PENNSYLVANIA RAILROAD SYSTEM
EASTERN REGION

MACHINERY EXAMINATIONS
QUESTIONS AND ANSWERS
FOR
LOCOMOTIVE FIREMEN

Philadelphia, Pa., 1920
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GENERAL NOTICE.

The examinations contained herein and the answers pertaining thereto have been compiled with the view of establishing a uniform method of examination and rating for Locomotive Firemen.

Locomotive Firemen will be required to pass the examination and obtain not less than the minimum rating on the questions herein set forth.

J. M. HENRY,
General Superintendent Motive Power.

APPROVED:

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General Manager.

OFFICE GENERAL SUPERINTENDENT MOTIVE POWER,
PHILADELPHIA, PA., JULY 1, 1920.
GENERAL DESCRIPTION.

1. Firemen, when first employed, and those now in the service, will be furnished a copy of the authorized machinery examinations. They will be required at the earliest possible date to visit the M. P. Instructor, preferably at the Instruction Room or Car, to receive necessary instructions. Firemen must also continue the practice of visiting the M. P. Instructor to become well informed on mechanical appliances.

2. These examinations are on the progressive plan. The entire subject is divided into three parts; the first, the second, and the third progressive examination.

3. Firemen will receive the first progressive examination at the end of twelve (12) months extended to cover 365 days period of actual service. The second examination at the end of an additional twelve (12) months extended to cover 365 days period of actual service, and the third examination after a succeeding period of twelve (12) months extended to cover 365 days period of actual service. If furloughed, an extension of time will be given, extending to that extent the 365 days period. Ninety (90) days continuous service must be had preceding the several examinations.

4. This method of progressive examinations shall become effective six (6) months after date book is issued and each Fireman then in the service will receive the progressive examination corresponding to his years of service. All Firemen who have been in the service over three years will take the third progressive examination. Firemen may, if they so desire, take their proper progressive examination in less than six (6) months above stipulated.

At any time after the issuance of this book, if Firemen are needed for promotion to engineers before they have taken their third progressive examina-
tion, they will take the third progressive examination for promotion.

5. No further machinery examination will be required for promotion to the position of engineer unless promotion is deferred for one (1) calendar year after passing the third progressive examination, in which event Fireman will be required to pass a fourth machinery examination for promotion.

6. Engineers demoted to the position of Fireman, and who have not been used as engineers for a period of two (2) years, will be required to pass the final or fourth machinery examination before permanently resuming duty as engineers.

7. The fourth examination is composed of fifty designated rating and five starred questions.

8. The required rating for the examinations will be as follows:

   First progressive examination... 80 per cent.
   Second progressive examination. 80 per cent.
   Third progressive examination... 80 per cent.
   Fourth examination ............. 85 per cent.

9. Firemen failing to obtain the required rating will be promptly notified in writing, specifying by number the questions on which they failed, and they should be re-examined after a period of thirty (30) days.

Firemen failing to obtain the required rating on the first examination will be re-examined after a period of thirty (30) days on the questions on which they failed, and in case of again failing, they will be allowed an additional thirty (30) days in which to qualify for a third examination. Firemen failing to obtain the required rating on the third re-examination of the several progressive examinations will not be permitted to resume duty until they pass. This opportunity is not to extend beyond six (6) months and will be cancelled if the employe takes employ-
ment elsewhere. Reasonable transportation will be given the employe to visit the instruction room.

Failure to pass the promotion examination will be handled in accordance with promotion rule.

10. Examiner may require answers to other questions than those enumerated on the printed list in order to determine if the man thoroughly understands the entire subject on which he is being examined. The examiner is privileged to take the fireman to a locomotive and have him demonstrate that he fully understands the questions and answers. The fireman has the same privilege if he desires to avail himself of it.

11. When the introduction of new equipment requires it, engineers and firemen will be instructed on same and examined if considered necessary.

12. Men will be examined orally and individually.
METHOD OF RATING.

1. In order that an accurate record may be obtained showing the employes' general knowledge of the locomotive, suitable blanks have been printed, a facsimile of which are shown on pages 46-47.

2. When the employe is being examined, the examiner will place an (X) mark on the number of all questions on which the employe fails, which will represent a total failure on that particular question, while a partial failure will be represented by one line drawn, crossing the square from diagonally opposite corners in which the number is enclosed.

3. Throughout the examinations, certain questions appear with a star in front of them, the star denoting that these questions are of such importance that they must be answered correctly; the failure to pass one or more of them meaning an entire failure in the block of questions in which they appear. For rating purposes, marking questions, not including the starred questions, have been grouped on the rating sheets in blocks of ten (10). Each of the ten (10) marking questions have a value of ten (10) for a full failure, and the value of five (5) for a partial failure. In case of failure to answer a sufficient number of questions in any one of the blocks to obtain the required rating, a re-examination will be required of the entire block in which these questions appear.

4. After the examination has been completed, and the rating for each block of ten (10) questions is higher than required, the average rating will be obtained by adding the total ratings together and dividing by the number of blocks on which the employe is examined. The average rating, however, will not be considered as a passing mark, unless the specified minimum rating has been obtained on each of the several blocks.

5. Immediately after the employe is examined, the rating blank should be filled out and forwarded to the Road Foreman of Engines.
FIREMEN'S PROGRESSIVE LOCOMOTIVE MACHINERY EXAMINATION.

EXAMINATION AFTER ONE YEAR'S SERVICE.

1. Q—What are the duties when reporting for service?
   A—Register and examine Bulletin Board. See that there is sufficient water in the boiler by trying the gauge cocks. Check the level of the water shown in the water gauge glass with that of the gauge cocks. Examine crown sheet and tubes, if leaking, must report. Try the grates to see that they are level and in working order. See that the engine is properly equipped with firing tools; that the proper flags, fusees, torpedoes, and lamps are on the engine, and see that the fire is in proper shape and that the ash-pan is clean and properly closed.

*2. Q—Where are the gauge cocks and water gauge glass located and what are their functions?
   A—The gauge cocks are located in the boiler-head and are for the purpose of ascertaining the level and action of the water in the boiler at that point. The glass water gauge is located on the boiler-head and is an auxiliary to the gauge cocks, but must not be wholly depended upon.

*3. Q—What attention should be given the gauge cocks, and how do you know the difference between steam and water when operating the gauge cocks?
   A—They must be kept open and used frequently. By looking and seeing what comes out of the drip pipes. *Never trust to sound.*

4. Q—When should gauge cocks be tried?
   A—Frequently when engine is working, and immediately after shutting engine off.

*5. Q—What is the least amount of water that should be carried in the boiler?
A—The position of the engine should always be considered and a sufficient amount of water carried in the boiler to insure full protection to the crown sheet and flues.

6. Q—Name some causes for injector failing to prime?
A—No water in tank, tank valve partly or entirely closed, strainer stopped up, hose lining loose, hose kinked, leaks in feed pipe, tubes in injector cut, leaking check valve, supply or inlet valve stuck open or overflow pipe obstructed.

7. Q—How would you prevent injectors, feed and branch pipes, steam heat pipes, etc., from freezing when not in use?
A—By closing overflow valve tight and permitting a small quantity of steam to blow back through the tank hose; open drain cocks in branch pipe. Crack the valve at the steam heat hose and allow enough steam to pass through to keep the pipes warm.

8. Q—What pressure is indicated by the steam gauge?
A—The pressure per square inch inside the boiler.

9. Q—How do you know the maximum working pressure allowed on a locomotive boiler?
A—By looking at the boiler badge plate.

10. Q—What is the purpose of safety valves on locomotive boilers? Why is more than one used?
A—To relieve the boiler of excess pressure. In case one fails or does not relieve the boiler of excess pressure fast enough, the other will assist.

11. Q—Is it important to know that the safety valves lift at the required pressure?
A—Yes.

*12. Q—What parts of the locomotive boiler are surrounded by water? Why?
A—The tubes or flues and the fire box. To gen-
erate steam and prevent sheets from overheating.

13. Q—Name the parts of the fire box?
   A—Two side sheets, a crown sheet, a tube or flue sheet, and a back sheet in which the fire box door is located.

14. Q—What is meant by the water legs of a boiler?
   A—The space between the fire box sheets below the crown sheet and the outside sheets of the boiler.

15. Q—What parts of the boiler are most sensitive to sudden change of temperature?
   A—The tube sheet and tubes or flues.

*16. Q—What attention should be given the lubricator before leaving a terminal?
   A—Should know that it has been filled, and feeds properly.

17. Q—How long before starting on a trip should lubricator feed valves be opened?
   A—About twenty minutes.

18. Q—How should the lubricator steam and condensing valves be operated?
   A—Wide open.

19. Q—When it is desired to stop lubricator, how would you do so?
   A—By operating the oil control valve on lubricators so equipped. On others by closing feed valves.

20. Q—Explain the oil control valve.
   A—It is a plug valve placed in the oil passage of the lubricator and is used to shut off the feed without disturbing the adjustment. When in the all-open position, or pointing down, all feeds are open. When half-way between the all-open and closed position, only the feed to the air pumps is open. When in the closed position or pointing up, all feeds are closed.

21. Q—Should the feed of lubricator be increased when nearing the end of day or trip, for the purpose of draining the oil out of the lubri-
cator, and what valves should be closed at the end of trip?
A—No. All valves.

*22. Q—What kind of oil should be used in a cylinder lubricator?
A—Nothing but valve oil.

23. Q—What is one of the greatest single items of expense of a railroad company?
A—Fuel.

24. Q—Who, then, is in position to help save fuel?
A—The fireman.

25. Q—How should engineers and firemen work, in order to obtain the best results?
A—They should work together so as to prevent smoke and save fuel.

26. Q—What is combustion? Is air necessary to combustion?
A—Another name for burning. Yes.

27. Q—What is the chief cause of imperfect combustion?
A—Not enough air being admitted to the fire.

28. Q—How is the draft created through a fire?
A—The exhaust steam from the cylinder passes up through the stack, carrying the air and gases out and creates a partial vacuum in the air-tight smoke box. Atmospheric pressure then forces the air through the ash-pan openings, grates, fire and tubes or flues, thus creating a draft through the fire.

29. Q—Describe a blower; its use and abuse?
A—The blower consists of a valve located in the cab and a pipe coupled to it, leading to the smoke box where it is attached to the blower nozzle, which points upward toward the stack. Its use is to form a partial vacuum in the smoke box, which creates a forced draft on the fire when the engine is not working. The abuse consists in using it too strongly when the fire is being cleaned, or while the fire box door is open, thus drawing
cold air through the tubes or flues, causing them to contract and leak.

30. Q—What bad effect is produced if the smoke box is not airtight?
   A—The amount of air that enters the smoke box through the openings (or leaks) would correspondingly reduce the amount of air that would pass through the grates, which results in reduced draft through the fire and causes poor steaming engines.

31. Q—Name some other causes for fire not getting enough air through the grates?
   A—Restricted ash pan openings, heavy or dirty fire, flues or tubes or front end, and stopped up.

*32. Q—If you get a red fire, what is the cause?
   A—Grates becoming clogged with ashes and clinkers, so that sufficient air cannot pass through them to the fire, or trouble in the smoke box.

33. Q—What causes pull on fire box door?
   A—The air that should be passing through the grates is being retarded by too heavy fire, dirt or clinkers.

34. Q—What is black smoke? Can these gases be burned?
   A—Black smoke is unburned gases passing off from the fuel. Yes, by having engine in good condition and firing properly.

35. Q—What are the advantages of a brick arch in the fire box?
   A—It induces more perfect combustion by retarding the gases in the fire box until they have reached the igniting point. It thus prevents, to some extent, black smoke by giving the fire time to consume the gases. It also partially heats the cold air before it enters the tubes, and otherwise acts as a deflector on the fire.

36. Q—How should a fire be built up to prevent black smoke?
A—Light, level and bright.

37. Q—What is the effect of putting too many shovelfuls of coal on a bright fire? Is this a waste of fuel?
A—Adding too much coal to a fire at one time reduces the temperature in the fire box below the igniting point, with the result that combustion is stopped until this fresh coal is heated to the burning point. During this time, there has been heat enough in the fire box to drive off the gases, and the draft has forced these gases out through the stack unconsumed. This causes the engine to fall back in steam, and also causes a waste of those unburned gases which is a waste of fuel.

38. Q—Why should the fireman anticipate the work the engine is about to do?
A—He must have his fire in proper condition to meet the work as it develops.

39. Q—If an engine should slip, how can damage to the fire be prevented?
A—By partly opening the fire door, thus permitting the air to be drawn over the fire for the instant, instead of through it.

40. Q—If fire is clean and draft appliances are right, and fire does not burn uniformly over the grates, where is the trouble?
A—In the flues. When the fire is not burning brightly, some of the flues are stopped up.

41. Q—Which is the best way to fire a locomotive?
A—To carry a level fire, and it must be a little heavier on the sides, to keep the air from coming through it near the sheets as rapidly as in the center of the fire box. Fire as lightly as possible; maintain uniform pressure, and avoid unnecessary black smoke and a waste of steam through the safety valves.

42. Q—What is the estimated waste of coal for each minute a safety valve is open on a modern engine?
A—Thirty pounds.

*43. Q—Why should the fireman be familiar with the grades, location of stations, etc.?
A—This is very important, as the engine must be fired according to the work it is called upon to do.

44. Q—Why should the gangway, deck, and steps be kept clear of coal?
A—Coal falling from an engine endangers the lives of persons along the track and is a waste of fuel.

45. Q—Why can firing be done more intelligently when the water level is closely observed?
A—Because intelligent firing can only be accomplished by closely observing the water level and the way the engine is being handled and pumped.

*46. Q—When should the grates be shaken?
A—Often enough to keep the fire clean and insure the proper amount of air passing through the fire.

*47. Q—What should be the condition of the fire when engine is brought to terminal, and what are the duties of the fireman on arrival at terminal?
A—Engine should not be brought to terminal with a dead fire, which would cause tubes to leak, or with too heavy fire, which is a waste of fuel. He should see that his fire is in proper condition so that it can be cleaned without waste of fuel, and should, also, see that tools are properly put away.

EXAMINATION AFTER TWO YEARS' SERVICE.

101. Q—Describe the glass water gauge?
A—It is a glass gauge connected to the boiler at both ends, so that the water level in the boiler can be seen. It is located on the boiler head, the bottom of the glass being about level with the first gauge cock.
102. Q—How must the glass water gauge be tested when taking charge of a locomotive?
A—Blow it out by shutting the top valve and opening the drain valve, leaving the bottom valve open and allowing the steam and water to blow out until the glass is clear; then, shut the bottom valve and open the top valve, allowing the steam and water to blow until the glass is clear.

103. Q—What is the effect of a leak in top joints or unions of glass water gauge? Bottom joints or unions?
A—The glass water gauge will register a higher level than the water in the boiler. The glass water gauge will register a lower level than the water in the boiler.

104. Q—What particular attention should the glass water gauge drain valve receive?
A—Must see that it is properly closed; a leak at this point will cause the glass water gauge to register untrue water level.

105. Q—When you find the gauge cocks registering one gauge of water and the glass water gauge shows full, what is the cause?
A—This indicates that top valve is closed or top passageway stopped up and not having the same steam pressure on top of the water in the glass gauge as there is in the boiler, the pressure in the boiler forces the water to the top of the glass water gauge.

106. Q—How does the water in the glass water gauge act when gauge is in good working order?
A—The water in the glass water gauge will move up and down with the movement of the engine.

107. Q—When engine is in motion and water in glass water gauge shows a stationary reading, what is wrong?
A—The bottom passageway is stopped up, or the bottom valve is closed and steam con-
densation will gradually fill the glass water gauge with water.

108. Q—Do the gauge cocks and glass water gauge always show the same water level when engine is working?
A—No. The gauge cocks show the agitated condition of the water at the point where they are located. The water in the glass water gauge passing through the connections should not show the agitated or foaming condition of the water in the boiler.

*109. Q—If an engine started to work water, and gauge cocks showed three gauges of water, and glass water gauge registered a much lower reading, what would be wrong and what should be done?
A—Boiler is foaming and throttle should be closed slowly and cylinder cocks opened to prevent damaging cylinders and the water supply increased. Note level of water by use of gauge cocks and glass water gauge and if water falls below first gauge cock immediately open throttle. On arrival at terminal, report that boiler should be washed and tank cleaned.

*110. Q—If glass water gauge is out of order, how would you detect a foaming boiler?
A—If an engine started to work water, or, if gauge cocks showed a higher reading than I thought they should, would immediately ease off throttle, trying gauge cocks continually until throttle was entirely closed, and if water dropped too far, would know boiler was foaming.

111. Q—Explain the action of the water in the boiler, when engine is started ahead?
A—Water surges to back head of boiler and causes the gauges to show a higher water level. Just the opposite occurs when the engine is running backwards.
112. Q—Why is the knowledge of the action of the water in a boiler necessary?
A—The water gauges only register the water at the point where they are located and the knowledge of the action of the water with the action of the engine will prevent damage. Allowance must be made when on other than level track.

113. Q—If you shut your engine off at any point and water should disappear from bottom gauge cock, what would you do?
A—Immediately ascertain if boiler is foaming. Would shut off at intervals, or, until gauge cocks registered solid water with engine shut off. During the remainder of trip throttle should be closed frequently and water level ascertained.

*114. Q—What is the result if the crown sheet is overheated?
A—If slightly overheated the crown bolts and probably the seams will be loosened, causing them to leak, if greatly overheated the crown sheets and crown bolts will soften and the boiler pressure on the crown sheet will then force off the heads of the crown bolts or force them through the crown sheet and also probably rupture the crown sheet.

115. Q—Name the valves and tubes in a Sellers Injector?
A—Steam, overflow, regulating, line check and inlet valves; steam nozzle, combining and delivery tubes.

116. Q—Where is the emergency valve in a Simplex Injector, and how is it operated? How can you tell whether it is open or shut?
A—Just above the inlet valve. Should the inlet valve stick or break, the emergency valve should be closed, then injector should start to work. On the key attached to the valve are the letters (O) and (S). When
(O) is up, it is open, and when (S) is up, it is shut.

117. Q—How is the water taken from the tank into the injector?
A—A jet of steam passing through the steam nozzle, exhausts the air out of the body of the injector and feed pipe, creating a partial vacuum therein. Atmospheric pressure on the water in the tank forces the water up into the injector.

118. Q—How is water from the injector forced into the boiler against the same or higher pressure?
A—The steam combining with the water gives the water velocity. This moving water passes freely out the overflow until it has gained sufficient velocity to force its way into the boiler against the stationary mass of water in the boiler.

119. Q—Name some of the causes why an injector will not work after it is primed?
A—Insufficient water or steam supply, tubes out of line or badly cut, boiler check or line check stuck shut, overflow valve not properly open, overflow pipe obstructed, combining or delivery tubes stopped up.

120. Q—Name some of the reasons which cause an injector while working, to spill or waste water or steam at overflow?
A—Too much water; steam not all condensed due to too much steam or insufficient water, tubes cut or worn or partially stopped up.

121. Q—If an engine steams poorly while working, but gains steam rapidly when shut off with blower applied, what is the trouble?
A—This condition usually indicates that steam is leaking into the smoke box, destroying the vacuum, which may be due to leaking steam pipe joint, or loose exhaust pot or nozzle, and with a superheater engine, it may be a leaking unit.
122. Q—If engine steams poorly while working and does not gain steam rapidly when shut off with the blower applied, where is the trouble?
A—Usually in the front end. Smoke box might be full of cinders, or the netting stopped up; if practicable, smoke box should be opened and front end or netting cleaned.

123. Q—What is saturated steam?
A—Steam at the same temperature as the water in the boiler. Any reduction in temperature causes condensation.

124. Q—What is superheated steam, and how is it superheated?
A—Steam, heated to a higher temperature than the water in the boiler. The steam, after leaving the dry pipe, enters the superheater header on one side of a partition wall in the header, then passes through the superheater tubes, to the other side of the superheater header partition, and from there through steam pipes to the steam chest. The hot gases from the fire box, passing through the large tubes, coming in contact with the superheater tubes, heat the steam in the superheater tubes on its way to the cylinder, with the result that it is of much higher temperature than when it left the boiler.

125. Q—What are the advantages in the use of superheaters in locomotives?
A—Sufficient heat is added to saturated steam passing through the superheater units to about equal the heat losses in the cylinders and steam passage, thereby preventing condensation when engine is working. This addition of heat also increases the volume of the saturated steam about twenty per cent.

126. Q—How does superheat save water and fuel?
A—The increase in volume and the reduction or total elimination of condensation reduces the water consumption by about twenty per cent,
and, as the water consumption is less, it follows that the coal consumption is also less.

127. Q—Why is it important that the fireman should understand the functions of a superheater?
A—The success of the superheater depends largely upon the performance of the fireman. A heavy or humped short flame fire may produce maximum boiler pressure, but a high temperature is not developed around the superheater units, with the result that the steam enters the steam chest at a very low degree of superheat. A light, bright, long flame fire not only produces maximum boiler pressure, but maintains a very high temperature around the superheater units with the result that when the steam enters the steam chest it is at a very high degree of superheat, which has increased its volume and results in a saving of water, fuel, and labor.

128. Q—Describe the fire box.
A—It has a door and consists of two shells. The inner shell is composed of side sheets, a crown sheet, a back sheet, and a tube or flue sheet from which the flues run to the front flue sheet or front end. The inner shell is surrounded by an outside shell.

129. Q—Describe a staybolt.
A—Bolt having a screw thread cut its entire length and screwed through both the inside and outside sheets, with its end riveted over.

130. Q—What is the object of hollow staybolts?
A—to indicate by the escape of steam and water that the bolt is cracked or broken.

131. Q—How is the boiler of a locomotive connected to the frame?
A—Front end of the boiler and cylinder saddles are securely fastened to the frame. The fire box end is carried on the frame by expansion plates, or hangers, as the case may be and is free to move backward or forward on the frame as expansion and contraction takes
place. Boiler should always be kept securely fastened to the frame.

132. Q—To what strain is the fire box subjected?  
A—The fire box is subject to crushing strains and those of unequal expansion and contraction.

133. Q—To what strain is the boiler subjected?  
A—Expension and contraction; internal pressure and vibration.

*134. Q—How is the boiler sometimes abused?  
A—By allowing the steam pressure to drop and then blowing the boiler hot quickly; over-pumping the boiler, thereby reducing the steam pressure, and then allowing the pressure to rise quickly. Improper firing, causing sudden changes in the fire box temperature.

135. Q—Why do boilers have steam domes?  
A—In order to place the throttle valve where it will be supplied with dry steam.

136. Q—Trace the flow of steam from the boiler to the cylinders and thence to the atmosphere.  
A—From the throttle to the dry pipe; thence through the steam pipes into each steam chest; thence through the steam port into one end of the cylinder, forcing piston to opposite end, after which it goes back through the same steam port into steam chest through the exhaust port into exhaust pipe and through the stack to the atmosphere.

137. Q—What is the effect of leaky steam pipe joints in the front end?  
A—Steam leaks in the front end decreases the vacuum in the smoke box; this in turn, decreases the draft through the fire, with the result that engine will not steam freely.

138. Q—Why is it important that there be no holes through the smoke box?  
A—There should be no possible chance for the
admision of air through any part of the
smoke box. Leaks decrease the vacuum
necessary to create proper draft on the fire
and also cause combustion to take place in
the cinders in the smoke box, this warps the
sheets of the front end.

139. Q—What causes the exhaust to issue from one
of plumb.
side of the stack?
A—The exhaust pot, lift pipe, or stack, is out

140. Q—Why should draft appliance defects be re­
ported in detail?
A—The engineer and fireman are in the best
position to determine the cause of engine not
steaming and the M. P. 62 reports should
furnish detailed information, specifying just
where, in their opinion the trouble is, so that
the enginehouse force will not be compelled
to draw the fire and make expensive tests
unnecessarily, which holds the engine out of
the service.

*141. Q—What is lubrication and what is its purpose?
A—The placing of a thin layer of lubricant be­
tween moving surfaces of metal so that they
do not actually touch each other, thus pre­
venting friction and wear.

142. Q—Where is the cylinder lubricator located
and why?
A—The cylinder lubricator is located in the
cab, so there is a gradual descent in the oil
pipes from the lubricator to the steam chest.

143. Q—Where is the condensing chamber located,
what is it for, and how is it connected to the
oil reservoir?
A—Condensing chamber is directly above the
oil reservoir connected at upper end to a
steam pipe leading from the boiler. It is
used to condense steam for the purpose of
keeping the oil reservoir constantly full. It
is connected to the oil reservoir by a water
or condensing valve and water pipe leading to the bottom of the oil reservoir.

144. Q—How does the oil get from the oil reservoir to the sight feeds?
   A—Oil being lighter than water the weight of the water in the condensing chamber raises the oil to the top of oil reservoir and forces it through the oil passage to and through the sight feed.

145. Q—How does the oil get from the feeds to the steam chest?
   A—The steam from the top of the condensing chamber passes through a circulating pipe to a chamber around and directly above the sight feed, to top of which chamber, oil pipe is connected. Condensation fills this chamber with water to the level of the oil pipe. Oil being lighter than water it passes from the feed to the surface of the water, from there, steam from the circulating pipe and gravity, carries it through the oil pipe to the steam chest.

146. Q—If lubricator feeds faster when throttle is closed than wide open, what is usually wrong?
   A—Choke plugs holes are too large.

147. Q—If valve should appear dry while using steam and the lubricator is working right, what should be done?
   A—Ease off throttle a few seconds to reduce the steam chest pressure. Oil that is being held above choke plugs will then flow to the steam chest. If that does not correct trouble, oil pipe is stopped up.

*148. Q—Why is it bad practice to carry water too high in the boiler?
   A—It washes the oil off the valve and cylinder walls; always reduces lubrication; retards the action of the engine, and will cause cutting.
149. Q—Why should engine oil be kept away from the boiler in warm weather?
   A—To keep it from becoming too hot. Hot oil runs off of bearings and is wasted.

150. Q—What should be observed when oiling the machinery?
   A—That all oil holes are open and that the oil goes to the bearings. Only enough oil should be used to lubricate the parts.

151. Q—What results are obtained by proper lubrication?
   A—Proper lubrication prevents friction and reduces wear and coal consumption.

152. Q—What are engine springs for?
   A—The springs lessen the amount of shock imparted to the frames and engine, and might be termed shock absorbers.

153. Q—How is the weight of the frames and boiler suspended on the driving wheel springs?
   A—The driving boxes rest on the axles and the springs are carried by the saddles, which rest on the boxes, and the frames are suspended from the springs by hangers and equalizers.

154. Q—What is the purpose of the equalizers?
   A—The equalizers are used to equalize or distribute the weight between the boxes or bearings.

155. Q—How are the driving boxes held, so that they will not move forward or backward?
   A—By means of shoes and wedges bearing against the jaws of the frame.

156. Q—Where is the wedge located, and what is it for?
   A—The wedge is located behind the driving box and is an adjustable liner used to take up the lost motion between the box and pedestal jaw of frame.

157. Q—What effect is produced when wedges are set up too tight?
A—The up-and-down movement of the driving box will be retarded which will interfere with the action of the springs and the engine will ride hard.

158. Q—How do you ascertain if engine is equalized?
A—The springs and hangers should be level and straight, and there must be clearance between the frames and top of driving boxes, also, between the bottom of the boxes and pedestal caps.

159. Q—Why is clearance above and below the driving box necessary?
A—To prevent the frame from striking the top of driving box or the pedestal cap from striking the bottom of the driving box. The frame and pedestal cap coming in contact with the driving box will knock nuts, bolts, and other parts loose, and will cause engine to ride hard.

160. Q—What should be minimum clearance between the pedestal caps and driving boxes?
A—Not less than one inch.

161. Q—Describe a slide valve?
A—It is rectangular in shape and is located in the steam chest, it moves backward and forward admitting steam to first one end of the cylinder and then to the other. It has a cavity which allows exhaust steam to pass from the cylinders to the exhaust.

162. Q—Describe a piston valve?
A—It is cylindrical or spool-shaped, having packing rings on both ends and it operates in a cylinder called the valve chamber, performing the same function as a slide valve.

163. Q—How many ports are in a slide valve seat?
A—Three. The front port allows steam to enter the front end of the cylinder; and the middle or exhaust port allows steam after
leaving the cylinder to pass through the exhaust. The back port allows steam to enter the back end of the cylinder.

164. $Q$—Name the principal parts of a Stephenson valve gear?
$A$—Reverse lever, reach rod, reversing arm, tumbling shaft, lifting arm, link hanger, link saddle and pin, link block, link block pin, eccentric and strap, eccentric rod, rocker arm, valve rod, valve yoke and valve, and on certain types of engines, transmission bar and hanger.

165. $Q$—Name the principal parts of the Walschaert valve gear?
$A$—Reverse lever, reach rod, reversing arm, tumbling shaft, lifting arm, radius rod, lifter or suspension arm, eccentric crank, eccentric rod, link, link block, link block pin, valve steam cross-head, valve stem combination or lap and lead lever, lap and lead connector, and crosshead arm.

*166. $Q$—How should cylinders be warmed up before engine is started?
$A$—Cylinder cocks must be opened, brakes applied, throttle opened and steam admitted alternately to each end of both cylinders until dry steam appears at all cylinder cocks.

167. $Q$—When warming up or blowing water out of engine how should throttle be operated?
$A$—It should be opened up slightly or just cracked. If too much steam is permitted to enter the superheater, accumulated water in the units is driven with great force against the superheater bends which might cause them to leak.

*168. $Q$—What is liable to occur if an engine is moved with water in the cylinders?
$A$—Water is incompressible and if trapped in cylinders when piston is moving toward
cylinder head it is liable to crack or knock out the cylinder head, crack or loosen the cylinder or bend or break the rods or pins.

169. Q—Does damage of this kind sometimes occur and the damage not become apparent at once?
   A—Yes, parts affected and fractures started may hold and not fail until later.

170. Q—Where is the piston packing located?
   A—The piston packing is in the cylinder head.

171. Q—Where is the cylinder packing located?
   A—The cylinder packing is in the grooves of the piston head.

172. Q—Why should packing be in good condition and well fitted?
   A—To eliminate, as far as possible, the loss of power, due to steam blowing by the packing. Steam leaks of any kind are objectionable; they not only reduce the power of the engine, but obscure the vision, and, in addition, increase the fuel consumption.

173. Q—Does efficient braking save fuel? How is the saving affected?
   A—Yes. After closing the throttle use the momentum of the train to move it as far as possible consistent with safety and the needs of the service.

174. Q—What qualifications are necessary to successfully practice economical engine operation?
   A—A thorough knowledge of the machine; willing co-operation between the engineer and the fireman; correct handling of the throttle, reverse lever, brake valve, and injectors. Fuel can be saved by using good judgment when drifting, and an engine should be pumped and fired so that water can be supplied to the boiler after engine is shut off to avoid waste of steam through the safety valves.
201. Q—What are the qualifications in general that an engineer should possess?
A—He must be a man of good habits, trustworthy, faithful and intelligent. He must understand the rules and obey them. He must understand the engine, not only as to the care and handling, but what to do in case of break-downs and emergencies.

*202. Q—What is the first duty of an engineer when taking charge of an engine?
A—He must see that there is sufficient water in the boiler by operating the gauge cocks and looking and seeing what comes out of the drip pipes. He should examine the glass water gauge and gauge cocks. He must know that they are open and working freely. He should examine the firebox and tubes or flues. He must know that the injectors are working properly.

203. Q—Would you attach any more importance to the top row of flues leaking than if the bottom rows were leaking?
A—Yes. A leak at that point indicates that the flues might have been damaged by low water.

204. Q—When examining firebox and flue sheets for leaks, how should the blower be operated?
A—Just strong enough to clear smoke. Strong draft created by operating blower valve wide open will draw leaking water through flues and will dry the flue sheet. This destroys evidence of leaking flues.

205. Q—How do leaking flues affect the steaming qualities of an engine?
A—Water from leaking flues evaporates into steam in the firebox and flues. This steam coming in contact with the hot gases lowers
their temperature and also partly fills the vacuum in the front end and thus lessens the draft through the fire.

206. Q—Name and explain the various appliances in the smoke box or front end?
A—Pipes to carry steam to the steam chest, exhaust pot, exhaust nozzle, blower, lift or petticoat pipe, stack, diaphragm, and netting. The exhaust pot conducts steam from exhaust ports towards the stack. The nozzle is a continuation of the exhaust pot and is used to create greater or less draft on the fire by decreasing or increasing its size. The blower is used to create draft when engine is not working. The diaphragm is used to equalize the draft through the flues. The netting prevents large sparks from passing out through the stack. The lift or petticoat pipe is an internal extension of the stack.

207. Q—What inspection should be made of an engine?
A—While engine is being prepared, the engine and tender should be inspected for defects. See that all important bolts, nuts and cotter pins are in place. See that there are no loose bolts, nuts, tools, etc., lying on running board, frames, etc. See that whistle and bell ropes are in good condition.

208. Q—How is the fire box end of the boiler stayed?
A—The inside and outside sheets are held together by staybolts. The crown and roof sheets are held together by crown bolts.

209. Q—What is meant by circulation in a boiler?
A—Circulation in a boiler is the movement of water within the boiler. It is caused by heat. The water in contact with the fire box sheet and flues absorbs the heat from the fire and rises. As the heated water rises it is re-
placed by water of a lower temperature. This movement is termed circulation.

210. Q—How is good circulation insured by the fireman?
   A—By firing a light, bright, long flame fire over the entire fire box the greatest amount of heat is produced, thus insuring good circulation.

211. Q—How can an engineer aid or hamper circulation?
   A—He can aid circulation by intelligent pumping. Water should be added to the boiler according to the boiler pressure and condition of the fire. Water, as it enters the boiler, is at a low temperature and feeding the boiler too fast retards circulation and steam pressure is not increased promptly.

212. Q—What is the function of the valve gear?
   A—to transmit the motion of the eccentric or eccentric crank arm to the valve causing it to move backward and forward.

213. Q—What is an eccentric? An eccentric crank arm?
   A—An eccentric is a circular device fastened out of center on the axle. The eccentric crank arm is fastened to the main pin in such a way that the eccentric crank pin is out of center with the axle.

214. Q—What is meant by a balanced slide valve?
   A—it is one where a certain percentage of the steam pressure on top of the valve has been removed. This is accomplished by a pressure plate fastened to the steam chest lid. The top of the valve is grooved for four snugly fitting strips, which are held against the pressure plate by springs which make a steam tight joint and prevent pressure from reaching the top of the valve.
215. Q—Why is it undesirable to wholly balance this type of valve?
A—The upward pressure from the cylinders would raise the valve off its seat.

216. Q—Why is there a hole in the top of the valve?
A—to permit any steam that leaks past the balancing strips to escape through the exhaust.

217. Q—What is meant by inside or outside admission?
A—Inside admission means that the steam enters the port from the inside edge, and is exhausted from the outer edge of the valve. Outside admission means that the steam enters the port from the outside edge and is exhausted from the inner edge of the valve.

218. Q—How is the travel of the valve regulated?
A—the motion of the eccentric is transmitted to the link and the distance which any point of the link travels always remains the same. When working in full gear, the link block is at the end of the link and the valve travels its maximum distance. As the reverse lever is hooked up, the link block is moved closer to the middle of the link and this decreases the travel of the valve.

219. Q—What is outside lap and its purpose?
A—Outside lap is the distance the valve overlaps the steam ports when the valve is on the center of its seat, earlier cut-off is thus obtained, than without lap, which permits the steam in the cylinders to be worked expansively.

220. Q—What is meant by cut-off?
A—the valve closes the steam port after the piston has traveled a portion of its stroke. A six-inch cut-off means that the steam to the cylinder has been shut off when the piston has traveled six inches from the beginning of its stroke.
221. Q—How is cut-off obtained?
A—The travel at the center of the link is less than at the end. When the link block is close to the center of the link, the valve closes the steam port earlier than when the block is at the end of the link. Steam thus held pushes the piston to the end of its stroke by expansion.

222. Q—At what cut-off should the valve be worked in order to obtain the most economical results?
A—As short as the engine will handle the train at the required speed, but not less than twenty-five per cent. When cut-off is less than twenty-five per cent, poor steam distribution results.

223. Q—At what cut-off should the valve gear be placed when drifting, starting or moving at slow speed?
A—To insure proper lubrication and uniform wear of valve, valve seats or bushings, the valve gear should be in almost full travel.

224. Q—What is a shifting valve?
A—The shifting valve is located in the side of the steam chest or steam passageway; when the engine is drifting it is open and prevents air, hot gases, etc., from being drawn from the smoke box into the steam chest and cylinders.

225. Q—What is the bad effect of leaking main valve or cylinder packing?
A—Steam blowing past the main valve or cylinder packing is wasted, and causes back pressure in the opposite end of cylinder and destroys lubrication.

226. Q—What is the effect of a broken balance strip spring and how can it be detected?
A—With the throttle open there will be constant blow at the exhaust with the reverse
lever in any position, and the reverse lever will handle hard.

227. Q—What is the effect of reversing an engine while running?
A—After the piston moves a short distance, the cylinder is then in communication with the exhaust port, with the result that air is drawn from the smoke box through the exhaust into the cylinder almost the entire stroke, and on the return stroke is compressed to an excessive pressure into the steam chest, steam pipe and dry pipe, producing resistance on the piston. In addition to the air, hot gases and cinders from the smoke box being drawn into the cylinders, destroying lubrication.

228. Q—How tight should wedges be adjusted?
A—Tight enough to take up the lost motion, but not tight enough to cause box to stick.

*229. Q—What position should engine be in when wedges are being adjusted?
A—Place engine so that both main crank pins are in the upper eighth position, one forward and the other back of the center of stroke. Block wheels, preferable ahead of engine truck wheels, place reverse lever in forward motion and use steam to pull the boxes against the shoes on all wheels. Set up wedges fairly tight, then pull them down not to exceed 7/8 in. This work should be done on straight and level track.

230. Q—What is meant by the dead center?
A—When the crosshead is at either the front or back end of the stroke and the pins and rods are on a line with the center of the wheels.

231. Q—Why should engine be placed on center after wedges have been adjusted?
A—in order to determine that the rod bush-
ings are free on the pins and do not bind when passing center.

232. Q—What is the effect if the driving wheel pins are not the same distance apart as the length of the side rod?
A—Side rod bushings bind on pins when passing center, causing them to run hot.

233. Q—When should driving box wedges be lined?
A—When the wedge has been forced up and the wedge bolt is run out and lost motion still appears between wedge and box.

234. Q—When should driving box shoes be lined?
A—The shoe should be lined when the side rod prevents box being forced against shoe.

235. Q—What trouble is likely to occur when a wedge bolt is broken?
A—Wedge is likely to stick to the box and be pulled up, causing the box to stick and run hot.

236. Q—When unable to pull down a tight wedge, what should be done?
A—Run wheel over a large nut which will sometimes loosen wedge.

237. Q—What is meant by engine out of tram?
A—An engine is out of tram when the distance between any two wheels on one side is not the same as the distance between the corresponding wheels on the opposite side.

238. Q—Why is it necessary to keep rod brasses keyed?
A—To prevent pounds and heating of rod brasses. Pounds sometimes result in loosening nuts and breaking brasses.

239. Q—In what position should an engine be placed to key the back end main rod brasses? The front end main rod brasses?
A—For the back end, place the side of the engine upon which the work is done on the upper forward eighth, as this position pre-
sents the greatest diameter of the pin to the rod brasses. For the front end, place the engine on the bottom quarter.

240. Q—When should rod brasses be reported closed, or reduced?
A—When they are keyed brass to brass and still pound.

241. Q—What are some of the usual causes of pounding?
A—Loose or worn brasses, loose wedges, driving box shells worn or loose, piston rod loose in its crosshead, loose cylinders, worn guides or crossheads, main rod too long or too short, loose nut on main piston rod, pedestal bolts loose, broken frame, or flat tires.

242. Q—How can a pound be located?
A—By placing the main pin on quarter, then blocking the driving wheels, giving the cylinder a little steam, and reversing the engine under pressure, observing the different parts.

*243. Q—If an engine develops a cylinder pound when drifting, what does it usually indicate, and what should be done?
A—Loose piston head or main rod too long or too short, causing the piston to strike the cylinder head. Throttle should be kept slightly open to form a cushion in the cylinder.

244. Q—When an engine using steam is running ahead, against which guide does the crosshead bear?
A—The top guide.

245. Q—When running with the reverse lever in full forward gear and reverse lever knocks and rattles but ceases when the engine is hooked up a notch or two, what is wrong?
A—The top of link is riding on link block, usually caused by the reach rod being too long.
246. Q—If steam issues from cylinder cocks with throttle shut off and engine is standing, what does it indicate?
A—If lubricator is shut off, it is usually either a leaking throttle or dry pipe.

247. Q—Is this always true with a superheater engine?
A—No. Steam may be coming from the water which has accumulated in the superheater units, in this case it will cease when all the water in the units is evaporated.

248. Q—What is back pressure and how does it affect an engine?
A—While the exhaust is open, it is the pressure that is on the exhaust side of the piston, which is the wrong side, and retards the engine.

249. Q—What is compression and its effect?
A—After the exhaust is closed, the steam trapped in the cylinder is compressed by the moving piston and acts as a cushion.

*250. Q—How should an engine be started to avoid jerks?
A—Slowly, until all slack is out of the train.

251. Q—How should the throttle be closed when hauling a long train?
A—The throttle should be eased off slowly to allow the slack in the train to gradually run in.

*252. Q—How should sand be used?
A—A slipping engine should not be caught on sand nor should sand be used on one side only. Rods, pins and axles are liable to break. By the proper use of sand to prevent slipping, coal, water and labor are saved.

*253. Q—If for any reason water in the boiler cannot be maintained at a safe level what should be done?
A—Fire should be deadened or drawn.
254. Q—What should be done in case throttle valve becomes disconnected while valve is closed? 
A—Engine is powerless and assistance must be obtained.

255. Q—What should be done if throttle valve fails to seat after throttle lever is in closed position? 
A—Engine must be controlled by reverse lever and brakes. Steam pressure should be reduced if necessary.

256. Q—How can a broken slide valve yoke, or stem, be located? 
A—Open the cylinder cocks, admit steam to the steam chest, then reverse engine several times, and if steam does not flow alternately from each cock the trouble is on that side. The side being tested should be on or near quarter.

257. Q—If an engine with a broken valve yoke, or stem, blows badly, what does it indicate? 
A—that valve has moved ahead far enough to open the exhaust.

258. Q—With a broken valve yoke, or stem, what can be done. 
A—that blow is such that engine cannot be moved, assistance is necessary. If exhaust port is not open, main rod should be taken down, piston blocked all the way ahead and can then proceed on one side.

259. Q—If an eccentric gets hot, what should be done to avoid breaking the strap? 
A—that it well, using valve oil if very hot. If the strap is so tight that it cannot be cooled down by the use of valve oil, then loosen the bolts, apply liners and tighten the bolts.

260. Q—What should be done if a forward motion eccentric, eccentric strap, or eccentric rod is broken? 
A—that run ahead on one side, take off broken parts, cover ports and clamp main valve.
Engine can be run backward at slow speed using both sides by unclamping valve and placing reverse lever in a position that will put the eccentric rod in line with the link block.

261. Q—What should be done if the back motion eccentric, eccentric strap, or eccentric rod is broken?

A—Engine can be run ahead at slow speed using both sides, by placing the reverse lever in position to bring the forward motion eccentric rod in line with the link block. Engine cannot be run backward using both sides. To run ahead on one side, connect the forward motion eccentric rod to the bottom of the link, cover the ports and clamp the valve. To run backward, remove the link hanger.

262. Q—Why are piston valve engines more liable to damage by water in cylinders than slide valve engines?

A—On a slide valve engine the water will force the valve off its seat and escape to the exhaust. On a piston valve engine the water cannot get past the valve packing rings.

263. Q—What should be done if a front cylinder head is broken or knocked out?

A—Disconnect valve rod, cover ports, clamp valve, and proceed on one side.

264. Q—What should be done if valve stem is broken outside of steam chest?

A—Take off broken parts, cover ports, clamp valve, and proceed on one side.

265. Q—What should be done if reverse lever, reach rod, or reversing arm or tumbling shaft is broken?

A—The failure of any one of these parts causes the link to drop down on the link block. Engine can be run ahead carefully, if cut-
off is desired, raise links by blocking between top of link and link block. To run backward, raise links to backward motion and use longer block.

266. Q—What should be done if a link hanger is broken?
A—Link on that side drops on link block. Engine can be run ahead, if cut-off is desired, raise link by blocking between top of link and link block. To run backward, raise link to backward motion and use longer block.

267. Q—What should be done if link block pin is broken?
A—The movement of the valve on that side is lost. Disconnect valve rod, cover ports, clamp valve, pull rocker arm to clear and proceed on one side.

268. Q—What is the transmission rod for, and where is it connected?
A—It is the rod which makes the connection between the link block and lower rocker arm and is held in position by a hanger. It transmits the movement of the link block to the lower rocker arm.

269. Q—What should be done if a transmission rod is broken?
A—Remove broken part if necessary, cover ports, clamp valve and proceed on one side.

270. Q—What should be done if a transmission bar hanger is broken?
A—Transmission bar will drop down and rest on axle, and if engine is linked up high it would be in back motion. Place engine in full forward gear and proceed on both sides.

271. Q—What should be done if main rod is broken?
A—Remove broken parts, block crosshead at back end of guide, disconnect valve, rod
cover ports, clamp valve and proceed on one side.

272. Q—What should be done if a guide is broken or lost, or a piston is bent?
A—Take down main rod, block crosshead, disconnect valve rod, cover ports, clamp valve and proceed on one side.

273. Q—Why are knuckle joints provided in side rods?
A—To provide vertical flexibility thereby relieving the up-and-down bending strain on side rods.

274. Q—If the back section of a side rod is broken or a knuckle pin lost out of a six or eight-wheel connected engine, what should be done?
A—Take down the disabled rod and the corresponding rod on the opposite side.

275. Q—If the front section of a side rod on a six-wheel connected engine is broken, what should be done?
A—Take down all side rods.

276. Q—If the front section of an eight-wheel connected engine is broken, what should be done?
A—Take down broken rod and corresponding rod on the opposite side.

277. Q—If the middle section of an eight-wheel connected engine is broken, what should be done?
A—Take down all side rods.

278. Q—What should be done if the main pin is broken off close to the hub?
A—All rods on the disabled side, and all side rods on the opposite side should be taken down. It is sometimes the practice to move engine with main and side rods on one side only, but it should be remembered that when brakes are applied pins or rods are liable to be bent or broken.
279. Q—What should be done if an engine running on one side stops on dead center?
   A—Unclamp valve, move it off center, and give engine enough steam to move good side off center.

*280. Q—When an engine truck spring or front driving wheel spring or hanger is broken what should be particularly noted?
   A—See that the pilot clears the rails properly.

281. Q—What should be done if a spring hanger is broken?
   A—if wheels do not rub the boiler, air pipe, etc., and pilot clears the rails, engine can be run carefully. If necessary, the engine frame should be raised and blocks placed between the frame and top of driving box.

282. Q—Without jacks, how can the engine frame be raised off of driving box?
   A—Block between frame and top of driving box next to disabled point. Then run the blocked wheel up on blocking and block between frame and top of driving box at disabled point. If this does not raise the frame enough, repeat the operation.

283. Q—What should be done if a driving wheel tire is broken?
   A—If it is necessary to swing the disabled wheel, that pair of wheels must be raised and blocking placed between pedestal cap and bottom of driving boxes.

284. Q—Without jacks, how can a disabled wheel be swung clear of the rail?
   A—Run the disabled wheel up on blocking and block between pedestal cap and driving box; also block between the frame and top of adjacent driving boxes.

285. Q—When covering ports, if steam issues from front cylinder cock on inside admission
engine, which way should valve be moved to cover port?
A—The valve should be moved back.

286. Q—On a Walschaert valve gear engine, what controls the movement of the valve?
A—The movement of the valve is controlled by the motion of one eccentric arm and the crosshead.

287. Q—What should be done if a Walschaert valve gear eccentric arm is broken?
A—to run on one side, disconnect radius rod, lap and lead lever, tie radius rod to clear, cover ports, clamp valve and proceed; or disconnect bottom of lap and lead lever from crosshead, tie it ahead, cover ports and proceed.

288. Q—If a Walschaert valve gear eccentric arm or eccentric rod is broken when handling a light train, can both sides be used?
A—Yes, if starting assistance is available. Place the reverse lever in position so that the link block will be at the center of the link. In this position the back end of the radius rod will be held firmly and the valve will receive its movement from the crosshead, which is sufficient to properly admit steam to the cylinder.

289. Q—With the eccentric rod disconnected and using both sides, should reverse lever be placed in any other than center position?
A—No. If reverse lever is moved off center, steam will be trapped in cylinder and considerable damage will result.

290. Q—If a breakdown, not due to defective Walschaert valve gear, necessitates totally destroying the movement of the valve, what should be done?
A—Disconnect the front end of the radius rod from the lap and lead lever and clamp the
valve or take off the eccentric rod and disconnect the bottom of the lap and lead lever.

291. Q—When running on one side, with both main rods up, how should the dead cylinder be lubricated?
A—Remove test plugs and oil through holes. To prevent churning air and heating cylinder, leave test plugs out or remove the cylinder cocks.

292. Q—What break in steam chest or cylinder will cause the engine to blow so badly it will be disabled?
A—Broken valve, valve yoke, valve seat, main piston, or cylinder packing.

293. Q—If trouble is in steam chest, can you proceed on one side?
A—No. But if trouble is in cylinder can proceed on one side.

294. Q—What test should be made to locate a blow in steam chest or cylinder?
A—Place the reverse lever in the center. If the engine is standing with one side on quarter, the ports will be covered on that side. If blow stops, the trouble is probably in the cylinder. Disconnect the valve on that side, clamp it, and proceed.

If the blow continues, disconnect the valve on the opposite side and cover the ports. If the blow stops, the trouble is probably in the cylinder on that side. If the blow continues, with the ports covered, trouble is in steam chest. Ask for assistance.

If engine cannot be placed on quarter it is necessary to disconnect the valve and cover the ports to make the above test.

295. Q—What is meant by valves out of square?
A—This means that the engine has a greater port opening at one end of the cylinder or
that one side is working stronger than the opposite side.

296. Q—What is the effect of main valve being out of square?
   A—Distribution of steam is uneven, and the efficiency of the engine is reduced.

297. Q—How do you know when the main valves are out of square?
   A—The sound of the exhaust is uneven and the time elapsing between the exhaust is not the same.

*298. Q—If a hot pin or bearing develops, or a failure or breakdown occurs, what should be done?
   A—To correct hot parts, or repair defects, all stops should be made, if practicable, clear of main track, or at a point where other trains will not be delayed. Prompt and correct information should be furnished the Superintendent.

299. Q—What inspection should be made at the end of trip?
   A—The engine should be inspected for hot parts and other defects.

300. Q—What other duty has the engineer to perform?
   A—He must make an intelligent report of the condition of the engine on the form provided for that purpose, and when a special explanation is necessary, should take the matter up personally with the foreman in charge.
M. P. 33-E.

PENNSYLVNA
EASTERN

REPORT OF MACHINERY EXAMIN

Name ......................................................................................................................... Occupation ............................................................ 

Date ............................................................................ Time .......................................................................

Number of Years’ Service in Above Occupation .............................................................. 

PROGRESSIVE EXAM

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All questions not starred (*) have a rating of

[ ] Partial failure.

[ ] Total failure.

Remarks—.................................................................................................
NIA SYSTEM
REGION
ATION OF LOCOMOTIVE FIREMEN

Division

M. P. Instruction

Rating

INATION QUESTIONS

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<th>THIRD YEAR</th>
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EXAMINATION QUESTIONS

| 223  | 226 | 227 | 250 | 252 |
| 24.  | 261 | 265 | 274 | 277 |
| 280  | 282 | 284 | 287 | 288 |
| 294  | 242 | 243 | 249 | 256 | 260 |

ten. Starred questions MUST be answered.

Instructor.