Nov. 21, 1939. J. BRISCOE 2,180,395

APPARATUS FOR CONTROLLING PRESSURE FLUID

Filed June 29, 1937 2 Sheets-Sheet 1

Fig. 1

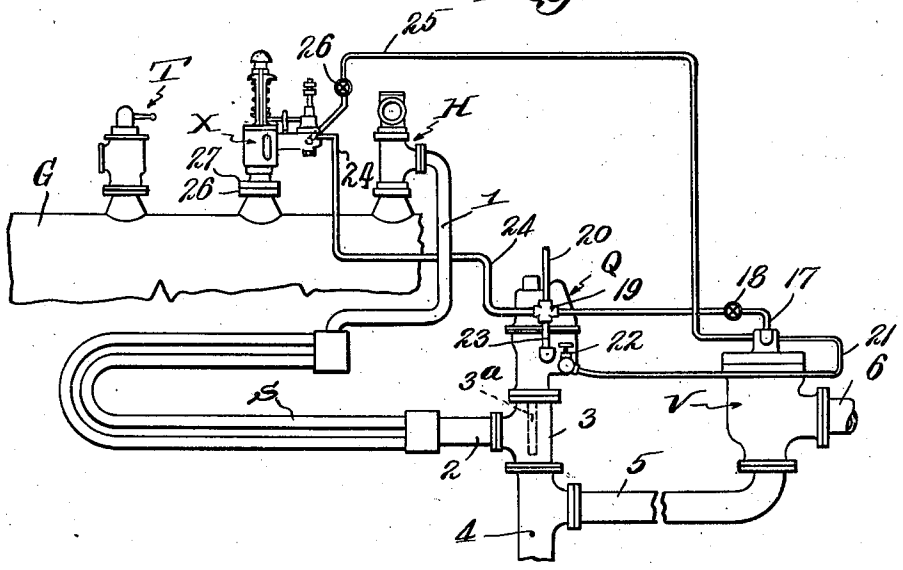


Fig. 2

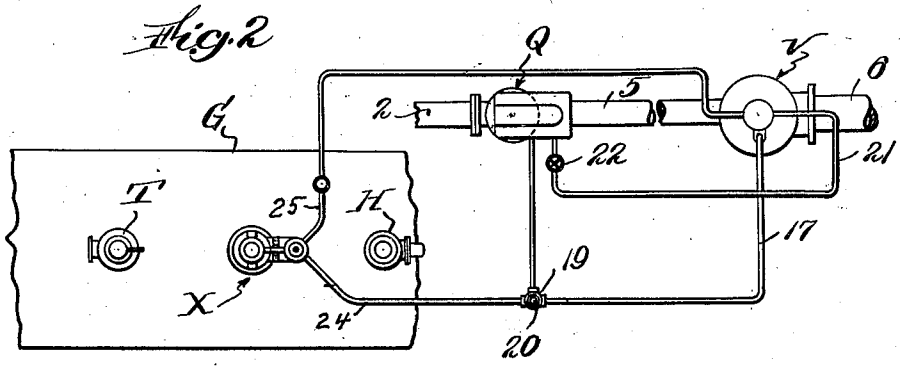
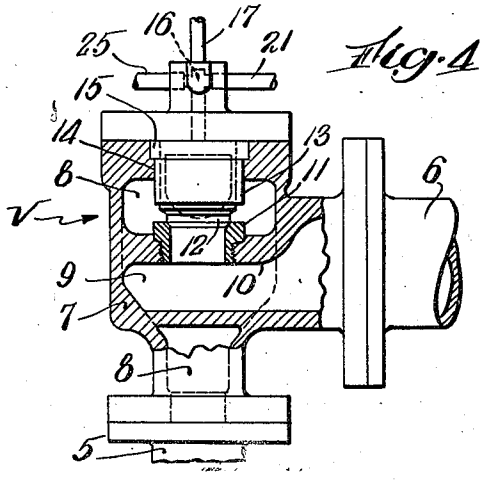


Fig. 4



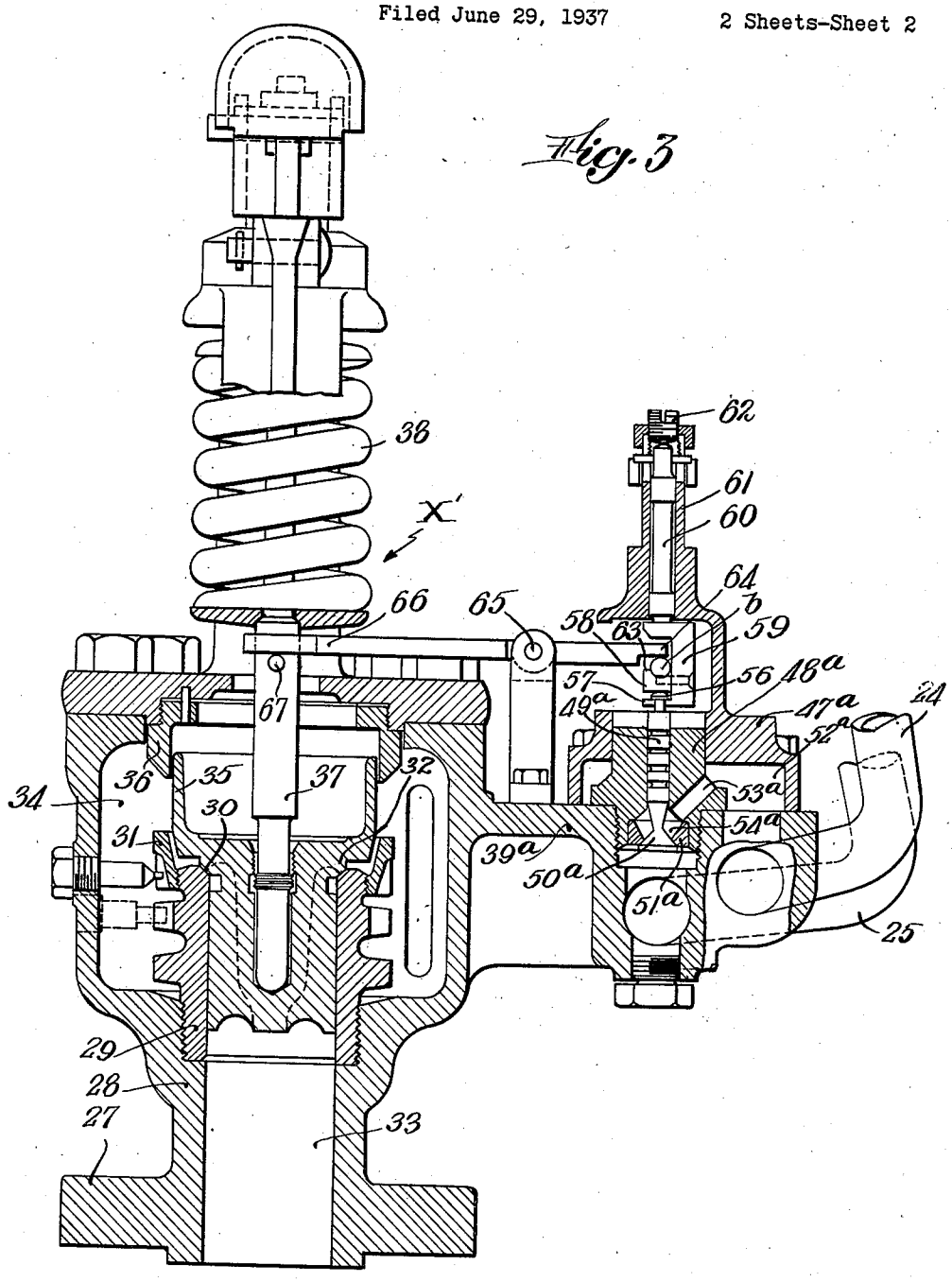
Inventor:
James Briscoe
by Roberts Cushman & Woodbury
his Attys.

Nov. 21, 1939. J. BRISCOE 2,180,395

APPARATUS FOR CONTROLLING PRESSURE FLUID

Filed June 29, 1937 2 Sheets-Sheet 2

Fig. 3



Inventor:
James Briscoe
by Roberts Cushman & Woodbury
his Attys.

Patented Nov. 21, 1939 2,180,395

UNITED STATES PATENT OFFICE

2,180,395

APPARATUS FOR CONTROLLING PRESSURE FLUID

James Briscoe, Bridgeport, Conn., assignor to Manning, Maxwell & Moore Incorporated, New York, N. Y., a corporation of New Jersey

Application June 29, 1937, Serial No. 150,905

4 Claims. (Cl. 122—479)

This invention pertains to an improved apparatus for use in protecting fluid pressure generators or other containers, for example, steam boilers, superheaters, oil stills, etc., from the injurious or destructive effects of excessive pressures and/or temperatures.

In the patent to Graesser No. 1,951,049, dated May 13, 1934, there may be found an extended discussion of some of the difficulties encountered in modern steam engineering practice by reason of the extremely high steam pressures and temperatures now employed, and in particular the necessity (for economy in operation) of using a working safety valve having a low blowdown. In said patent there is disclosed and claimed a highly desirable method of and apparatus useful for controlling the pressure in a steam boiler and superheater system such that the blowdown need not exceed one per cent of the working pressure, although with complete safety to the generator, superheater and associated parts. This patented device depends for its operation upon electrically actuated elements, but although modern electrical equipment is dependable and effective, there still remains a certain prejudice against its use in some branches of the engineering profession, and while the Graesser method and apparatus have been widely accepted, they are still excluded from some fields of utility by reason of this unfounded prejudice.

In the patent to Beck and Briscoe No. 2,059,722, dated November 3, 1936, it is pointed out that, under some conditions, excessive temperature is a more important factor than high pressure in determining the operation of the relief valve, and in this patent there is described a method of and apparatus for controlling the release of pressure fluid from a system in response to excess temperature, but without resort to the use of electrical devices. This Beck and Briscoe device thus extends the field to which the fundamental principle of the Graesser patent is admissible, and carries forward the Graesser idea in the specific direction of control by temperature rather than directly by pressure.

Both in the Graesser and Beck et al. patents reference is made to the fact that in a steam generating system employing a boiler and superheater, it is essential at all times to maintain an adequate flow of steam through the superheater in order to prevent burning of the superheater tubes, and to this end it is proposed, in accordance with the disclosures of both patents, to place the working relief valve at or beyond the delivery end of the superheater. In view of the fact that when located close to the superheater a valve is subjected to a very high temperature such as might prove injurious to a spring-loaded valve, it is proposed in each of the patented devices to employ a relief valve of the pressure-loaded type, such, for example, as that illustrated in the patent to Darling No. 1,500,674, dated July 8, 1924. The device of the Beck et al. patent, like that of the Graesser patent, is useful and commercially valuable in certain fields of steam engineering practice, but under some conditions neither the electrically actuated device of Graesser nor the temperature controlled device of Beck et al. is acceptable or considered wholly adequate.

The principal object of the present invention is to provide a novel method of and apparatus for relieving the pressure in a steam generating system, or the like, of such character as to make it acceptable and useful under conditions such as those just alluded to. As one instance of such particular conditions, attention is called to the fact that under some circumstances a pressure generating system may be subject to very sudden and sharp rises in pressure, commonly referred to as pressure surges, which may, for example, be caused by a very sudden closing of the throttle. In the Beck et al. system, if such a sudden rise in pressure occur, the pressure-actuated safety valve T on the generator drum will blow (although the temperature in the drum may not be high enough to cause the thermally actuated device K to operate), but the blowing of the drum safety valve does not occasion flow through the superheater, with the result that the temperature-responsive device Z on the superheater may subsequently cause the superheater relief valve V to open. If, under these conditions, the throttle be immediately opened, an appreciable time intervenes before the superheater cools sufficiently to permit the thermally actuated device on the superheater to respond to the drop in temperature and close the relief valve, with the result that great quantities of high temperature steam are exhausted, even to the extent, in some cases, of reducing the boiler pressure below the working pressure. Such conditions as those above described may occur, for example, on shipboard in the event of a near collision—and in such event, the inability of the engines immediately to pick up speed, by reason of low boiler pressure, when the throttle is reopened, may be a serious matter, far more so in fact than the great loss of heat energy resultant from the escape of so much high temperature steam.

In accordance with the present invention these

difficulties are overcome, without recourse to electrically controlled elements, by the use of a pressure-actuated motor device, for instance a pop-valve, upon the generator designed to respond to pressure surges and which controls the opening and closing of the pressure-loaded relief valve at the outlet of the superheater. Preferably the latter valve is alternatively controlled by a thermally responsive controller subject to superheater temperature so as to open if the temperature at the superheater becomes excessive, but it is to be noted that when the control motor on the generator acts in response to pressure surges, there is no consequent danger of overheating the superheater with concomitant actuation of the thermally responsive controller, and thus no prolonged and unnecessary blowdown can occur such as may be the case in the Beck et al. system when subjected to pressure surges. Thus the present arrangement provides for effective opening of the relief valve in response to pressure surges, and since the motor device (to wit, the pop-valve) on the drum need have little actual relief capacity, it may readily be designed to have a very low blowdown so that the relief valve at the delivery end of the superheater will close promptly upon restoration of normal working pressure in the system.

Other and further objects and advantages of the invention will be pointed out in the following more detailed description and by reference to the accompanying drawings, wherein

Fig. 1 is a diagrammatic view illustrating a boiler and superheater provided with the improved control apparatus of the present invention, certain parts being broken away and certain parts being omitted;

Fig. 2 is a diagrammatic plan view of the parts shown in Fig. 1;

Fig. 3 is a vertical section, partly broken away and to much larger scale than Fig. 1, showing details of the control valve which is mounted upon the boiler or generator drum; and

Fig. 4 is a fragmentary vertical section illustrating one desirable form of exhaust valve which, in accordance with the present invention, is arranged beyond the delivery end of the superheater and which is actuated by the control valve of Fig. 3.

Referring to Figs. 1 and 2, a boiler or other form of pressure generator is indicated diagrammatically at G. The pressure fluid from this generator is delivered to a header H which may, if desired, be arranged to receive pressure fluid from other generators of a battery, and from this header the pressure fluid is delivered through a pipe 1 to a superheater S. From the delivery end of the superheater a pipe 2 leads to a fitting 3 upon the upper end of which is mounted a thermal control valve Q which includes a thermally responsive element 3a, for example a bimetallic couple which is exposed to the pressure fluid flowing through the fitting 3. From the lower end of the fitting 3 leads the delivery pipe 4 by means of which the superheated pressure fluid is conveyed to the engine, turbine, or other apparatus which makes use of the pressure fluid. A pipe 5 leads from the conduit 4 to a relief valve V and from this, in turn, an exhaust pipe 6 extends to any convenient point of discharge for exhaust pressure fluid. While the above-described arrangement exemplifies apparatus in which the present invention is useful, it is to be understood that the present invention is not necessarily limited to use in an arrangement of this precise construction or design but may be employed in any system wherein pressure fluid flows from a container through a device in which its temperature is elevated and then to a delivery conduit.

The exhaust or relief valve V as herein illustrated is a pressure-loaded valve of the kind more fully described and illustrated in the patent to Darling No. 1,500,674, above referred to, although it is to be understood that relief valves of other types may be employed providing they are of the kind in which the valve is normally held to its seat by back pressure, at least in part.

Referring to Fig. 4 in which the relief valve V is shown in section, the valve casing 7 has the inlet chamber 8 communicating with the pipe 5, and the exhaust or discharge chamber 9 which communicates with the pipe 6. Between these chambers is a septum 10 having an opening which receives an annular valve seat 11 defining a passage which is normally closed by the valve 12. This valve is furnished with an actuating piston 13 which slides loosely in a cylindrical guide 14, and above the piston is a back pressure chamber 15 into which steam from chamber 8 may slowly leak by passing around piston 13, and which communicates with a space or chamber 16 conveniently formed in the top member of the valve casing. From this chamber 16 a pipe 17 (furnished with a manually actuable valve 18) leads to a four-way fitting 19 (Fig. 1) from which an exhaust pipe 20 leads to any convenient point for the discharge of pressure fluid. The pipe 17, with its manually actuable valve 18, is designed to permit manual opening of the relief valve V at any time desired, for example, for testing the relief valve, without reference to its control by the other elements of the apparatus.

From the space 16 a second pipe 21 leads to the thermal control valve Q. This thermal control valve Q may desirably be of the kind more fully described in, and specifically illustrated in Fig. 10 of the copending application of Beck et al., Serial No. 56,658, filed December 30, 1935. This thermal control valve, as above noted, includes a thermally responsive device 3a which expands and contracts in response to variations in the temperature of the pressure fluid flowing through the fitting 3 and which, by its response to a predetermined increase in pressure, opens a normally closed passage within the valve structure, such passage, when open, providing free communication between the pipe 21 and a pipe 23 which leads outwardly from the casing of the valve Q. As herein illustrated, a manually actuable valve 22 in the pipe 21 permits the thermal controller Q to be cut out of action if desired. The pipe 23 extends to the four-way fitting 19 above described, and thus, when the thermally controlled valve in the device Q is open, there is a free communication, through pipes 21 and 23, between the back pressure chamber 15 of the valve V and the exhaust pipe 20.

Another pipe 24 also leads from the fitting Q to the control device X'. This control device X' (shown in detail in Fig. 3) includes an actuating motor, here shown by way of example as a pop safety valve, though it is contemplated that other types of pressure-actuated motor may be employed. The control device has a casing provided with an attaching flange 27 designed to be secured to a flange 26 (Fig. 1) forming a part of a fitting upon the shell of the generator drum G. From this flange 27 rises a tubular stem

member 28, here shown as internally screw threaded for the reception of a valve seat bushing 29 which may, for example, be of the kind described in the patent to Graesser et al., No. 1,668,453, dated May 1, 1928. This bushing is of the distortion-compensating type and has a valve seat 30 at its upper end which is surrounded by an adjustable blowdown ring 31. A valve feather 32 cooperates with the seat 30 and normally closes a passage 33 leading up through the stem portion 28 of the casing, the feather preferably having guide fins of usual type which slide in the passage 33. The valve feather 32 is also provided with a guide skirt 35 which slides in a cylindrical guide 36 projecting down into the outlet or exhaust chamber 34, the valve feather being normally held to its seat by a stem 37 which is loaded by means of a spring 38. Since this valve is mounted in a comparatively cool location it may be spring-loaded without danger that the spring will lose its temper due to exposure to too high temperature. Moreover, since this valve is not called upon to discharge any substantial amount of pressure fluid when it opens, it may be made of small dimensions such that a very low blowdown may readily be obtained. When the valve feather 32 is unseated by pressure within the generator G, the pressure fluid escapes upwardly through the passage 33 between the guide fins of the valve feather and over the valve seat and up over the edge of the blowdown ring 31.

At one side of the casing of the main valve is a bracket 39^a which supports a housing 47^a within which is a guide 48^a for the stem 49^a of a valve 50^a which normally seats against a valve seat 51^a,—the valve being held to its seat by pressure against its under surface. A space 52^a within the housing 47^a, and surrounding the guide 48^a, communicates by means of a passage 53^a with a space 54^a just above the valve seat 51^a, and the space 52^a communicates with the pipe 24, while the space below the valve feather 50^a communicates with the pipe 25.

The upper end of the valve stem 49^a is provided with a head 56 which is disposed with some freedom of movement between two spaced members 57 and 58 of an actuator 59 having a stem 60 which slides in a guide member 61 carried by the part 47^a and which is furnished with an adjustable stop 62 for limiting the upward movement of the actuator 59. The member 59 is furnished with a bracket 63 having a support for a ball member *b* upon which rests one end 64 of one arm of a lever which is fulcrumed at 65 upon a bracket carried by the member 39^a and whose other arm 66 is forked to straddle the stem 37 and which rests upon a pin 67 projecting from opposite sides of the stem 37.

It is to be understood that the control apparatus hereinabove described is desirably adjunctive to relief valves of usual type mounted upon the generator and superheater respectively, one such usual relief valve on the generator being indicated at T.

In the operation of the apparatus and assuming that the generator G is a steam boiler and that the superheater S is designed for raising the temperature of the steam delivered from the generator, and assuming that the motor device X has been set to act at a pressure very slightly above the working pressure, but below that at which the ordinary relief valve T will blow, and further assuming that the thermal controlled valve Q is so set as to open in response to a temperature of the fluid discharging from the superheater somewhat higher than the normal working temperature of such fluid, and further assuming that the engine or turbine is taking steam at the ordinary working rate, the parts will remain in the positions illustrated so long as these conditions subsist. If, however, by reason of some emergency or otherwise, the throttle of the engine or turbine be suddenly closed, there would normally result a very sudden increase or surge in pressure in the generator and the passages leading from the generator to the throttle. Ordinarily if the present apparatus were not employed, this sudden increase in pressure would cause one of the usual relief valves T on the generator to blow, although the temperature of the superheated steam in the fitting 3 might not yet have increased sufficiently to cause the thermal control valve Q to act. Thus although steam might freely blow off from the generator there would be no flow through the superheater until the temperature in the latter had arisen to so substantial a degree as to cause the valve Q to operate. Eventually, the valve Q would open the relief valve V, in accordance with the method of operation described, for example, in the patent to Beck et al., No. 2,059,722, and thus a flow would be established through the superheater sufficient to prevent burning of the latter. However, if immediately after the opening of the relief valve V in response to temperature rise, the emergency requiring closing of the throttle should cease, and the throttle were again opened, the temperature in the fitting 3 might not drop instantaneously so as to cause closure of the valve V. In consequence, the valve V might continue to blow, even after the boiler pressure had dropped below the working pressure, even to such an extent that the engine or turbine would not receive steam at operating pressure. Under some circumstances this might be a very serious matter, for example on shipboard where perhaps, after a near collision and stopping of the engines, it might be imperative to resume full speed at once by reason of weather conditions, pilotage difficulties or the like.

By the use of the present apparatus these difficulties are avoided since, as soon as a pressure surge is created in the system, the motor device X', which is preferably set to act just above the working pressure, as above noted, will respond to slight increase in pressure in the generator,—the valve feather 32 lifting from its seat and thus pushing the stem 37 upwardly. The pin 67 projecting from the stem lifts the arm 66 of the actuating lever and the arm 64 is thus depressed and pushes the actuator member 59 downwardly, thus unseating the valve 50^a and providing free communication between the pipes 24 and 25 with the same result as when the valve 50 above described is unseated. As there is a slight clearance between the head 56 of the valve stem 49^a and the parts 56 and 58, it is possible for the valve feather 50^a to seat firmly in response to the pressure beneath it without the necessity of extreme accuracy in the fitting of the operating parts, and by the provision of the ball *b* between the lever 64 and the actuator member 63, the arcuate movement of the lever arm 64 does not tend to cause the actuator member 59 to bind in its bearings when the lever is actuated for opening the valve.

By the employment of the apparatus above described, the system is effectively safeguarded against over pressure or against burning of the

superheater tubes, while at the same time the blowdown is kept at a minimum and undue discharge of high temperature pressure fluid is avoided. At the same time the operation of the relief valve is controlled without resort to electrical devices and solely by the use of fluid pressure-actuated elements.

While certain desirable embodiments of the invention have been illustrated by way of example, it is to be understood that the invention is not necessarily limited to these precise embodiments, but is to be regarded as broadly inclusive of any and all equivalents and rearrangements of parts such as fall within the scope of the appended claims.

I claim:

1. Apparatus of the kind which includes a pressure generator which delivers pressure fluid to a superheater and wherein the superheater is provided with a pressure-loaded relief valve having a back pressure chamber and wherein the generator is provided with a pop safety valve including a movable valve feather, said valve having a low blowdown and designed to open at a predetermined pressure in excess of the working pressure in the generator, characterized in having a conduit leading from the back pressure chamber of the relief valve, an exhaust valve normally closing said conduit, and motion-transmitting means including a lever device, so constructed and arranged as to transmit motion from the valve feather of the pop safety valve, when the latter opens, to the exhaust valve thereby to open the latter.

2. Apparatus of the kind which includes a pressure generator which delivers pressure fluid to a superheater and wherein the superheater is provided with a pressure-loaded relief valve having a back pressure chamber and wherein the generator is provided with a pop safety valve having a low blowdown and designed to open at a predetermined pressure in excess of the working pressure in the generator, characterized in having an exhaust valve which normally closes an outlet conduit leading from the back pressure chamber of the relief valve to the vicinity of the generator safety valve, said exhaust valve being so constructed and arranged as normally to be held seated by the back pressure in said chamber, and means including lost motion connections responsive to the popping of the generator safety valve to initiate opening of the exhaust valve.

3. Apparatus of the kind which includes a pressure generator which delivers pressure fluid to a superheater and wherein the superheater is provided with a normally closed relief valve and wherein the generator is provided with a safety valve of small capacity and having a low blowdown and designed to open at a predetermined pressure in excess of the working pressure in the generator, characterized in having control means for the relief valve, said control means comprising mechanical connections constructed and arranged to receive movement from the movable element of the generator safety valve and thereby to initiate opening of the relief valve.

4. Apparatus of the kind which includes a pressure generator which delivers pressure fluid to a superheater and wherein the superheater is provided with a normally closed relief valve and wherein the generator is provided with a safety valve designed to open at a predetermined pressure in excess of the working pressure in the generator and in which the safety valve has a normally closed, movable valve feather, characterized in having valve control means, including an actuating lever designed and arranged to rock when the safety valve feather lifts from its seat in response to excessive generator pressure, said valve control means being constructed and arranged to respond to rocking of the lever thereby to initiate opening of the relief valve.

JAMES BRISCOE.