

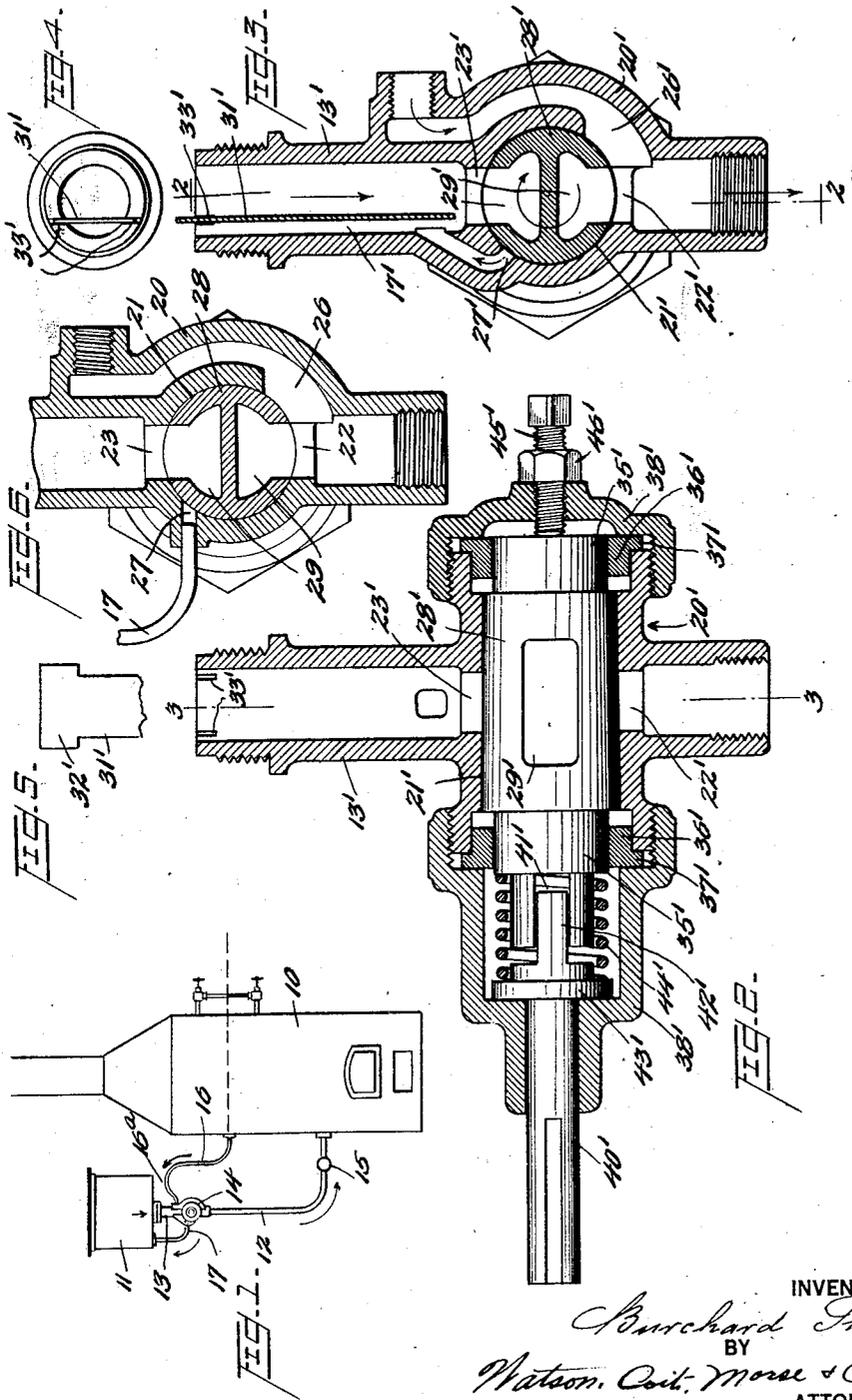
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GRAVITY LIQUID FEEDER

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# UNITED STATES PATENT OFFICE.

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## GRAVITY LIQUID FEEDER.

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The present invention relates to liquid feeding devices and particularly to devices for feeding water under atmospheric pressure or less into steam boilers in which much higher pressure prevails.

The object of this invention is to provide an improved device of this character for feeding a liquid by its own gravity head, even though this head may be small, into a closed vessel in which any vapor pressure obtains, which liquid may be either hot or cold, volatile or otherwise. The device is of the type in which a constantly moving mechanically operated member serves to feed measured quantities of liquid continuously as long as the needs of the chamber to which it is being fed may require. The arrangement is such that notwithstanding the action of the feeding device the difference in pressures between the two chambers, that from which the liquid is obtained and that to which the liquid is fed, may be maintained, although the feed water or other liquid being fed may be under atmospheric pressure or less and the boiler or other receiving receptacle may have very high pressure therein.

Applicant is aware of the fact that others have made attempts at various times to perfect a feeding device of this general type but all such devices with which he is acquainted have serious shortcomings in one form or another and have not proven satisfactory in use. Applicant has built and tested for experimental purposes a number of feeding devices patterned upon various of these known forms and in all cases has found that they either will not operate at all or will not operate satisfactorily. In one form, a rotating plug was provided with pockets operating between an inlet port and an outlet port spaced circumferentially in a casing surrounding the plug and a steam equalizing pipe was provided to connect the outlet port with the steam space in the boiler, but this device would not operate successfully because the steam accumulated below the pocket at the time it was in its emptying position and hindered the necessary quick evacuation of liquid from the pocket and moreover the steam which did enter the pocket in the displacement of the liquid was carried around to the inlet port where it hindered the entry of the liquid into the pocket. In another form, a steam bleeder port was provided between the outlet port and the inlet port

for discharging the steam from the pocket before the pocket reached the inlet port, but this form did not embody the equalizing pipe. Neither of these forms have come into commercial use and from the evident advantages which so simple a device would have over the more expensive and complicated pumps and injectors now in general use it is thought that they would have been exploited if their operation had been at all satisfactory. Applicant has not only provided a device which will work, but one which will work with great efficiency and which besides embodies distinct improvements in its general and detail design.

Other objects and various features of novelty residing in the invention will be apparent from the following detailed description of two embodiments of the invention taken in connection with the accompanying drawings, in which:

Figure 1 is an assembly view in elevation of a steam boiler showing the feeding device applied thereto;

Figure 2 is an enlarged sectional view of the feeding device proper taken on line 2—2 of Fig. 3;

Figure 3 is a section taken on the line 3—3 of Fig. 2;

Figure 4 is a top plan view of Fig. 3;

Figure 5 is a fragmentary elevation of a detail shown in Figs. 3 and 4; and

Figure 6 is a section similar to Fig. 3 but showing a modification.

Referring more particularly to the drawings, 10 denotes a receptacle for a liquid and a gas under pressure—specifically a steam boiler—into which it is desired to feed a liquid such as water from an elevated receptacle or open topped tank 11. A conduit 12 connected to the lower portion of the boiler, a short conduit 13 connected to the bottom of tank 11, and a feeding device 14 disposed between the conduits 12 and 13 constitute the line by which water from the tank 11 reaches the boiler 10. The conduit 12 may be provided with a hand valve 15 if desired, but the same is not required for the proper operation of the device.

Steam conduits 16 and 17 connect the feeding device with the boiler and tank respectively. The conduit 16 which may be termed a steam equalizing pipe enters the boiler at the maximum desired water level and intermediate the boiler and feeding device is pro-

vided with a bend 16<sup>a</sup> having its highest point elevated above the feeding device 14 to prevent water from the feeding device from entering and stopping the conduit 16 for the passage of steam. The conduit 17 enters the tank 11 at one side of the conduit 13 to allow an uninterrupted flow of water into conduit 13 from the tank 11.

The feeding device includes a casing 20 formed with a slightly tapered bore 21 there-through. A plurality of ports are provided in a common axial zone about the circumference of the bore 21. These ports are clearly shown in Fig. 6 and consist of a water inlet port 23, steam inlet port 26, water outlet port 22 and steam outlet port 27. These ports are connected by suitable ducts to the outside of the casing where they connect with the conduits 13, 16, 12 and 17, respectively.

The ports 26 and 22 may be joined to form a continuous circumferential groove. A tapered rotatable plug 28 provided with one or more closed pockets 29 has a snug running fit in the bore 21. The plug is rotated in a clockwise direction to bring the pockets successively by water inlet port 23, steam inlet port 26, water outlet port 22 and steam outlet port 27.

With the above description of one modification, shown particularly in Figs. 1 and 6, it is thought that the general characteristics and principles of the invention will be evident. A second and at present the preferred modification is shown in Figs. 2, 3, 4 and 5. Here a casing 20' is provided with a tapered axial bore 21' and circumferentially arranged water inlet port 23', steam inlet port 26', water outlet port 22', and steam outlet port 27', as before. In the present form the duct leading from port 27' does not reach the outside of the casing but opens into one side of the channel of conduit 13' which channel is divided by a removable partition 31' to constitute, beside the water inlet, the gas outlet channel 17' also. The partition 31' is provided with a T-shaped head 32' (Figure 5) adapted to drop into slots 33' and rest on the walls of the conduit 13'. This provides for holding the lower end of the partition at such height as to leave a small passage between the channels 13' and 17'. A tapered rotatable plug 28' provided with diametrically opposed pockets 29' has a snug running fit in the bore 21'. The ports 26' and 22' are joined as before to form a parti-circumferential groove which is considerably longer than the pockets 29'.

The ends of the plug 28' are reduced to form cylindrical journals 35'. These journals are rotatable and have longitudinal movement in bearing sleeves 36'. The sleeves 36' have flanges 37' held in position against the ends of the casing 20' by caps 38'.

A shaft 40' has bearing in one of the caps

38' and engages the plug 28' by a flexible driving connection consisting of a slot 41' in the plug and a flat plug 42' on the shaft loosely fitting in the slot 41'. The shaft 40' is axially slotted for a pulley or any other suitable driving member. The flexible connection prevents wobbling of the plug in the bore and also prevents axial movement of the plug from the drive. It is well known that a shaft that is driven by a belt passing about a pulley on the shaft tends to take up an axial oscillation.

The shaft 40' is provided with a flange 43'. A spring 44' is placed between the flange 43' and the larger end of the plug 28' to keep the plug pressed to its seat in the tapered bore 21'. A set screw 45' provided with a lock nut 46' passes through the end of the other cap 38' and into contact with that end of the plug to limit its axial movement under the influence of the spring 44' and thus prevents jamming of the plug on its seat.

In operation, when the plug 28' is rotated clockwise the pockets 29' pass first beneath the port 23' where they are filled with water, then pass by port 26' where steam begins to enter to force the water out, by the port 22' where the water is discharged, and lastly by port 27' where the steam is discharged. The distance between port 26' and 23' should be greater than the length of the pockets so that no steam will blow through into the water intake conduit. Also the distance between port 22' and 27' should be greater than the length of the pockets to prevent steam which has access to the port 22' from blowing through to the steam outlet pipe.

The pockets of the plug will feed water from conduit 13' to conduit 12 and into the boiler until the water covers the end of the steam conduit 16 when the pressure of steam in the boiler will force water up the conduits 16 and 12 and prevent discharge of water carried in the pockets 29' as they pass the port 22'.

The provision of the circumferential groove joining the steam inlet port 26' and the water outlet port 22' is thought to be of particular importance because in practice it has been found to greatly increase the efficiency of the feeding device. If the plug has pockets of a given size it will be necessary to rotate the plug at a predetermined minimum speed to supply an adequate amount of water to a boiler of a given size. In practice it is obviously desirable to make the feeding device as small as possible and hence to rotate the plug as rapidly as possible. The water evacuates the pockets only by displacement by steam from the equalizing pipe and this transfer requires a certain amount of time. When the plug is rotating rapidly past the outlet port 22' the transfer cannot be fully completed if the port 22' is small. Neither will the transfer be prop-

erly effected if the steam equalizing port be located along the length of water conduit 12' rather than at the surface of the plug. By opening the steam equalizing port upon the surface of the plug and connecting it with the water outlet port 22' by a groove, the steam will tend to blow water from the pocket into the port 22' and when this groove is made longer than the pockets there will be considerable time for this action to take place, whereby the pockets will be completely emptied even when the plug is rotating with considerable speed.

It will be obvious that various changes may be made in the details of the above described structure without departing from the spirit of the invention and I do not, therefore, wish the invention to be limited except by the prior art and the scope of the appended claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In a gravity liquid feeding device, in combination, a casing having a bore therethrough, spaced fluid inlet, fluid outlet, gas inlet and gas outlet ports arranged about the inner periphery of the bore of the casing and all lying in the same zone, a rotatable plug having a closed pocket in its periphery adapted to pass said ports, said gas inlet port and liquid outlet port being joined on one side of the casing to form a parti-circumferential groove having a length greater than the length of said pocket, said gas outlet port and fluid inlet port being spaced from said groove in either direction by a distance greater than the length of said pocket, a receptacle containing a liquid and gas under pressure, conduits leading from the lower and upper portions of said receptacle to said fluid outlet and gas inlet ports respectively, a second receptacle positioned above the liquid level of the first receptacle containing a liquid under atmospheric pressure or less, conduits leading from separated points in said second receptacle to said water inlet port and gas outlet port respectively, and means to rotate said plug to cause the pocket to turn past said water inlet port, gas inlet port, water outlet port and gas outlet port in the order named.

2. In a gravity liquid feeding device in combination, a casing having spaced fluid inlet, gas inlet, fluid outlet and gas outlet ports arranged in the order named about the circumference of a bore through the casing, a rotatable plug having a pocket adapted to move past said ports in the order named, said gas inlet port and fluid outlet port being joined to form a parti-circumferential groove of greater length than the length of said pocket, conduits connecting said fluid inlet port and gas outlet port to a source of fluid supply, and other conduits connecting

said fluid outlet port and gas inlet port to a closed receptacle for gas and liquid.

3. A device as claimed in claim 2 which further includes in combination a single member provided with separated channels serving to connect both said liquid inlet port and gas outlet port to separated points at the source of liquid supply.

4. A device as claimed in claim 2 which further includes in combination a single member provided with a single channel serving to connect both said liquid inlet port and said gas outlet port to separated points at the source of liquid supply, and a removable partition inserted endwise in said channel to provide said separated conduits.

5. A device as claimed in claim 2 which further includes in combination a single member provided with a single channel serving to connect both said liquid inlet port and said gas outlet port to separated points at the source of liquid supply, and a removable partition inserted endwise in said channel to provide said separated conduits but leaving a small passage at its lower end between the conduits.

6. A device as claimed in claim 2 in which said gas inlet conduit at some portion of its length has a greater elevation than the elevation at which it connects with said gas inlet port.

7. A device as claimed in claim 2 in which the gas inlet conduit and fluid outlet conduit are connected to said receptacle at different elevations, the gas inlet conduit connection being above the fluid outlet connection and at the desired fluid level for the receptacle.

8. In a gravity liquid feeding device in combination, a casing having a tapered cylindrical bore therethrough, a tapered plug rotatably mounted therein, a cap secured to said casing beyond the ends of the plug, cylindrical journals formed adjacent the ends of the plug, bearing sleeves for said journals providing for endwise movement of the journals, a flange on each of said sleeves caught between faces on said casing and caps, a spring bearing against the larger end of the plug and one of said caps for forcing the plug into the bore, and adjustable means between the smaller end of the plug and the other cap for positively limiting its endwise movement.

9. A device as claimed in claim 8 in which a driving shaft is inserted in a bearing in the cap at the larger end of the plug, said shaft having a flexible driving connection with said plug, and a flange interposed between said spring and said cap.

10. In a gravity liquid feeding device in combination, a casing having spaced fluid inlet, gas inlet and fluid outlet ports arranged about a bore in the casing, a rotatable plug having a pocket adapted to move

past said ports, said gas inlet port and fluid outlet port having their remote edges along the circumference of the bore spaced at a distance greater than the length of said pocket but not having a separation between adjacent portions as great as the length of said pocket, conduits connecting said fluid outlet port and gas inlet port to a closed receptacle for liquid and gas under pressure and a conduit connecting said fluid inlet port to a source of fluid supply. 15  
 5  
 10  
 20  
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11. In a gravity liquid feeding device, in combination, a casing having spaced fluid inlet, gas inlet and fluid outlet ports arranged in the order named about the circumference of a bore through the casing; a rotatable plug having a pocket adapted to move past said ports in the order named, a conduit connecting said fluid outlet port to a closed receptacle, a conduit member connecting said fluid inlet port and gas outlet port to a source of fluid supply, and a removable partition in said member to separate the inflowing liquid from the outflowing gas. 25

In testimony whereof I hereunto affix my signature.

BURCHARD THOENS.