-hand feeds are for the left and the right steam chests, respectively. The five-feed lubricator is designed to feed oil to both the steam

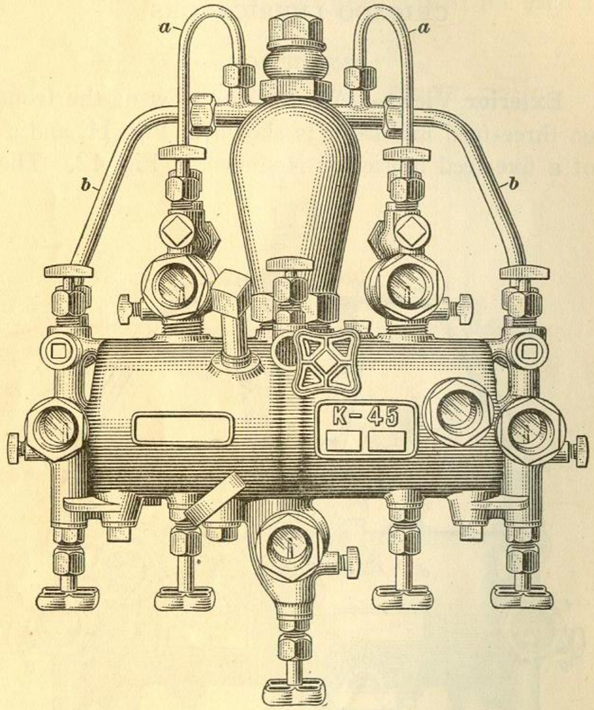


Fig. 12

chests and the cylinders. The two outside feeds are connected by the oil pipes to the steam chests, the two inner feeds are connected to the cylinders, and the center feed supplies oil to the air compressor.

30. Names of Parts.—The names of the exterior parts of the lubricator, Fig. 11, are as follows: *c*, condenser; *d*, oil reservoir; *e*, water valve; *f*, regulating valves; *g*, sight-feed drain valves; *h*, pressure valves; *i*, sight-feed glasses with similar glasses directly opposite on the other side of the lubricator;

j, gauge glass with a similar glass opposite to show the amount of oil in the oil reservoir; *k*, oil-reservoir drain valve; and *l*, the filling valve. The pressure valves are used to shut off the steam to the sight-feed chambers should one of the gaskets,

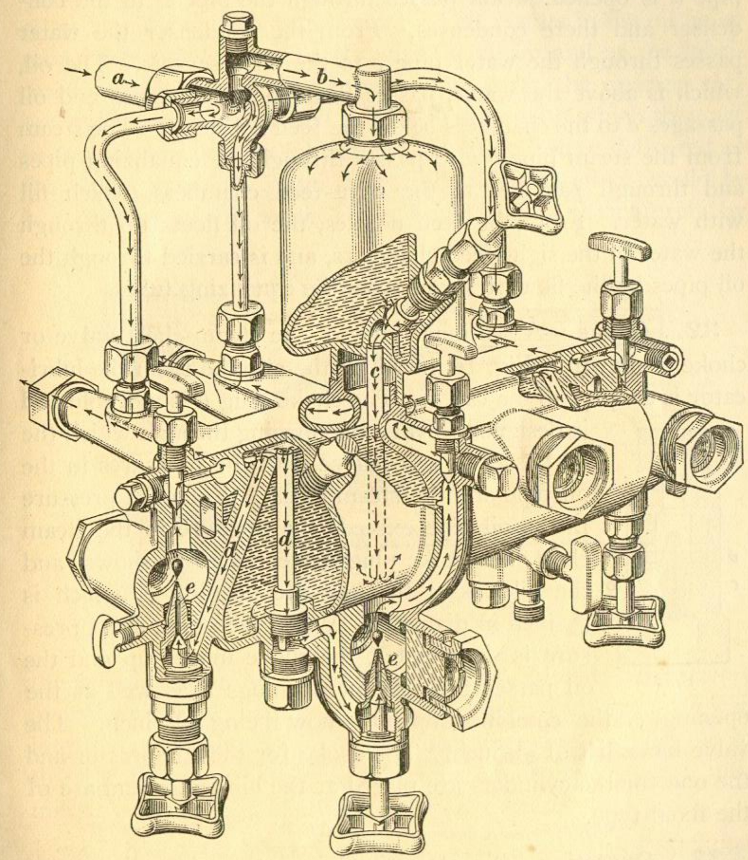


Fig. 13

used to pack the sight-feed glasses, blow out. In this event, the regulating valve at this feed should also be closed and the sight-feed drain valve opened. The regulating valves *f* are threaded through the center pieces, which are screwed into the oil reservoir.

31. Interior View.—In Fig. 13 is shown a perspective view of one style of Chicago three-feed lubricator with a part of the condenser and oil reservoir broken away so as to show the interior arrangement. When the steam valve in the steam pipe *a* is opened, steam passes through the pipe *b* to the condenser and there condenses. From the condenser the water passes through the water pipe *c* to the oil reservoir. The oil, which is above the water, passes through the oil pipes and oil passages *d* to the chambers below the feed nozzles *e*. The steam from the steam pipe *b* also passes through the equalizing pipes and through passages to the sight-feed chambers, which fill with water. From the feed nozzles, the oil floats up through the water in the sight-feed chambers, and is carried through the oil pipes by the flow of steam from the equalizing tubes.

32. Choke.—A sectional view of the steam-chest valve or choke is shown in Fig. 14, in which the oil pipe from the lubricator is coupled to the cap *a*. The choke plug *b* is movable and is designed to vary the opening through which the oil passes in accordance with the pressures in the oil pipe and the steam chest. When the pressure in the oil pipe exceeds the pressure in the steam chest, the choke plug moves down as shown, and the oil passes through the opening *c*, which is $\frac{5}{64}$ inch in diameter. When the steam-chest pressure is the greater, the choke moves up and the oil passes through the openings *d* as well as the opening *c*, the combined opening now being $\frac{3}{32}$ inch. The valve has a lift of $\frac{3}{32}$ inch. The choke for the compressor and the one for the cylinders are placed at the lubricator and are of the fixed type.

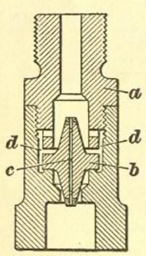


Fig. 14

33. Operation.—To stop the lubricator, close the water valve first, then the regulating valves, and the steam valve last. To start the lubricator, open the steam valve fully, the water valve next, and the regulating valves last.

STEAM CHEST OIL PLUG

34. Purpose.—The purpose of the steam chest oil plug used with all types of lubricators is to convey the oil from the choke to about the center of the steam pipe and there atomize the oil or break it up into a fine spray. This results in the oil being mixed more or less intimately with the steam and as the lubricated steam passes to all of the moving parts, the wearing surfaces of these parts as well as the surfaces with which they are in contact are thereby lubricated. If the oil were delivered to the steam pipes in a liquid state, its lubricating effect would be lost because the oil would either be swept out prematurely by the exhaust steam or the oil would not be distributed uniformly over the wearing surfaces. The steam chest oil plug is screwed into the steam pipe as far above the steam chest as possible so that the oil spray will have a greater opportunity to mix intimately with the steam before it enters the steam chest.

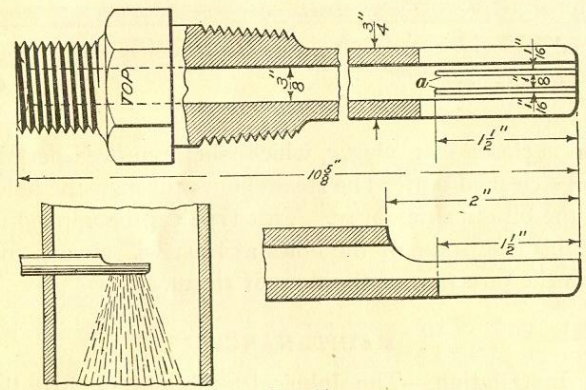


Fig. 15

35. Types of Plugs.—One style of steam chest oil plug, known as the spoon type, is shown in section in Fig. 15. The casing that contains the oil-pipe choke screws on to the upper end of the oil plug, and the central threaded portion is where the plug is screwed into the steam pipe. Two slots, each $\frac{1}{16}$ inch wide and $1\frac{1}{2}$ inches long, are cut in the spoon-shaped end that projects into the steam pipe. The atomization of the oil is accomplished by the steam in its passage to the steam chest, impinging on the oil as it flows along the exposed end of the pipe, and forcing the oil through the slots *a* in a spray. The action that occurs is illustrated in the small view at the left. Unless the slots are lined up with respect to the travel of the steam, the atomization of the oil will be impaired and it will not mix properly with the steam. The slots are lined up properly when, with the plug applied, the word *top*, stamped on the plug, comes uppermost. In Fig. 16 is shown the choke and the oil plug combined in one part. The choke *a* has a $\frac{1}{16}$-inch opening, and the lower end of the plug has a series of $\frac{3}{32}$-inch drilled holes *b*.

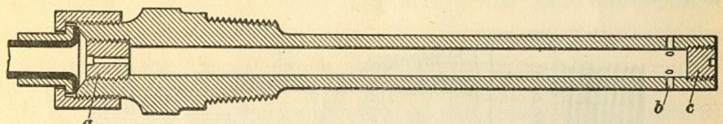


Fig. 16

The end is closed by a plug *c*, which when removed permits the plug to be cleaned out. The steam blows through the holes and carries the oil out in a spray. This type can be applied in any position because some of the holes at least will always come in line with the direction of the flow of steam.

MAINTENANCE

36. Installation.—The lubricator should be installed so that it will receive a continuous supply of dry steam at full boiler pressure. The boiler valve should be designed to provide ample area of passage when open, and should be placed on the highest part of the boiler head. Steam should never be taken from a point anywhere near the water level because the steam will pick up scum and impurities from the surface of the water and carry them into the lubricator and obstruct the nozzles, chokes, and interior passages. Also, the water level may be so high as to carry water instead of steam to the condenser. The support bracket used to connect the lubricator to the boiler should be absolutely rigid, otherwise excessive vibration will result, thus preventing the proper formation of the drops of oil and causing the feeds to work in an erratic manner. Also, the lubricator

should be placed vertically, otherwise its perfect action may be interfered with. The oil pipes must be absolutely free from traps and have a gradual descent from the lubricator to the point of delivery so as not to trap or arrest the progress of the oil. The pitch of the pipes should be sufficient to maintain the downward inclination when ascending the steepest grade; a slope of $\frac{3}{4}$ inch to the foot should be sufficient. Oil pipes should always be run as far as possible under the jacket of the boiler so that the oil will not become sluggish in cold weather. The hotter the oil is kept the more freely and the more evenly it will flow.

37. Blowing Out.—If the lubricator is blown out thoroughly at regular intervals of about 1 or 2 weeks, very little trouble will be experienced with obstructed oil or water passages. If these passages are permitted to become choked, they cannot always be cleaned satisfactorily on the road without draining the lubricator and blowing it out. The best time to blow out a lubricator is when it is fed empty. Then all valves should be left in the same position as when the lubricator is operating and all the vent stems should be opened below the sight-feed glasses. This lessens the pressure within the sight-feed chambers and the hot water from the oil reservoir is forced through the oil passage and the feed nozzles to the atmosphere. The regulating valves should be closed as soon as the water ceases to flow from the feed nozzles, as this indicates that all the water is exhausted. Steam should then be blown through the lubricator by opening the drain valve at the bottom of the oil reservoir. This latter operation blows out the water pipe and the oil reservoir. A small piece of soap put in the oil reservoir about once a week before filling will keep the walls, passages, and glasses clean, provided that after the oil is fed out, the feed is allowed to continue so that the soapy water will be forced through into the sight-feed chambers.

38. Lyeing Out.—If the lubricator is not blown out at regular intervals the passages in it will finally become filled up with a gummy deposit and will have to be cleaned out with lye. This is done by removing the filler plug and placing the lubricator in a lye vat and allowing it to remain for about 3 hours.

A greater length of time will result in injury to the glasses. The lubricator should be thoroughly cleaned out with steam or hot water after it is removed from the vat.

DISORDERS

39. Decrease in Rate of Feed.—With the lubricator receiving full steam pressure, thereby providing for ample condensation, a decrease or stoppage in the feed of oil is due to disorders that prevent the weight of the water in the condenser from being transmitted to the oil, or to disorders that prevent the free flow of oil through the oil passages or feed nozzles. Therefore, the trouble is generally due to the water pipe being partly or wholly stopped up by impurities that are carried with the steam into the condenser, to the oil passages being clogged with sediment from the oil, or to dirt in one or more of the feed nozzles. If the lubricator is blown out regularly, there is little liability of the passages in it becoming stopped up. Another cause for a decrease in the rate of feed is that the choke becomes too large, in which event the steam from the steam chest will exert a back pressure on the sight-feed chambers and will cause the oil to feed slowly with a wide-open throttle, and feed rapidly when the throttle is closed. Also, if the lubricator is placed in an exposed position in the cab, the oil in severe weather may congeal immediately beneath each feed nozzle, and the feed of oil will stop. This condition can be corrected by closing all of the regulating valves and opening the vents to the sight-feed chambers. The steam from the equalizing passages then heats up the feed nozzles and the congealed oil beneath them.

40. Clearing Obstructed Feed Nozzle.—Several methods can be used to clear an obstructed feed nozzle. One is to open and close quickly the sight-feed drain valve at the obstructed nozzle. If this does not clear the feed nozzle, the drain valve should be opened wide and all water drained from the sight-feed chamber. The steam that then escapes lessens the pressure in the chamber and the effect is the same as if the pressure in the oil reservoir was increased. This unbalancing of

the pressures will usually cause the obstruction to be forced through the feed nozzle. Another method is to close the regulating valves to the other feeds and also the water valve. The steam valve should then be closed gradually until the steam pressure that is confined in the oil reservoir forces the obstruction through the tip of the feed nozzle. A more positive method, which, however, can be used only with a lubricator that has an oil-control valve or an oil cut-out valve, is to place the valve handle in closed position, thereby preventing the pressure in the oil reservoir from being transmitted to the oil passage beneath the feed nozzles. The centerpiece of the feed affected should then be removed and the nozzle cleaned out with a piece of wire. The ball check in the feed nozzle of a Detroit lubricator prevents the nozzle from being cleaned out in this way, but the wire can be used to raise the ball check, when the pressure in the sight-feed chamber will force the obstruction down and out to the atmosphere.

41. Stopped-Up Choke.—The end of the choke next to the steam chest may become stopped up by the carbon deposit that accumulates in the steam chests of superheated locomotives, or the oil pipe end of the choke may become closed by sediment or dirt. A stopped-up choke is indicated by the oil pipe and the sight-feed chamber filling with oil. When a blow-out stem is used, the choke can be cleaned by opening the stem and allowing the steam from the lubricator to blow out. Next, the steam should be shut off at the lubricator and the engine given steam. Then the steam to the engine should be shut off and the stem should be opened again; the choke plug should then be clear. In the absence of a blow-out stem, the choke can be cleaned by closing the steam valve at the lubricator and opening the throttle. The steam from the steam chest will force the obstruction through the oil pipe into the sight-feed chamber, from which it can be blown out by opening the sight-feed drain valve.

42. Loss of Oil.—The loss of oil when the lubricator is in operation is generally due to a leak from the oil reservoir to the condenser. The connection between the reservoir and the condenser is made by the water pipe, the upper end of which is screwed into the top of the reservoir. The upper end of the water pipe is surrounded by oil as long as there is any in the reservoir, and should there be a leak at this point, the oil will pass into the pipe and, being lighter than the water, will float up to the surface of the water in the condenser. From the condenser, the oil will be carried by the steam through the equalizing tubes to the oil pipes. A loose feed nozzle or a sand hole between the oil reservoir and the condenser will also cause a loss of oil. A leaky oil pipe will allow water to pass from the oil reservoir to this pipe, and the lubricator will feed water instead of oil.

43. Syphoning.—The passage of the oil, when the lubricator is not working, from the oil reservoir through the water passage to the condenser and thence through the equalizing passages to the oil pipes is known as syphoning. This action cannot occur if the valves of the lubricator are closed in the proper order, that is, the water valve first, the oil control valve next, and the steam valve last. If the steam valve is closed first, the steam in the condenser will condense and reduce in pressure more rapidly than the hot oil in the oil reservoir. The oil will then expand and in the absence of a check-valve in the lower end of the water pipe some of the oil may back up this pipe to the condenser and will then pass down the equalizing passages to the oil pipes.

44. Dirty Feed Glasses.—The sight-feed glasses may become dirty, owing to impurities in the water or to the sediment in the oil. Moving the engine on the roundhouse tracks with the lubricator shut off, results in the glasses being clouded by the contents of the oil pipes that is then forced back into the sight-feed chambers.

SCHLACKS FORCE-FEED LOCOMOTIVE LUBRICATOR

45. Types of Lubricators.—The lubricators used in locomotive service are either of the hydrostatic or of the force-feed type. With the hydrostatic type of lubricator the oil is forced through the feed nozzles by the pressure due to the weight of a column of water and is then carried through the oil pipes by a current of steam. With a force-feed lubricator, the oil is forced from the lubricator and through the oil pipes by mechanical means and neither water or steam pressure is used. The force-feed lubricator is really an oil pump, the mechanism of which is operated by some moving part of the locomotive, such as the valve-stem crosshead or the link. The principal reason for the use of the force-feed lubricator is that it is not influenced by the back pressure from the steam chest which at times affects to some extent the operation of the hydrostatic lubricator. With a hydrostatic lubricator, after the oil enters the oil pipe, the rate of its flow through the pipe is dependent on gravity, and on the difference between the steam pressure in the oil pipe and the steam chest. When working the locomotive with a full throttle for a considerable length of time, the difference between the pressures may finally not be enough to insure a proper flow of oil. The feed of the mechanical lubricator is based on the actual running speed of the moving parts, thus the feed increases with the speed, and decreases as the speed decreases. With the hydrostatic lubricator, the oil is fed on the basis of time, or so many drops per minute and can be varied at will; thus more oil can be fed with heavy loads at low speed than with light loads at high speed. There is not complete agreement as to whether correct lubrication should be based on the running speed or on a time basis.

46. Exterior View.—An exterior view of the Schlacks locomotive force-feed lubricator as manufactured by the United States Metallic Packing Company is shown in Fig. 17. The lubricator shown has four feeds, hence the oil pipes *a* lead to the steam pipe and cylinder on one side of the locomotive, and

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the oil pipes *b* to the steam pipe and cylinder on the other side. The pumping apparatus of the lubricator is operated by the lever pipe *d*, and the lubricator is filled by removing the filling cap *e*. The observation glasses *f* are used to determine the height of the oil. A heater pipe is connected to the opening *g*.

47. Arrangement.—The arrangement of the lubricator on the locomotive is shown in Fig. 18. The lever pipe *a* is connected by the pipe *b* to the top of the combining lever of the

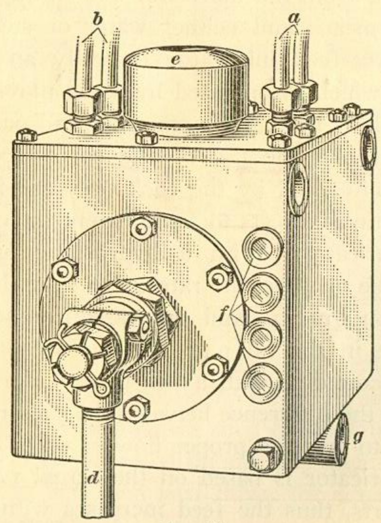
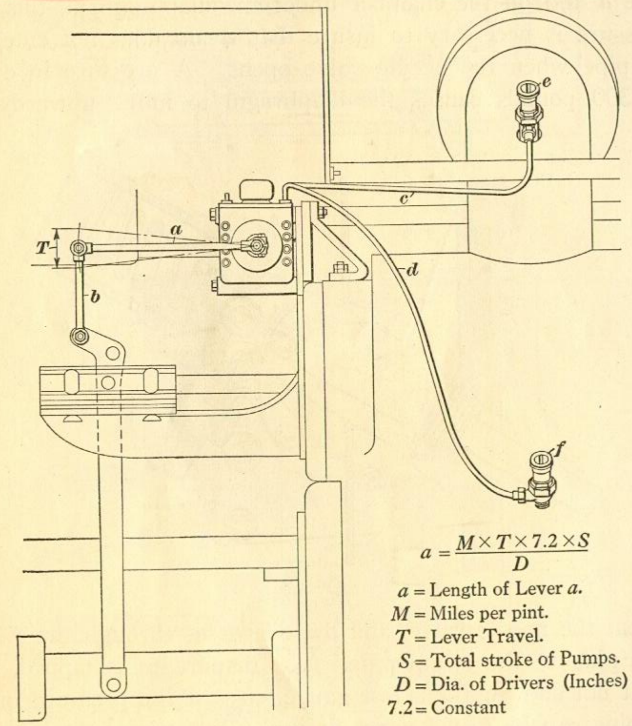


FIG. 17

valve gear and the oil pipes *c* and *d* are connected to terminal check-valves *e* and *f* tapped into the steam pipe and the cylinder, respectively. Two other oil pipes lead to the terminal check-valves on the other side of the locomotive. The lubricator is bolted to a bracket connected to the steam chest.

48. Terminal Check-Valve.—In Fig. 19 is shown a sectional view of the terminal check-valve and the steam-pipe plug, which is screwed into the steam pipe. A similar type of check-valve is used at the cylinder, except that the steam-pipe plug is omitted from the terminal check-valve. The cylinder check-valve is applied by drilling and tapping a $\frac{3}{4}$-inch hole in the

cylinder wall to within $\frac{1}{2}$ inch of the inside of the cylinder bushing. A $\frac{1}{4}$-inch hole is then drilled from the bottom of the $\frac{3}{4}$-inch hole to the inside of the cylinder. The purpose of the terminal check-valve is to prevent steam from entering the lubricator through the oil pipes and also to prevent the oil from being drained out of the oil pipes when the engine is drifting.



$$a = \frac{M \times T \times 7.2 \times S}{D}$$

a = Length of Lever a.
M = Miles per pint.
T = Lever Travel.
S = Total stroke of Pumps.
D = Dia. of Drivers (Inches)
7.2 = Constant

FIG. 18

Steam must not be allowed to enter the lubricator, because the condensation that results would leave the lower ends of the suction tubes submerged in water instead of oil, owing to the fact that the oil is lighter and would float on the surface of the water. When the locomotive is drifting, a partial vacuum forms in the steam pipes and cylinders, and in the absence of the diaphragm check-valves, the oil would be sucked out of the oil pipes.

49. The outer edge of the diaphragm *a*, Fig. 19, is held between the body and the retaining ring *b* when the spring housing is screwed down tight. The tension of the diaphragm spring is transmitted through the spring seat to the needle valve *c*. This spring is set by the spring screw cap to withstand an oil pressure of 300 pounds to the square inch in the oil pipe *d* and, in the chamber under the diaphragm *a*, this high pressure is necessary to insure that steam does not enter the oil pipe when the needle valve opens. A pressure in excess of 300 pounds causes the diaphragm to move upwards and

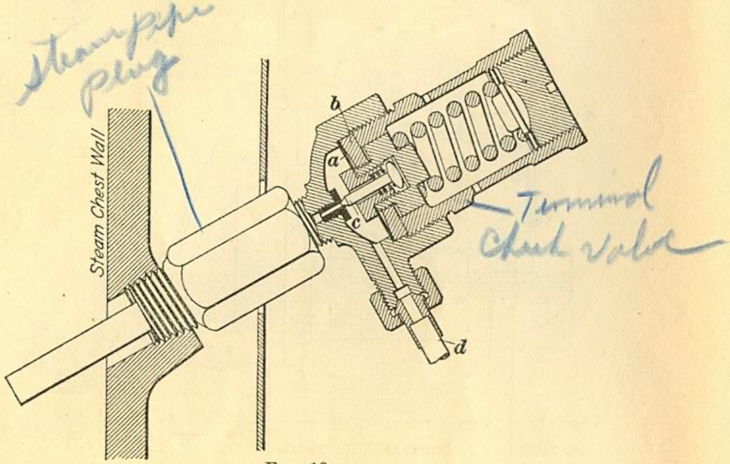


Fig. 19

unseat the needle valve, and the oil passes through the steam-pipe plug to the steam pipe. The diaphragm is tapped, at a point not shown, for a test gauge, so that the pressure in the oil pipe can be tested when desired. Sometimes the terminal checks are so piped that the one in the steam pipe feeds oil only when the locomotive is working steam, and the terminal check in the cylinder operates only when the locomotive is drifting.

50. Driving-Shaft and Cam-Shaft Arrangement.—The arrangement of the driving shaft *a*, the cam-shaft *b* and the cam *e* is shown in the sectional views of the six-feed lubricator in Figs. 20 and 21. The driving shaft partly rotates as the lever pipe *c* is moved back and forth. However, the arrangement is

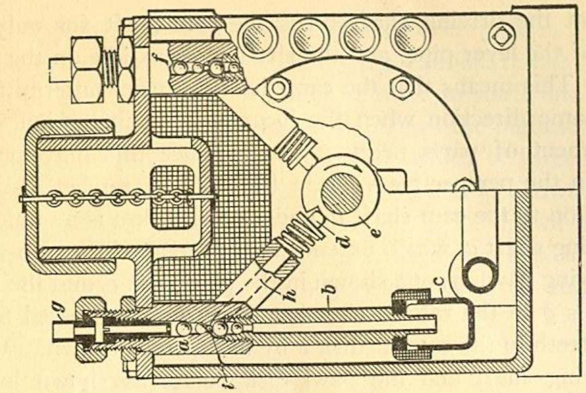


Fig. 21

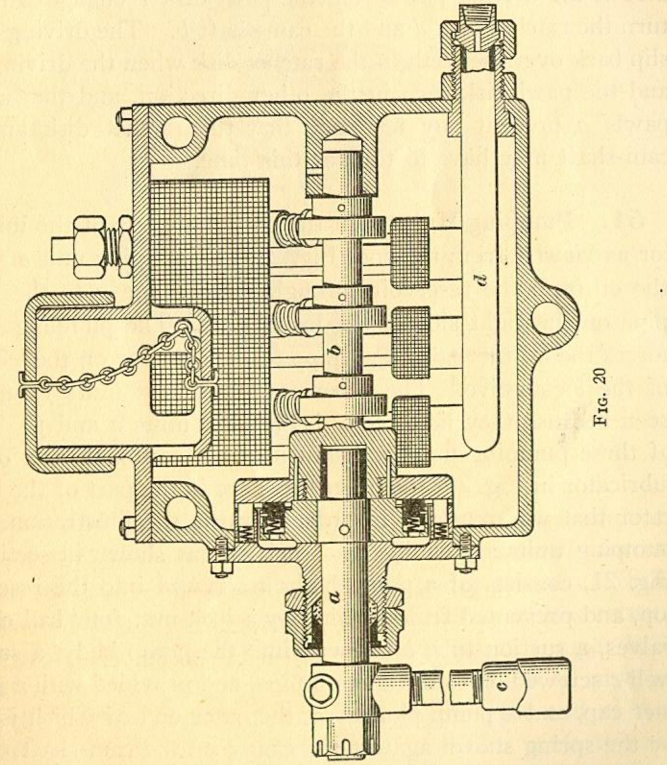


Fig. 20

such that the driving shaft turns the cam-shaft for only one stroke of the lever pipe, and the shaft remains idle on the other stroke. This means that the cam-shaft is turned intermittently in the same direction when the locomotive is in motion. The arrangement of parts necessary to produce this movement is shown in the perspective view in Fig. 22. A ratchet disk *d* is screwed on to the cam-shaft *b*, and a pawl disk *e* is mounted on the driving shaft *a*, which extends into the end of the cam-shaft. The driving pawls *f*, one shown in the pawl disk *e*, and the holding pawls *g* in the ratchet-chamber cover *h*, are pressed firmly against teeth in the ratchet disk *e* by the springs shown. When the driving shaft and the pawl disk rotate as shown by the arrow, the driving pawls *f* in the pawl disk *e* engage with and turn the ratchet disk *d* and the cam-shaft *b*. The driving pawls slip back over the teeth in the ratchet disk when the driving arm and the pawl disk turn in the other direction, and the holding pawls *g* prevent any tendency that the ratchet disk and the cam-shaft may have to turn at this time.

51. Pumping Units.—In the sectional view of the lubricator as viewed from the end, Fig. 21, the pumping unit *a* forces the oil from the reservoir through the oil pipe *g* to the steam pipe on the right side of the locomotive. The pumping unit *f* forces the oil through its oil pipe to the cylinder on the left side of the locomotive. The other four pumping units cannot be seen because they lie directly behind the units *a* and *f*. Three of these pumping units are shown in the sectional view of the lubricator in Fig. 20; the other three are in the part of the lubricator that was removed in order to make the illustration. All pumping units are similar and each one as shown in section in Fig. 21, consists of a pump body *a* screwed into the reservoir top, and prevented from turning by a lock-nut, four ball check-valves, a suction tube *b* screwed into the pump body, a suction well *c* screwed on to the suction pipe, and provided with a skimmer cap, and a pump plunger *d*, the outer end of which is held by the spring shown against the cam *e* on the cam-shaft. The end of the plunger of the other pumping unit is also in contact with the cam *e*.

52. Operation.—The action of the lever pipe *c*, Fig. 20, and the driving shaft *a* in turning the cam-shaft has already been explained. A slight rotation of the cam-shaft and cam *e*, Fig. 21, in the direction of the arrow draws the highest part of the cam from the end of the plunger *d*, which is forced by its spring down against the lowest part of the cam as shown. This movement of the plunger causes the oil to be drawn through the openings in the suction well and skimmer cap into passage *b*, then the oil moves the ball checks upwards and enters

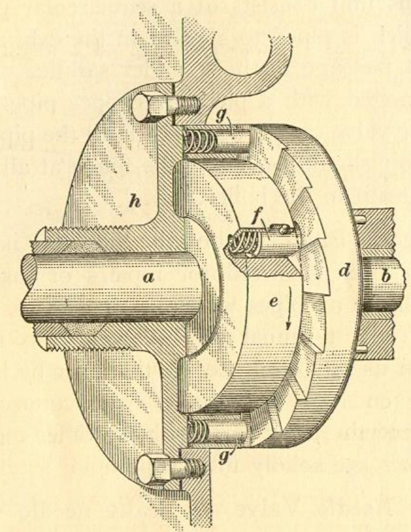


Fig. 22

chamber *h* and also through port *i* into a chamber in front of the plunger *d*. The rotation of the cam *e* now gradually forces the plunger *d* inwards and places the oil under pressure. The pressure of the oil seats the two lower ball checks and the return of the oil to the suction pipe is prevented; the two upper ball checks then unseat and permit the oil to pass to the oil pipe *g*. When the cam-shaft turns the cam far enough, the end of the plunger again falls off its highest point, and oil is again drawn into passage *b*. The opposite pumping unit is also operated in the same manner by the cam *e*. Each cam therefore operates two pumping units. Owing to the terminal check-valve at the steam pipe, the oil in the oil pipe is at a pressure of about 300 pounds, so that the two upper ball checks are used to prevent the return of the oil during the suction stroke of the plunger. Two ball checks are used, as this lessens the liability for leakage. The two lower ball checks are used for the same reason.

53. Heater Unit.—The oil in the oil reservoir is kept warmed by the heater unit *d*, Fig. 20, in the bottom of the oil reservoir. This unit consists of a semicircular piece of pipe, one end of which is piped to a valve in the cab, and the other to the exhaust passage in the cylinder saddle. The valve in the cab is arranged with a piece of copper pipe on the valve stem so that the valve cannot be closed until the pipe is removed. The oil reservoir should be hot to the touch at all times whenever there is steam in the boiler.

54. Filling Oil Pipes.—When the lubriator is first applied or after it has been removed for repairs or inspection, it is necessary to fill the oil pipes with oil. To do so, uncouple the oil pipes from the terminal check-valves, also uncouple the lever pipe from its link, and operate the lever by hand until oil appears at the ends of the pipes. Then connect up the oil pipes and operate the lever forty or fifty times more to insure that the oil pipes are solidly filled.

55. Leaky Needle Valve.—A leaky needle valve in the terminal check-valve permits steam to pass to the lubricator and affect its operation, as already explained. A leaky needle valve is indicated by the oil pipe being hot at a greater distance than 2 feet from it and they should be felt after each trip.

56. Length of Lever Pipe.—The length of lever pipe for any specified oil delivery can be calculated from the formula shown in Fig. 18. Assume total stroke of pumps is 1 inch and it is desired to deliver one pint of oil in 30 miles, that T is 4 inches and the diameter of the drivers is 72 inches, then $30 \times 4 \times 7.2 \times 1$ divided by 72 equals 12 inches.

DETROIT FORCE-FEED OILER

57. General Description.—The Detroit force-feed oiler is made with from one to eight feeds. Each feed is a separate unit and can be adjusted to vary the rate of oil delivery as desired.

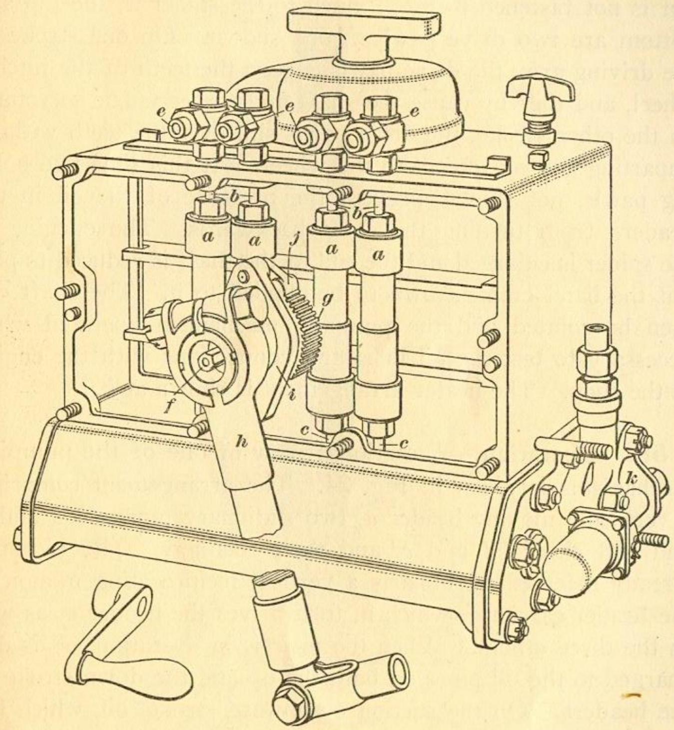


Fig. 23

A view of a four-feed force-feed oiler, designed to feed oil to each steam chest and cylinder, is shown with the cover removed in Fig. 23. The oil-pumping mechanism comprises four headers *a*, which operate up and down on the eight plungers *b* and *c*. The lower ends of the bottom plungers are in communication with the oil supply, and the upper ends of the top plungers connect to the oil pipes *e*. The vertical movement of the headers causes the oil to be drawn in to the bottom plungers and discharged through the top plungers to the oil pipes. The headers derive their movement from an eccentric secured to the inner portion of the shaft *f*. The shaft and hence the eccentric are caused to rotate as follows:

A *ratchet wheel g is secured to the shaft and the driving* arm *h* is connected to the spider *i*, which encircles the shaft but is not fastened to it. Pinned to the spider at the top and bottom are two drive pawls *j*, one shown. On one stroke of the driving arm, the drive pawls engage the teeth of the ratchet *wheel, and thereby cause the shaft and the eccentric to rotate;* on the other stroke, the drive pawls slip over the teeth without imparting any movement to the wheel. At this time two holding pawls, not shown, prevent the pressure of the oil in the headers from turning the shaft backwards. The opening in *the spider is enlarged and the end of the shaft is reduced to per*mit the hand crank shown to be applied to it. The shaft can then be rotated and the pumping mechanism operated when necessary to test the oil lines and connections with the engine in the shop. The heater arrangement is shown at *k*.

58. Operation.—A sectional view of one of the pumping mechanisms is given in *Fig. 24*. The arrangement comprises a vertically moving header *a*, two stationary plungers *b* and *c*, and ball checks *d* and *e*, and their retainers. The eccentric already referred to, imparts a vertical reciprocating motion to the header carrier *f*, which in turn drives the header *a*, as well as the three others. *When the oiler is in operation, oil is dis*charged to the oil pipes on both the up and the down stroke of the headers. On the suction or upward stroke, oil, which has been filtered through the strainers *g*, is drawn past the ball checks *d* and through the plunger passage *h* to chamber *i*. On *the down stroke the ball checks prevent the return of the oil,* and the oil in chamber *i* is forced through passage *j*, past the spring-loaded ball check *e*. The plunger *b* has only half the displacement of the plunger *c*, therefore, on the down stroke, one-half of the oil is forced through passage *k*, past the ball check *l*, and is discharged into the oil delivery pipe. The other half of the oil from chamber *i* is drawn into chamber *m* and

remains there until the header reverses its cycle of travel. The remaining oil is then forced on the upward stroke of the header through passage *k*, past the ball check *l* and is likewise dis-

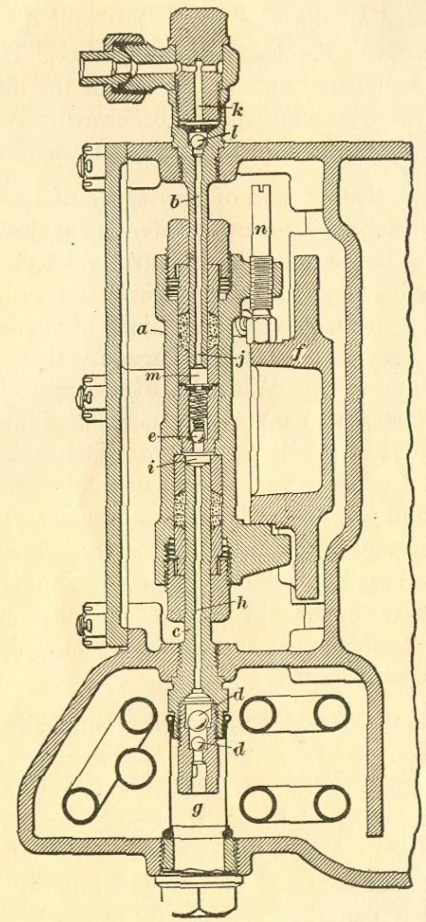


FIG. 24

charged into the oil delivery pipe. The rate of oil delivery can be regulated by the feed adjusting screw *n*, one for each feed. With the screw turned to the right until it is all the way down as shown, the header receives its greatest movement from the header carrier and the maximum amount of oil is pumped. The carrier, when the screw is turned to the left, imparts less movement to the header and the rate of oil delivery reduces. The header carrier will not come in contact with the screw when it is turned all the way to the left and the pumping of oil stops. Access to the feed adjusting screws is obtained by loosening two castellated nuts on the top of the oiler, and then swinging the two protecting plates backward. A screwdriver is then inserted, and the adjusting screws turned.

59. Heater.—Either one of two types of heaters may be used. An adjustable heat-control valve is regularly furnished, but if desired a thermostatic heat-control valve can be applied. The adjustable heat-control valve is furnished with a disk with three ports of $\frac{1}{16}$ inch, $\frac{3}{16}$ inch, and $\frac{1}{4}$ inch in diameter, and any of these ports may be adjusted to engage with the steam passage through the valve. With the thermostatic heat control, the passage of steam to the heater units is controlled by the action of a liquid in a bulb an arm of which extends into the oil. The liquid expands and contracts as the temperature of the oil varies and this action imparts movement to a valve that controls the passage of steam to the heater. The heater with either type of heat control consists of two units. One unit keeps the oil warm in the oil reservoir; the other unit keeps the oil in the compartment that surrounds the suction screens at a relatively high temperature.

60. Terminal Check-Valve.—A sectional view of the terminal check connected to the steam-pipe plug extension is shown in Fig. 25. The diaphragm *a* is made up of a series of thin diaphragms of special alloy steel and no additional spring loading is required. When the pressure of the oil in passage *b* exceeds the pressure exerted by the diaphragm on the valve *c*, the diaphragm is deflected, and the oil passes by the unseated valve to the steam pipe and steam chest. By removing the pipe plug *d*, a pressure gauge may be attached for testing the piping and connections, also, when testing to see whether the checks are holding the specified pressure. The terminal check should be located as high up in the steam pipe as possible so as

to permit the oil that is atomized at the tip of the plug extension, to mix thoroughly with the steam. The steam-pipe plug extension should be located at about an angle of 30° from the horizontal. The terminal check-valve is set to open at 275 to 325 pounds per square inch. The adjustment of the pressure at which the valve operates is obtained by changing the num-

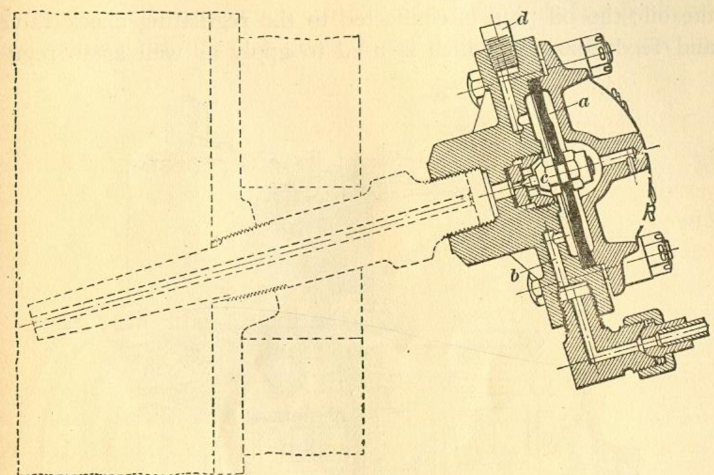


FIG. 25

ber of .008-inch-thick, copper gaskets between the diaphragm and the body of the valve, which change alters the distance from the seat to the diaphragm. The addition or removal of one of these gaskets causes the pressure at which the check opens to decrease or increase approximately 35 pounds per square inch.

FLANGE OILERS

DETROIT AUTOMATIC FLANGE OILER

61. Purpose.—The purpose of the Detroit flange oiler is to apply lubrication to the flanges of the driving wheels so as to reduce the wear of the flanges, as well as of the rails, switches, and frogs. The flange oiler is made with two and four feeds. With the two-feed type, lubrication is applied to the flanges of the front pair of driving wheels; with the four-feed type, the oil is applied to the flanges of the front pair of driving wheels, and to the flanges of either the intermediate pair or the rear pair of driving wheels. A good grade of thin crude oil of such a nature as not to deposit solids is used in the oiler.

62. Description.—A Detroit two-feed automatic flange oiler is shown installed on the valve-stem guide of a locomotive in Fig. 26. The arrangement consists of a tank *a* that contains the oil; the oil pipe *b*, connected to the regulating check-valve and feed nozzle *c*, which is used to apply as well as to regu-

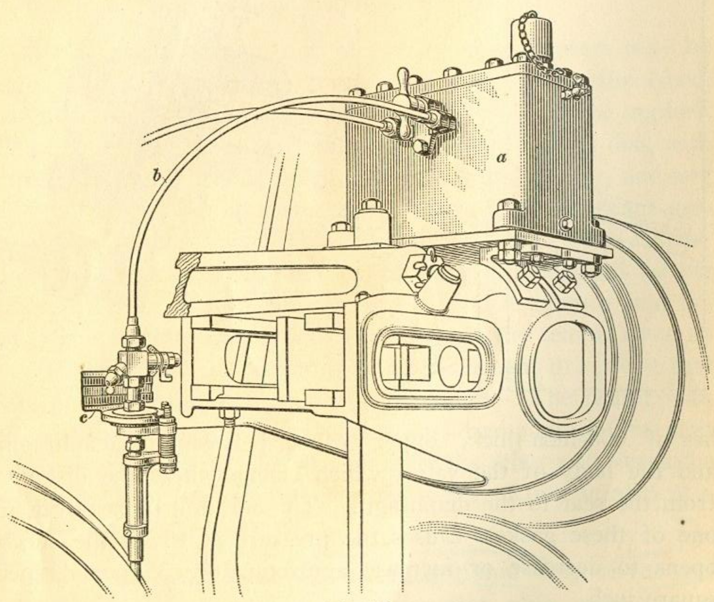


FIG. 26

late the amount of oil that is applied to the flange of the driving wheel. The other oil pipe shown is connected to the regulating check-valve and feed nozzle on the other side of the locomotive. An exterior view of a four-feed flange oiler, with a part of the wall of the tank and the pumping mechanism cut away, is shown in Fig. 27. The pumping mechanism for the oil pipe *a* consists of a pendulum *b* mounted on the shaft *c*, the ends of which are carried in bearings in the walls of the tank, a plunger *d* operated by a rocker *e* on the shaft, and a suction

pipe *f*. The shape of the rocker is such that a partial rotation of the shaft will cause a vertical movement of the plunger. A plunger *g* similarly arranged on the other side of the shaft is used to discharge oil to the other oil pipe, not shown. The other pendulum *h* is used to actuate a shaft similar to the shaft *c*, as well as two plungers for the delivery of oil to the two other oil pipes. The primer *i* is used to operate the shaft *c* by hand and thereby fill the oil pipes, should they be empty due to

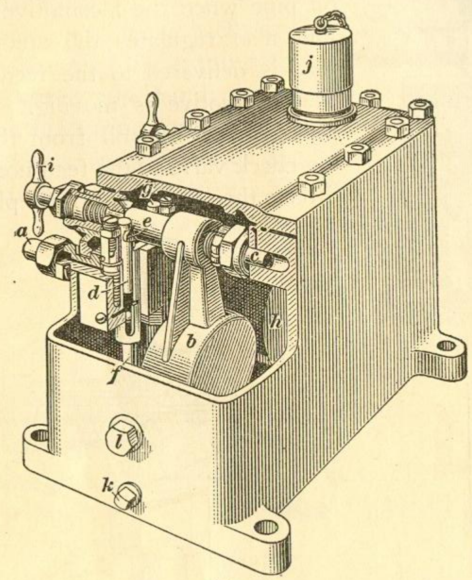


FIG. 27

repairs to the lubricator. In order for a rib on the end of the primer to engage with a slot in the end of the shaft, the primer handle has to be pushed in against the tension of the spring shown as well as turned until the two engage. The tank is filled by removing the cap *j* and the tank is drained by removing the plug *k*. The inner end of the plug *l* is threaded so that a brass rod can be screwed into it to keep the pendulum from swinging during shipment.

63. Regulating Check-Valve and Feed Nozzle.—In Fig. 28 is shown the regulating check-valve *a*, also the feedpipe *b* and the feed nozzle *c*. The connection between the regulating check-valve and the feed pipe is made by a ball-and-socket-joint, and the bracket springs *d* keep the point of the feed nozzle thrust at all times into the fillet of the flange. The ball-and-socket joint permits the feed nozzle to move freely with the lateral movement of the driving wheel. The regulating check valve retains the oil in the oil pipe when the locomotive is at rest, and also regulates the amount of oil that is delivered to the feedpipe when the locomotive is moving. The feedpipe conveys the oil from the regulating check valve to the feed nozzle, which directs the oil to the proper place on the flange. A series of holes are drilled in the feed nozzle in order to make possible readjustments that become necessary because of its wearing against the flange. The nozzle is connected to the feed pipe by the cotter *e*. The feed nozzle should be turned half way around each time it is adjusted. When the feed nozzle is worn out by rubbing against the flange, it can be easily replaced by a new one. The bracket *f* on the feed nozzle in combination with the clamp and the bracket bolts shown are used to secure the device to the support bracket on the engine.

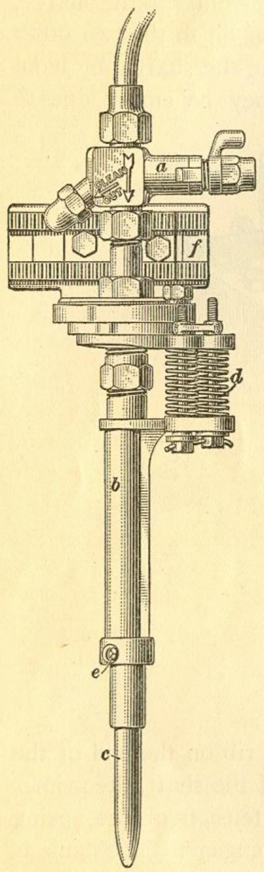


FIG. 28

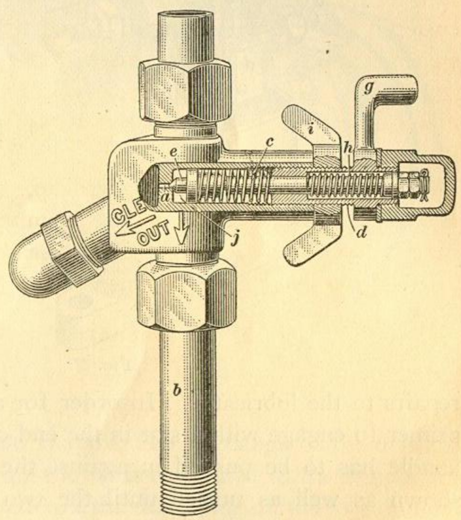


FIG. 29

64. In the sectional view of the regulating check-valve shown in Fig. 29, the amount of oil that can pass through the opening *a* to the feedpipe *b* is governed by the distance the tension of the springs *c* and *d*, which are of unequal strength, permit the valve *e* to move backwards. The movement of the valve can be changed by turning the adjusting stem *d* by its handle *g*. Turning the handle to the right screws the stem *d* in, and places the spring *c* under greater tension, thereby reducing the backward movement of the valve *e*. The counterspring *h* permits of a sensitive adjustment of the valve. As the adjusting stem is screwed in by turning the handle *g*, the tension of the heavier spring *c* is increased and the tension of the lighter counterspring is decreased owing to the adjusting stem moving away from the inner end of the spring. A movement of the handle to the left has a reverse effect on the tension of the springs.

The thumb nut *i*, when screwed up, prevents any change in regulation. When the oil in the chamber *j* is not under pressure, the springs keep the valve *e* seated. The drain cap is provided to clean out the sediment that is deposited from the oil.

OPERATION

65. Pumping the Oil.—The pendulum *b*, Fig. 27, is so sensitive that the lateral movement of the locomotive will cause it to swing and oscillate the shaft *c*, which in turn will cause the plunger *d* to make a stroke. On the up stroke of the plunger *d*, Fig. 30, the oil is drawn up from the tank through the suction pipe *e* past the ball check *f*. On the down stroke, the ball check closes the passage in the suction pipe, and the ball check *g* that is held seated by the spring shown is forced open, and the oil passes through the passage *h* to the oil pipe. While the plunger is making an up stroke again, the ball check *g* prevents the oil from returning from the oil pipe and interfering with the inflow of oil through the suction pipe. The pressure of the oil in the oil pipe forces the valve *e*, Fig. 29, backwards, and the oil then passes through the port *a* and flows by gravity through the feedpipe *b* to the feed nozzle. The by-pass valve *i*, Fig. 30, is provided to prevent the pressure in the oil pipe from increasing above a certain specified amount should the pipe for any reason become stopped up. The spring shown is set by the setscrew for a pressure of 50 pounds, which is the maximum desired in the oil pipe. Should this pressure be reached at any time the oil, which always fills the space below the by-pass valve when the oiler is operating, will lift the valve and pass through the passage *j* back into the oil tank.

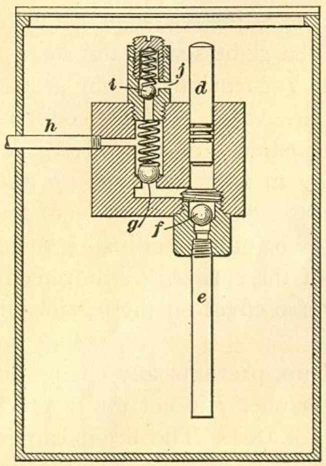


Fig. 30

66. Filling.—To fill the tank remove the filler cap and open the air cock to permit the escape of air. Fill the tank with the proper grade of oil and replace the filler cap and close the air cock. An oil strainer is inserted in the filler cock to prevent foreign matter from entering with the oil, but in addition the oil should be poured into the tank through a funnel also provided with a strainer of perforated metal.

67. Testing.—To determine whether the pumping mechanism is forcing oil through the oil pipes remove the drain cap on the regulating check-valve and work the primer at the oil reservoir until oil appears at the check-valve. To test the oil pipes for leakage, replace the drain cap, close the regulating valve by turning the handle to the right, and work the primer until the oil is under pressure in the pipes. Then examine all joints for leaks.

68. Regulation.—The proper regulation of the oil supply is important because, if too much oil is fed, some of it will get on to the tread of the tires and cause the driving wheels to slip. To regulate the amount of oil that is delivered to the flange, open the regulating check-valve four complete turns from closed position by means of the adjusting handle, and lock the handle in position by means of the locknut. The valve is in closed position when the adjusting stem is screwed in as far as the thread permits. The regulating check-valve when open four turns feeds about the proper amount of oil required for average service. After setting the regulating check-valve, operate the primer until oil appears on the nozzle feed point. The proper adjustment of the regulating valve can be determined after the oiler has been put in service. The effect desired is to have the flange coated with a thin film of oil, but not to such an extent that the oil will be thrown off the flange.

69. Cleaning.—The drain plugs should be removed and the oil tank should be thoroughly washed out every 6 months. The oil tank should be drained at least once a month in cold weather to remove any water that may accumulate, and thereby prevent freezing.

CHICAGO AUTOMATIC FLANGE OILER

70. Description.—The Chicago automatic flange oiler is manufactured by the Ohio Injector Company and is made with two and four feeds. An exterior view of the two-feed type is shown in Fig. 31. The oiler operates on about the same principle as a hydrostatic lubricator and feeds heavy asphaltum oil to the flanges of the wheels by means of a current of steam. Valve oil, engine oil or grease must not be used because any of these would cause the wheels to slip. A diagrammatic view of the oiler with one feed shown is given in Fig. 32. The steam passes to the flange oiler through the pipe *a* and the choke shown, to the condenser coil *b*. The choke has a $\frac{1}{16}$-inch opening and reduces the pressure of the steam from 200 pounds to 85 pounds. The steam condenses in the condenser coil and the water passes by the condenser valve ball *c* and the water pipe *d* to the oil bowl *e*. The condenser coil is used instead of a condensing chamber as with lubricators, because on account of a lower grade of oil, it is necessary to have the water enter the oil bowl cooler than otherwise, and the coil has a greater radiating surface than a condensing chamber. The passages *f* and *g* and the passage in the feed tip *h* connect the oil bowl with the sight-feed chamber and the delivery pipe *i*. The steam

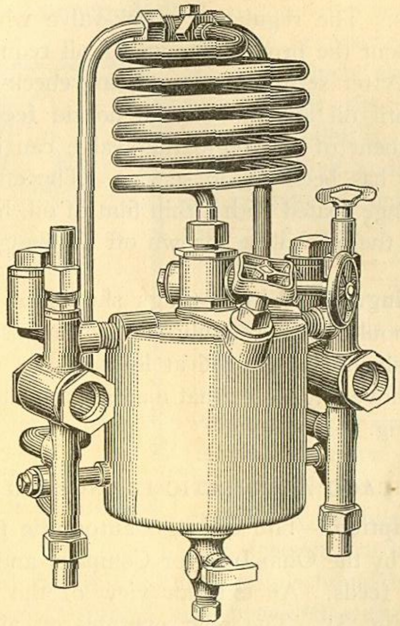


Fig. 31

circulating pipe *j* leads from the top of the condenser coil to a point in the delivery pipe just below the sight-feed chamber. The delivery pipe has a small choke which reduces the steam pressure already lowered by passing through the choke in the steam pipe, to such an extent that there is no gauge pressure at the flange nozzle *k*. Too much pressure at the flange nozzle would be undesirable because the oil would be distributed to a greater extent than necessary and slipping would probably occur.

71. The oil bowl is filled by removing the filler plug at the top and is drained by opening the drain valve at the bottom. The feed valve *l*, Fig. 32, controls the amount of oil that passes through the feed tip *h*. The feed valve is so made that it can-

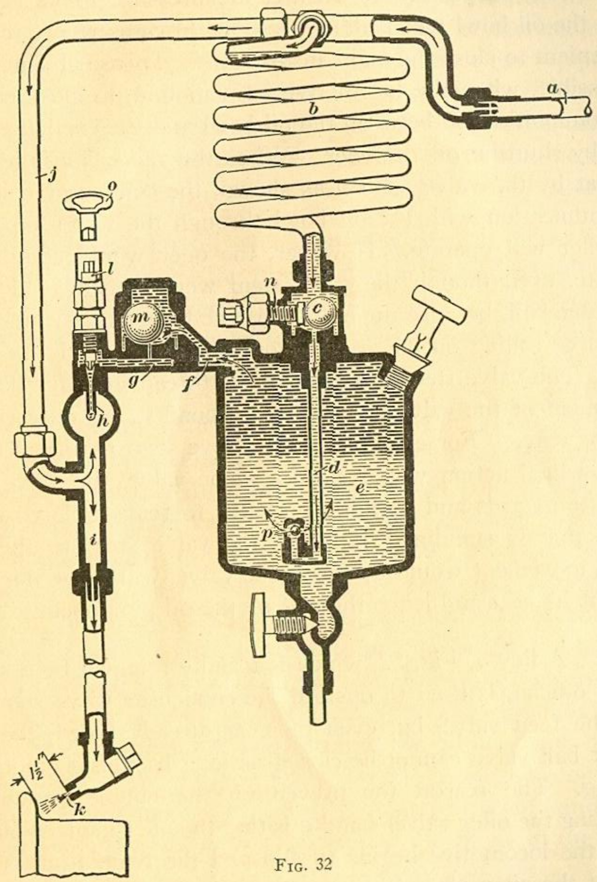


Fig. 32

not be entirely closed. The ball feed valve *m* is used to prevent the passage of oil from the oil bowl to the delivery pipe when the locomotive is not running. The ball operates on a six-degree disked seat, and the ball, owing to the motion of the locomotive when it is running, rolls on its seat and keeps opening and closing the passage in the seat. When the locomotive stops, the valve moves by gravity to the lowest point of its seat and closes the passage. The condenser valve ball *c*, which also operates on a disked seat similar to the ball feed valve, serves two purposes. It permits the pressure to be shut off from the oil bowl when filling the bowl in cases where it is not convenient to close the main steam valve. Its use also makes it impossible, when the locomotive is in motion, to close entirely the communication between the oil bowl and the condenser coil, thereby shutting off the oiler. When the valve ball is held off its seat by the valve stem *n* as shown, the condenser coil is in communication with the oil bowl through the water pipe, and the oiler will operate. However, the oiler would continue to operate, even though the valve stem were turned away from the valve ball, because the motion of the locomotive would keep the valve rolling on its seat and opening the end of the water pipe. The valve stem has a left-hand thread in order that the movement of the valve ball will correspond to the operation of a globe valve. For example, if the valve stem is turned to the right, which action would close a globe valve, the valve stem moves outwards and permits the valve to remain closed if the locomotive is standing. Turning the valve stem to the left, which movement would open a globe valve, will move the valve ball off its seat and leave the end of the oil pipe open.

72. A key *o*, Fig. 32, which is usually retained by a supervising official, is used to operate the condenser valve stem and also the feed valve, but even then, as already noted, the condenser ball valve cannot be closed as long as the locomotive is moving. The reason for preventing the engine crew from operating the oiler valves *l* and *n* is that the oiler is often blamed when the locomotive begins to slip and the temptation is then to shut the oiler off. As a further precaution against shutting the oiler off, the steam pipe to it is usually tapped into the compressor steam line so that the oiler cannot be shut off without stopping the compressor. The ball check-valve *p* prevents the oil from the oil bowl from passing up into the condenser coil when the oiler is shut off.

73. Operation.—With the oil bowl filled and the steam turned on to the oiler, the condenser coil and the water pipe fill with water. The pressure due to the weight of the water in the condenser coil forces the oil through the passages *f* and *g*, Fig. 32, and thence through the passage in the feed tip *h*. The oil drops from the end of the feed tip and is carried by the steam from the circulating pipe through the delivery pipe and the flange nozzle *k* against the flange of the wheel. The motion of the locomotive keeps the ball feed valve *m* moving and the passage in its seat is never closed for any length of time unless the locomotive stops, in which event the oiler stops operating.

74. Filling.—To fill the oiler shut off the steam at the source of supply, open the drain valve so as to drain all water from the oil bowl and remove the filler plug. Then close the drain valve, fill the oil bowl with a special oil furnished by the manufacturer, and replace the filler plug.

75. Cleaning.—The oil used in the oiler is of a heavy nature and the oiler should be thoroughly cleaned once a month. To do so, proceed as follows: Drain all oil from the oil bowl by opening the drain valve, and close the condenser ball valve by turning the stem to the right with the key provided for that purpose. Then disconnect the steam pipe and remove the choke in the steam line so that full pressure will be admitted to the oiler; next couple up the steam pipe without the choke and turn on full steam pressure. Then open one feed valve at a time, thereby permitting the steam from the circulating pipe to blow back through the feed tip into the oil bowl and out the drain valve. After all the feeds have been cleaned, open the condenser ball valve by turning the stem to the left and blow out the condenser coil. Finally, replace the choke in the steam pipe.

76. Location of Flange Nozzle.—The proper location of the flange nozzle with respect to the flange of the driving wheel is shown in Fig. 32. The distance between the end of the nozzle and the throat of the flange should be $1\frac{1}{2}$ inches, as shown.

Date:	**Description**	
8/28/2009	Original release	
9/10/2009	Revised release	Electronic Devices
1-31-2010	Revised Release	Standard Clock

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