APPENDIX—PART I.

TEST QUESTIONS FOR ENGINEERS.

AN efficient engineer must certainly be able to determine any practical question that may arise in the management, not only of his engine and boiler, but also in that of such shafting, pulleys, gear wheels, etc., as may constitute the driving gear connected with the engine.

A very moderate examination of an engineer (whether to test his suitability for employment or for promotion) should therefore include questions tending to determine his capability to give such directions as may be necessary when the engine or shafting breaks down, or when alterations are to be made and he is consulted with reference to them. The following questions have been framed with a view to include such information as a first-class engineer, and even an assistant or night engineer, may be expected to possess, and a large proportion of these questions have been taken from actual engineers' examinations in various parts of the country.

In many cases engineers of manufactories are required to make, as far as possible, their own repairs and sometimes indeed also the repairs to the machinery the engine drives, but to give questions covering this ground would be to refer the reader to nearly every page in the two volumes, which is manifestly impracticable.

Matching gear wheels.—Suppose you were running a hoisting engine whose pinion had 15 teeth, driving a wheel with 150 teeth in it; if the pinion had teeth with radial flanks, what orders would you send to get another wheel that would work with the pair?—For answer, see Volume I., page 15.

Radial flanks.—If a pinion has radial flanks what information does that give to the engineer if at any time he requires to order another wheel to work with it? I. 15.

Teeth of gear wheels.—What is the difference between an epicycloidal tooth and an involute tooth of a gear wheel? I. 8, 13.

Ordering bevel gears.—Two lines of shafting are to be connected by a pair of bevel gears and one is to run twice as fast as the other; how would you find the bevel of the wheels so as to be able to tell the maker what was wanted, and what dimensions would you give, leaving the pitch and the shape of the teeth out of the question? I. 22.

Ordering taps.—Suppose you were ordering a set of taps for use in the engine room, what precautions would you be obliged to take as to the shape of the thread in order to get proper taps? I. 85.

Fitting a nut.—Will a nut having a United States standard thread fit a bolt having a common V thread, both threads having the same pitch and diameter, and how could you tell one bolt from the other? I. 85.

Curing a pounding cam.—Suppose some part of the machinery driven by an engine had a cam motion with a small roller which hammered and pounded on the cam, how would you cure the defect? I. 83.

Ordering a new spur wheel.—Suppose a spur wheel broke and you wanted to give the diameter for a new one, where would you measure the diameter of the old one? I. 1.

Comparing screw threads.—What is the difference between the common V thread and the United States standard thread? I. 85.

Using two set screws.—When two set screws are placed in a hub how should they be located? I. 127.

Best lathe tool.—What is the most useful turning tool for a hand lathe, such as is sometimes provided for an engineer to make repairs with? I. 331.

Fitting a crank pin.—How would you proceed to put in by a contraction fit a crank pin, the crank being on the engine? I. 366.

Increasing strength of teeth.—Suppose you had to order a new pair of wheels to replace a pair whose teeth frequently broke, what alterations in the dimensions of the wheels would you make so as to get stronger teeth in wheels of the same diameter? I. 65.

Wear of a cam roller.—If an engine had a valve motion worked by a parallel roller in a parallel cam groove, would the roller wear out quick, and why? I. 84.

Altering the speed of a shaft.—Do a pair of mitre wheels alter the speeds of the shaft they drive or not? I. 1.

Driving out a key.—In driving out a key is a quick or a slow hammer blow the most effective? II. 65

Riveting a crank pin.—For riveting a crank pin what shape should the pene or pane of the hammer be? II. 73.

Face of a cold chisel.—What is the proper shape for the face of a cold chisel? II. 73.

Key bearing.—What is the effect upon a wheel if its key bears upon opposite corners? II. 107.

Fitting a key.—Should a key be driven lightly or not when fitting it, and why? II. 106.

Angle of wrench jaws.—What angle should the jaws of a wrench be to its body in order to enable it to turn a nut in a corner with greatest advantage? Volume I., page 123.

Chucking a crank.—How should a crank be chucked in order to prevent the crank pin from being out of true, and the engine from beating and pounding? I. 247.

Chucking a cross-head.—How should a cross-head be chucked so as to have its piston rod and wrist pin at a true right angle? I. 252.

Length of drill edges.—Why should both edges of a drill be exactly equal in length and of equal angle? I. 277.

Boring bar edges.—Should a boring bar for an engine cylinder have one, two, three or four cutters? I. 289.

Spiral spring.—Give a method of making a spiral spring. I. 329.

Expansion fit.—What is meant by an expansion or a contraction fit, say for an engine crank pin? I. 366.

Fitting brasses.—Suppose the joint faces of a pair of brasses are not square with the sides of the box or strap in which the brasses fit, what will the effect be when the brasses are locked tight together by the key? II. 125.

Wear of brasses.—When an engineer is taking up the wear of connecting rod brasses, what must he do to keep the rod of the proper length? II. 124–127.

Case hardening.—Describe the simplest method of case hardening. II. 128.

Fitting pillar block brasses.—State the proper order of procedure in fitting in a new pair of main bearing or pillar block brasses for an engine. II. 130.

Driving brasses.—What will be the effect of driving a brass in and out with a hammer and without a block of wood to strike on? II. 72 and 132.

Originating a true plane.—How is a true plane or flat surface originated? II. 133.

Cover joint.—What is the best form of joint for an engine cylinder cover? II. 137.

Grinding a cover.—How must a cylinder cover be moved when grinding it? II. 137.

Appearance of a joint.—What is the appearance of a finished ground joint? II. 137.

Grade of emery.—About what grade of emery would you use to make a ground joint? II. 137.

Best heat joint.—What is the best kind of joint to withstand great heat or flame? II. 138.

Best water joint.—What are the best kinds of joints for withstanding water pressure? II. 138.

Fitting a flange.—In fitting a flange to a boiler what part of the flange face should bed most? II. 140.

Rust joint.—How are rust joints made? II. 140.

Leaky plug.—How would you test the fit of a leaky plug in a cock? II. 144.

Well-ground plug.—What is the appearance of a well-ground plug? II. 145.

Quick brass fitting.—Describe the quickest method of fitting a new brass or bearing box to its journal. II. 147.

Babbitt bearing.—What is the principal advantage of a Babbitted bearing? II. 156.

Adjusting guide bars.—What two essential points are there in adjusting the bottom guide bars of an engine? Volume II., page 162.

Setting guide bars.—Describe roughly the method employed to set guide bars by means of a stretched line or cord? II. 163.

Pounding journals.—What are the two principal causes of the beating or pounding of the journals of an engine? II. 164.

Locating a pound.—How may the location of a pound be discovered? II. 164.

Cause of pounding.—What is the ordinary cause of beating and pounding in an engine? II. 164.

Wearing down.—What is the defect induced by letting the parts of an engine wear down to a bearing? II. 166.

Testing alignment.—What are the tests that should be made to find out what part of an engine is out of line? II. 166.

Best test for alignment.—What part of an engine can be used to form the best test of alignment to cure pounding? II. 167.

Connecting rod alignment.—State in a general way the method of using the connecting rod to place the engine in line, and thus prevent beating and pounding. II. 167 to 172.

Difficult alignment.—What error in the alignment of the parts of an engine is the most difficult to discover? II. 170.

Alignment of crank pin.—What is the general cause of a crank pin being out of line with the crank shaft? II. 170.

Pound at quarter stroke.—When a pound occurs in an engine at the time the crank pin is at quarter stroke, or thereabouts, where would you look for the cause? II. 170 to 172.

Setting a slide valve.—What are the three objects, either of which a slide valve may be so set as to accomplish? II. 173.

Essentials of slide valve setting.—What are the two operations essential to the setting of a slide valve? II. 173.

Squaring a valve.—Why is the common process of squaring the valve an improper proceeding? II. 173, 394.

Crank pin on dead centre.—How would you proceed to put an engine crank pin exactly on the dead centre for setting the valve? II. 173, 394.

Direction of movement.—What are the considerations that determine in which direction the engine should be moved when setting the valve? II. 173, 174, 394.

Setting eccentrics.—What tools are used to set eccentrics upon shafts before the shafts are upon the engine? II. 175.

Patching a break.—In patching a broken beam or frame, how may the bolts be made to serve to act as keys closing the crack? II. 178.

Erecting shafting.—Give a general or rough description of the method of adjusting or aligning or erecting shafting. II. 184 to 186.

Kinds of shafting.—What is the difference between bright and black shafting? II. 187.

Fitting a pulley.—If you had a pulley whose bore was $1\frac{15}{16}$ inches, what diameter of bright shafting would you order for it? II. 187.

Locating collars.—What is the best location for the collars that prevent end motion on a line shaft? II. 189.

Ball and socket hangers.—What are the advantages of hangers having a ball and socket adjustment? II. 192.

Shaft couplings.—What four objects should the couplings for line shafts accomplish? II. 194.

Universal joint.—What object does a universal joint accomplish? II. 199.

Crowning a pulley.—What is the object of crowning a pulley? II. 201.

Pulley balance.—Why should a pulley be balanced? What is a running and what a standing balance for a pulley? At what speed should a running balance be made? II. 202.

Size of pulleys.—If a shaft makes 150 revolutions per minute, and it is required to drive a pulley on a machine at 600 revolutions, what proportions must the diameter of the two pulleys have, and what determines the diameters of the pulleys? II. 205, 206.

Testing belts.—What appearance in leather belting indicates that it was cut from the spongy shoulder? II. 208.

Stronger side of belts.—Which is the stronger side of leather, the smooth or grain side or the rough or flesh side? II. 208.

Placing a belt tightener.—Should a belt tightener be placed on the tight or slack side of a belt? II. 210.

Crossed vs. open belt.—Which will transmit more power, an open or a crossed belt, and why? II. 210.

Crossed belt.—What are the objections to a crossed belt? II. 210.

Shortening a round belt.—Can a round twisted belt be shortened without removing either the hook or the eye and how? II. 216.

Wide belt.—How would you get a very wide belt on a pulley? II. 217.

Mending an eccentric rod.—Suppose an eccentric rod broke, and you were required to weld it again, what shape could you make the scarf for the weld? Volume II., page 234.

Butt weld.—What is a butt or pump weld? II. 236.

Scarf weld.—Describe roughly the means you would employ to make a scarf weld. II. 235.

Tongue weld.—What are the shapes of the two pieces that come together in a tongue weld? II. 235.

Strain on boiler joint.—How would you calculate the amount of stress there is upon the riveted joint of a boiler? II. 350.

Shearing strain.—What is meant by the terms, shearing, tearing and crushing strains of a steam boiler? II. 351.

Lapped and butt joints.—How does a lapped joint differ from a butt joint or seam in a boiler? II. 352.

Chain and zigzag riveting.—How does a chain riveted joint differ from a zigzag riveted joint? II. 352.

Butt joint.—What are the advantages of the butt joint? II. 352–353.

Margin for holes.—How would you find the proper distance the rivet holes should be from the edge of the plate in a boiler seam? II. 353.

Spacing rows of rivets.—How would you find the distance apart for the rows of rivet holes in a double riveted joint? II. 353.

High percentage joint.—What is meant by a "high percentage" riveted joint? II. 353.

Single and double shear.—What is meant by a rivet being in single shear or double shear? II. 353.

Allowance for shear.—How much additional allowance is made in the shearing strength of a rivet in double shear over that of the same rivet if in single shear? II. 358.

Taking charge of a boiler.—What is the first thing you would do in taking charge of a boiler? II. 368, 400.

First inspection.—What part of the boiler would you inspect first? II. 368.

Safety valve defect.—To what defect is a safety valve most liable? II. 368, 400.

Water supply.—How much water should there be in the boiler when the fire is lit? II. 368.

Reliability of gauge glass.—Is a gauge glass always reliable for showing the height of the water in the boiler? II. 368, 402.

Testing gauge glass.—What would you do to find out if the guage glass was showing the correct water level? II. 368.

Condensation in boiler.—What is likely to happen if the steam condenses in the boiler without any of the cocks being open? II. 368, 400.

Cleaning a boiler.—What parts of the boiler would you clean before lighting the fire? II. 368.

Laying a fire.—How would you lay the fire? II. 368.

Quick combustion.—Does bituminous (soft) or anthracite (hard) coal light more easily? II. 368.

First coal.—How soon would you put coal on after the fire is lit? How deep would you make the first layer of coal? II. 368, 401.

Amount of coal.—How much coal would you put on the fire at a time? II. 368, 401.

Even heat.—How can an even temperature be kept up in the fire box? Why is it necessary to keep an even temperature in the fire box? II. 368, 370.

Shaking grate.—What is the advantage possessed by shaking grate bars? II. 369.

Before cleaning a fire.—What preparations would you make before cleaning the fire? II. 369.

Fire tools and their uses.—What tools are used in cleaning a fire? And what is the use of each? II. 369.

Draught while firing.—How should the draught be regulated while the fire is being cleaned? II. 369.

Temporary interruption.—What should be done to prevent blowing off through the safety valve when the engine is stopped and no steam is being taken from the boiler? II. 369.

Blue flame.—What does blue flame in the fire box indicate? II. 369.

Water supply at night.—How much water would you have in a boiler when leaving it for all night? II. 369.

Fire at night.—How would you leave the fire for the night? II. 369.

Banking.—What is banking a fire? Give a safe method of banking a fire. II. 369, 401.

Dampers at night.—How should the dampers be left when the fire is banked? II. 369.

Safety valve at night.—How would you set the safety valve for a banked fire? Volume II., page 369.

Opening a banked fire.—What is the first thing to do in starting up a banked fire? II. 369, 401.

Regulating boiler feed.—How would you regulate the boiler feed? II. 369.

Regulating a pump.—How can a pump be regulated so as to be kept pumping without surcharging the boiler? II. 369.

Even boiler injection.—Can a continuous feed be maintained if injectors are used? II. 370.

Stuck valve.—How may a stuck valve or a check valve be released? II. 370.

Hot feed water.—What would you do if the feed water got so hot that the pump worked imperfectly or not at all? II. 370.

Scale.—What causes scale to form in the boiler and what effect does scale have on the boiler? II. 370.

Preventing scale.—What are the principal methods employed to prevent the formation of scale in the boiler? II. 370.

Horizontal heater.—What advantage does a horizontal heater possess? II. 370.

Dirty gauge glass.—What should be done to the gauge glass if the feed water is dirty? How many times a day should the gauge be blown out? II. 370.

Priming.—What is the priming or foaming of the water in a boiler? What are the known causes of priming? Why is priming wasteful? Can blowing off at the safety valve cause priming? What are other causes of priming? How can priming be detected? What would you do to stop priming? What would you do to prevent priming? What parts of the engine would you attend to if the boiler primes? II. 370.

Low water.—What would you do if the water got dangerously low in the boiler? In such a case how would you regulate the dampers? What do you consider dangerously low? What is blowing down a boiler? II. 370.

Cleaning a boiler.—How often would you clean a boiler? II. 371.

Water falling.—What would you suppose was going wrong if the pump was kept going and the water still fell in the boiler? II. 370.

Empty pump.—What causes a pump to fail? II. 370.

Blowing down.—How much would you blow down a boiler? How low should the pressure get before the water is let out? What would be the result if the boiler was blown off under a high pressure? What would you do after the water is all out of the boiler? II. 371.

Special examination.—What parts would you pay special attention to in examining the boiler after cleaning it? II. 371.

Hammer test.—What does the "hammer test" consist of? II. 371.

Washing and scaling.—What determines the periods at which a boiler should be washed out and scaled? II. 371.

Regulating dampers.—How would you regulate the dampers when letting the fire out? II. 371.

Naming the parts.—Name all the parts of a simple or plain D slide-valve engine, beginning with the cylinder. II. 372.

Dividing the parts.—Into what three divisions may the parts of a plain slide-valve engine be divided? II. 372.

Defining clearance.—What is the meaning of the word "clearance" as applied to an engine cylinder? II. 372.

Finding equal clearance.—How would you proceed to find if the clearance in the cylinder was equal at each end? II. 372, 404.

Parts of valve motion.—What parts constitute the valve motion or valve gear? II. 372.

The driving parts.—What parts constitute the driving or power-transmitting mechanism? II. 372.

Lubricating attachments.—Name the attachments used upon an engine cylinder to lubricate the piston and valves. II. 373.

Pet cock.—What is the difference between a cylinder pet cock and a cylinder relief valve? II. 373.

Relief valves.—What are cylinder relief valves used for? II. 373.

Quick steam admission.—Which gives the quickest steam admission, a long and narrow or a wide and short steam port, both having the same area? II. 373.

Placing the piston-ring split.—At what part of the cylinder bore should the split of a piston ring be placed? II. 374.

Fitting a piston ring.—How tight should a piston ring fit to the cylinder bore? II. 374.

Testing steam tightness—How would you test the steam tightness of a piston? II 374.

Jacketed.—What is a jacketed cylinder? II. 374.

Valve gear.—What is a releasing valve gear? What is a positive valve gear? Volume II., page 374.

Packing a stuffing box.—About how full of packing would you fill a stuffing box for a piston gland? II. 375.

Connecting rods.—What are the two principal kinds of connecting rods? What is meant by the angularity of a connecting rod? II. 375.

Oiling guide bars.—Which guide-bar is the most difficult to oil, the top or the bottom one? II. 375.

Effect of angularity.—What effect does the angularity of the connecting rod have on the piston motion? Is this effect increased or diminished by shortening the connecting rod? II. 375.

Crank at full power.—When the crank is at its point of full power, is the piston in the middle of the cylinder? Is it nearer to the crank-end or the head-end of the cylinder? II. 375.

Piston motion irregular.—What causes the piston to have irregular motion? II. 375.

Live steam period.—What constitutes the live steam period of a position? II. 376.

Cut-off.—What is the point of cut-off? II. 375.—What is a separate cut-off valve, and what event does it control in the supply of the steam to the cylinder? How is the point of cut-off varied when a cut-off valve is used? II. 378.

Working expansively.—What causes the steam to be worked expansively in an engine cylinder? II. 402.

Follower.—What is a piston follower? II. 374.

Valve lead.—What is the lead of valve? II. 376.

Valve lap.—What is the lap of a valve? II. 376.

Admission.—What is the point of admission? II. 376.

Cushioning.—At what point in the valve travel does cushioning begin? II. 376.

Release and compression.—What are the points of release and of compression? II. 376.

Double-ported valve.—What is a double-ported valve? II. 377.

Valves.—What is a griddle valve? What is a balanced valve? II. 377.—What is a piston valve? II. 378.

Slide and piston valves.—Is there any difference between the action of a plain slide valve and a piston valve if both have the same amount of lap, lead, and travel? II. 378.

Cut-off diagram.—Make a diagram to give the dimensions of a slide valve, to cut off at $\frac{3}{4}$ stroke, the valve travel being 4 inches. II. 380.

Reversing an engine.—What is the ordinary means provided for reversing an engine? II. 383.

Full gear.—What is the meaning of the term full gear, with regard to a link motion? II. 383.

Third use of link motion.—What does a link motion accomplish besides enabling the engine to run in either direction? II. 383.

Slide valve for link motion.—What are the two operations to be performed in setting the slide valve of an engine having a link motion? Describe these two operations. II. 383.

Governors.—What is a throttling governor? What is an isochronal governor? What is a dancing governor? II. 384.

Forward.—What is full gear forward? II. 383.

Backward.—What is full gear backward? II. 383.

Starting.—How would you proceed to start a plain slide valve? II. 384, 400.

Crank position.—What is the best position for the crank to be in to start the engine, and why is it the best position? II. 384.

Taking charge.—What is the first thing you would do in taking charge of an engine? II. 385.

Length of connecting rod.—How would you find out if the connecting rod was the right length to give an equal amount of clearance at each end of the cylinder? II. 385, 404.

Order of examination.—In what order should a thorough examination of the engine be made? II. 385.

Least examination.—What would constitute the least permissible examination of an engine, with a due regard to safety? II. 385.

Thorough examination.—What would constitute a complete examination of a plain slide-valve engine? In what order should such an examination be made? II. 385.

Quick examination.—What examination should an engineer make of a plain slide-valve engine, if called upon to start it as quickly as possible without knowing its condition? II. 385.

Taking a lead.—How would you take a lead for adjusting the fit of a bearing to its journal? II. 386.

Set of slide valve.—How would you test whether the slide valve was set properly? II. 386.

Squaring a valve.—Is it proper to square a plain slide valve? Volume II., page 386.

Lead affected by wear.—How does the wear of the parts affect the lead in vertical engines? II. 386.

Heating of crank-shaft.—What would you do if the crank-shaft bearings began to heat? II. 386.

Hot crank-pins.—What are the principal causes of hot crank-pins? II. 386.

Heating.—What part of the engine is the most likely to get hot from the friction of the fit? II. 386.

Use of lead.—What is a lead used for in adjusting the fit of a brass to its journal? II. 386.

Fit of top brass.—When a liner is used between the two brasses, what does the fit of the top brass depend upon? II. 386.

Oiling.—In oiling the engine, what precaution would you take to prevent the journals from heating? II. 401.

Cold weather.—What is liable to happen to an engine that is used out of doors in cold weather? II. 386.

Leaky throttle valve.—What damage might a leaky throttle valve do, and how would you prevent it? II. 386.

Leaky check valve.—What damage may a leaky check valve do, and how would you prevent it? II. 387.

Freezing in the pump.—How would you prevent the water from freezing in the pump? II. 387.

Freezing oil.—How would you prevent the oil from freezing? II. 387.

Thawing oil.—How would you thaw frozen oil? II. 387.

Setting a portable engine.—How should a portable engine stand when it is at work, and why should it stand so? II. 387.

Natural supply of water.—What precaution would you take when feed water is drawn from a stream, or other natural source of supply? II. 387.

Pumps.—Into what classes may pumps be divided? What is a force pump? What is a piston pump? What is a single-acting pump? What is a double-acting pump? II. 387.

"Suction."—What causes the flow of water up the suction pipe of a pump? How high can a pump lift water, or cause it to lift or rise? II. 388.

Regulating a pump.—How can the quantity of water a pump will deliver be regulated? II. 388.

Pump valves.—What is the check valve of a pump? What is the foot valve of a pump? II. 388.

Speed of pumping.—What is the highest speed at which a pump should run? What is the consequence if a pump runs too fast? II. 388.

Locating the air chamber.—When should the air chamber be placed on a pump, and what is its use? II. 388.

Belt pump.—What is the advantage possessed by a belt pump? II. 388.

Starting bar.—What is a starting bar, and what is it used for? II. 389.

Link sketch.—Make a rough sketch of a locomotive link motion. II. 392.

Link gear and eccentric.—Does a link motion when in full gear operate the valve much different to what a simple eccentric motion would do? II. 393.

Exchanging eccentric rods.—If the forward eccentric rod was to break, could the backward eccentric be utilized to run the engine forward? If so, how? II. 393.

Broken reach rod.—How would you hold the tumbling shaft if the reach rod broke? II. 393.

Eccentric and crank motions.—Does the acting eccentric lead or follow the crank when the link is in full gear? II. 393.

Setting a slide valve.—In what position would you place the link motion when the slide valve is to be set? II. 394.

Length of eccentric rod.—What determines the length of the eccentric rods when setting the slide valve? II. 394.

Setting an Allen valve.—What difference is there between setting a common slide valve and another (an Allen) valve? II. 395.

Injector.—What is an injector? II. 395.

Before firing.—What should be done before laying the fire? II. 400.

Kindling the fire.—How long should the wood burn before putting on coal? II. 400.

Oiling.—What points require examination when oiling the engine? II. 401.

After oiling.—What points would you move after having oiled the engine? II. 401.

Using tallow.—Where would you place tallow in oiling the engine, and for what purpose would you use it? Volume II., page 401.

Fire too hot.—What would you do if steam was rising too rapidly? II. 401.

Link position.—Where should the link be when starting the engine? II. 402.

Even steam pressure.—Why should the steam pressure be kept up, and what difference does it make in the consumption of the fuel? II. 402.

Quick steaming.—Can steam be made quickest with a large or with a small quantity of water in the boiler? II. 402.

Best boiler feed.—Which is better, a constant or an intermittent boiler feed? II. 402.

Best firing.—Which is better, heavy firing at long intervals or light and frequent firing, and why? II. 402.

Broken cylinder cover.—What would you do if the cylinder cover got knocked out while on the road? II. 402.

Hot piston rod.—What would you do if the piston rod got hot? II. 403.

Broken piston rod.—What if the piston rod broke? II. 403.

Broken crank-pin.—What if the crank-pin broke? II. 403.

Tire off.—What if a wheel tire came off? II. 403.

Driving wheel off.—What if a driving wheel came off? II. 403.

Broken lifting link.—What if a lifting link or saddle-pin broke? II. 403.

Slipping eccentric.—What if an eccentric slipped? II. 403.

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Broken spring hanger.—What if a spring or spring hanger broke? II. 403.

Bursted tube.—What if a tube bursted? II. 403.

Fitting axle-box wedges.—In what position should the engine be placed when the axle-box wedges are to be adjusted for fit to the pedestals? II. 404.

Changing clearance.—What is it that, as the engine wears, tends to alter the amount of clearance? II. 404.

Crank-pin centres.—How would you get the distance from centre to centre of the crank-pins when adjusting the axle-boxes and the side rods, parallel rods, or coupling rods, as they are promiscuously termed? II. 404.

Adjusting shoes.—In what position would you place the crank when adjusting the shoes or wedges of the axle-boxes? Why is this adjustment important? II. 404.

Force, pressure, and power.—What is the difference between force or pressure and power? II. 405.

Increase of power.—Can we increase a given amount of power by means of mechanical appliances? II. 405, 406.

Speed vs. power.—Is a gain in speed a loss in power? II. 405.

Lever.—Explain the principle of the lever. II. 405.

Elements of power.—What are the three elements composing power? II. 407.

Horse-power.—What is a horse-power as applied to steam-engine calculations? How would you calculate the horse-power of a steam engine? II. 407.—Give a method of testing the effective horse-power of an engine. II. 408.

Safety-valve problem.—A safety valve is three inches in diameter; the lever is twenty-eight inches long from the point of suspension of the weight to the pivoted end of the lever; the valve pin is four inches from the pivot; the weight is twenty pounds. What is the greatest pressure of steam the valve will hold, leaving the weight of the valve and of the lever out of the question? II. 409.

Thermal unit.—What is the heat unit or thermal unit? II. 410.

Latent heat.—Is all the heat in steam or water shown by a thermometer? What is the latent heat of water? What is the latent heat of steam? II. 410.

Sensible heat.—What is the sensible heat of steam? II. 410.

Total heat.—What is the total heat of steam? II. 410.

Heaviest water.—At what temperature is water at its greatest density? What is the weight of a cubic foot of water when at its maximum density? II. 410.

Heat of boiling water.—What determines the temperature at which water will boil? II. 410.

Heat of steam.—Can steam be made hotter than the water while they are in contact? What is superheated steam? II. 410.

Absolute pressure.—What is meant by the absolute pressure of steam? II. 411, 416.

Dry steam.—What is meant by dry steam? II. 411.

Weight of steam.—Is there any difference between the weight of water and that of the steam it will evaporate into? II. 411.

A perfect gas.—What is Marriott's law, or Boyle's law? Is steam a perfect gas? Volume II., page 411.

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