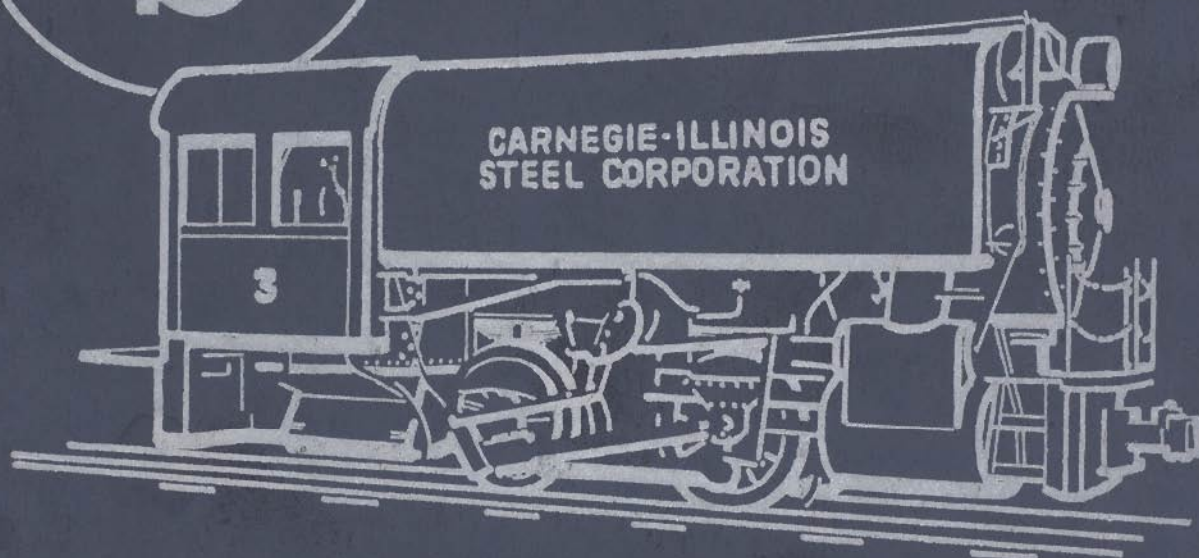


NARROW GAUGE
LOCOMOTIVE OPERATOR'S
TRAINING MANUAL



• INDUSTRIAL RELATIONS •

CARNEGIE-ILLINOIS STEEL CORPORATION



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NARROW GAUGE LOCOMOTIVE
OPERATOR'S MANUAL

APRIL 1943

Industrial Relations
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FOREWORD

This manual was developed for the training of narrow gauge locomotive operators and is adapted from material originally prepared by the Homestead Steel Works' Maintenance Division and Industrial Relations Department, Training Division. Acknowledgment is made to James B. Quigg, narrow gauge locomotive job instructor, Homestead Steel Works, for his recommendations regarding the presentation of the material. Appreciation is also expressed to the locomotive companies who contributed suggested descriptive material, and to the H. K. Porter Company of Pittsburgh, Pennsylvania, who furnished material for the photographs and drawings reproduced in the manual.

INTRODUCTION

This manual has been prepared for the men of the Narrow Gauge Department who have the qualifications and the desire to become certified locomotive operators. Every phase of the Narrow Gauge Locomotive operations is presented here. The operator should know and understand the information in this manual to become a certified operator. This information will be supplemented by on-the-job instruction given by the Narrow Gauge job instructor.

A Narrow Gauge locomotive is small in size when compared to standard gauge. It is capable of performing heavy work when operated by a man who knows his job. It also is capable of causing considerable damage when operated by careless workers or untrained workers. This damage can mean loss of life to the operator or to fellow workers; or damage to the locomotive itself, or to other valuable equipment, as well as slowing down production, or loss of locomotive power.

All repairs necessary to the operation of locomotives are done in the Narrow Gauge Locomotive Repair Shop. This shop tries to improve the operation by making up-to-date changes in parts and construction. Competent operators can assist in this repair job by making minor adjustments and reporting broken parts, parts needing adjustment, parts that are not doing the work for which they are designed, and by operating the locomotive in the manner in which they are instructed.

Safety experience and hazards of the job necessitate that operators' safety rules and regulations be set up in the Narrow Gauge Department. These rules and regulations are for the protection of the operators and other employees. Many times these regulations prevent collisions or rail mix-ups. All operators must be thoroughly familiar with and observe these safety rules and regulations.

The first part of the manual covers all the locomotive parts and their use. The second part of the manual lists the work which an operator must know and do. The third part deals with the safety rules and regulations. The operator should note that this manual has been prepared specifically for his training and education. It is the desire of the Narrow Gauge Department that the operator make as much use of this information and the job instructor as practical.

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TYPES AND PARTS
OF
THE NARROW GAUGE LOCOMOTIVE

SECTION I

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

A. THE H. K. PORTER AND THE VULCAN LOCOMOTIVES

The two types of Narrow Gauge locomotives used in the Homestead Steel Works are the H. K. Porter, made by the H. K. Porter Company, Pittsburgh, Pennsylvania, and the Vulcan, made by the Vulcan Iron Works, Wilkes Barre, Pennsylvania. The Porter locomotive illustrates the Walschaert Piston Valve gear (Figure 1) and the Stephenson Slide Valve gear (Figure 2). The Narrow Gauge Department has 51 Porter locomotives and 2 Vulcan locomotives. The Porter locomotives range in weight from 20 to 60 tons, and the two Vulcans are 40 tons each. Both engines operate on 30-inch gauge track.

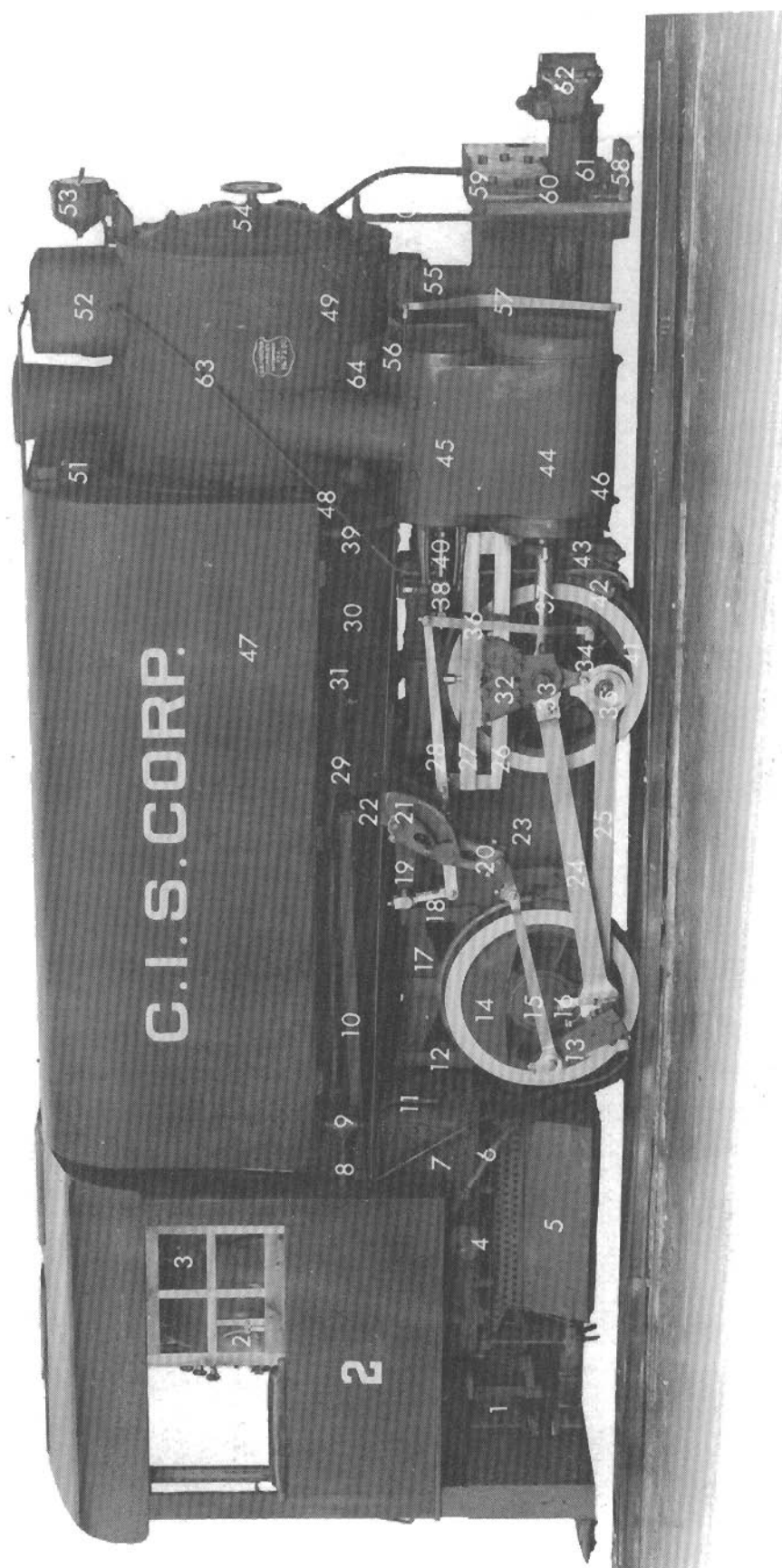
The correct designation of locomotive power is given in terms of diameter of the cylinder and the length of the piston stroke. The Porter locomotives vary in cylinder diameter from 12 inches to 18 inches, and the length of the stroke varies from 16 inches to 22 inches. Both Vulcan engines are rated at 14 inches by 18 inches. The traction or holding power of the smaller Porter locomotives range from 200 to 243 tons, and the larger Porter locomotives range from 1,119 to 1,639 tons. The Vulcans have a holding power of 700 tons each. The steam pressure allowed on all locomotives ranges from 125 to 200 pounds. The maximum pressure to be carried is regulated by the State Boiler Inspector.

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

Porter Locomotive Walschaert Piston Valve

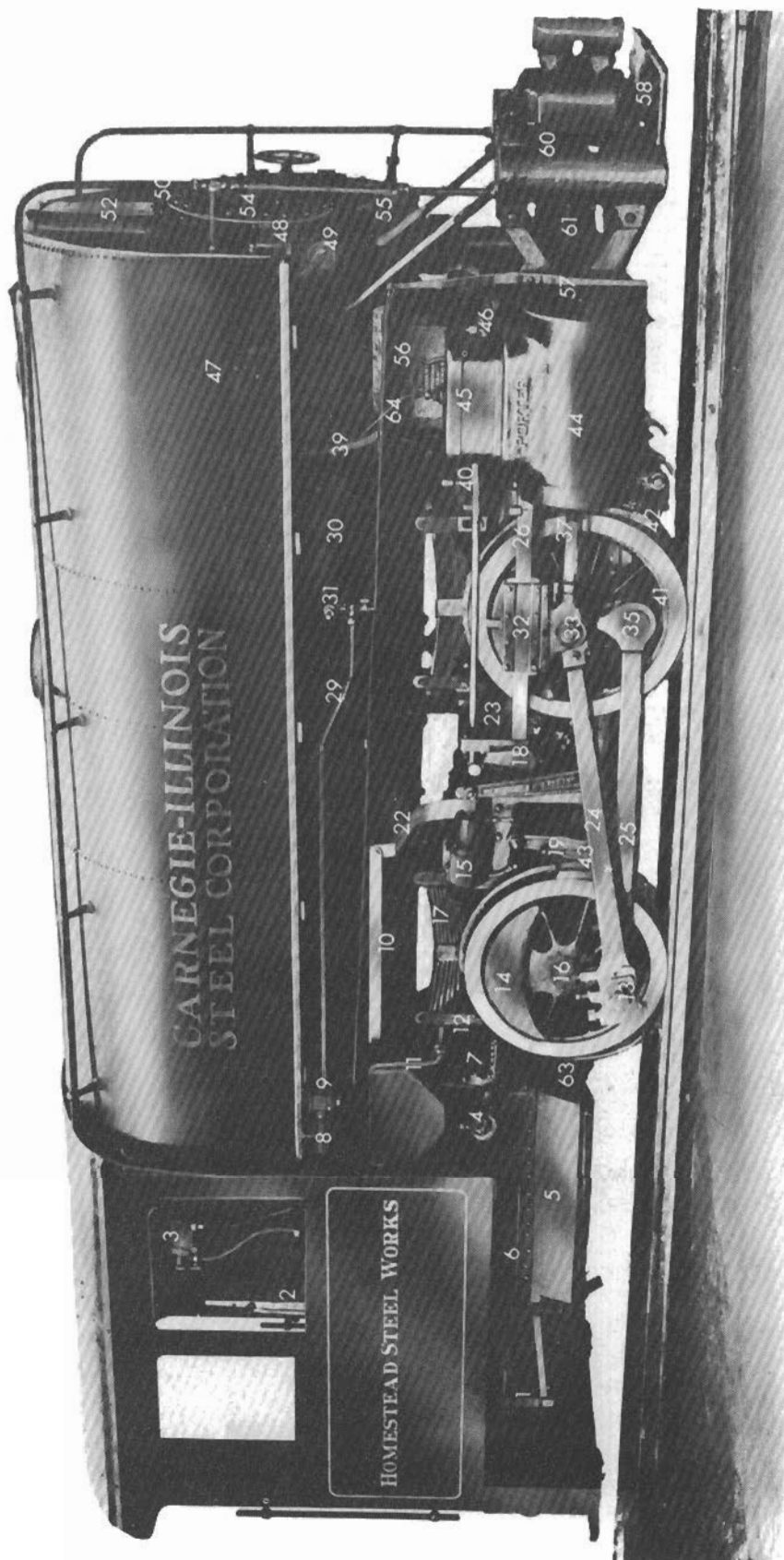
1. Grate Shaker	17. Spring	33. Wrist Pin	49. Poke Hole
2. Reverse Lever	18. Radius Rod Lifter	34. Union Link	50. Hand Railing
3. Injector	19. Radius Rod Arm	35. Collar Plate	51. Bell
4. Blow-off Cock	20. Links	36. Lap and Lead Lever, Combination Lever	52. Sand Box
5. Ash Pan	21. Link Hanger	37. Piston Rod	53. Headlight
6. Waste Pipe	22. Reverse Shaft Arm	38. Valve Rod Crosshead	54. Smoke Box Door
7. Fire-box	23. Frame	39. Equalizing Pipe	55. Cinder Hopper
8. Feed Line	24. Main Rod	40. Valve Stem	56. Cylinder Saddle
9. Strainer Body	25. Side Rod	41. Tire	57. Cylinder Cock Arm
10. Reach Rod	26. Guide Bar	42. Brake Shoe	58. Steps
11. Steam Pipe to Brake Cylinder	27. Top Guide Bar	43. Brake Clog	59. Platform
12. Spring Hanger	28. Radius Rod	44. Cylinder	60. Pilot Log
13. Eccentric Crank	29. Branch Pipe	45. Steam Chest	61. Draft Gear
14. Counter Balance	30. Boiler	46. Relief Valve	62. Drawhead
15. Eccentric Crank Rod	31. Boiler Check	47. Tank	63. Sand Pipe
16. Axle	32. Cross head	48. Hand Hold Plate	64. Tallow Pipe

Figure 1



Porter Locomotive With Walschaert Valve

Figure I



Porter Locomotive With Stephenson Slide Valve

Figure 2

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

Porter Locomotive
Stephenson Slide Valve

1. Grate Shaker	14. Counter Balance	31. Boiler Check	47. Tank
2. Reverse Lever	15. Brake Cylinder	32. Cross head	48. Hand Hold Plate
3. Injector	16. Axle	33. Wrist Pin	49. Poke Hole
4. Blow-Off Cock	17. Spring	35. Collar Plate	50. Hand Railing
5. Ash Pan	18. Rocker Arm	37. Piston Rod	52. Sand Box
6. Waste Pipe	19. Brake Hanger	39. Equalizing Pipe	54. Smoke Box Door
7. Fire-box	22. Reverse Shaft Arm	40. Valve Stem	55. Cinder Hopper
8. Feed Pipe	23. Frame	41. Tire	56. Cylinder Saddle
9. Strainer Body	24. Main Rod	42. Brake Shoe	57. Cylinder Cock Arm
10. Reach Rod	25. Side Rod	43. Brake Clog	58. Steps
11. Steam Pipe to Brake Cylinder	26. Guide Bar	44. Cylinder	60. Pilot Log
12. Spring Hanger	29. Branch Pipe	45. Steam Chest	61. Draft Gear
13. Main Driving Pin	30. Boiler	46. Relief Valve	63. Sand Pipe
			64. Tallow Pipe

Figure II

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

B. THE BOILER

A locomotive is a steam power plant on wheels. It consists of two steam engines and one boiler on one frame. A steam engine is a machine for converting heat into mechanical power. The boiler generates the steam to operate the steam engines. Therefore, it is the most important part of the locomotive.

The principal parts of a boiler (Fig. 3) are:

1. THE BARREL is round in shape. The boiler flues (#2) are in the barrel and extend from the fire-box to the smoke box.
3. THE FIRE-BOX is at the rear of the barrel. The crown sheet (#4) side and end sheets (#5) make up the fire-box. The mud ring (#28) is under the fire-box and is a part of the boiler. All sediment in the boiler drains into the mud ring because it is the lowest part of the boiler. The drain plugs are opened to clean out the mud ring. The fire door (#27) is the opening of the fire-box.
6. THE SMOKE BOX is in front of the barrel. All smoke from the fire-box is carried through the flues to the smoke box, through the petticoat pipe (#8) and out the stack (#7). Exhaust steam is also taken out through the smoke box, through the petticoat pipe and out the stack.
9. A BLOWER PIPE is a steam jet placed in the smoke box to create a draft in the fire-box by exhausting through the flues, the petticoat pipe and out the stack. The stack also has a diaphragm (#10) and diaphragm plate (#11) set in it to regulate the draft and they act as a damper. A netting (#12) is also placed in the stack to break up heavy cinders before they go out the stack.
13. THE STEAM DOME is on top of the boiler. It is the storage place for dry steam.
14. THE THROTTLE VALVE, operated from the locomotive cab by the throttle lever, is located in the elbow (#18) of the stand pipe (#19) in the steam dome.
15. THE TWO SAFETY POP VALVES are mounted in the steam dome. They are set to release steam from the boiler when the steam pressure in the boiler exceeds the maximum pressure permitted on it by the state boiler inspector. The maximum pressure allowed on a boiler is marked on the State Inspection Certificate which must be in the locomotive cab at all times. There are two safety pop valves on a locomotive, one of which is set at the maximum limit and the other about three pounds higher. It works when the other pop valve fails. Both valves blow down to five pounds under the maximum pressure before they stop.

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

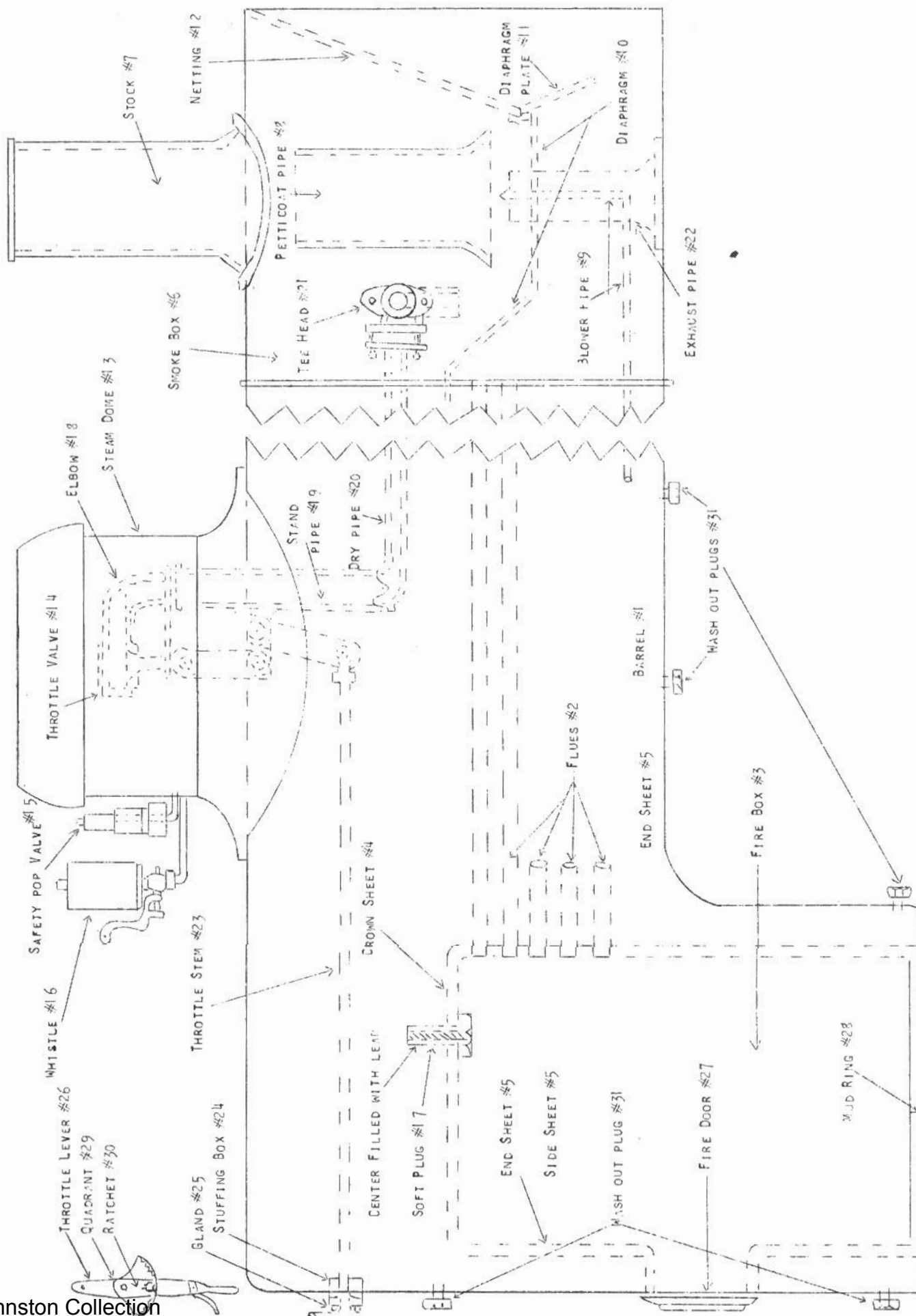


Figure 3

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

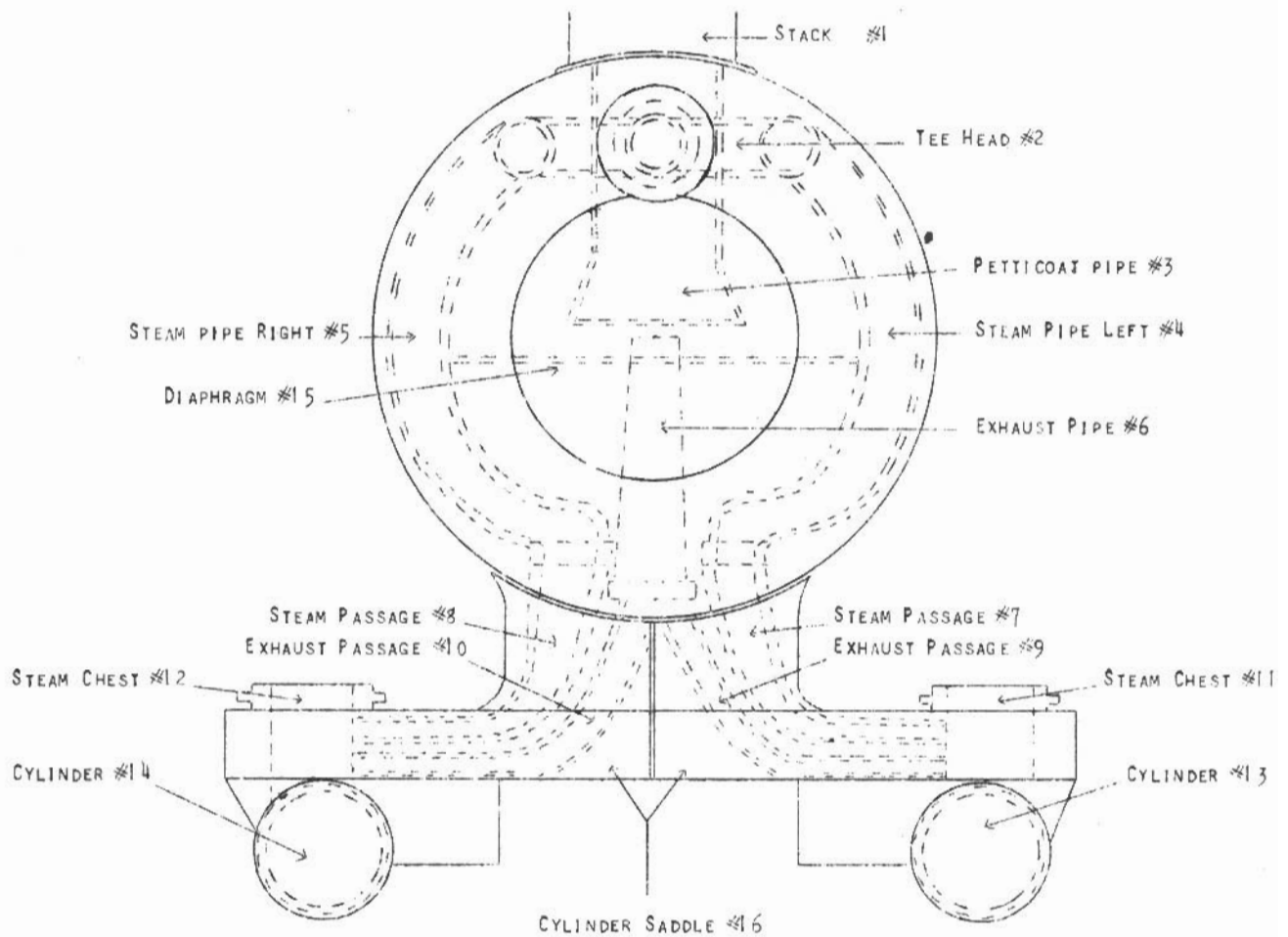


Figure 4

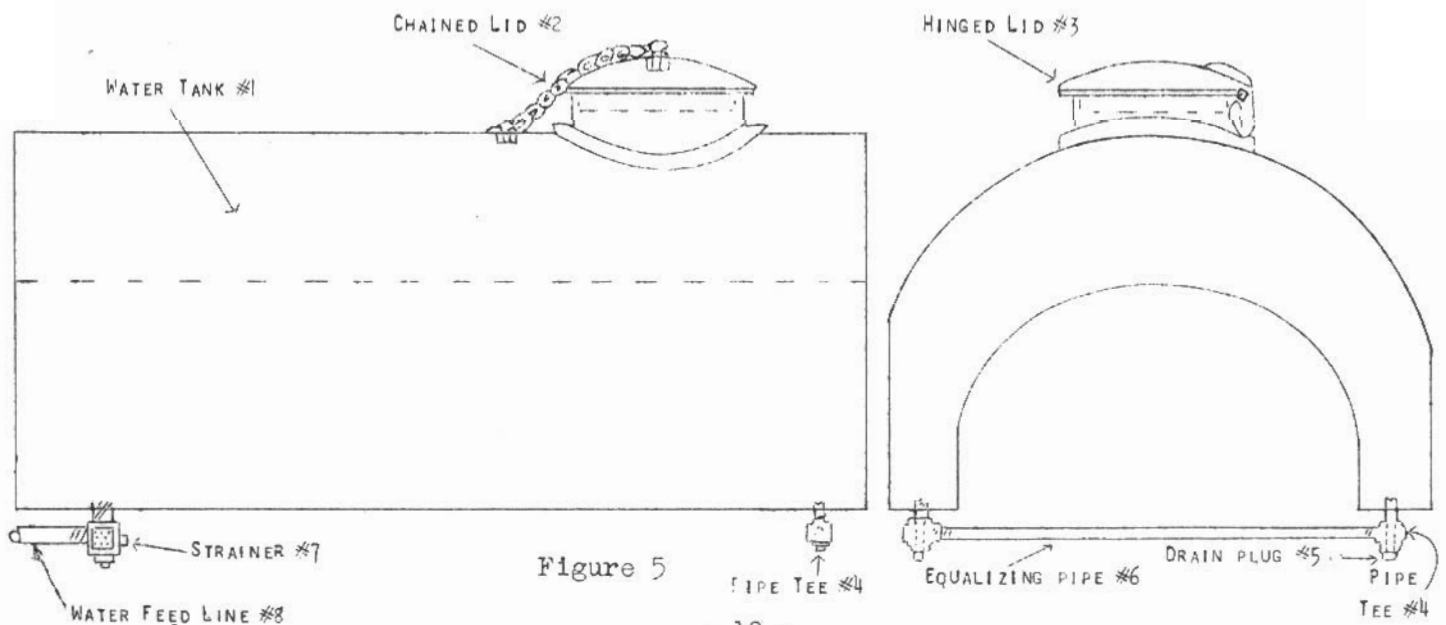


Figure 5

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

16. THE WHISTLE is on the outside of the steam dome and is operated by steam from the dome. It is used as a warning signal and as a signal to the hook-on to let him know that the signals he gives have been heard or seen.

C. THE SADDLE TANK

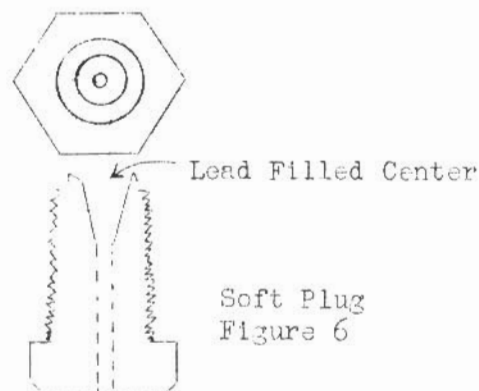
The saddle tank (Figure 5) holds the water supply for the boiler. It is located on top of the boiler and extends about half way down the sides of the boiler. This tank should be washed out at least twice a year to free it of accumulated mud, dirt and corrosion. It should be drained once each month to keep strainers free of mud and scale.

The parts of the saddle tank are:

1. THE TANK is filled with water through the lid (#2 and #3). It is opened to take on water and must be closed after the tank has been filled. All lids should have hinges (#3) or safety chains (#2).
6. THE EQUALIZER PIPE extends beneath the boiler and is connected at the bottom on each side of the tank. The purpose of the equalizer pipe is to keep the water level on each side of the tank equal. It is connected to the tank by a pipe tee (#4) which has a drain plug (#5). This plug is opened when the tank is flushed out.
7. THE STRAINERS are placed in the pipe leading to the injectors to prevent mud, dirt or scale from entering the injectors.

D. THE SOFT PLUG

The soft plug (Figure 6) is made of brass with a hollow center. This center is filled with lead. It is located in the highest part of the crown sheet of the fire-box and extends from the fire-box side of the crown sheet to inside the boiler. When the water in the boiler drops below the top of the soft plug, the lead in the soft plug center will melt. Steam and water in the boiler will force itself through the hole in the soft plug to the fire-box. This soft plug is a safety device to indicate low water level.



TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

E. STAYBOLTS

The staybolts (Figure 7) have a hole drilled in them extending $1\frac{1}{4}$ " from the outer end. They are screwed through the boiler sheet and the fire-box sheet to support them. The ends of the staybolt are riveted over. The small hole drilled into them is called a tell-tale hole and is visible from the outside. Care should be taken that this hole is open on the outside. When a staybolt is broken, steam and water leak through the tell-tale hole.



Staybolt

Figure 7

F. GAUGE COCKS

There are three gauge cocks (Figure 8) on a locomotive. They are used to check the level of the water in the boiler. They are located on the right side of the boiler head in the cab and are arranged in a vertical position. The bottom gauge cock or No. 1 gauge cock is four inches from the highest point of the crown sheet. No. 2 gauge cock is the center gauge cock and is located three inches above No. 1. No. 3 gauge cock is the uppermost one and is located about three inches above No. 2. The parts of a gauge cock are as follows:

1. THE BODY is the top part of the gauge cock in which the packing (#2) is placed and through which the valve stem (#4) passes. It has outside threads for the connecting nut (#3) which clamps the shank (#2) against the gasket (#11) in the valve. The nozzle (#5) is screwed into the body. The packing nut (#8) holds the packing tight in the body.
2. THE HANDLE of the valve stem, used to control the opening and closing of the valve (#9) is connected to the valve stem by a handle nut (#10).

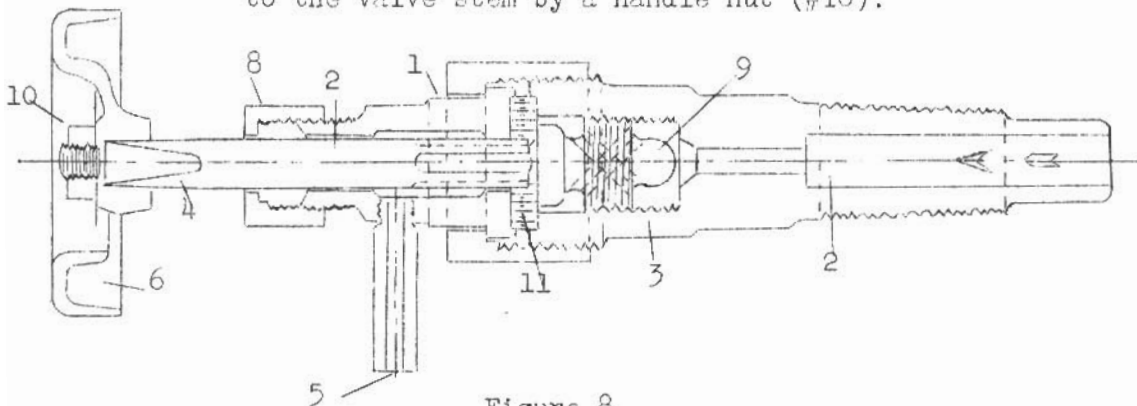
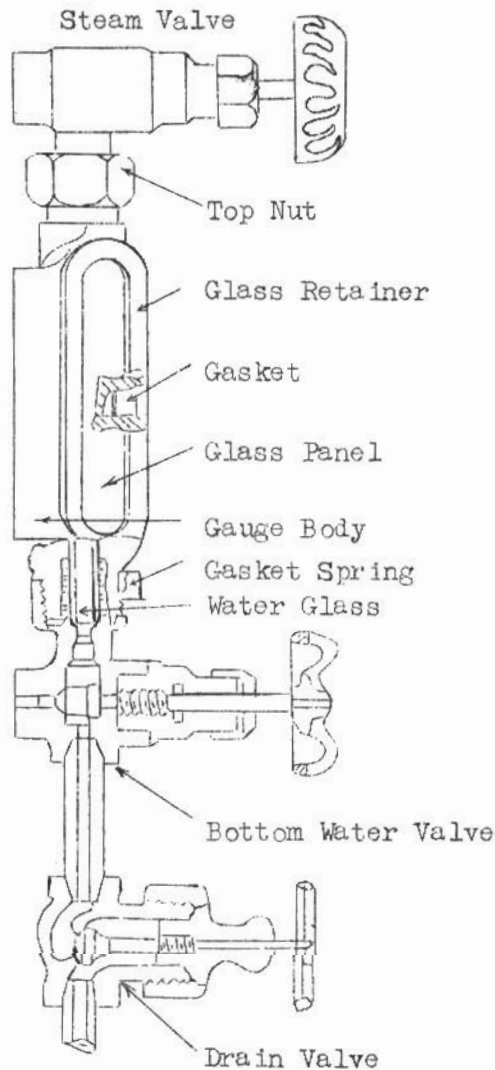


Figure 8

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

G. WATER BOTTLE

The water bottle (Figure 9) shows the level of water in the boiler. The water is admitted from the boiler into the bottom of the water bottle. Steam from the boiler is admitted in the water bottle at the top. The steam pressure on the top of the water bottle holds the water to the same level as in the boiler. The water bottle must be blown at the beginning of the turn and several times during the turn if necessary. The parts of a water bottle are as follows:



1. THE STEAM VALVE admits steam into the water bottle. It is connected directly to the boiler. It is left open at all times except when blowing down.
2. THE WATER VALVE is connected to the boiler to allow water into the water bottle. It is set below the border of the water line and is left open at all times except when blowing down.
3. THE GLASS PANEL is a $3\frac{1}{4}$ " thick glass sheet in the front of the water bottle. This allows the operator to observe the water level at all times.
4. THE DRAIN VALVE is used when blowing down the water bottle. It is closed at all times except during this operation.

Water Bottle

Figure 9

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

H. STEAM GAUGE

The steam gauge (Figure 10) is a device to indicate the steam pressure inside the boiler in pounds per square inch. This steam gauge is located in the cab, and is connected to the top of the boiler by a $\frac{1}{4}$ inch steam pipe. When the boiler is under fire, the highest reading on the steam gauge should not exceed the maximum pressure set for the boiler by the state inspector. The maximum steam pressure for the boiler will always be found on the state certificate posted in the locomotive cab at all times. The parts of the steam gauge are as follows:

1. THE CASE is a round, brass box, approximately six inches in diameter, and two inches deep. It contains the working parts of the steam gauge.
2. THE POINTER indicates the pressure markings on the dial. The pointer is made to move by the action of the Bourdon tubes against the rack, pinion, and hair spring mechanism in the steam gauge.
3. THE DIAL is a flat surface marked with the pounds of pressure units. The dial is marked from 0-300, and is graduated in five pound units. This reading represents pounds of pressure per square inch inside the boiler.
4. THE BOURDON tubes are shaped in the form of an oval, and are filled with water. These tubes are connected to the rack. The oval formed by the tubes is expanded or contracted according to the pressure of the steam against the water inside the tubes.
5. THE RACK, representing about $\frac{1}{8}$ of a circle, works against the pinion, which in turn regulates the tension of the hair spring.
6. THE HAIR SPRING is a flat, coiled spring, action of which moves the pointer over the dial.

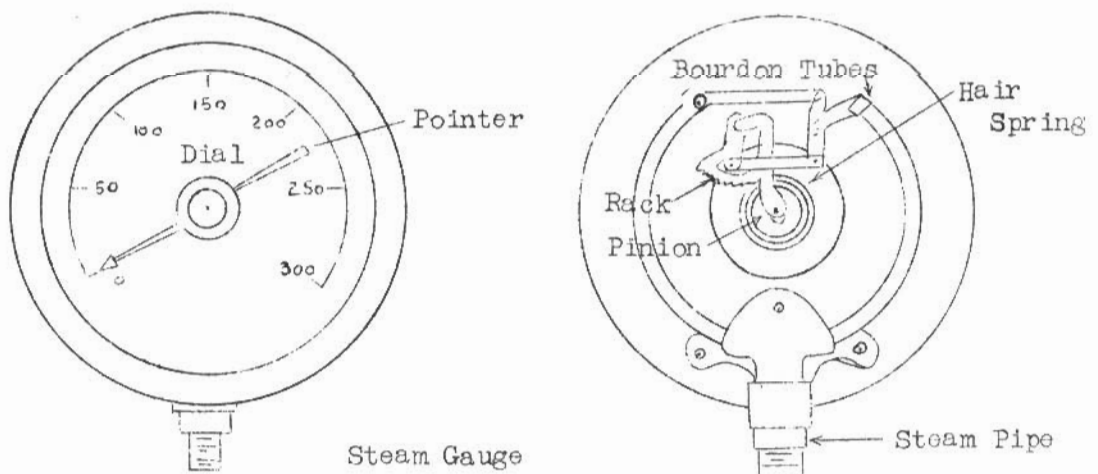
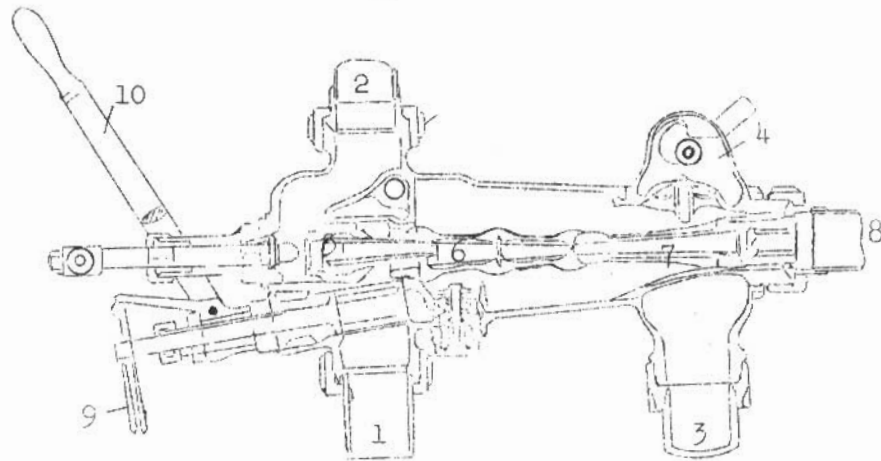


Figure 10

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

I. THE INJECTORS

The injectors feed water from the tank into the boiler. Each locomotive has two injectors, designated as right injector and left injector. They are located in the cab, on the right and left hand sides of the boiler. Water and steam are combined in the injector to build up a high pressure to force the water into the branch pipe and through the combination boiler valve check into the boiler. Usually only one injector is used at a time. The second provides a safety in case of emergency, and both must be in good working condition at all times. Use of these injectors should be alternated occasionally to keep them in working condition.



Injector

Figure 11

The parts of an injector are:

1. THE FEED WATER LINE, at the bottom of the injector, is a pipe connected to the water tank. It carries the water from the tank to the injector.
2. THE STEAM PIPE, at the top of the injector, is a pipe connected to the spider, and carries steam to the injector.
3. THE OVERFLOW PIPE is at the front of the injector. When the injector is being primed, water will come out the overflow pipe until enough pressure is developed in the injector to carry water into the branch pipe. The injector will show steam in the overflow pipe if it is leaking. If the boiler check is leaking, water will come out at the overflow pipe.
4. THE OVERFLOW VALVE controls the action of the overflow pipe. When the overflow valve is closed, it forces steam back through the feed lines to blow them out. This valve is also used to force steam through feed lines in cold weather to prevent them from freezing.

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

5. THE STEAM NOZZLE is a brass tube. It carries steam to the combining tube.
6. THE COMBINING TUBE is a mixing chamber where the water and steam enter and mix together. The water condenses the steam under pressure.
7. THE DELIVERY TUBE is a brass pipe connecting the combining tube and the branch pipe, and carries the water to the branch pipe.
8. THE BRANCH PIPE is also copper, and is connected to the boiler check. It carries the water into the boiler check.
9. THE WATER VALVE is located in the injector at the point of the feed water line. It controls the amount of water fed into the injector.
10. THE STARTING LEVER is a hand lever used to regulate the amount of steam admitted through the steam pipe into the injector.

J. COMBINATION BOILER CHECK VALVE

The combination boiler check valves (Figure 12), connected at the front end of the branch pipes on the left and right sides of the locomotive, admit water into the boiler from the injector and are controlled by automatic and hand check valves. The use of two valves in one fitting gives the device the name combination. The combination boiler check valves are placed as far from the fire-box as possible in order to give water returning through the boiler a chance to get heated to a high temperature before reaching the fire-box sheets. This plan prevents cool water from coming in contact with the fire-box sheets and causing severe contraction to these sheets. It also prevents loss of steam power because of the cooling effect of letting water directly from the saddle tank into the hottest part of the boiler. This system of admitting fresh water into the front of the boiler first also improves the circulation of water in the boiler, because there is no sudden drop in the steam pressure, which forces the circulation of water in the boiler.

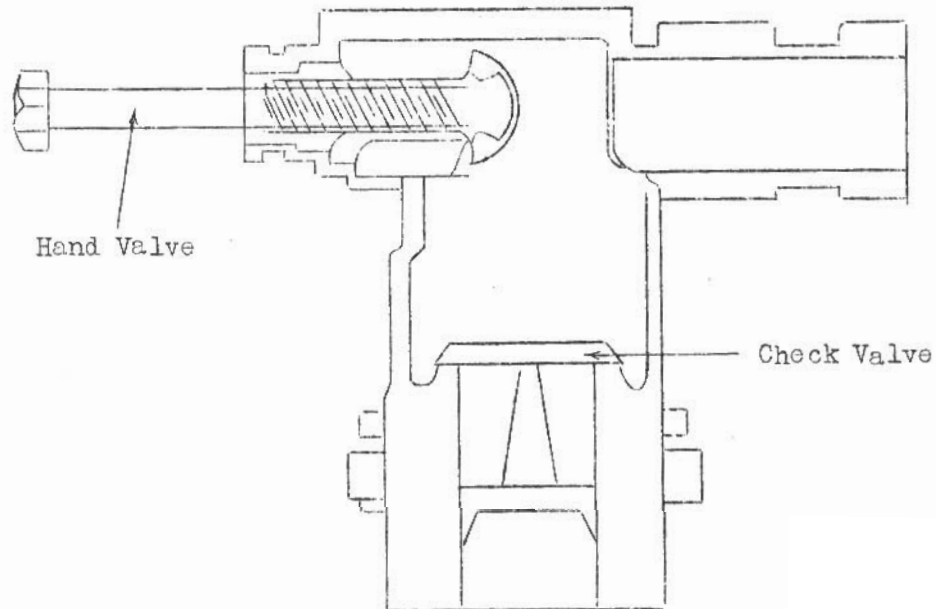
The automatic valve check is operated by the injector water pressure which is greater than the pressure in the boiler and forces open the valve, allowing the water from the injector to enter the boiler. The automatic valve is kept closed by the boiler pressure when the injector is turned off.

The hand valve check is set in the combination check valve; fitting between the automatic valve check, and the boiler and is only closed when the automatic check valve fails to operate or is in need of cleaning or repairs. The automatic valve check can be disconnected and removed for cleaning, repairing or replacing with a new valve.

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

The parts of a combination boiler check valve are:

1. THE AUTOMATIC VALVE CHECK is the valve in the combination boiler check valve which leads into the boiler and is opened by the pressure of water from the injector and closed by the pressure in the boiler. It has packing on each side.
2. THE HAND VALVE CHECK is placed between the boiler and the automatic valve check and is to be used when the automatic valve check fails or has to be removed for repairs. It is kept open at all other times. It has a hand wheel, or nut, for opening or closing the valve which is the movable metal part which stops, blocks or regulates the flow of steam or water through the valve body.



Combination Boiler Check Valve

Figure 12

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

K. THE LUBRICATOR

The lubricator (Figure 13) is an automatic device to force lubrication to the valves, pistons, cylinders, and brake valve and cylinder. Steam from the boiler is used to create the pressure and condensation to supply water for the operation of the lubricator. The lubricator should be feeding at all times during the operation of the locomotive. The feed valves may be turned off if the locomotive is to be idle for a considerable length of time, or when draining and filling the lubricator. To check the lubricator for proper operations, a thin film of oil should cover the piston rods and valve stems.

The parts and operation of the lubricator follow:

1. THE STEAM VALVE admits steam from the spider at full boiler pressure into the condensing chamber (#2) and the water resulting from this condensation fills the condenser to point (#3). The condenser is connected to the oil reservoir (#4) by water passage (#5).
6. WITH WATER VALVE open, water enters the oil reservoir and fills all space not occupied by the oil. Because oil is lighter than water it floats on the water. The weight of the volume of water in the condenser exerted under the oil in the reservoir, forces the oil in the manner indicated by the arrows down the oil passage (#7) and past the regulating valve (#8), drop by drop into the sight feed chamber (#9). The sight feed chamber is kept filled with water through condensation of steam from the equalizing passage (#10). The drops of oil float to the top of the water at (#11) and are carried by the circulation of steam from the equalizing passage into the oil delivery tube (#12) and to the engine cylinders and valves and the brake cylinders and valves.
13. THE OIL CONTROL VALVE is a rotary plug placed in the oil passage between the oil reservoir and the feed regulating valves and is used for instantly starting, throttling or shutting off the feed valves of the lubricator without disturbing the regular adjustments. It has three positions as indicated on the dial. The all open position is used for regular operations and permits the passage of oil through the regulating valves at the rate to which they have been adjusted. By moving the handle to the right from the all open position, the amount of oil going to the regulating valves can be throttled. In the closed position all the oil supply to the feed lines is shut off.
14. THE FILLER PLUG is a round stopper attached to a handle, designed to fit in the filler hole at the top of the oil reservoir. It is made of brass and has a lead joint or gasket. It should be tightened firmly but not forced. The plug can be tightened enough by use of the hand wheel. When screwed down too tight, the lead joint or gasket is cut out or destroyed.

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

15. THE SIGHT FEED CHAMBERS and RESERVOIR SIGHT have prism lenses, called Bullseye Glass, to indicate the amount of oil passing through the feed valves or the level of oil in the reservoir.
16. THE OIL EXPANSION CHAMBER is provided to permit the oil to expand when it becomes heated and to prevent the building up of too much pressure in the lubricator, resulting in damage to it.
17. THE CLEAN OUT VENT is opened to clean out sediment and dirt in oil passage.
18. THE DRAIN VALVE is opened before filling or refilling oil reservoir, in order that all oil is drained out. It must be closed before filling reservoir with new oil.
19. THE CHOKE PLUGS are set on the cylinder steam chests to prevent steam pressure from blowing oil back into the delivery line.

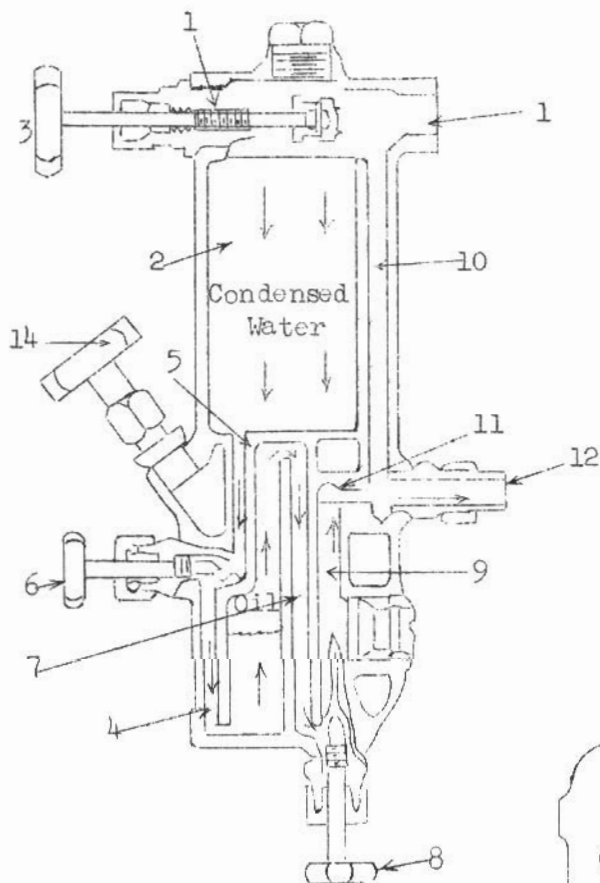
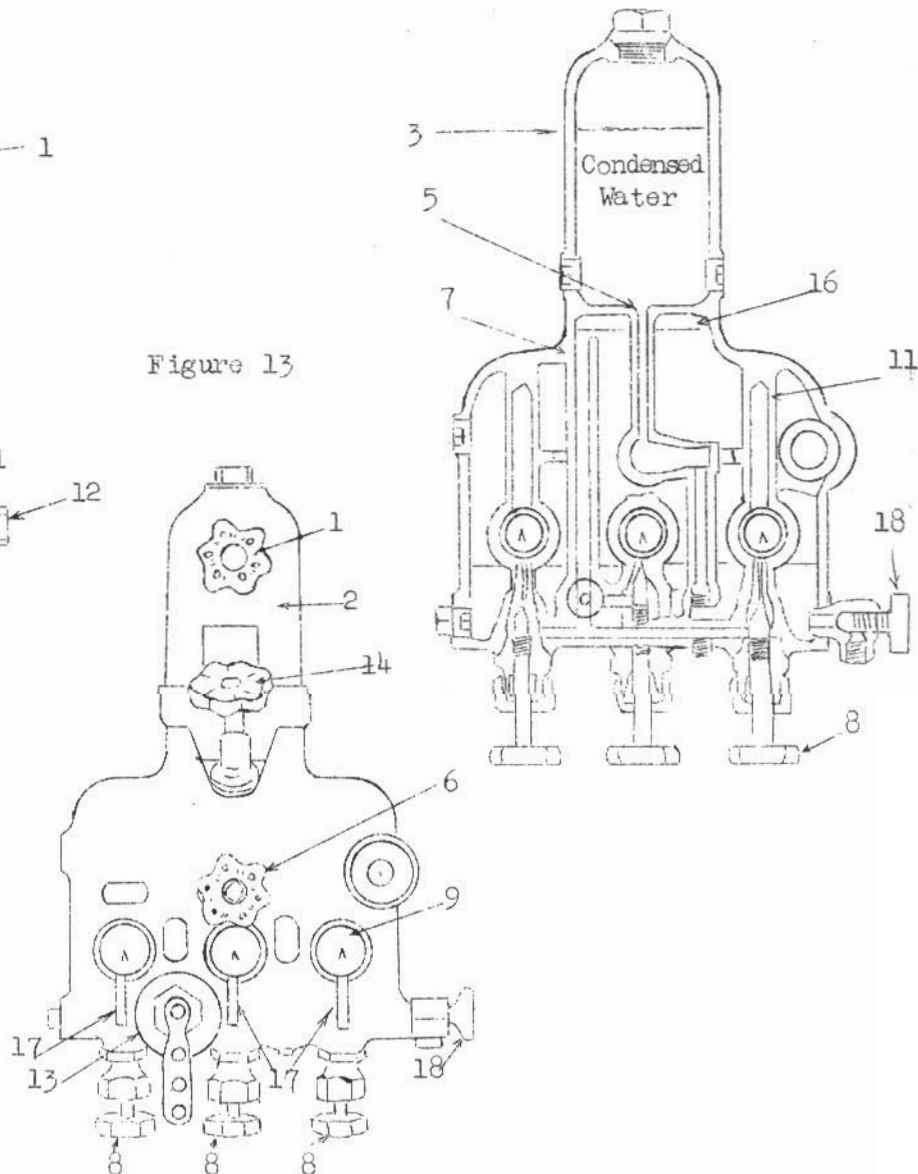


Figure 13



TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

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D-24

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF LABOR AND INDUSTRY
Bureau of Inspection
HARRISBURG


Nº 146326

CERTIFICATE OF BOILER INSPECTION

CERTIFICATE ISSUED

Date Issued: February 3 1943

Fee Paid \$1.00





CERTIFICATE EXPIRES

February 3, 1944

But may be revoked for failure to keep boiler in standard safe condition

THIS IS TO CERTIFY, that the No. #3698 NB 488 Boiler on premises
of Carnegie Illinois Steel Corp. No. Homestead Works Loco #5 Street
City of Munhall County of Allegheny Pa., has been
inspected by H. R. Curtis of the Hartford Steam Boiler I. I. Co. and
may be operated at a pressure not to exceed 200 pounds per square inch.
Type of Boiler Track Loco. Built by Porter

RE-INSPECTIONS		
KIND	DATE	INSPECTOR
		by
		by
		by



 Secretary of Labor and Industry
 Chief, Boiler Division

THIS BOILER MAY NOT BE OPERATED LEGALLY UNLESS THIS CERTIFICATE IS POSTED UNDER GLASS IN A CONSPICUOUS PLACE IN ENGINE OR BOILER ROOM

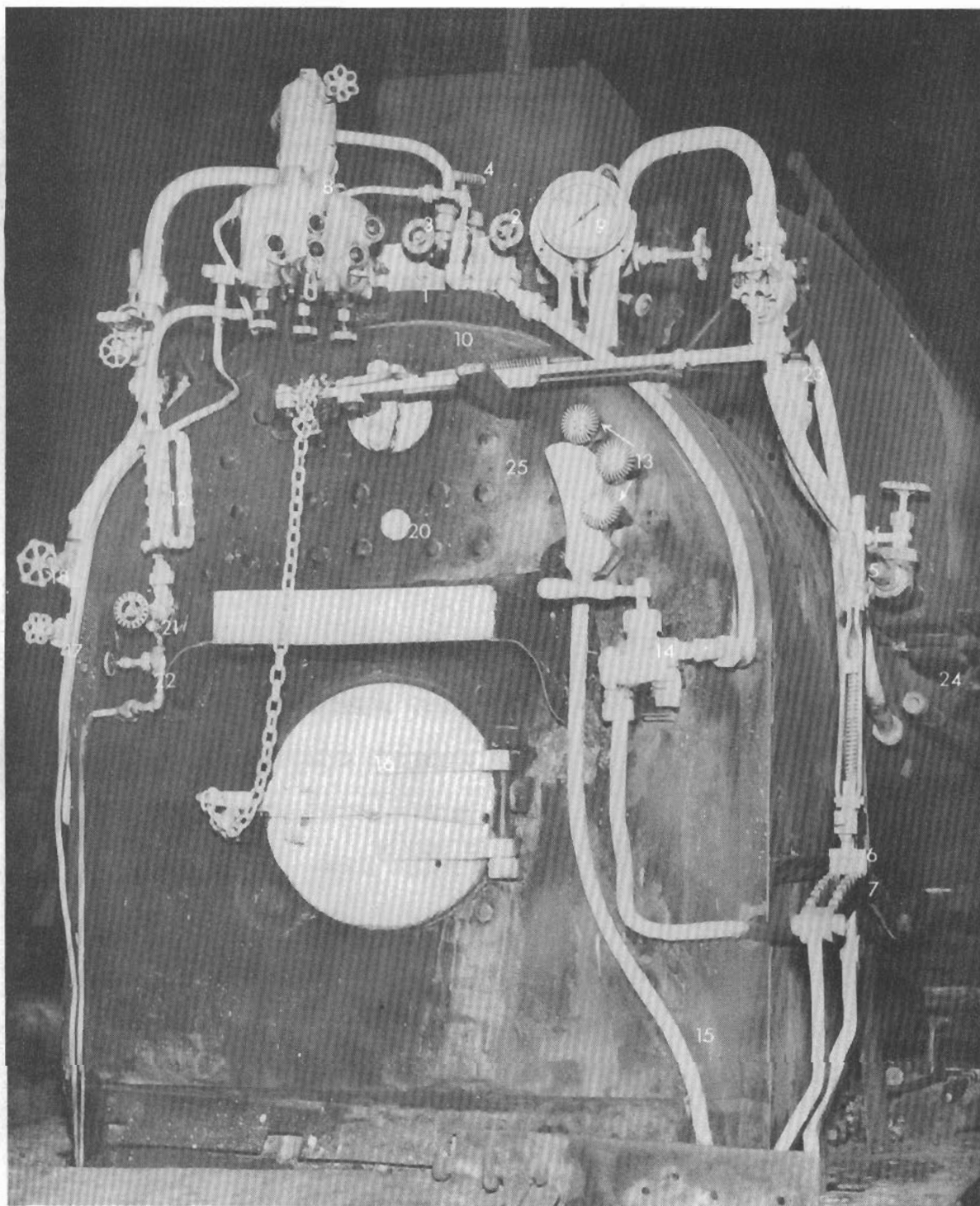
Figure 14

STATE INSPECTION CERTIFICATE

The State Inspection Certificate (Figure 14) has marked on it maximum steam pressure which an operator is permitted to carry in the boiler of a locomotive. It is illegal to operate a locomotive without this certificate framed in the cab.

The locomotive operator must know exactly the maximum steam pressure he is permitted to carry. This is very important and must be checked before an operator starts a locomotive at the beginning of a turn. Homestead Works locomotives are inspected once a year and since they are not all checked on the same date, new certificates are constantly being posted.

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE



View Inside Cab of Engine

Figure 15

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

L. THE SPIDER

The spider (Figure 15) is a steam box mounted on top of the boiler with a main valve to control the flow of steam. The steam enters the spider from the top of the boiler, and is distributed from the spider to the injector, lubricator, brake, blower, and generator.

The parts of a spider are:

1. THE STEAM BOX is a metal chamber commonly called the spider in which dry steam is stored before it is used.
2. THE BRAKE VALVE which controls the steam flow to the brake valve.
3. THE LUBRICATOR VALVE controls the flow of steam to the lubricator.
4. THE MAIN VALVE which controls the flow of all steam into the spider.

The other operating parts and controls in a locomotive cab and shown in Figure 15 are:

- | | |
|--------------------------------------|---|
| 5. REVERSE LEVER | 21. WATER VALVE ON WATER BOTTLE |
| 6. REVERSE LEVER RACHET | 22. WATER BOTTLE DRAIN VALVE |
| 7. QUADRANT | 23. INJECTOR OVERFLOW PIPE (RIGHT SIDE) |
| 8. LUBRICATOR | 24. BRANCH PIPE LEADING FROM INJECTOR |
| 9. STEAM GAUGE | 25. BOILER HEAD |
| 10. THROTTLE | |
| 11. INJECTOR (RIGHT SIDE) | |
| 12. WATER BOTTLE | |
| 13. GAUGE COCKS | |
| 14. STEAM BRAKE | |
| 15. GAUGE COCK OVERFLOW PIPE | |
| 16. FIRE-BOX DOOR | |
| 17. BLOW VALVE TO OPERATE BLOWER | |
| 18. INJECTOR WATER VALVE (LEFT SIDE) | |
| 20. WASHOUT PLUG | |

M. THROTTLE AND STEAM AND DRY PIPES

The throttle and steam and dry pipes (Figures 3 and 4) are the units in a locomotive which control and direct the flow of steam from the boiler to the engine cylinders. The throttle is located in the cab and operates the throttle valve in the elbow of the standpipe which is set in the steam dome. The throttle valve admits dry steam stored in the steam dome into the standpipe which carries it to the dry pipe, then to the tee head at the drypipe end in the smokebox. The tee head distributes the steam into the steam pipes leading to the cylinder steam chests which, through valves, regulate the flow of steam into the cylinders.

The elbow, standpipe and dry pipe are located along the highest point of the boiler to insure a supply of the driest steam in the boiler to the engine cylinders. All joints in these pipes must be kept steam tight to prevent leaks and loss of steam power.

The parts of the throttle and steam and dry pipes are:

In Figure 3:--

26. THE THROTTLE LEVER is located in the cab of the locomotive and is the manual control for the throttle valve.
30. THE RATCHET is attached to the lever and holds it in place on the quadrant (#29) by dropping into position on the teeth cut into the half-circle side of the quadrant.
24. THE STUFFING BOX is inside the boiler and the throttle stem (#23), which carries the throttle lever action to the throttle valve (#14), passes through it. The stuffing box is packed tight to prevent steam and water from entering the cab. The stuffing box is held tight and in position by a gland (#25).
18. THE ELBOW is attached to the top of the standpipe (#19) and contains the throttle valve. Steam enters the elbow and standpipe when the throttle valve is opened.
20. THE DRY PIPE is a pipe extending from the standpipe in the steam dome, along the top of the boiler to the smokebox in the front of the locomotive. It carries the steam to the tee head (#21) in the smokebox.

In Figure 4:--

2. THE TEE HEAD distributes the steam coming from the dry pipe to the steam pipes (#4 and #5) which carry it to the left and right cylinder steam chests (#11 and #12), through steam passages (#7 and #8). The tee head is a metal pipe fitting with a center and left and right side opening.

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

N. THE REVERSE LEVER

The reverse lever on a locomotive controls the movements of the locomotive through the control of the valves. By means of this control, the position of the reverse lever sets the direction in which the locomotive will travel. If the lever is set in the forward part of the quadrant, the motion of the locomotive will be forward. If the lever is set in the rear half of the quadrant, the motion of the locomotive will be to the rear. The center position on the quadrant is a neutral position. "Cut off" is the term applied to the movement of the reverse lever from full stroke to partial stroke. The closer the reverse lever is moved to the center of the quadrant the shorter the movement of the valves.

Parts of the reverse lever are: (Figure 14)

5. THE LEVER is a bar which moves over the quadrant.
6. THE RACKET on the lever sets into the teeth on the quadrant holding the lever into position, and is lifted or lowered with the thumb latch.
7. THE QUADRANT is a curved metal bar with teeth on which the lever and racket works.

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

O. THE CYLINDER

The cylinder (Figures 16 and 17) is the steam engine of the locomotive. In it the steam from the boiler is converted into mechanical energy used to operate the locomotive. There are two cylinders on a locomotive; one on the left side and one on the right.

When the reverse lever is moved either to the forward or reverse position on the quadrant, the links are raised up or dropped down, opening the valves and allowing steam to enter the cylinder from the steam chest. The steam forces the piston back and forth in the cylinder, creating mechanical energy. The movements of the pistons are carried to the main driving wheels by the main rods, making the locomotive run. The amount of steam released from the boiler for the operation of the locomotive is controlled by the throttle. The steam entering the cylinders and the direction in which the locomotive travels, is controlled by the reverse lever.

The parts of a cylinder are:

In Figure 17:--

3. THE SADDLE or block is the cast metal housing of the cylinder. The front end of the boiler is placed on the saddle of the left and right cylinders. The saddle contains the steam passage (#1) and the steam exhaust passage (#2) which connect to the steam pipes and steam exhaust pipe in the smokebox. The cylinder (#4), the intake ports (#6) and the exhaust port (#7) and holes for the steam chest studs (#8) and cylinder cocks (#5) are bored and machined in the saddle.

In Figure 16:--

15. THE STEAM CHEST is bolted to the top of the cylinder block of the saddle. It houses the piston or slide valve motion for regulating the intake and exhaust of steam in the cylinder. The slide valve motion (#9) is shown in the drawing. It controls the flow of steam into the intake ports (#17) and from the exhaust port (#16). The steam chest has an oil line from the lubricator and is equipped with a choke plug (#8) to prevent steam from the steam chest forcing itself into the oil line (#7). The valve stem for the slide valve enters the steam chest through a stuffing box (#11) which is kept tight against the steam chest by a gland (#10).

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

2. THE PISTON is a cast iron head to which the piston rod (#3) is attached. The piston is fitted with rings (#4) to make it steam tight. It is moved back and forward in the cylinder by steam. The piston rod extends to the crosshead (#1) and carries the motion of the piston to the crosshead, then to the main rod and to the main crank pin on the driving wheel.
18. THE CYLINDER COCKS (#18) are drains placed near the bottoms and ends of the cylinder. They are opened and closed by a slide rod (#19) which is controlled from the locomotive cab. The cocks are used to drain out water, condensed from steam in the cylinder.

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

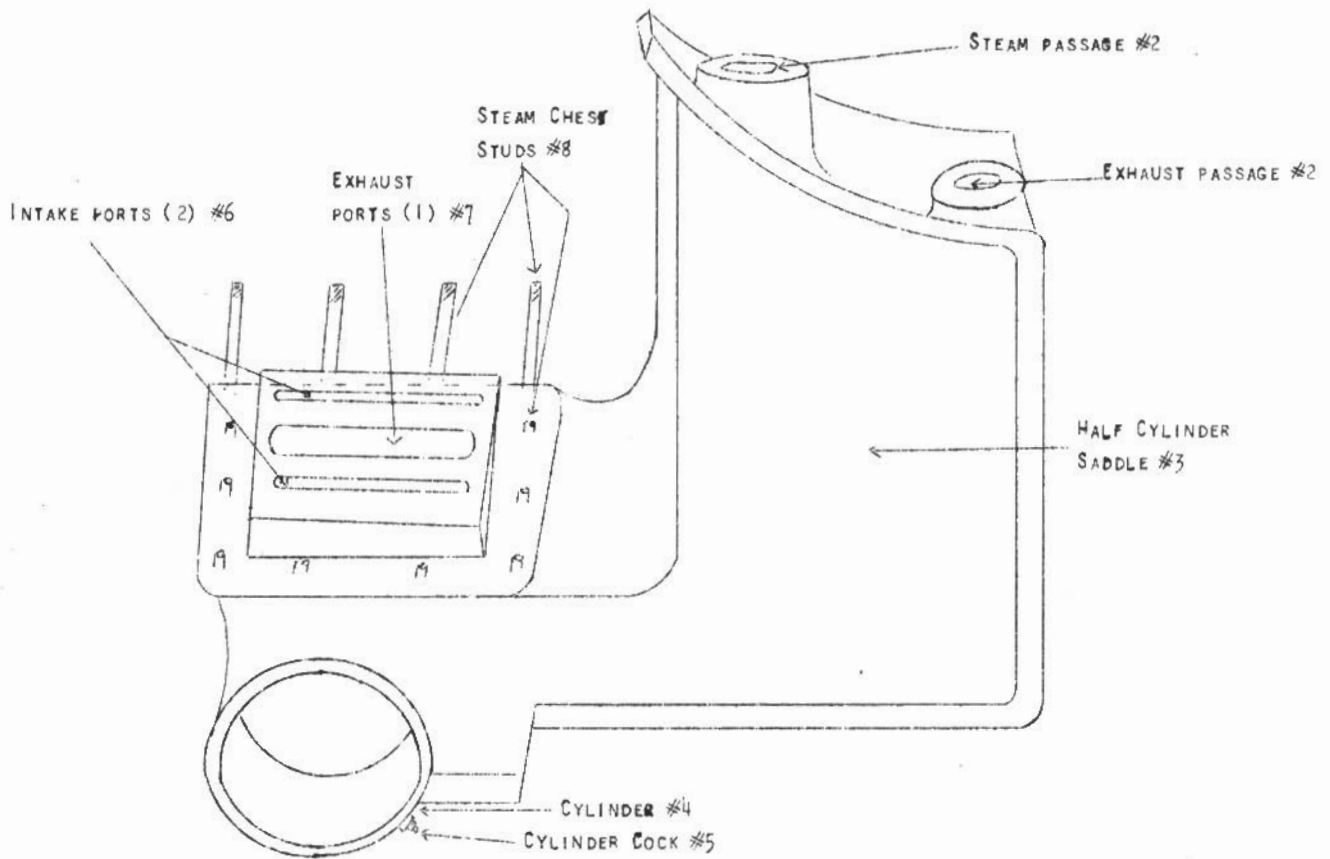


Figure 16

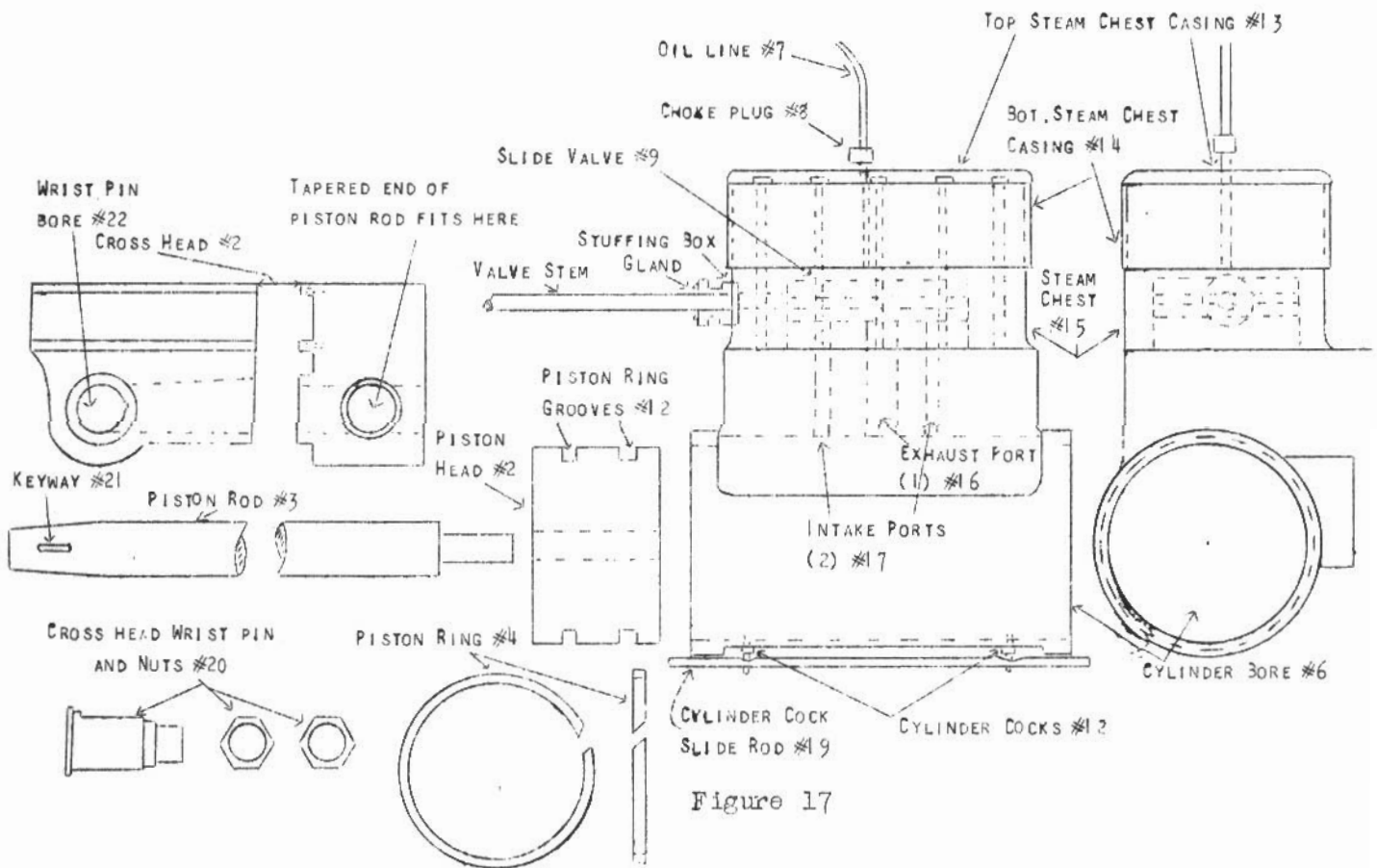


Figure 17

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

P. STEPHENSON SLIDE VALVE GEAR

The Stephenson Slide Valve Gear (Figure 18) is placed between the frames of a locomotive and its parts are eccentrics, eccentric straps, links, link blocks, rocker arms, valve stems and valves. This gear controls the movement of the valves in the steam chests of the engine cylinders and by means of such control sets the direction of travel in which the locomotive will run. The operation of the Stephenson Slide Valve Gear is controlled by the reverse lever in the locomotive cab.

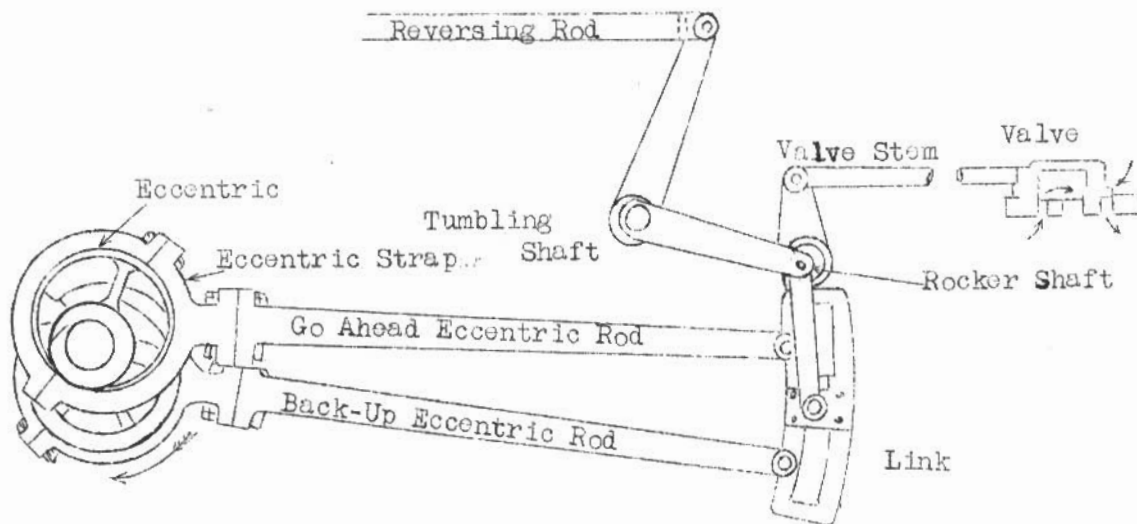
The operator must inspect the valve gear and tighten any loose nuts or bolts. Any repairs which require a worker to crawl under the locomotive must be reported to the Narrow Gauge repair shop. No employee, other than those in the Narrow Gauge shop, is permitted to get under a locomotive. All adjustments to the valve gear are made in the Narrow Gauge shop.

The parts and operation of the parts of the Stephenson Slide Valve Gear are:

1. THE ECCENTRICS are heavy discs, bored off center, that fit into the rear axle and between the insides of the frame. The off center bore of the eccentrics gives them a crank-like motion when the eccentrics are turned with the axle. There are four eccentrics, two for each side of the locomotive.
2. THE ECCENTRIC STRAPS are metal rings which fit around the eccentrics and in which the eccentrics turn. The off-center fitting of the eccentrics gives the straps a forward and backward motion.
3. THE ECCENTRIC RODS are attached to the eccentric straps and to the links and carry the motion of the eccentric straps to the link. The forward eccentric rods are connected to the top of the link and give the forward motion of the eccentrics to the locomotive. The back-up eccentrics are connected to the bottom of the link and carry the reverse action of the eccentrics to the locomotive driving wheels.
4. THE LINK is a slotted bar, the slot being curve shaped and there is one on each side of the locomotive. The links are lowered for forward motion on the link block in the link and are raised on the link block for reverse travel of the locomotive.
5. THE LINK HANGER mounted to the link on a saddle block ("S") is connected to the tumbling shaft arm which is connected to the reach rod of the reverse lever by the tumbling shaft reverse arm. The link hanger rises and the valve seat lowers the links according to the set of the reverse levers.

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

6. THE ROCKER ARM operating in the rocker box controls the valve motion as set by the position of the eccentrics. The bottom rocker arm is attached to the link block and the top rocker is connected to the valve stem. The rocker arm is a bearing in which the rocker shaft works.
7. THE VALVE STEM is the rod which is attached to the slide valve and moves it to reverse or forward operating position.
8. THE SLIDE VALVE is an oblong, cast iron box which moves on the valve seat in the steam chest. The valve seat has three ports, two outer ones for steam intake to the engine cylinder and a center one for exhaust steam from the engine cylinder. The exhaust steam is exhausted into the smoke box through the petticoat pipe and out the stack.



Stephenson Slide Valve Gear

Figure 18

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

Q. WALSCHAERT PISTON VALVE GEAR

The Walschaert Piston Valve Gear (Figure 19) is placed outside the frame of a locomotive and has an eccentric crank attached to the end of the main pin on each side of the locomotive, with an eccentric rod from this pin to the connection at the bottom of the link. This eccentric crank is located so that it serves for both forward and back motion. The link swings on the center trunnion and cannot be moved up and down as in the Stephenson link, but the link block can be moved from one end of link to the other to regulate travel of the engine or part toward the center of the link to change the cut-off. A radius rod connects the link rod to the valve stem. Since there are no eccentrics in a Walschaert Piston Valve Gear, the regulation of the travel of the valve for cut-off and direction of travel, and for the control of the lap-and-lead is accomplished by means of a combination lever. This combination lever is connected to the radius rod for regulating the travel of the valve and to the crosshead for control of lap-and-lead. The Walschaert Piston Valve Gear arrangement makes it a much easier gear to inspect and service than the Stephenson Gear. The eccentric connections in the Walschaert are much lighter and more direct than in the Stephenson which makes the Walschaert less liable to wear.

The parts of the Walschaert Piston Valve Gear are:

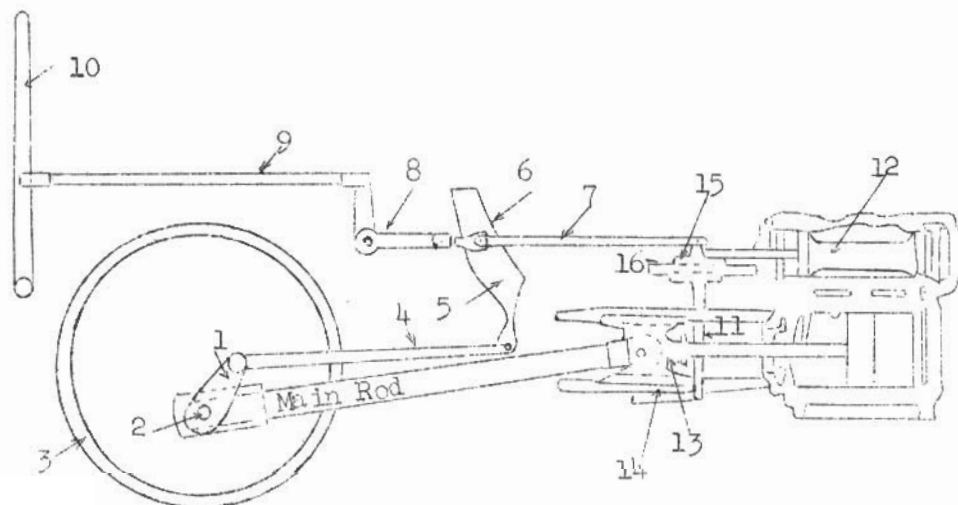
1. THE ECCENTRIC CRANK is attached to the crank pin, (#2) on the main driving wheel (#3) and it revolves with the wheel.
4. THE ECCENTRIC ROD is connected to the eccentric crank and the other end of the eccentric rod is coupled to the bottom of the link (#5) and swings the link back and forth on the center trunnion.
6. THE LINK BLOCK is in the link and it slides up and down in the link and is connected to the radius rod (#7) which moves the link block to regulate travel, cut-off, or reverse of the valves.
8. THE REVERSE SHAFT LIFTING ARM moves the radius rod and is connected to the reach rod (#9) of the reverse lever (#10) which controls the movement of the radius arm.
11. THE COMBINATION LEVER is located in back of the engine valve (#12) and controls the lap-and-lead and cut-off of the valves. The top of the combination lever is connected to the radius rod and the bottom of it is attached to the crosshead (#13) by a union link, (#14). The combination lever is moved by the crosshead to take care of the lap-and-lead in the valve, and the cut-off in the valve is regulated

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

by the movement of the radius rod against the combination lever.

The term "Lead" refers to the amount of steam which the valve admits into the cylinder at the beginning of the stroke. The term "Lap" refers to the amount the valve overlaps the intake steam port opposite the one into which steam is being admitted.

15. THE VALVE STEM CROSSHEAD holds the radius rod, combination lever, and valve stem and it rides on a guide bar (#16) which keeps it in line with the valve.
12. Valves in a Walschaert Gear are generally the piston type although a slide valve can be used with it. Piston valves are spool-shape, hollow in the center and fitted with packing rings on both ends to insure a perfect seat between the intake and exhaust steam ports.



Walschaert Piston Valve Gear

Figure 19

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

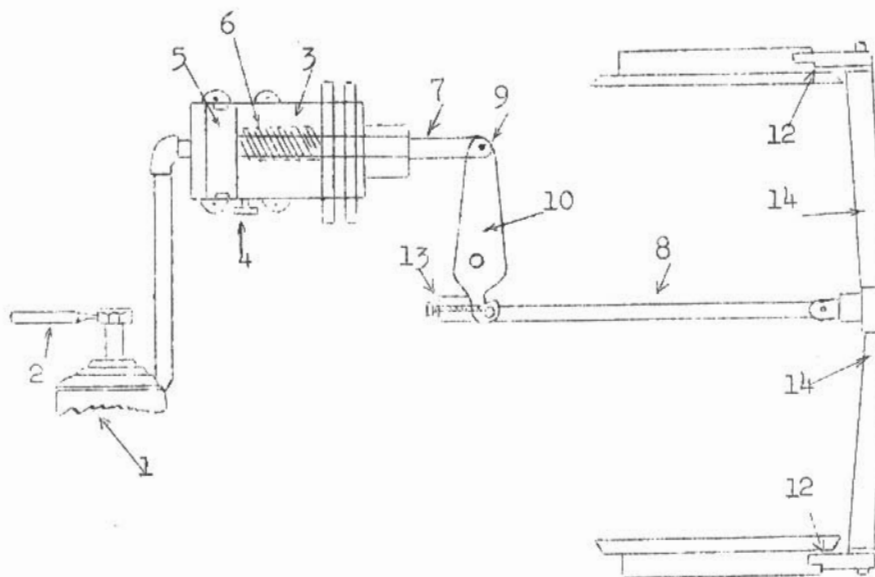
R. STEAM BRAKES

The steam brakes (Figure 20) are located on all driving wheels and are operated by a brake cylinder in between the locomotive frames or outside the locomotive frames. Brakes are controlled by a brake valve in the locomotive cab which controls the flow of steam from the spider to the brake cylinder. Steam is used to apply the brakes and they are released after the steam has been shut off by a head spring on the piston rod inside the cylinder. The brake cylinder is drained of water by a cylinder drain cock which closes when steam is admitted to the cylinder and opens when the steam is exhausted. The parts of a brake are:

1. THE BRAKE VALVE controls the flow of steam to the brake cylinder.
2. THE BRAKE is the hand control lever for opening and closing the valve.
3. THE CYLINDER in which the steam is used for the brakes is connected to the valve by a steam line.
4. THE CYLINDER DRAIN COCK is used to drain water condensed from steam out of the cylinder.
5. THE PISTON is a cast iron head attached to the piston rod. The steam of the cylinder forces the head forward to breaking position.
6. THE PISTON ROD carries the piston head action to the brake shoes, forcing the shoes against the tires.
7. THE HEAD SPRING fits on the stem of the piston rod against the piston head. It forces the piston to an "off brake" position when steam is released from the cylinder.
8. THE LEATHERS are used on the brake piston and serve the same purpose as piston rings. They are leather sheaths which fit over the piston head. The leathers can be burned out by the heat of steam if the brake is kept on for a long period of time. The standard cast iron piston ring is also used on brake cylinder pistons.
9. THE PISTON ROD CROSSHEAD provides for the free movement of the piston rod and the brake arm.
10. THE BRAKE ARM connects the piston to the brake shaft.

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

11. THE BRAKE HANGER holds the brake rigging to the frame of the engine.
12. THE BRAKE SHOE fits against the tire of the wheel. It is pushed against the tire to stop the engine.
13. THE BRAKE ADJUSTING SCREW is at the bottom of the brake arm and is used to adjust the brake.
14. THE BRAKE ARM extends the width of the left wheel to the right wheel and has a brake shoe and a brake head to it.



Steam Brake

Figure 20

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

S. DRIVING WHEELS

The driving wheels of a locomotive supply the traction or pulling power for operations. The driving wheels are revolved by the action of the piston rod on the main driving rod and by side rods which carry the traction power to the wheels not connected to the main driving rod. The combination of main and side rods gives all wheels of a locomotive the same amount of traction, resulting in more power and more efficient operation. The parts of a driving wheel are:

1. THE WHEEL (Figure 21) contains the bore for the axle (#2), counterweight (#3), the crank pin bore (#4) and the tire (#5) is fitted tight around the wheel.

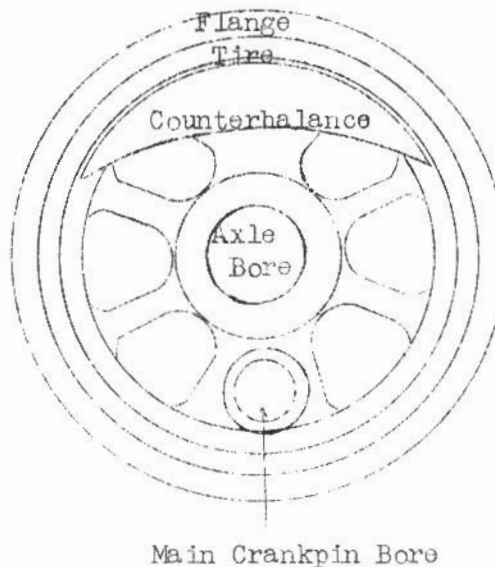


Figure 21

6. THE AXLE (Figure 22) extends through the locomotive frames and there are at least two on a locomotive. The wheels of a locomotive are attached to the axles.

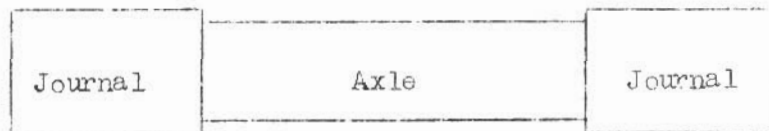


Figure 22

7. THE DRIVING BOX (Figure 23) sets in the axle jaws of the frames as a housing for the axle and a driving box journal (#7) is set into the driving box and works as a bearing for the journal. The driving box shoe and wedge (#8) are placed between the sides of the driving boxes and the frame. They keep the driving box in position and enable the driving box to ride up and down in the jaws of the frames.

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

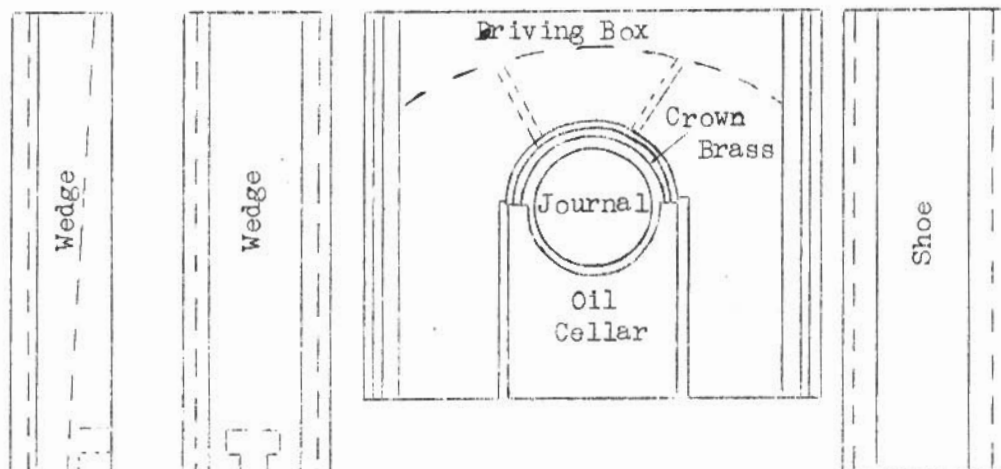


Figure 23

10. THE CRANKPIN (Figure 24) is a pin to which the main driving rod, the side rod and the eccentric crank are attached. The side rod is connected to the front driving wheel by a side rod pin.

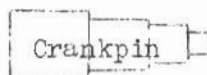


Figure 24

T. COAL CAR

The coal car is a metal body on wheels and is used as a coal storage place for the fire-box. The shovel and hook used in filling and cleaning out the fire-box are carried in it. Coal should not be overloaded in the coal car as this practice results in coal being dropped off, wasting fuel and creating a safety hazard and a dirty yard.

U. TRACK

The track is a system of two steel rails, set an equal distance apart, on which the locomotive runs. The narrow gauge track at Homestead Steel Works is 30 inches wide. The standard gauge track is 56-1/2 inches wide. A map of the track system is kept in the Narrow Gauge Department office. The operator should know the track system and the best route to follow for efficient operation.

TYPES AND PARTS OF THE NARROW GAUGE LOCOMOTIVE

H-15866	
CARNEGIE-ILLINOIS STEEL CORPORATION	
N. G. LOCOMOTIVE ENGINEER'S REPORT	
ENGINE NUMBER _____	
INSTRUCTIONS: EACH ENGINE AND COAL CAR MUST BE INSPECTED AFTER EACH DAY'S WORK AND REPORT MADE ON THIS FORM WHETHER NEEDING REPAIRS OR NOT.	
INSPECTED _____	TIME _____ M. DATE _____ 194 _____
REPAIRS NEEDED: _____	

IS STATE INSPECTION CERTIFICATE IN CAB OF ENGINE?	YES _____ NO _____
DID YOU HAVE ANY ACCIDENT TODAY?	YES _____ NO _____
HAVE YOU LUBRICATED YOUR ENGINE?	YES _____ NO _____
ENGINE CLEANED? YES _____ NO _____	ASH PANS _____
CONDITION OF INJECTORS _____	WATER BOTTLE _____
CONDITION OF GAUGE COCKS _____	BRAKES _____
CONDITION OF PISTON ROD AND VALVE STEM PACKING _____	
SAFETY VALVE LIFTS AT _____ POUNDS. SEATS AT _____ POUNDS.	
CONDITION OF (FRONT END _____	
COUPLING (ENGINE AND COAL CAR _____	
ATTACHMENTS (REAR OF COAL CAR _____	
HAND HOLDS (ENGINE _____	
AND STEPS (COAL CAR _____	
_____ ENGINEER	

Figure 25

V. ENGINEER'S REPORT

The Engineer's Report (Figure 25) must be turned in at the end of each turn.

The information required on it is self-explanatory and all details must be checked. However, operators must bear in mind that although the operator who worked the turn before him has checked the engine, he also must check it before he begins to work.

JOB BREAKDOWN
FOR
OPERATION OF NARROW GAUGE LOCOMOTIVE

SECTION II

JOB BREAKDOWN FOR OPERATION OF NARROW GAUGE LOCOMOTIVE

Part N. G. Locomotive

Operation Taking charge of locomotive

Important Steps in Taking Charge of Locomotive

Key Points

1. Check water level in boiler.

1. Use gauge cocks.

2. Check Fire-box.

1. Flues, staybolts, crown sheet.

3. Check water bottle.

1. Shut steam and water off.

2. Open drain valve.

3. Open water valve

4. Close drain valve.

5. Open steam valve.

6. Open valve wide open.

7. Compare water level in water bottle with gauge cocks.

4. Check injector.

1. Open water valve.

2. Gradually pull starting lever all the way back.

3. Must be little or no water from overflow pipe.

4. Gradually push starting lever in.

5. Close water valve.

5. Check water in the tank.

1. At least half full.

6. Check sand boxes.

1. Fill sand boxes.

2. Pull each lever to see if sand pipes are open.

7. Check lubricator.

1. If lubricator is feeding, oil will show on piston rods and valve stems.

8. Clean fire.

1. Locate engine over ash pit.

2. Turn blower on.

3. Remove clinkers with hook.

4. Shake grates.

5. Spread fire over grates.

6. Add coal.

7. Keep fire bright.

8. Use blower lightly.



9. Clean out smoke box.

1. Open slide.

2. Turn poke hole cap 1/4 turn, remove.

3. Poke cinders out.

4. Replace poke hole cap, turn 1/4 turn.

5. Close slide.

JOB BREAKDOWN FOR OPERATION OF NARROW GAUGE LOCOMOTIVE

Part N. G. Locomotive

Operation Inspection and Lubrication

Lubrication and inspection of the various parts of the locomotive should be performed at least once each turn. A long spout oil can filled with engine oil, which is kept in the cab, is used in oiling the parts of the locomotive. Various parts will be listed below where lubrication is essential. The lubrication and inspection job is done at the same time. The parts are inspected for loose nuts and bolts, broken or missing parts, worn packing, hot bearings and other parts that are subject to frequent wear as listed below. Excess oil and grease is wiped off during lubrication with waste.

- | | |
|--------------------------|--|
| 1. Driving box journals. | 1. Oil, sponging on top of boxes.
2. Check for hot bearings.
3. Shoes, oil.
4. Wedges, oil, check for play, adjust.
5. Hub liners, oil, check for wear. |
| 2. Eccentrics. | 1. Oil, check bolts and nuts on eccentric straps.
2. Oil eccentric rods, check bolts and nuts.
3. Eccentric cranks, grease. |
| 3. Links. | 1. Oil link blocks and hangers, check for loose nuts and bolts. |
| 4. Tumbling shaft. | 1. Oil and check bearings.
2. Oil reach rod, Rocker box, Rocker arms, Valve rod and check nuts and bolts. |
| 5. Guide bars. | 1. Oil, check nuts and bolts.
2. Oil crosshead gibs. |
| 6. Rods | 1. Main rods - Grease with alemite gun and check for nuts, bolts, keys and wear on main brasses.
2. Side rods - Grease with alemite gun, check bushings and collar plates. |
| 7. Valve motion. | 1. Grease union links and check nuts and bolts.
2. Grease lap and lead lever, check nuts and bolts.
3. Oil radius rods and check for wear.
4. Oil radius rod lifters and check for wear.
5. Oil valve stem crosshead and check for wear.
6. Grease link and trunnions, check nuts and bolts for wear. |

JOB BREAKDOWN FOR OPERATION OF NARROW GAUGE LOCOMOTIVE

Part <u>N. G. Locomotive</u>	Operation <u>Inspection and Lubrication</u> (Continued)
8. Throttle connections.	1. Oil, check pins for wear.
9. Reverse lever connections.	1. Oil and check for wear.
10. Brake.	1. Oil brake hangers and shaft and check pins, nuts and bolts and wear.
11. Draft gear.	1. Oil, check for play and nuts and bolts.
12. Spring Equalizers.	1. Oil, check for breaks.
13. Bell	1. Oil, check bearings.
14. Miscellaneous	1. Check the following for broken and worn parts and safe operation: <ul style="list-style-type: none">1. Foot boards2. Steps3. Grab iron4. Cutting levers5. Ash pans6. Safety chains7. Cylinder cocks8. Coal car9. Piston rod keys

JOB BREAKDOWN FOR OPERATION OF NARROW GAUGE LOCOMOTIVE

Part <u>Lubricator</u>	Operation <u>Filling Lubricator</u>
1. Operation.	1. Check sight feed glass frequently to see if oil drops are flowing. 2. If oil drops have stopped flowing, stop engine.
2. Drain lubricator.	1. Close feeds. 2. Close water valve. 3. Close steam valve. 4. Open drain. 5. Remove filler plug.
3. Fill lubricator.	1. Close drain. 2. Use valve oil from tallow pot. 3. Replace filler plug. 4. Open steam valve. 5. Open water valve. 6. Open feed valves.
4. Check sight feed glasses	1. See that drops of oil flow.
5. Check piston rod and valve stems	1. Feed lubricator fast until there is an oil film on piston rods and valve stems before continuing.

JOB BREAKDOWN FOR OPERATION OF NARROW GAUGE LOCOMOTIVE

Part N. G. Gauge Locomotive

Operation Operating Locomotive

1. Starting

1. Remove blocks from under wheels.
2. See that cylinder cocks are open.
3. See that everything is in the clear.
4. Get signal from hook-on.
5. Put reverse lever in corner.
6. Open throttle slowly to avoid slipping.
7. Close cylinder cocks.

2. Taking locomotive from side track to main track.

1. Open throttle to give more steam.
2. Move reverse lever towards center of quadrant.
3. Obey hook-on signals and lights.

JOB BREAKDOWN FOR OPERATION OF NARROW GAUGE LOCOMOTIVE

Part N. G. Locomotive

Operation Operating Locomotive
(Continued)

- | | |
|--|---|
| 3. Stop. | <ol style="list-style-type: none"> 1. Shut throttle off. 2. Put reverse lever in corner. 3. Apply brakes. 4. Stop approximately 3 feet from buggies. |
| 4. Coupling. | <ol style="list-style-type: none"> 1. Hook-on adjusts couplers, and lines them up. 2. Hook-on steps clear of engine and buggies. 3. Hook-on signals to couple. 4. Hit buggies easy. 5. Reverse to see if coupling is made, and take up slack. 6. Proceed to destination if coupling is made; if pin fails to fall, repeat operation. |
| 5. Making the run. | <ol style="list-style-type: none"> 1. Open throttle to give more steam. 2. Move reverse lever towards center of quadrant. 3. Keep steam near maximum working pressure. 4. Check water frequently, keep level between No. 1 and No. 3 gauge cocks. 5. Keep lubricator working. 6. Obey hook-on signals and signal lights. 7. Operate at speeds designated for the particular areas. |
| 6. Putting engine back on side track. | <ol style="list-style-type: none"> 1. Stop. 2. Shut throttle off. 3. Put reverse lever on center. 4. Open cylinder cocks. 5. Block engine. 6. Release brakes. 7. Check water in boiler. 8. Check water in supply tank, must be full. 9. Check fire. 10. Check the feeds off the lubricator. 11. Report to hostler. |
| 7. Make daily Narrow Gauge locomotive engineer's report. | <ol style="list-style-type: none"> 1. Report must be complete; additional information put on the back. 2. Must be signed by operator. 3. Turned in at yard master's office. 4. Should be initialed by foreman in charge. |

NARROW GAUGE DEPARTMENT
SAFETY RULES AND REGULATIONS

SECTION III

SAFETY RULES AND REGULATIONS

A. Plant Running Rules

1. The engineer must, at all times blow for a signal from Flagman and answer the signal.
2. Engines with or without buggies must at all times obey traffic rules, traffic lights, Flagman's signals and U. R. R. Operator's signals.
3. When an engine is coming out of a mill or building and heading on the main track, the Hook-on must go outside and see that the main track is clear before giving the engineer a signal to come out.
4. When an engineer is going in on a dead end track, it is his responsibility to feel his way to the bumping block.
5. Hook-ons must not cut away from buggies while the buggies are moving.
6. Engineers must not leave their engine unless reverse lever is on center, throttle completely shut off, and cylinder cocks open. If the engine is on a grade, blocks must be properly placed under wheels.
7. All Hook-ons must have a whistle.
8. Hook-ons must block all buggies to prevent movement when stopped on a grade.
9. No one but the engineer is permitted to ride in the cab of the engine except the Hook-on and he only while traveling through OH#4 tunnel or over OH#4 bridge. (Special permission to ride in cab may be granted only by the General Foreman of N. G. Department.)
10. Firing of engines while in motion is absolutely prohibited.
11. No one is permitted to get under the engine to make repairs while it is in the yard.
12. Never walk or ride under crane loads.
13. Improperly loaded cars or buggies are not to be moved.
14. Couplers must not be adjusted while engine or buggies are in motion.
15. Couplers must not be adjusted with your feet.
16. Hook-ons must use stick when making link and pin coupling.
17. Safety Shoes should be worn.
18. Hook-ons must not ride buggies in or out of the mill, but must be ahead of train.
19. Engineers must see that all foot-boards, steps, grab irons, and cutting levers are in a safe condition.

SAFETY RULES AND REGULATIONS

20. Hook-ons must not cross in front of the engine or train to throw a switch when the train is in motion.
21. Engineers must never move engine coupled to train without first getting signal from Hook-on.
22. Signals for train movement are to be taken from Hook-on only, but stop signals can be given by anyone.
23. Engine must not be fired at water plug under bridge of main gate.
24. All switches must be lined for main track at all times.
25. Engines must not run over danger signs placed on tracks. These signs can be moved only by the person who placed the sign on the track.
26. Never reach over draw heads to couple or uncouple buggies.
27. Engineers must file a daily report on form provided.
28. Engineer must give warning signal before moving engine.
29. Never move buggies when men are working in or on buggies.
30. Never run through switches; stop engine until switch is properly thrown.
31. Never make a flying switch; never poll or kick buggies or standard gauge cars.
32. Engineers and Hook-ons assigned to jobs must never leave engine unless engineer or Hook-on is on or near engine at all times. If it should be necessary for either the engineer or the Hook-on to leave the engine, he should tell the one who remains where he is going and how long he expects to be gone.
33. Traveling to or from OH#4 via tunnel:
 - A. If lights are burning when approaching tunnel wait until lights are out.
 - B. To enter tunnel - pull switch cord, throwing lights GREEN, proceed to other end, pull switch cord, throwing all lights out.
34. Signal lights at #10 and #11 Bay, also cross over at OH#1 Yard, are to be operated only by U. R. R. crews.
35. Inspect engine and coal before starting to work.
36. Never operate engine at high speed.
37. Hook-on must operate signal lights at the West end of 54" and 44" Mills when going to or from these mills. Lights must be left red for West traffic

SAFETY RULES AND REGULATIONS

and green for East traffic. Hook-ons must walk to other side of mill to see that everything is clear before giving green light.

38. Engineers must clean their fires only at placed provided.
39. Engines enroute to or from OH_{#4} over bridge must get right of way from U. R. R. Operator.
40. Traveling south over bridge, engine must shove train; traveling North over bridge, train must be back of engine.
41. When going South over bridge, engineer must get signal from U. R. R. Operator.
42. When train is in the clear at south end of bridge, Hook-on must call U. R. R. Operator and report train in the clear.
43. When going north over bridge, Hook-on must call U. R. R. Operator and get right of way before going over bridge.
44. Engineer must make a dead stop at switch on north end of bridge and wait until U. R. R. Operator gives the signal to proceed.
45. All Safety chains must be coupled securely before going over the bridge to or from OH_{#4}.
46. When cars or buggies are put on the transfer table at OH_{#4} to proceed to the level, the Hook-on must see that the Safety blocks are on the rails.
47. Engineer and Hook-on must know that transfer table is in right position before going on or over table.
48. Engineer must put reverse lever on center, apply brakes and open cylinder cocks when engine is put on transfer table to go to or from lower level.
49. Engineer must not stay on engine while it is being transferred up or down OH_{#4} transfer table.
50. Engineers must inspect and report any broken or missing parts as well as other unsafe conditions of their engines to the Shop within one hour after the start of the turn.
51. Buggy greasers when greasing must place a danger sign on the tracks several feet away from buggies, both in front and rear of them.
52. Engine greasers must hang danger sign on the throttle before greasing engine.
53. Engineers and Hook-ons must check clearance markers - also report daily any clearance markers not visible.
54. All N. G. traffic travelling East or West under Lake Erie Bridge must stop. Hook-on must go to East or West side of bridge to see that everything is clear before pushing button to get green light. 1-Bell for East; 2 Bells for West; and 3 Bells in or out of Chipping Yard.
55. When an engine, with or without train, is moving on tracks, where vision is obstructed by steam, smoke or objects, it shall be ascertained by some member of the crew that the track is clear before movement proceeds.

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56. Warning devices are placed on each side of all bridges for clearances under the bridges. When a load is too high, it will touch an arm extending across the track and a bell will ring. When the bell rings, the engineer must stop and call the yardmaster and secure a clearance check before attempting to pass under the bridge.
57. Hook-on must flag Boulevard going in or out of OH#1 Yard.

B. General Instructions

1. Engineers should be very careful when hauling hot slabs; hot slabs slide very easily.
2. Avoid black smoke as much as possible.
3. Keep all crossings, frogs and switches clear, if possible.
4. Engines going to and from water plug under main gate bridge to other yards by way of main store must obey all stop signs and signal lights.
5. Hook-ons should be in view of the engineer as much as possible.
6. Materials along right of way should be reported to Narrow Gauge Department at once.
7. Do not put storm curtain on top of cab of engine. It may catch on fire or the wind may blow it off. This is an unsafe practice.
8. When taking water, be sure that tank does not overflow. When taking coal, do not over load; it is an unsafe practice and a waste of coal and water.
9. Do not step over draw-head on engine or coal car to go from one side to the other. This is an unsafe practice.

C. Narrow Gauge - Open Hearth No. 2

Safety Rules

1. The engineer must stop before going into mill. The Hook-on must go into the mill and see if track is clear, before giving the engineer a signal to come in. (Engines hauling hot metal from the metal mixer to either side of OH#2 charging floor must run very carefully.)
2. When shoving buggies in on steel pouring track on the South West end of OH#2, it will be the engineer's responsibility to see that the bumping block is not hit too hard. (The pit for lining ladles is in back of this bumping block and if it is hit too hard moulds might tumble into the ladle.)
3. Engineer must get signal from Flagman before crossing to the metal mixer, over Narrow Gauge crossing.
4. Improperly loaded cars or buggies are not to be moved.
5. It is the responsibility of the engineer handling ladle buggies in center of mill at OH#2 to see that anyone or anything near the engine is in the clear of the engine and of the ladle buggy. (The ladle buggy is much wider than the

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6. An engine going in on charging floor at OH#2 must get the proper signal to proceed, from the Hook-on before going into the mill. (Hot metal is delivered on broad gauge tracks to the charging floor and this hot metal may be above the switch which the Narrow Gauge is going to use.)
7. Hook-ons must set couplers on cinder squares, then walk a safe distance away before giving the engineer a signal, because the cinder square may contain hot slag.
8. Never part engine beside a heat. Hot top brick might break, rimmed or capped heat might blow up.
9. Engineers must clean their fires at ingot yard at 48" Mill.

D. Narrow Gauge - Open Hearth No. 3

Safety Rules

1. Hook-ons must operate Safety gates when going in on charging floor at OH#3.
2. Switches must be lined for main track after using coal bin track and water track at OH#3 mixing house.
3. Engine must not run under a heat which is being poured unless given the signal from the Steel Pourser.
4. Engineer must close windows of cab while passing platform.
5. Engineer must not park beside a heat. Hot top brick might break, capped or rimmed heat might blow up.
6. Engineer using broad gauge crossing between OH#3 and 30" Mill Stripper must get signal from U. R. R. Operator.
7. Engineer must get horn signal from Hook-on before going in on charging floor at OH#3.
8. Engineers must be very careful when coupling up cinder squares.
9. Hook-on must set couplers on cinder squares, then walk a safe distance away before giving Engineer a signal. The cinder square may contain hot slag.
10. Engineers must clean their fires only at West End of OH#3 or the south end of OH#3 ingot yard.
11. Never place cinder square at hunch pits.
12. Engine leaving OH#3 stripper must get green light before crossing broad gauge track.
13. Engine must get green light at east end of Roll Shop before crossing broad gauge track.

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E. Narrow Gauge - Open Hearth No. 4

Safety Rules

1. When cars or buggies are put on transfer table to go to upper level, Hook-on must know that the safety blocks are on the rails.
2. Engineer and Hook-on must know that transfer table is in right position before going on or over table.
3. Engineer must put reverse lever on center, apply brakes and open cylinder cocks when engine is put on transfer table to go to or from lower level.
4. Engineer must not stay on engine while it is being transferred up or down OH^{#4} Transfer Table.
5. When going south over bridge, Hook-on must call U. R. R. Operator from south end and report that the train is in the clear.
6. When going north over bridge, Engineer must call U. R. R. Operator and get right of way before going over bridge.
7. When going north over bridge, Engineer must make a dead stop at switch on north end of bridge, and wait until U. R. R. Operator gives the proper signal to proceed.
8. All safety chains must be coupled up securely on buggies before travelling over OH^{#4} bridge. Defective chains or hooks must be reported to Narrow Gauge Office at once.
9. When travelling south over OH^{#4} bridge, engine must shove train.
10. When travelling north over OH^{#4} bridge, train must be back of engine.
11. After Hook-on reports train in the clear at South end of OH^{#4} bridge, Hook-on must walk to west end of OH^{#4} Stock Yard to see that everything is clear before giving the engineer a signal to proceed.
12. When engine is coming off the Charging floor into Stock Yard, the Hook-on must line switch for main track.
13. When the engine is parking in the doorway, the Hook-on must know that the switch is lined for the main track, as the switch operates the traffic light on the charging floor for all traffic.
14. Never enter charging floor when charging machine has the red light showing.

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