Jan. 18, 1949. L. E. HUGHES 2,459,166

MAIN FEED PUMP RECIRCULATING LINE EROSION CONTROL DEVICE

Filed Dec. 20, 1944

2 Sheets-Sheet 1

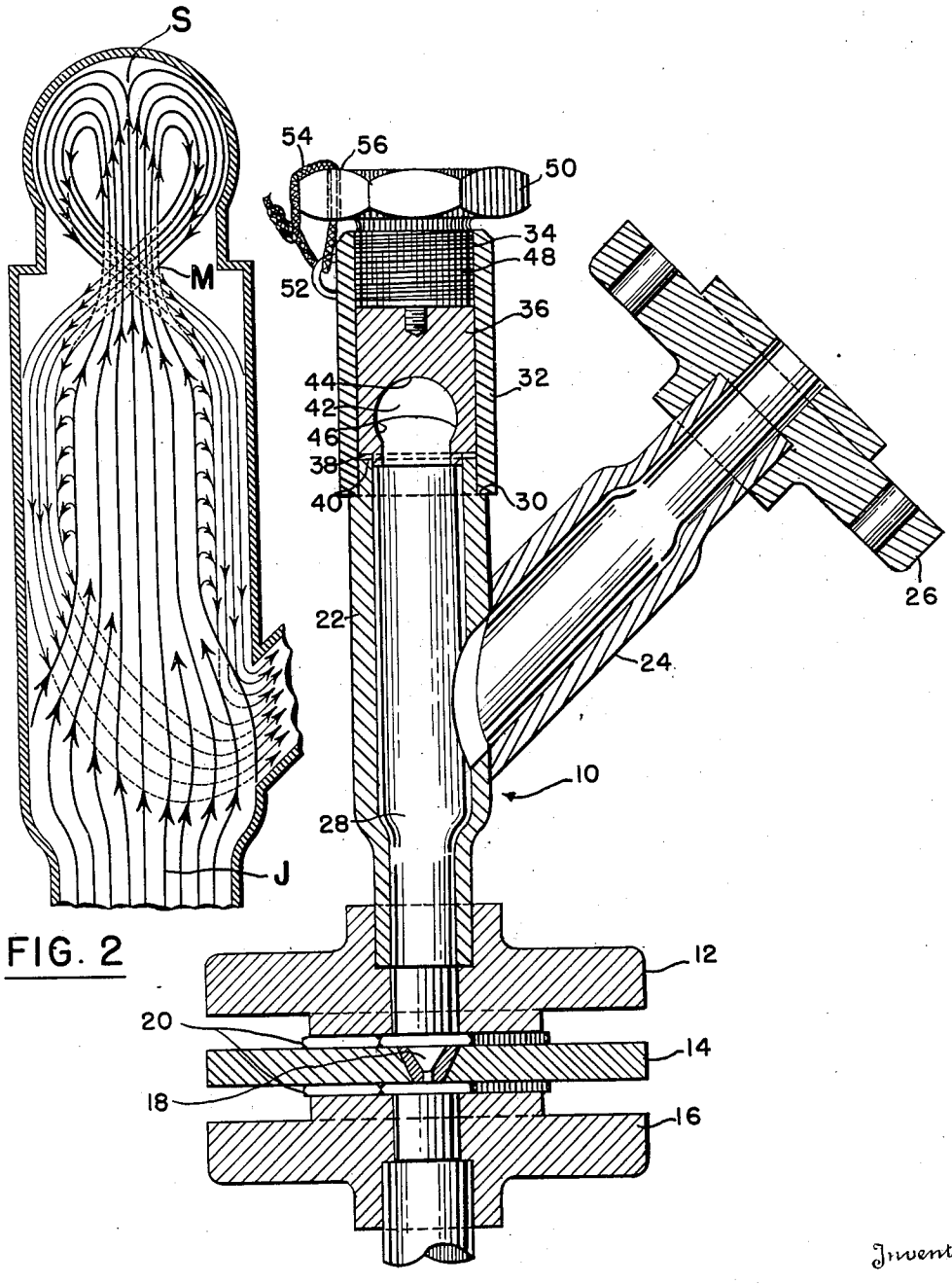


FIG. 2

FIG. 1

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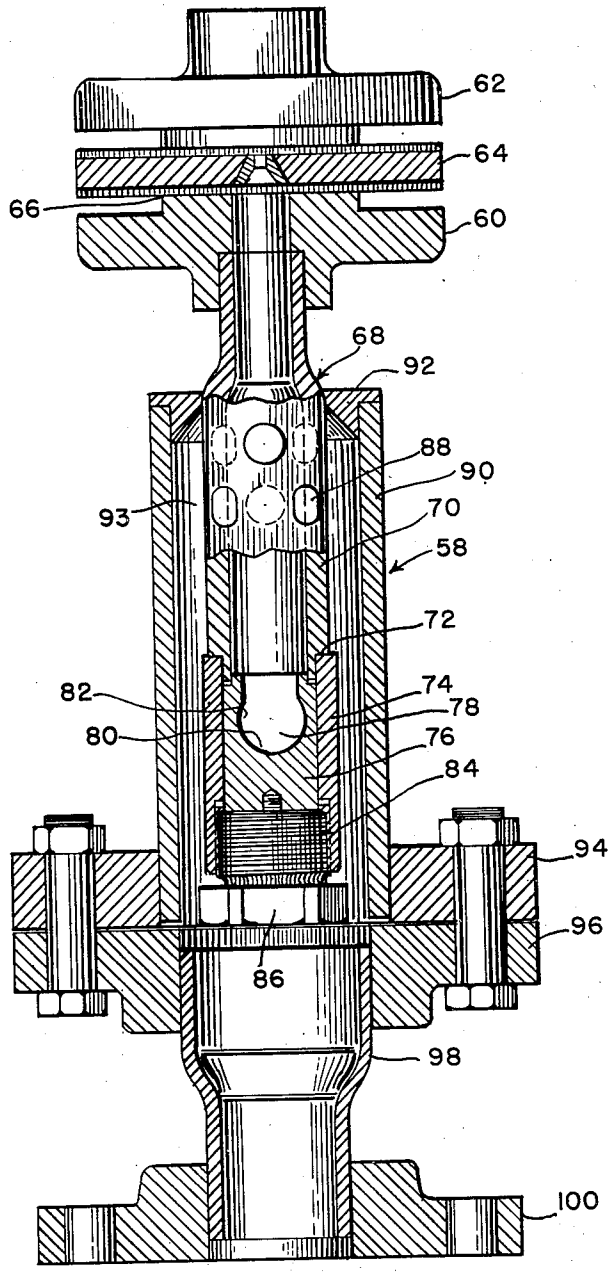


FIG. 3

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MAIN FEED PUMP RECIRCULATING LINE EROSION CONTROL DEVICE

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3 Claims. (Cl. 138—37)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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This invention relates to erosion control in conduits in which a high velocity water jet is directed, and more especially to means for dissipating the energy of a jet employed in the recirculating conduit of a high pressure water pump to prevent damage to the conduit.

In steam plants, whether ashore or afloat, it is customary continuously to feed water at high temperatures and pressures to the boiler. In the conduit between the pump and the boiler, there is provided a control valve which may manually be operated if the level of the water in the boiler rises too high to shut off the flow of feed water. While there is usually a governor for controlling the speed of the feed pump, and hence, the volume of water it discharges, before this becomes effective, the churning action of the pump upon the water which is already approximately 250° F., will raise the temperature of the water to such an extent as to cause the pump to become vapor bound. For this reason there is provided a bleeder or return conduit from the discharge side of the pump for returning the water, when the discharge of the pump is stopped by closing the aforesaid valve, to the condenser. A conduit of very small diameter will take care of the volume of water to be returned at the high pressure employed, approximately 750 pounds per square inch, but for practical reasons, a conduit of much larger diameter actually is employed so that it will not easily be broken. When a large conduit is employed, however, an orifice of small diameter must be included therein to reduce the volume of water flowing through the conduit, and it is the damage caused by this high velocity jet with which the present invention is concerned.

Considerable difficulty is experienced when a high velocity jet of water is discharged in a conduit due to the fact that small particles of abrasive material in the water are thrown with great force by the jet against the walls of the conduit which causes erosion of the conduit, hence, it is an object of the present invention to provide means for dissipating the energy of the jet after it has passed through the orifice, so that its velocity will be comparatively low, which may readily be installed in existing equipment with a minimum of change therein and which is susceptible of replacement when it becomes worn out, at a low cost.

In its broadest aspect, invention resides in means for dissipating the energy of a high velocity jet passing through an orifice, the aforesaid means comprising a member having a substantially spherical recess therein open toward the jet

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and adapted to receive the impact thereof and to turn it back upon itself so that in counterflow it is in contact with the surface of the forwardly moving jet.

As illustrated herein, the invention resides in disposing between the pump discharge and the return conduit, a fitting having an orifice at the end adjacent to the pump discharge through which water under high pressure flows, thereby to produce a jet, and a member disposed in the conduit in a position to receive the impact of the jet having a recess therein, the walls of which are reentrant, and are adapted to change the direction of flow of the jet to cause it to double back upon itself and hence to create counterflow along the jet, and also to intersect the incoming jet, thereby to retard its forward movement. As shown herein, the aforesaid recessed member is removably mounted in the fitting and when worn out may be replaced without difficulty and without uncoupling the fitting.

It is another object of the invention to provide a method for dissipating the energy in a high velocity jet.

In this aspect invention resides in intercepting the high velocity jet, turning its direction of flow back upon itself so that it intersects the forwardly moving jet and causing it to flow rearwardly while confined in part along the surface of the forwardly moving jet.

The invention will now be described with reference to the accompanying drawings, in which:

Fig. 1 shows a section through the fitting which includes my invention;

Fig. 2 is a diagrammatic illustration of the method in which the jet is caused to flow backwardly upon itself thereby to dissipate its energy; and

Fig. 3 shows a modification of the fitting embodying my invention.

In steam power plants, the boiler is supplied with feed water at high temperatures and high pressures by a feed water pump. In the steam power plant of the type with which the present invention is concerned, a two-stage centrifugal pump is employed for feeding water at high temperature and high pressure to the boiler. Between this pump and the boiler, there is provided a manually operable valve which is normally open to permit substantially continuous feed of water to the boiler but which may be closed by an operator if the level in the boiler rises too high. If this valve is closed, however, the centrifugal pump will churn the water so violently that the temperature will rise to the point where the pump

will become vapor bound. To prevent this a bleeder or return conduit is led off from the discharge side of the pump to the main condenser through which a sufficient volume of water may pass when the aforesaid valve is closed to prevent overheating. The discharge pressure of the feed pump is around 750 pounds per square inch, and hence, a very small diameter pipe would take care of the by-passed water. However, a small diameter conduit is apt to be broken and for this reason a pipe of sufficient diameter is provided so that it will withstand ordinary shocks. If, however, a large conduit is used, an orifice must be provided to reduce the volume of water flowing through the same, and for this reason, there is placed in this conduit adjacent to the discharge side of the feed pump, an orifice for controlling the volume of water passing through the pipe. Since the pressure of the water passing through the orifice is high, a jet is formed which is very destructive and soon erodes the return conduit so that it must be replaced. It is the purpose of this invention to provide means for dissipating the energy of this jet to render it harmless, and hence, to reduce the erosion in the return feed conduit.

Referring to Fig. 1, the fitting is designated generally by the reference character 10 and is provided with a flange 12 by which it is attached to the flange 16 of the discharge side of a high pressure water pump. Between the flanges 12 and 16 there is disposed a plate 14 having an orifice 18 therein adapted to constrict the flow of high pressure water from the pump and to regulate its volume. To make the connection between the flange and the plate 14 watertight, a pair of washers 20 are disposed on opposite sides of the plate between the flanges 12 and 16. The fitting 10 consists of a hollow cylindrical body 22 having a branch conduit 24 leading from one side thereof substantially midway between its ends, the branch 24 having fixed thereto a flange 26 which is adapted to be clamped to the end of a conduit (not shown) for returning the feed water to the condenser. The end of the cylindrical body 22 adjacent to the orifice is reduced at 28 and its opposite end is turned down to form a shoulder 30. Over the turned down end portion there is telescopically fitted a sleeve 32 which sits against the shoulder 30 and is fastened thereto in any suitable manner as by welding. The sleeve 32 is of somewhat larger diameter than the inside diameter of the body 22 and is adapted to removably receive a block 36, the inner end of which is provided with a shoulder 38 which abuts the peripheral end 40 of the body 22. The block 36 has formed therein a recess 42 which opens into the hollow cylindrical body 22 and has a spherical bottom and sides, the sides 46 being reentrant. The block 36 is held in place within the sleeve 32 by a threaded plug 48 which has a nut shaped head 50 to which a tool may be applied for inserting or removing the same. To prevent accidental removal of the plug 48, a staple 52 is formed on the side of the sleeve 32 through which there is passed a wire 54, the wire in turn being threaded through a perforation 56 formed in the periphery of the head 50.

A modified form of the fitting is shown in Fig. 3, indicated generally by the reference character 58. In this form of the invention, the fitting 58 is provided with a flange 60 by which the fitting is attached to the flange 62 of the discharge side of a high pressure pump and as in the previous case, a plate 64 having an orifice 66 therein is clamped between the flanges 60 and 62, appropriate washers being disposed between the plate and the flanges to prevent leakage. In this instance, the fitting comprises a hollow cylindrical body 68 which is reduced in diameter adjacent to the orifice, but is of a larger diameter throughout most of its length, as indicated at 70. The end of the cylindrical body 68, remote from the orifice, is turned down to provide a shoulder 72 and telescopically fitted over this turned down end is a sleeve 74. Into the sleeve 74 there is inserted a block 76 having the recess 78 formed therein which is open to the inside of the cylindrical body 68, the recess having a spherical bottom 80 and sides 82, the sides 82 being reentrant. The block 76 is retained in place by a threaded plug 84 which is screwed into the end of the sleeve 74, the plug being provided with a nut shaped head 86 adapted to receive a tool for removing or replacing the plug. In this form of the invention, the cylindrical body 68 is enclosed in a hollow cylindrical housing 90 of larger diameter than the body 68, one end of which is closed by a wall 92 welded thereto, which is apertured to receive the body 68 and is adjacent to the reduced portion thereof. The cylindrical body 68 has a plurality of openings 88 formed therein adjacent to the end wall 92 through which the water will flow from the body 68 into an annular space 93 between the cylindrical body 68 and the cylindrical housing 90. The open end of the cylindrical housing 90 terminates near the head 86 of the plug and has fastened thereto a flange 94 by which the fitting 58 is fastened to a flange 96 of a coupling 98, the coupling in turn having a flange 100 whereby it may be fastened to the end of the conduit for returning the feed water to the condenser.

In operation, the high pressure water (750 pounds per square inch), which is also at a rather high temperature, 250° F., discharges from the feed water pump through the orifice of the fitting, and in dissipating the energy of the jet, it is desirable to prevent damage to the return conduit. As illustrated in the two forms of the invention, the jet J is intercepted by the spherical surface 44 or 80 of the block 36 or 76. To illustrate the action which takes place, there is shown in Fig. 2, a purely diagrammatic view of the course of the jet from the time it leaves the orifice until its energy is dissipated and it flows at greatly reduced velocity to the return conductor. The jet which is designated by the reference character J, Fig. 2, passes through the orifice in a fairly well defined stream of smaller diameter than the enlarged portion of the fitting, and strikes the bottom of the recess where it is spread by its spherical contour at about the point S and its direction of flow is reversed so that it travels along the inner walls of the recess. Since the walls are reentrant in character, the rearwardly moving water is caused to flow across, that is, to intersect the forwardly moving jet as it leaves the recess at about the point M, and to travel rearwardly between the surface of the incoming jet and the walls of the cylindrical body. This rearwardly flowing liquid has considerably less velocity than the incoming jet and its intersection with the jet tends to retard the oncoming jet thereby dissipating part of its energy. Moreover, the rearwardly flowing stream is constantly retarded by contact with the walls of the fitting and this retarded stream in turn by surface contact with the jet, retards its flow, setting up a turbulence between them as indicated by the

arrows *t*. When the rearwardly flowing stream reaches the branch **24** or the openings **88**, it will flow into the return conduit and back to the condenser.

The invention described herein may be manufactered and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:

1. In a conduit in which there is an orifice through which passes a jet of fluid under high pressure, means for dissipating the energy of the jet, comprising a member having a substantially spherical recess therein opened toward and symmetrically disposed with respect to the axis of the jet, the reentrant walls of which extend through an arc of substantially more than 180° to reverse the flow of fluid to cause it to intersect the oncoming jet in a substantially opposite direction, thereby to retard its flow.

2. In a fitting for a recirculating system comprising a length of conduit having an orifice near one end through which fluid under high pressure flows in a high velocity jet, said conduit being of larger inside diameter beyond the orifice, and a member having a substantially spherical recess therein with reentrant walls extending through an arc of substantially more than 180° disposed in the enlarged portion of the conduit in a position symmetrically disposed with respect to the axis of the jet and to receive the impact of the jet and to reverse the direction of the deflected water to intersect said incoming jet in a substantially opposite direction, said member being composed of hardened steel and being removably mounted therein.

3. A fitting for a recirculating system comprising a length of conduit having an orifice near one end through which fluid under high pressure passes in a high velocity jet, a member having a substantially spherical recess therein with reentrant walls extending through an arc of substantially more than 180°, said recess being symmetrically disposed with respect to the axis of the jet and arranged in the conduit to cause a reverse flow of the fluid to intercept the incoming jet in a substantially opposite direction, said conduit having a plurality of openings therein near the orifice end thereof, and having telescopically surrounding the conduit, in axial alignment therewith, a second conduit adapted to receive the flow of fluid from said openings and conduct it in the direction of the jet along the outside of the first conduit.

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