Dec. 1, 1959 J. D. CONRAD, SR 2,915,075

POWER PLANT APPARATUS

Filed Oct. 29, 1956 2 Sheets-Sheet 1

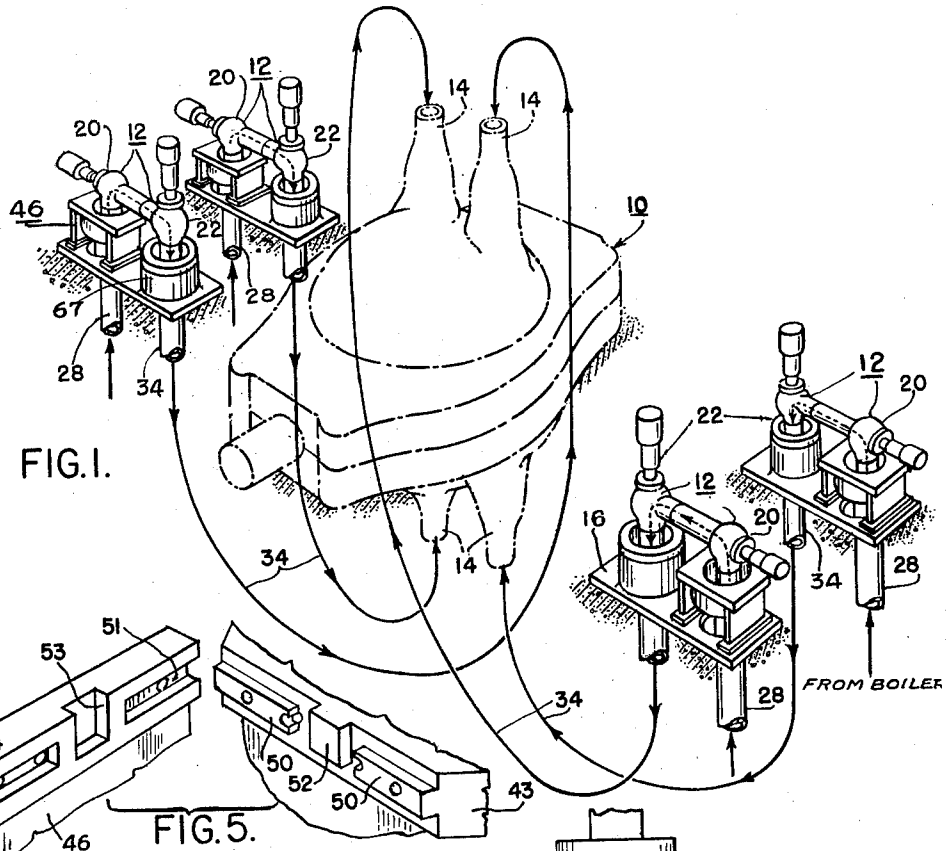


FIG. 1.

FIG. 5.

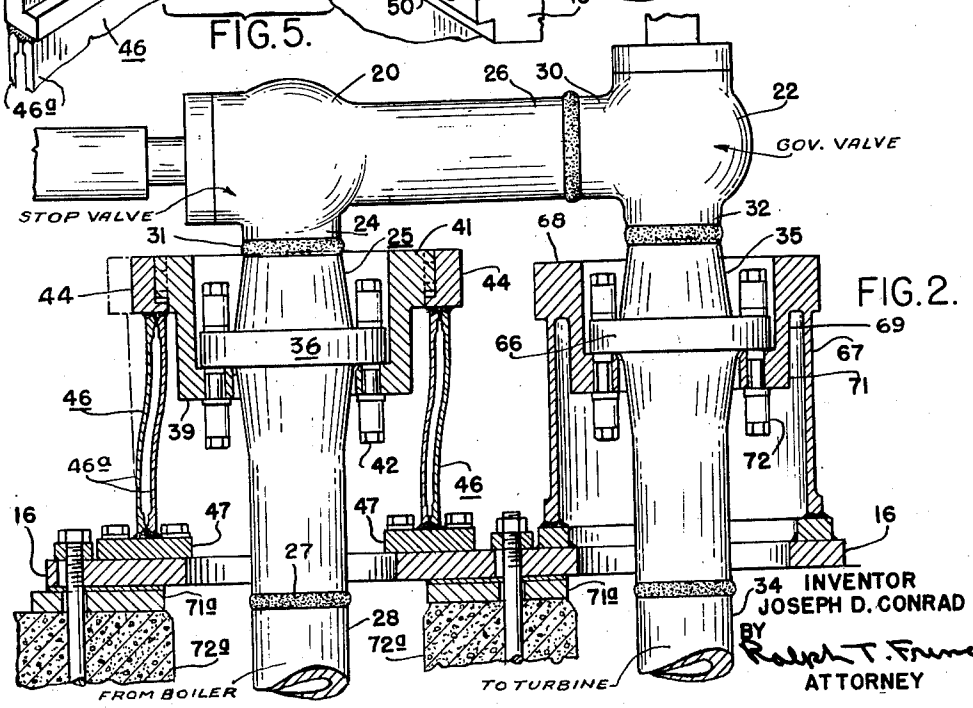


FIG. 2.

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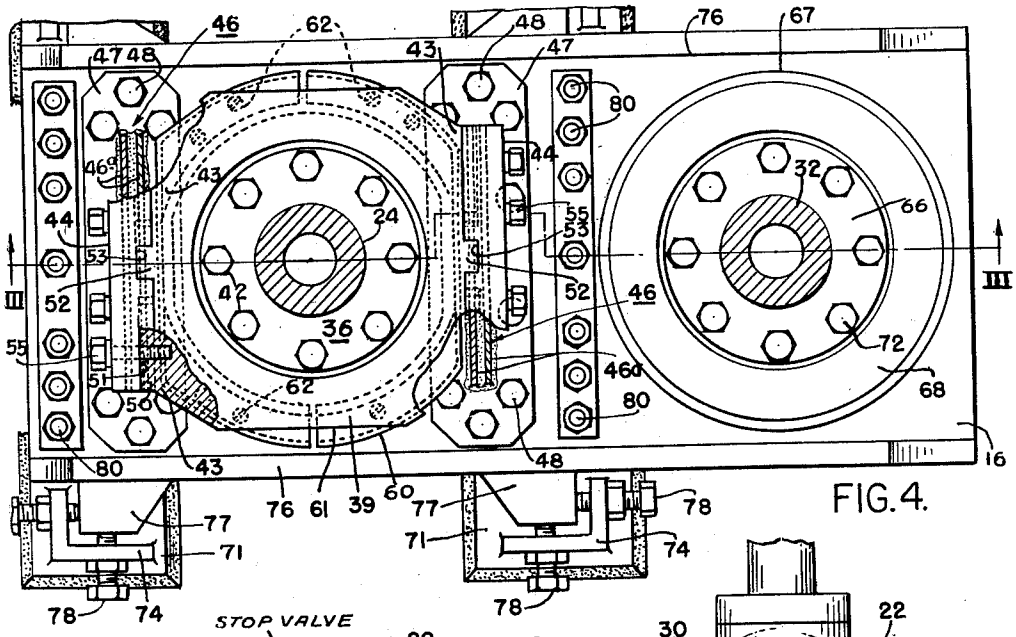


FIG. 4.

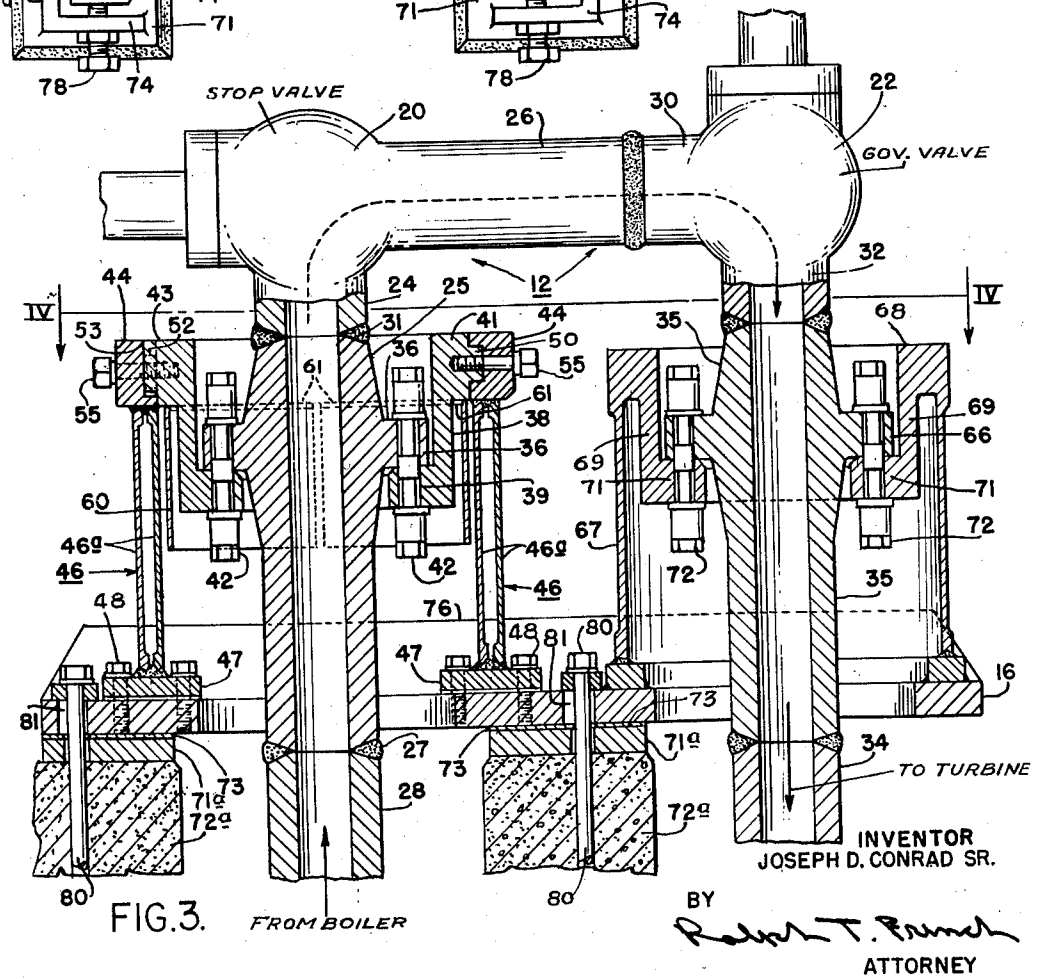


FIG. 3.

FROM BOILER

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2,915,075

POWER PLANT APPARATUS

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Application October 29, 1956, Serial No. 618,901

5 Claims. (Cl. 137—16)

This invention relates to an arrangement of and a support for a pair of valves, and in particular, to an arrangement of and a support for a stop valve and a governor valve as utilized in an elastic fluid turbine.

In turbines which utilize motive fluid at high pressures and temperatures, particularly those operating with steam in the super-critical range, the governor valves are each contained in a separate casing and each is preceded (when considered in the direction of fluid flow) by an emergency stop valve which is also contained in a separate casing. For such high pressure and temperature operation it is desirable, because of the stresses imposed upon the valves and the necessity for extended service without failures, to utilize stop valves and governor valves that are of the right angle type. This type of valve is constructed having its inlet perpendicular to its outlet. It is an object of the present invention to provide an arrangement of right angle valves such that the steam flow is required to undergo a minimum number of turns in direction of flow and consequently a minimum amount of pressure reduction.

It is a further object of the present invention to construct a supporting means for such valves so that a pair of valves will have approximately the same elevation and be exposed to approximately equal temperatures.

In steam turbine power plants, the conduits from the boiler to the stop valve and from the governor valve to the turbine inlet will expand and contract in response to temperature changes and the valves may be subjected to stresses due to the expansion and contraction of the conduits. It is another object of the present invention to provide valve supporting means which will minimize such stresses.

Since the stop valve and the governor valve are themselves exposed to elevated temperatures, they, in addition to the connecting conduits, will also tend to expand and contract in response to temperature changes and may impose undesirable stresses on the valve supporting means. Consequently, it is an object of the present invention to prestress certain members of the supporting means such that under normal operating conditions of the unit, compensation will be obtained for the thermal stresses which would otherwise be imposed upon the support.

One embodiment of the present invention provides a pair of valves comprising a stop valve and a governor valve with the outlet of the stop valve connected to the inlet of the governor valve. The inlet of the stop valve is connected by a suitable conduit to a boiler and the outlet of the governor valve is connected by a suitable conduit to the inlet of a turbine. The stop valve and the governor valve are each right angle valves as hereinbefore described. The governor valve is rigidly connected to a base by a cylindrical element. The stop valve is flexibly connected to the same base by a plurality of parallel flexible plates secured at one end to the base and at the other end through intermediate means to the stop valve. The cylindrical support at the governor valve provides restraint in the three directions of possible movement and, in addition, restrains rotation about any axis. The flexible plates at the stop valve are arranged so that movement in two directions is restrained, but movement is allowed in a direction parallel to the common axis of the stop valve outlet and the governor valve inlet.

The foregoing and other objects are effected by the invention as will be apparent from the following description taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a perspective view illustrating the present invention as utilized in a steam turbine;

Fig. 2 is a sectional view, partly in elevation, of a pair of valves constructed in accordance with the present invention;

Fig. 3 is a sectional view, taken along the line III—III, of Fig. 4 showing the valves of Fig. 2 in the position they occupy after they are fully heated by operation for a period of time;

Fig. 4 is a sectional view, taken along the line IV—IV of Fig. 3; and

Fig. 5 is a fragmentary exploded view of a portion of the structure of Figs. 2 and 3.

Referring to the drawings and in particular to Fig. 1, there is illustrated a steam turbine fluid receiver **10** designed to utilize steam in the super-critical range, supplied by a boiler (not illustrated). The supply of steam to the turbine is controlled by a plurality of valves which are arranged in pairs **12**. Each pair of valves supplies a turbine inlet **14**. In the embodiment illustrated, four pairs of valves **12** are utilized to supply four turbine inlets **14**. For the sake of clarity, the arrangement and support of one pair **12** of valves will be described, it being understood that the remaining pairs of valves are similarly constructed.

Referring to Fig. 2, the valves are shown in assembled position, when cold, that is, prior to the attainment of a normal operating temperature by the turbine **10**. The pair of valves comprises a stop valve **20** and a governing valve or rigid member **22** mounted in tandem on a base **16**. The stop valve **20** has an inlet **24** and an elongated, tubular outlet conduit portion **26**. A connector **25** joins the inlet **24** to the supply conduit **28** from the boiler. The outlet **26** of the stop valve **20** is connected to an inlet **30** of the governing valve **22**. A connector **35** joins the governing valve outlet **32** to the turbine inlet conduit **34**.

It is to be understood that in the usual installation the conduit **28** from the boiler to the stop valve **20** will be of greater length than the conduit **34** from the governor valve **22** to the turbine inlet **14**. Because of this, the governor valve is secured rigidly to the base **16** and the stop valve is flexibly connected to the base, as hereinafter described in detail.

Each of the valves is constructed as a right angle valve, that is, the outlet **26** or **32**, respectively, is disposed 90 degrees from the corresponding inlet **24** or **30**, respectively. The valves are placed so that the outlet of the stop valve is aligned with and abuts the inlet of the governor valve. In this manner a minimum number of turns in the steam flow path occur, thereby holding flow losses and pressure reductions to a minimum.

Referring to Figs. 3 and 4, the pair of valves is shown in greater detail in the position they assume after the turbine has been in operation for some time and the valves and their associated conduits are fully heated and expanded. The connector **25** is welded to the steam supply conduit, as at **27**, and to the stop valve inlet **24**, as at **31**, and is provided with an annular flange **36** intermediate the welds **27** and **31**.

The connector **25** is encompassed by a sleeve **38** having an inwardly-directed flange **39** at its lower edge and an outwardly-directed flange **41** at its upper edge. The

lower flange 39 extends beneath and supports the flange 36 of the connector 25, the two flanges being retained in mating relation by a plurality of bolts 42.

The upper flange 41 of the sleeve 38 has a pair of parallel spaced side portions 43 which interlock with, and are supported by, a pair of parallel spaced bars 44. Each bar 44 is fixedly mounted on the upper edge of a vertical plate support 46 comprised by a pair of closely-spaced parallel plates 46a extending vertically from a foot 47 bolted to the base 16, as at 48.

The interconnection between the side portions 43 of the upper flange of the sleeve 38 and the parallel spaced bars 44 is best shown in Fig. 5, where it will be apparent that a pair of horizontal ribs 50 on the flange side portions or members 43 are closely received in mating recesses 51 on the mating face of bar 44. Relative movement of the two members 43, 44 in the direction of the longitudinal axes of the ribs 50 is prevented by close engagement of a vertical rib 52 on the face of member 43 in a mating recess 53 in the face of member 44. As best shown in Figs. 3 and 4, a plurality of horizontally-disposed bolts 55 maintain the members 43 and 44 in interlocking relation.

To prevent excessive flow of heat from the connector 25 and associated flanges 36 and 39 to the adjacent plate supports 46, a shield or apron 60 is interposed therebetween. At the upper edge of the shield 60 is an inwardly-extending flange 61 abutting the under surface of the outwardly-directed flange 41 of the sleeve 38 (Figs. 3 and 4) and secured thereagainst by suitable means, for example, screws 62.

The connector 35, which joins the governor valve outlet 32 to the turbine inlet conduit 34, is provided with a flange 66 which, preferably, lies in the same horizontal plane as the flange 36 on the connector 25. As is evident from the foregoing, the connector 25, valves 20 and 22, and connector 35 form a U shape, illustrated in Figs. 2 and 3. A cylindrical member 67, concentric with respect to the connector 35, extends vertically from the base 16 and surrounds the flange 66 of the connector 35. An inwardly-directed flange 68 at the upper edge of cylindrical member 67 carries a depending sleeve 69 at its inner edge, the sleeve terminating in an inwardly-extending bottom flange 71 disposed beneath, and in supporting relation to, the connector flange 66. The flanges 66 and 71 are retained in position by bolts 72.

The base 16 rests upon a pair of plates or bars 71a secured to foundations 72a of concrete or other suitable material. Shims 73 may be interposed between the bars and the base, if desired.

As best shown in Fig. 4, corner brackets 74 extend upwardly from end portions of the bars which project beyond opposite sides of the base 16. Flanges 76 extend upwardly from the two long sides of the base and have lugs 77 projecting outwardly therefrom for engagement with adjusting lock bolts 78 carried by the corner brackets 74. By means of these bolts the entire assembly of the base 16, valves 20 and 22, and the associated supporting structure may be adjusted in a horizontal plane on the foundations. To this end, clearance is provided around bolts 80, which secure the base to the foundations, where they pass through the base, as at 81. After the turbine conduit 34 has been secured to the turbine at one end and to the connector 35 at the other end, the entire assembly consisting of the base 16, valves 20 and 22, and the associated supporting structure may be moved in a horizontal plane in a manner to accurately prestress the conduit 34 an amount equal and opposite to the stress which would be induced in the conduit 34 (if the conduit 34 were not so moved) by the temperature induced expansion occurring during normal operation. In this manner the conduit 34 may be prestressed without interfering with the prestress in the plates 46.

When cold, the vertical plates 46 which support the stop valve 20 are deflected and thereby prestressed toward the governor valve 22, as indicated in Fig. 2. The amount of deflection and prestress is such that the stress in the vertical plates 46 during normal operating conditions is reduced by the movement of the plates, from right to left, due to the expansion of the valves 20 and 22, as is evident in Figs. 2 and 3. Preferably, the deflection and prestress, from left to right, imposed upon the plates 46 is equal to the movement of the plates 46, from right to left, due to the expansion of the valve 20 and its outlet 26 and the valve 22 and its inlet 30 and the flexibility of the plates 46. In other words, the amount of deflection imposed is such that a stress is induced in the plates equal and opposite to that stress which would have been induced in the plates 46 had the plates 46 been disposed vertically, when cold, by the expansion of the two valves due to the high temperature conditions prevailing therein under normal operating conditions.

The stop valve 20 is rigidly restrained against movement in two directions by the plate support 46, movement being permitted only in a direction toward or away from the governor valve 22. The governor valve is restrained by its support (the cylindrical member 67) against movement in any direction, and both valves are restrained by their respective supports against rotation.

From the foregoing, it will be apparent that the present invention provides an improved and effective support for controlling the forces which may result from the expansion and contraction of the valves and their associated conduits, due to wide temperature changes.

While the invention has been shown in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof.

What is claimed is:

1. In combination, a steam turbine, a stop valve having an inlet and an outlet, a governor valve having an inlet and an outlet, means joining said valves with the inlet of the stop valve and the outlet of the governor valve in parallel spaced relation and with the outlet of the stop valve and the inlet of the governor valve in axial alignment and in communication, means providing a communication between the outlet of the governor valve and said steam turbine, means communicating with the inlet of the stop valve for supplying elastic fluid thereto, the inlet of the stop valve and the outlet of the governor valve being on one side of a longitudinal axis common to the outlet of the stop valve and the inlet of the governor valve, a support structure, means carried by said support structure and providing a connection between the inlet of said stop valve and the support, and means carried by said support structure and providing a connection between the outlet of said governor valve and said support, the connections between said valves and said support lying in approximately the same plane, whereby said connections are exposed to approximately the same temperature.

2. In combination with a steam turbine, a first valve having an outlet conduit portion, a second valve having an inlet axially aligned and communicating with said outlet conduit portion of said first valve, said first valve having an inlet and said second valve having an outlet disposed in parallel relation with each other, said outlet conduit portion being axially aligned with and connected to said inlet of said second valve, means for supplying steam to the inlet of the first valve, means providing a communication between said outlet of said second valve and said steam turbine; supporting structure for said valves including a flexible support for the first valve permitting to and fro movement thereof, with respect to the support structure, in one direction and the opposite direction only; a tubular member rigidly supporting the second valve and preventing movement of the latter with respect to the supporting structure in any direc-

tion; said flexible support and said tubular support being connected to said valves in approximately the same plane, said directions of movement of said first valve being due to expansion and contraction of said valves and conduit, whereby the expansion and contraction of the valves and conduit is accommodated.

3. In combination, a steam turbine, first and second valves each having an inlet and an outlet, a base for supporting said valves, a plurality of plates connected adjacent one end to and extending vertically from the base, all of said plates being mutually in parallel spaced relation, a first tubular connecting member supported by and connected adjacent the opposite end of said plates, means for supplying steam to said connecting member, means securing the inlet of said first valve with said first connecting member, a cylindrical support member extending perpendicularly from said base with its axis parallel to the planes containing the spaced parallel plates, a second tubular connecting member connected to and supported by said cylindrical support member, means secured to said second connecting member and providing a communication between the latter and said steam turbine, means securing the outlet of said second valve to said second connecting member, and means joining the outlet of said first valve and the inlet of said second valve in aligned communicating relation.

4. In apparatus for supplying high temperature elastic fluid to an elastic fluid utilizing device, first and second valves each having an inlet and an outlet disposed at right angles to each other, the outlet of said first valve being axially aligned with the inlet of said second valve, said outlet of said first valve being elongated and tubular and connected to the inlet of the second valve, means for conducting high temperature elastic fluid to the inlet of said first valve, means for conducting high temperature elastic fluid from the outlet of said second valve to the elastic fluid utilizing device, a base, a first support connected to said base and said first valve, said first support being deflectable in one direction and the opposite direction only and permitting said first valve to move to and fro only in the direction parallel to the axis of the aligned first valve outlet and the second valve inlet, and a second support connected to said base and to said second valve, said second support being rigid and preventing said second valve from moving in any direction, said first support being deflected in the direction toward said second support and prestressed, whereupon the expansion of said valves and conduit moves the first support in the opposite direction and relieves the stress therein.

5. In combination with a fluid receiver, apparatus for supplying high temperature fluid to said fluid receiver comprising first and second valves each having inlet and outlet portions, said first valve having its outlet portion connected to said inlet portion of said second valve, support structure for said valves, a conduit secured to said receiver and to said outlet of said second valve, said support structure comprising a base, flexible plates connecting said first valve to said base, and a rigid member connecting said second valve to said base, said valves and conduit expanding when heated by the high temperature fluid, all of said flexible plates being mutually parallel and deflected and stressed in the direction opposite to the movement of said flexible plates due to the expansion of said valves, the expansion of said valves reducing said deflection and thus reducing the stresses in the flexible members from those stresses which would arise therein if said flexible members were not initially so deflected; and means for adjusting said base to a fixed position after said conduit is secured to said outlet portion and said fluid receiver, relative to said fluid receiver, for deflecting and stressing said conduit in the direction opposite to the movement of said conduit due to the expansion of said conduit without interfering with the deflection of said flexible plates, the expansion of said conduit reducing said second mentioned deflection and thus reducing the stresses in the conduit from those stresses which would arise therein if said conduit were not so deflected.

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