

kinds of road surfaces and on hills. The speed of the motor at 40 volts, the second controller notch, would, of course, be half the value shown on the curve for the same current input. With a set of curves of this kind obtained from brake test and knowing the total ratio of reduction between armature shaft and rear axle it becomes unnecessary to take any speed readings on the road, as the whole performance can be deduced from simply the voltage and current readings.

The following is a brief summary of the principal design data of the motor and the winding:

#### SUMMARY OF DATA FOR MOTOR.

¾ kw, 80 volts, 9-10 amperes; estimated efficiency, 75 per cent. Steel frame, 4 poles, W. E. punchings in arm; armature, 3½ inches diameter, 2¾ inches long; 18 slots 13/32 inch diameter round, 3/8 inch net diameter after insulating; No. 19 wire, d.c.c.; 46 wires per slot; 18 coils, 23 turns per coil, No. 19 d.c.c. Parallel lap winding, connections straight out to adjacent commutator segment. Field coils 94 turns per coil; No. 12 d.c.c. wire. Coils must not exceed 1 inch in depth. Weight of armature wire, 2 pounds, No. 19 d.c.c.; weight of field wire, 8 pounds, No. 12 d.c.c.

### MODERN STEAM TRAPS.

BY W. T. EDWARDS.

Water of condensation which usually collects in a steam pipe system is invariably removed by drip pipes which feed into what is known as a steam trap. This is a device consisting of a reservoir wherein the water of condensation collects and is forced out into a tank, drain reservoir or sewer by the pressure of steam in the drip pipe system, the controlling valve being actuated by the water in the trap.

Steam traps should be so placed that the water gravities into them. This water may be discharged to a height or head equivalent in pressure to somewhat less than that in the pipes drained. Such traps are known as tank or separating traps.

Return traps which return the condensation to the boiler are placed in a convenient location about three feet above the water line in the boiler, the condensation being forced into the trap by the pressure in the drip pipes. When the trap discharges communication is had between it and the boiler. The entering steam from the boiler equalizes the pressure and the water gravitates into the boiler.

Steam traps are often condemned, not because of faulty design, but because they are operated under conditions for which they were never designed, and sometimes because of improper connections or arrangement of piping, valves, etc. It is the purpose of the present article, therefore, to show modern types of steam traps, their method of operation, and in some cases the manner of piping that is recommended to obtain the best results.

The A. A. Griffing Company, Jersey City, N. J., manufactures a line of return and separating traps, which is known as the

"Bundy." These are made in four series, comprising 29 sizes, each series being designed to operate under certain definite

trunnion and the pipe *C P*. Should any air be trapped it is discharged through this pipe and passes through the air vent valve

*AV* into the ash pit. This valve is fixed on the same stem as the steam valve and is open while the trap is filling and closed while it is discharging.

Should the pressure upon the steam system to be drained not be sufficient to force the drips to the bowl of the trap located above the boiler a system called the duplex is used. This comprises two return traps of the same size, one elevating the water into the other, which is placed in its proper position above the boiler. Fig. 2 shows this arrangement. The lower trap, 1, receives the water and communicates directly with trap 2, which is supplied with live steam as indicated. It has been found advisable to locate in the discharge pipeline from trap 1 a weighted check valve or spring relief valve, set to open at a pressure less than that supplied to the trap. This acts as a stop in the pipe whereby the full hydrostatic pressure of the water in the supply pipe may be utilized to fill trap No. 2 promptly. This system is sometimes used for boiler feed purposes.

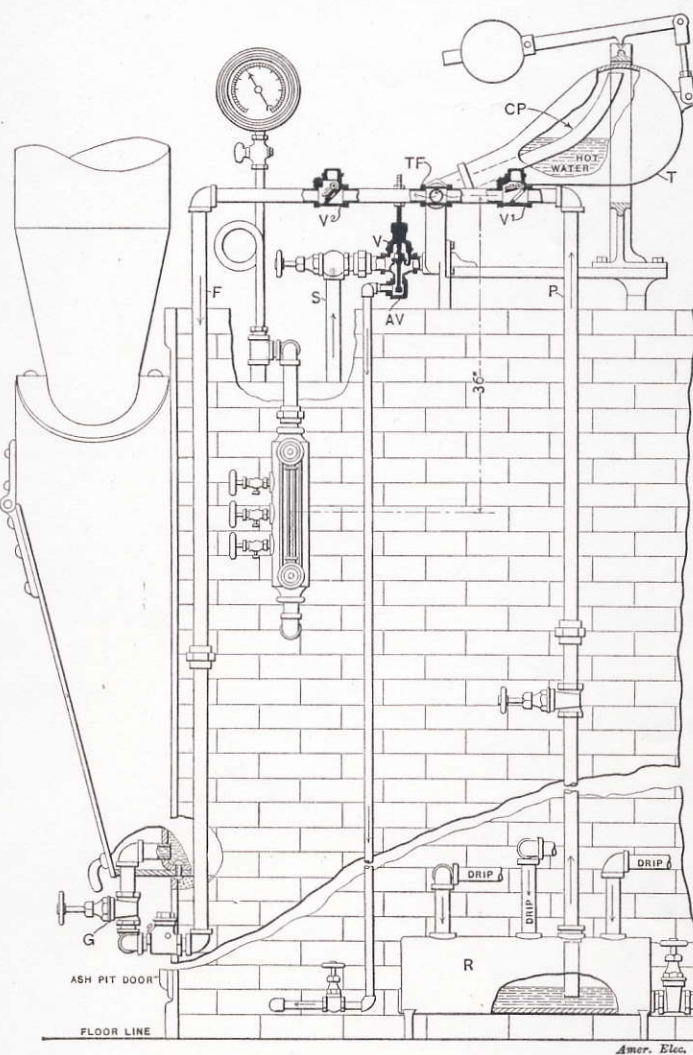


FIG. 1.—"BUNDY" STEAM TRAP CONNECTED.

pressures. Fig. 1 shows the return trap properly piped. The receiver *R* is shown in position for receiving the drips. These are forced into the bowl *T* by way of the pipe *P* through the check valve *V*<sub>1</sub> and the fitting *TF* by the pressure on the drip pipes. Communication between the trap and the boiler is cut off by the steam valve *V*, which is part of the trap, and the check valve *V*<sub>2</sub>, the latter being held tightly closed by the pressure in the boiler, which forces a column of water through the pipe *F*. When the bowl *T* is filled with water, the combined weight overbalances the weight on the ball of the lever and causes the bowl to drop to the discharging position, which opens the valve *V*. Live steam from the boiler is then admitted into the trap through the pipe *S*, thus equalizing the pressure on both sides of the entrapped water, which then gravitates into the boiler. While the trap is discharging the check valve *V*<sub>1</sub> is held closed against the drips by the pressure of steam in the boiler and the check valve *V*<sub>2</sub> is open, permitting the water to pass through the pipe *F* to the boiler. When the trap is empty the bowl returns to its original position. The drip water enters and is discharged from the bowl through one trunnion, while live steam from the boiler enters through the other

trunnion and the pipe *C P*. Should any air be trapped it is discharged through this pipe and passes through the air vent valve

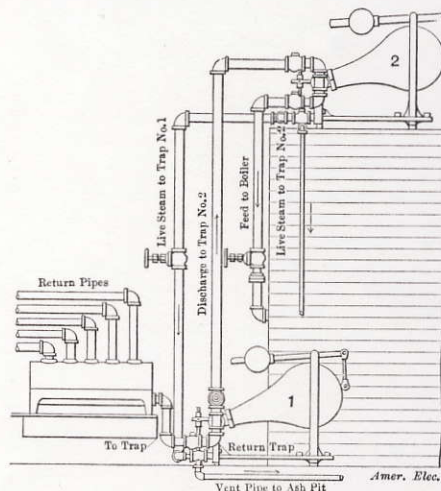


FIG. 2.—DUPLIX SYSTEM OF "BUNDY" TRAPS.

A sectional view of the 100 and 200 series of "Bundy" return trap is illustrated by Fig. 3. A cast iron receiving bowl is supported on a yoke and frame by two trunnions. The water enters the feed trunnion

*D* as shown in the sectional view of the yoke and passes into the bowl. The weight of this when full overbalances the weight of the ball *E* on the horizontal lever *F*.

pipe *A*, the bowl tilts back into the filling position and effectually closes the discharge valve. This style of valve will raise water

nions are part of the cylinder and move with it. Fastened to the end of the outlet trunnion is the discharge valve, which is of

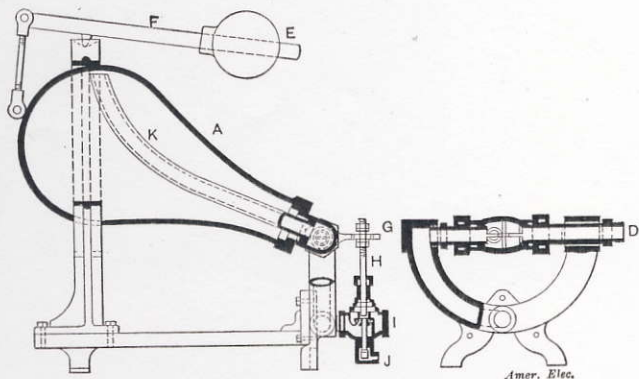


FIG. 3.—SECTIONAL VIEW OF "BUNDY" RETURN TRAP.

The projecting ring *G* pulls up the valve stem *H* when the bowl drops, thus opening the valve *I* and admitting live steam.

to a height equal to the pressure available, or it will discharge against any pressure which is less than the pressure on the trap,

the ball type; in the bottom of the valve is a loose pin, which comes in contact with a projection in the valve casing and lifts

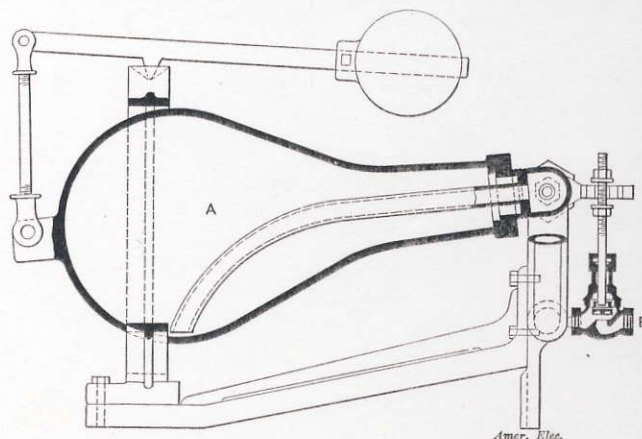


FIG. 4.—SECTIONAL VIEW OF "BUNDY" SEPARATING TRAP.

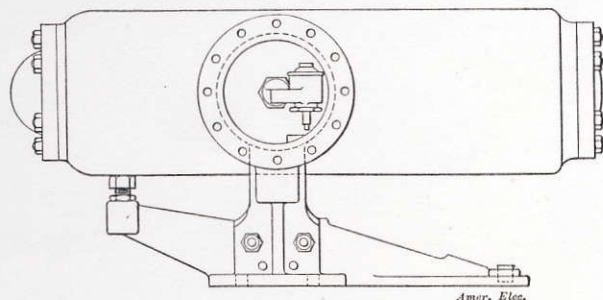


FIG. 5.—"BONER" STEAM TRAP.

The pressure on the trap and boiler now being equal, the water is free to flow into

allowing a reasonable amount for friction losses. The traps are made of cast iron and the trunnion and boxes are fitted with brass followers. When a receiving tank

the ball from its seat while the tank is discharging. When the tank assumes its normal position the discharge valve closes and the trap is again ready for use. Fig. 6

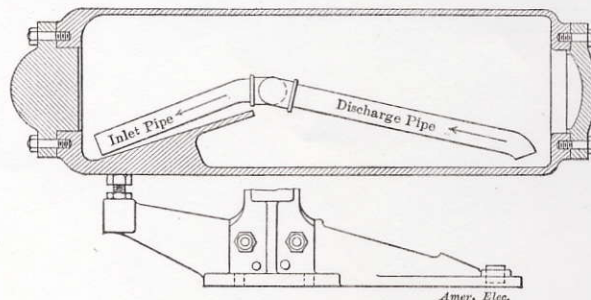


FIG. 6.—SECTIONAL VIEW OF "BONER" STEAM TRAP.

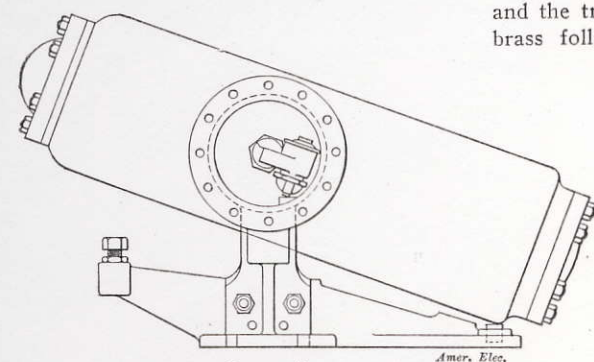


FIG. 7.—"BONER" STEAM TRAP.

the boiler. When the bowl is empty the weight on the lever returns it to its normal position, closing the steam valves, and at the same time opening the air valve *J* in order to permit any steam and air which may remain to escape. The steam enters the bowl through the curved pipe *K* and is discharged upon the surface of the water.

is used to collect the drips, it is advisable to place a swing check valve in each line near the tank in order to prevent any possible short circuiting. It is also advisable to place a shut-off valve in each line near the appliance dripped.

shows the tank in the receiving position, Fig. 7 shows it in the discharging position

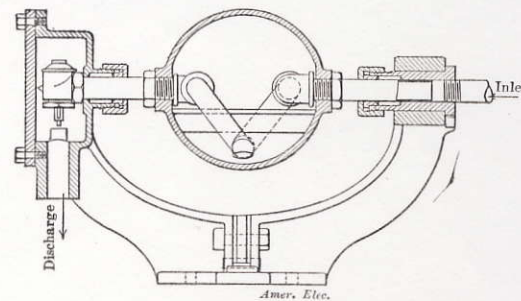


FIG. 8.—TRANSVERSE SECTION OF "BONER" STEAM TRAP.

Fig. 4 shows a sectional view of a separating trap of the 50 and 75 series. This construction is practically the same as that of the 100 and 200 series; but the method of operation is somewhat different. The water enters the feed trunnion which occupies the same position as that on the return trap. When the bowl drops the discharge valve *B* is opened, as shown in this sketch. The pressure on the drips forces the water out through this valve. Before the bowl is entirely empty, and while there is enough water left to seal the end of the

Another trap in which the discharge valve is operated by the movement of the collecting tank is the "Boner," manufactured by James Bonar & Co., Incorporated, of Pittsburg, Pa. This trap is shown by Fig. 5. It consists mainly of a cylindrical receiving tank supported on trunnions placed nearer one end than the other. The shorter end is made heavier than the longer end in order to keep the tank in a horizontal position. When the tank is full the long end tilts, opens the discharge valve and permits the water to be forced out. The trunnions receive and discharge the drips, as shown in the sectional views. The trun-

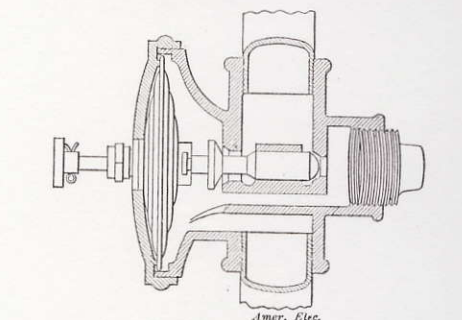


FIG. 9.—"DUNHAM" STEAM TRAP.

and Fig. 8 is a transverse section showing the inlet and discharge pipes connected with the trunnions and also the ball discharge valve. The trap is very simple and effective in operation.

Fig. 9 shows a sectional view of the "Dunham" special steam trap, manufactured

condense when the temperature is lowered, forming a vacuum, and the pressure upon the outside of the walls of the chamber forces them together and opens the valves. From this it is evident that the valve is governed by the amount of condensation occurring in the system drained. The trap may be adjusted to discharge continuously. It is made of phosphor bronze throughout, and is peculiarly adapted to steam heating systems. As it remains open at a normal

The Cookson Steam Specialty Company, of Cincinnati, Ohio, manufacture the "Cookson" steam trap. This is of neat design and large capacity and is built to withstand all ordinary working pressures. But one type of trap is manufactured and this is adapted to either high or low pressure by simply changing the valve and seat. All

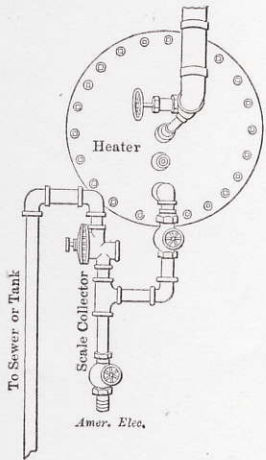


FIG. 10.—"DUNHAM" TRAP CONNECTED.

by the C. A. Dunham Company, of Marshalltown, Iowa. The principle of operation is quite different from that of the regu-

low temperature it allows air or water which may be in the heating system to escape, the trap closing when steam reaches it. It possesses an advantage in size and is designed to work from vacuum up to 125 lbs., adjusting itself to any pressure

parts are made from templates and are interchangeable. By turning a hand wheel operating a threaded spindle acting against the valve the latter may be opened to its fullest extent, as indicated by Fig. 11, for the purpose of blowing out any foreign

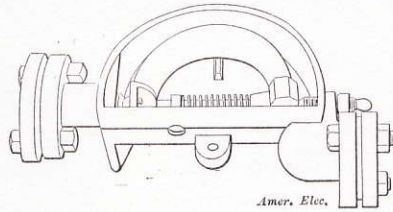


FIG. 13.—"MARCK" STEAM TRAP.—FIG. 15.

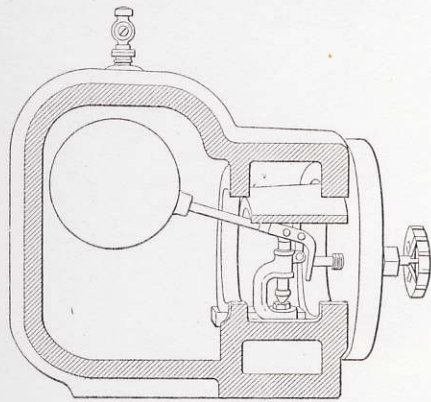
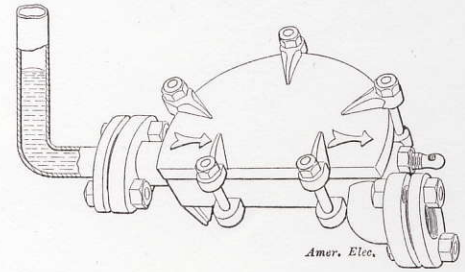


FIG. 11.—"COOKSON" STEAM TRAP.

lar type of trap. Instead of making use of floats, levers, pots or buckets to operate the valve, use is made of a chamber formed

within these limits. The valve opening is large and the valve is double seated, as shown in Fig. 9. The trap body, disc, valve, steam cap and plug constitute all of its parts. By removing the cap the valve is exposed for any repairs. The 1-inch size has a capacity of 1000 linear feet of 1-inch pipe. There being no reser-

voir in this trap to catch and hold scale or foreign matter, provision must be made to prevent its entrance into the trap. This may be obtained by a system of piping like that shown by Fig. 10.

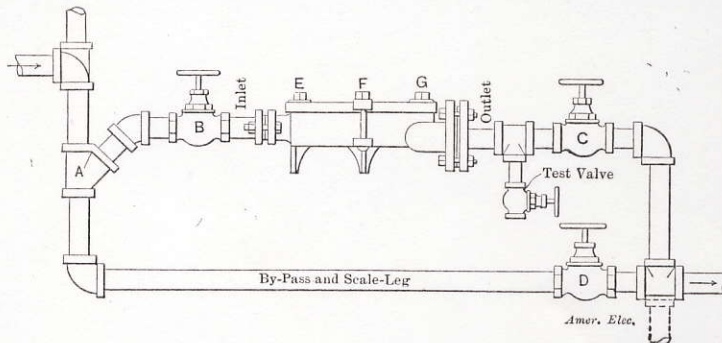


FIG. 14.—"MARCK" TRAP CONNECTED.

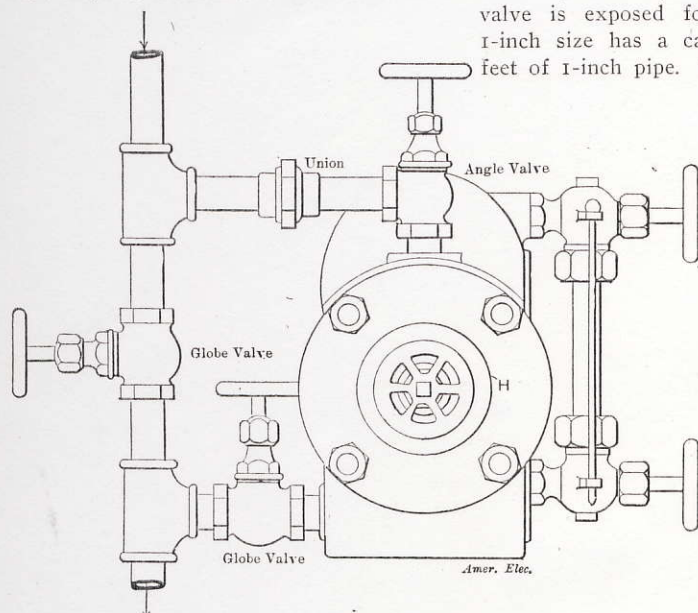


FIG. 12.—"COOKSON" TRAP CONNECTED.

by two discs of sheet bronze which contains three fluids of different degrees of volatility. These fluids flash into vapor as the temperature rises, thereby developing a pressure and closing the valve. They

voir in this trap to catch and hold scale or foreign matter, provision must be made to prevent its entrance into the trap. This may be obtained by a system of piping like that shown by Fig. 10.

The "Marck" steam trap, with its cover removed, is shown by Fig. 13. This trap has but one movable part, consisting of a hollow tube bent to the shape of a crescent. This tube is made of strong selected metal,

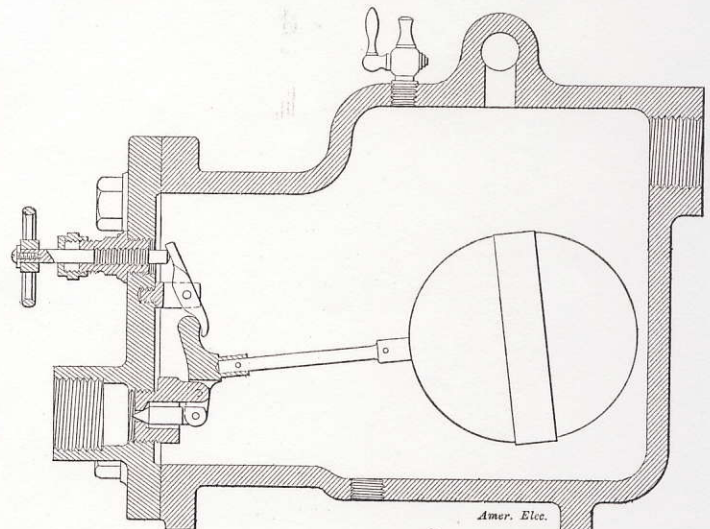


FIG. 16.—"RELIANCE" STEAM TRAP.

and is filled with liquid which gasifies at 212° Fahr. When this liquid becomes gaseous, the expansive force has a tendency to straighten the tube. This causes the valve to press against the valve seat and close

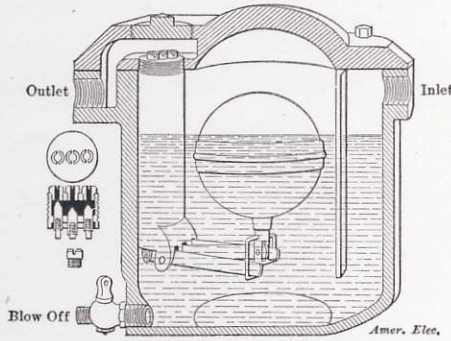


FIG. 17.—WRIGHT "EMERGENCY" STEAM TRAP.

the trap. When the temperature falls below 212° Fahr. liquefaction takes place and the tube assumes its normal position, drawing the valve away from its seat and opening the trap. The trap is automatic, depending for its effective working on the tube in which the fluid is contained. It is simply an automatic valve or separating trap, which always opens below 212° Fahr. and closes above that temperature. It will operate at any pressure below 200 lbs. to the square inch, and since it is not provided with a receptacle for the collection of sediment, scale, etc., it is advisable to construct a trap or scale leg by extending the inlet pipe as indicated by Fig. 14. This illustration also shows the trap by-passed. Fig. 15 shows another view of the "Marck" trap, which is manufactured by E. F. Houghton & Company, Philadelphia, Pa.

Another separating trap, the valve of which is operated by a float, is shown in section by Fig. 16. This is called the "Reliance" trap, and is manufactured by the Reliance Gauge Column Company of Cleveland, Ohio. The working of the trap is so clearly indicated in the engraving that no description is necessary. The traps are made in six sizes, from 1/2-in. to 2-in. connection inclusive, the smallest draining 1000 ft. and the

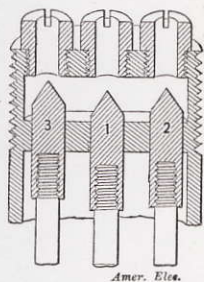


FIG. 18.—WRIGHT VALVES AND SEATS.

largest 16,000 ft. of one-inch pipe. When the pressure under which the trap is to work is less than 30 lbs., a large valve outlet is provided.

The traps already described are provided

with single valves, but the one shown in Fig. 17 is provided with three. This illustration shows a sectional view of the Wright "Emergency" trap, manufactured by the Wright Mfg. Company of Detroit, Mich. This trap operates successfully on all pressures from 20 to 200 lbs. per square inch. A low pressure trap called the "Victor" is made by the same company for pressures up to 20 lbs.

The "Emergency" trap consists of a cast iron chamber wherein the water collects. Within this chamber is a specially designed and reinforced copper ball float, which actuates the three valves. The valves are arranged so that a normal quantity of water is discharged through one valve. Should the quantity of water be abnormal the float is raised high enough to open the second

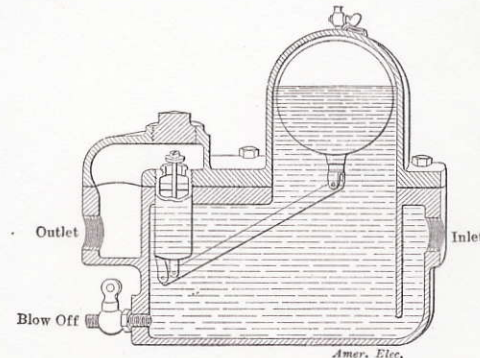


FIG. 19.—"VICTOR" STEAM TRAP.

valve, and in cases of emergency the third valve is also opened, the float then being in its highest position. When the three valves are open they provide for the full capacity of the inlet pipe. Ordinarily one valve is sufficient to do the work. The valves and seats are made of steel jet metal and are so arranged as to be easily renewed or repaired without removing the cover, a plug being provided for that purpose. The valves are held in alignment by a bar placed diametrically across the tube, which also serves to center the valves into the seats. An

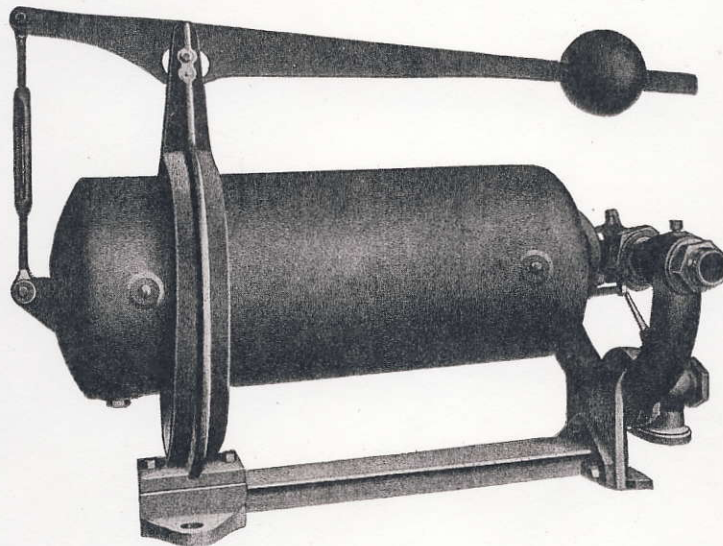


FIG. 20.—"GOLDEN" HIGH-PRESSURE TILTING STEAM TRAP.

enlarged view of this arrangement is shown by Fig. 18.

The "Victor" low pressure trap is similar in construction and operation to the "Emergency" trap with the exception that

it has but one valve. This, however, is large enough to enable the trap to handle large quantities of condensation. Both types of trap are provided with gauge glasses and blow-off cocks and the "Victor" is provided in addition with an automatic air valve. This trap is shown in section by Fig. 19.

Fig. 20 shows the Golden high-pressure, automatic tilting steam trap made by the Golden-Anderson Valve Specialty Company of Pittsburg, Pa. The trap is shown in normal position ready to receive the condensation. When sufficient water is trapped to overcome the weight of the ball on the lever, the trap drops, thereby opening the steam valve and the water is forced out. The trap then resumes its normal position under the action of the weighted lever. The trap is well made, all working parts being of bronze and removable.

The American Electric & Controller Company of New York City is the manufacturer of the "Thoen" steam trap, shown in section by Fig. 21. The operating element of the trap consists of a bucket supported at its upper end between the forked ends of a counterweighted lever. The counterweight exactly balances the weight of the bucket when it is empty. That is to say, the moments of all the weights on the right side of the pivot are equal to those on the left

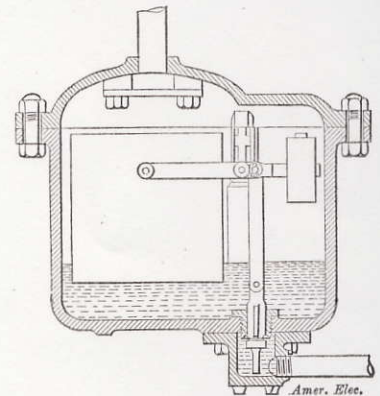


FIG. 21.—"THOEN" STEAM TRAP.

side, so that when the trap is empty the moving parts are in equilibrium. When the trap begins to fill the preponderance of weight on this side of the lever support keeps the outlet valve tightly closed. When the bucket is full and overflows, the body of the trap begins to fill up and the buoyancy of the bucket increases until such a point is reached that the moments on each side of the fulcrum are again nearly equal, when the unbalanced steam pressure on the upper side of the valve seat causes it to open. Discharge then, of course, takes place until the level of the water outside the bucket lowers to such a point that the weight of the water in the bucket again causes the outlet valve to close. Since the bucket is full of water at all times when the trap is in operation, and from the nature of its operation, the discharge of liquid is seen to be but a small amount at a time, and the action of the trap very sensitive. The outlet valve is also submerged at all times, and this, of course, prevents the escape of steam. A feature which is not perhaps noticeable is that the outlet hood

308  
 or chamber is attached to the main body by four bolts placed exactly 90 degrees apart, so that the outlet pipe may be turned in any one of these four positions.

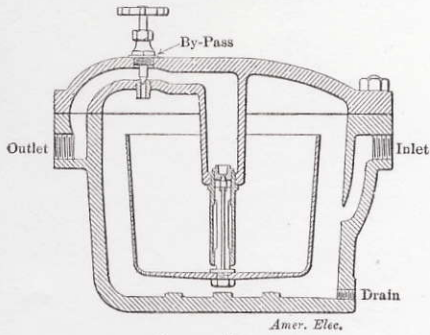


FIG. 22.—"CRANE" STEAM TRAP.

The Crane Company of Chicago manufactures a steam separating trap of the bucket type, as shown by Fig. 22. In operation the trap does not differ from the many

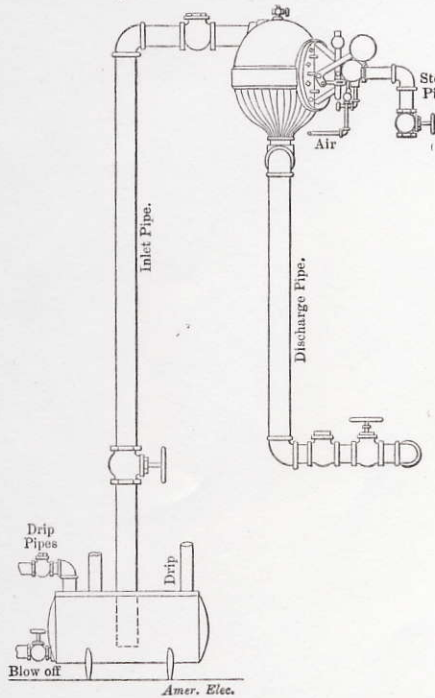


FIG. 23.—"CURTIS" TRAP CONNECTED.

similar traps of this type, the condensation entering at the inlet side and surrounding the float or bucket and lifting the valve to

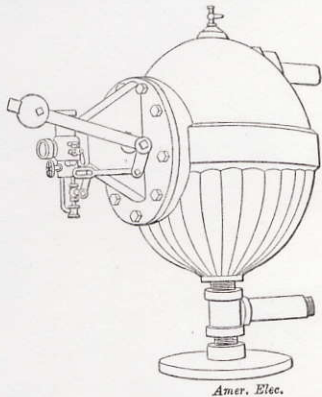


FIG. 24.—"CURTIS" STEAM TRAP.

its seat. The rising water fills the bucket and causes it to sink, thus opening the valve, which permits the water to be forced out of the trap by the pressure of the steam in the drip system. After sufficient water has been discharged out of the bucket to lighten it the water on the outside raises

it, and again forces the valve against its seat and the trap is again ready for the next discharge. The float is of pressed steel and rarely gives cause for trouble. The

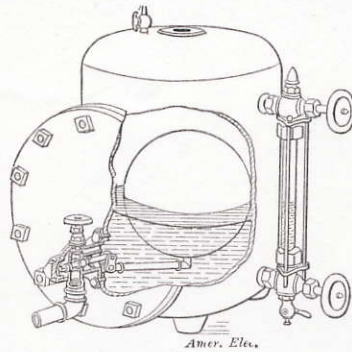


FIG. 25.—"CURTIS" BALANCED TRAP.

body of the trap, is large and forms a convenient place for sediment to lodge to be blown out through the drain, the slow rising of the water to the top of the bucket being favorable for this. The valve and seat are located in the top section of the trap, and are thus protected from sediment which lodges in the bottom of the

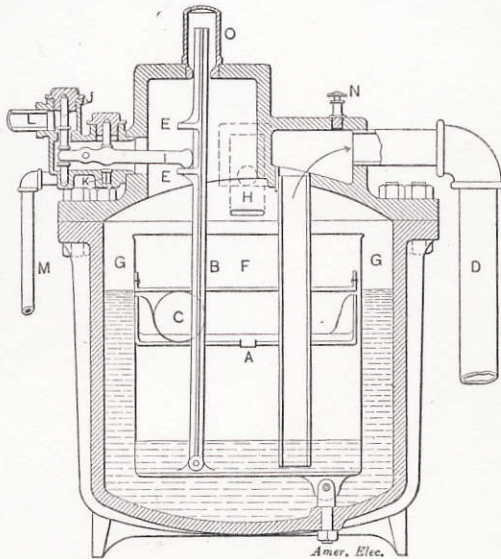


FIG. 27.—ALBANY "CLASS A" STEAM TRAP.

trap. The traps are equipped with a by-pass and, if desired, a gauge glass is provided.

The Julian d'Este Co. of Boston, Mass., manufactures a line of "Curtis" traps that includes both the return and the non-return types. The return trap operates practically the same as those already described, being located above the boiler and having the water of condensation forced into it from a receiver by the pressure of the steam in the drip system.

The water rising in the trap raises a float which in turn operates a valve letting full boiler pressure on to the surface of the water in the trap. A check valve prevents the water from returning to the receiver and it flows by gravity into the boiler. The series of movements follows so closely those already described in detail that it is needless to enter upon a further description. Fig. 23 shows a trap applied to a boiler, and Fig. 24 shows an enlarged view of the same trap. Fig. 25 shows the "Curtis" balanced trap, which consists of a cylindrical pot with rounded ends. The operation of the valve is by means of a ball float

made of copper. On one side of the body of the trap is a nozzle of sufficient diameter to admit the float. This nozzle is covered with a strong plate to which is bolted the composition valve. The valve consists of two discs of equal area on a single stem, one with a short sliding fit, the other with a ground seat taper fit, which guides it on to its seat, while the valve stem is guided by a spider with three arms, and is loosely connected by a knuckle joint to the float. The valve stem is in two parts, the outer one carrying the discs screwing into the inner one.

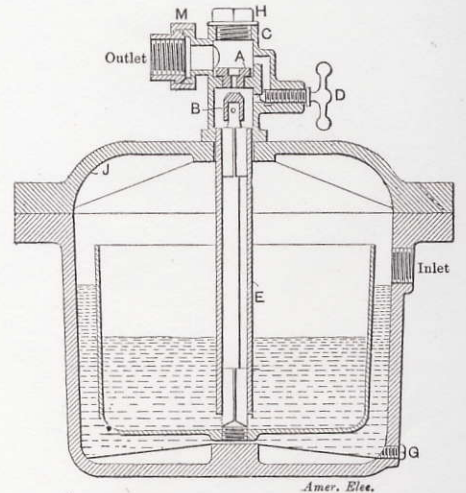


FIG. 28.—ALBANY NON-RETURN STEAM TRAP.

A bucket return trap is manufactured by the Albany Steam Trap Company of Albany, N. Y. It consists of an approximately cylindrical body provided with a closed bottom. A removable bonnet forms the closure for the top of the casing and is secured thereto by through bolts. An open top copper bucket is attached to the casing by a hinged joint in such a manner as to allow it to freely tilt as occasion requires. Channeled guides are arranged within the bucket, and in these guides are rolling counterweights, which complete the tilting movement of the bucket by gravitating to the depressed ends of the guides. A valve-operating rod is connected by a joint to the bottom of the bucket; the upper end of the rod is fitted to move more freely in a chambered guide secured to the bonnet. The rod is provided with tappets projecting laterally, which are adapted to engage against the inner end of the equalizing valve lever. The tappets are spaced such a distance apart as to allow this lever to work freely between them. The purpose of this equalizing valve is to admit live steam direct from the boiler when it is required. The valve is shown connected to the bonnet, the casing which contains the equalizing valve also containing a small exhaust valve.

Water of condensation enters through the inlet check-valve and opening H into the space G between the bucket and the outer case. The bucket F is forced upward by this water, and it is this action of the bucket that operates the equalizing valve J and the exhaust valve K through the medium of the valve rod B. When the bucket is raised sufficiently, the counterweights C roll on the channeled guides A to the side of the bucket that is adjacent to the hinge joint, thereby providing a sudden impulse to the

tilting of the bucket and making the operation of the equalizing valve more positive.

When the space *G* is filled the water flows into the bucket, which when filled tilts downward, causing the ball weights to roll to the opposite side, giving a sudden impulse downward and bringing the upper tappet *E* on the rod *B* suddenly against the inner end of the valve lever *I*, thus opening the inlet equalizing valve *J* for the admission of steam at boiler pressure. The pressure in the trap and in the boiler now being equal, the water flows by gravity from the trap into the boiler through the syphon pipe *D*, passing through a check valve on the way. When the bucket is emptied of water, it again moves upward, going through the operation just described of closing the equalizing valve *J* and opening the exhaust valve *K* to the exhaust opening *M*. The purpose of this exhaust valve and opening is to allow the escape of any steam that might remain.

The small air valve shown on top of the

valve and its seat, the disc, which may be readily replaced, is worn, entailing a minimum expense.

Referring to Fig. 29, it will be seen that the water enters the trap through the inlet pipe *A*, in which there is provided a strainer *B* for preventing dirt and sediment from entering the trap proper. After leaving the strainer the water enters the small chamber *D*, formed in the top casting, running thence through an opening into the space between the casing and the bucket. The rising water carries the bucket with it, thus operating the discharge valve through the guide sleeve and the bell-crank *N*. The valve seat is marked *K*, the valve *H*, and the valve stem *G*. When the bucket has received enough water to seal the lower end of the pipe, *P*, see Fig. 29, the pressure of steam on the trap will force part of the water from the outside of the bucket, as well as some from the bucket, up into the tank *T* through the pipe *P* and the pipe *C*. When the tank *T* is full, the water

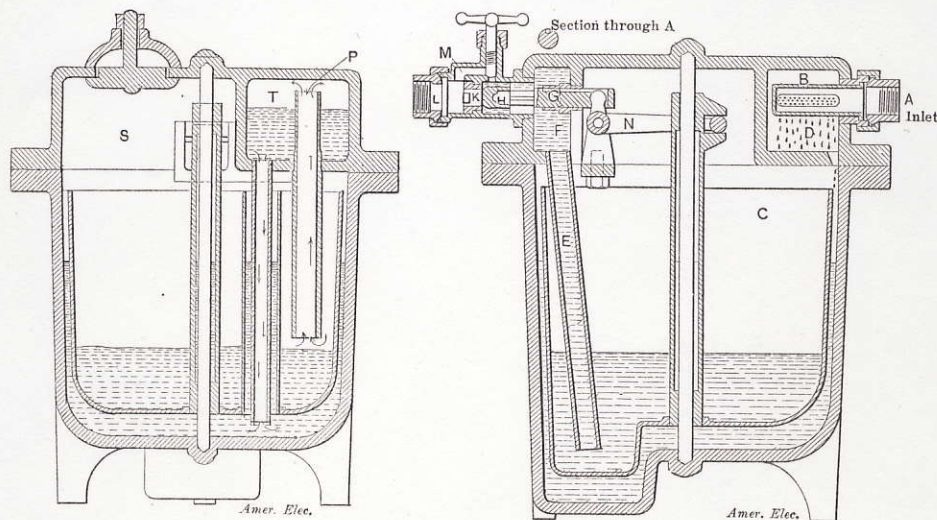


FIG. 29.—ALBANY "CLASS B" STEAM TRAP.

discharge chamber is to relieve the discharge pipe of air when first placing the trap in operation. An automatic air valve is provided, which is adjusted to relieve any accumulation of air from the trap cylinder during its regular operation. This trap is shown in section by Fig. 27.

A duplex system is also provided for cases where the pressure in the drip system is not high enough to force the water into the return trap; it consists of two return traps, one placed so as to receive the water from the drip system by gravity and discharging it into another trap placed above the boiler which operates simply as a return trap.

The Albany Steam Trap Company also makes two classes of non-return traps, one for pressures up to 100 lbs. and the other for pressures from 100 to 175 lbs. These are called class "C" and class "B." Class "C" trap is shown in Fig. 28, and needs but little explanation. Class "B" is called the high pressure trap and has several features, one of which consists in protecting the discharge valve by a thin disc having in it the proper sized opening to allow the water to flow without undue friction; this disc is placed in the body of the discharge valve outside of the valve seat, and instead of the rapid wearing away of the

fills the bucket, which drops and operates the discharge valve. Water is forced out of the bucket through the discharge pipe *E* into the chamber *F* and through the valve *K*, passing through the disc *L*, mentioned above. When enough water has been discharged to uncover the lower end of the pipe *P* steam enters the tank *T*, equalizing the pressure and allowing the water in the tank to flow into the space between the bucket and the outer shell, thus raising the bucket to its highest position and closing the discharge valve. The trap is provided with an air valve.

