THERMAL EXCESS-PRESSURE DEVICE

Filed April 19, 1961

Fig. 1

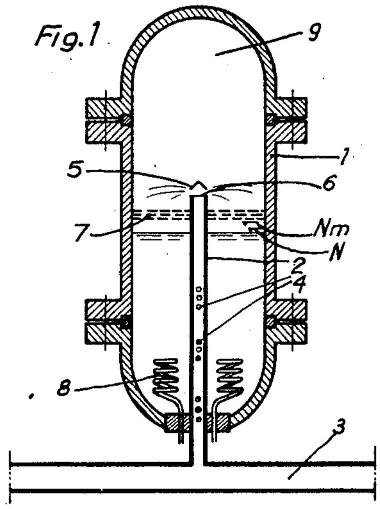
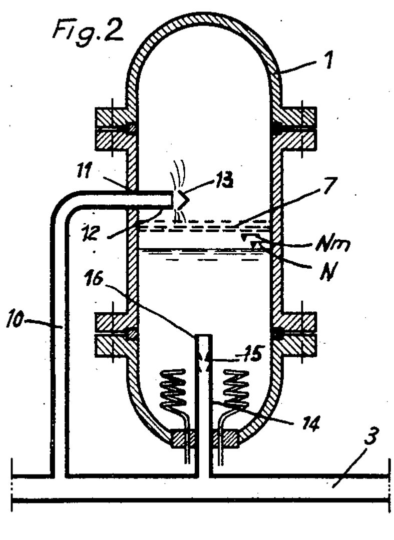


Fig. 2



INVENTORS
LOUIS BERTHOD
MICHEL GRENON
BY
Bacon & Thomas
ATTORNEYS

3,164,174

THERMAL EXCESS-PRESSURE DEVICE

Louis Berthod, 22 Rue du Commandant Bulle, Grenoble, France, and Michel Grenon, 6 Rue Saint Vincent de Paul, Paris, France

Filed Apr. 19, 1961, Ser. No. 104,074
Claims priority, application France Apr. 29, 1960
6 Claims. (Cl. 138—30)

Thermal excess-pressure devices are intended to maintain a definite pressure in hydraulic circuits, for example those of reactors, by reacting very rapidly to any possible variations in pressure due in particular to variations of volume in the said hydraulic circuits.

In general, they consist of a tank, capacle of withstanding the required pressure, connected to the hydraulic circuit to be regulated via a pipe opening out into the lower part thereof.

Inside the tank, and at the bottom, there are electrical resistances which have the object of keeping the liquid at the saturation temperature corresponding to the pressure encountered in use.

Excess-pressure devices are fed with liquid by the hydraulic circuit to be regulated, and in normal operation they contain a certain volume of liquid whereof the free surface is in contact with saturated vapour. A definite balance pressure prevails therein.

The principle on which these applicances operate is as follows:

When there is a decrease in the volume of liquid in the hydraulic circuit, due for example to a fall in temperature, the free surface in the excess-pressure device tends to fall, with a corresponding decrease in the pressure of the vapour, giving rise to evaporation which restores the balance pressure.

This evaporation of liquid is an almost instantaneous phenomenon, and under these conditions the pressure is automatically re-adjusted.

When the volume of liquid in the hydraulic circuit increases, for example because of an increase in temperature, the free surface in the excess-pressure device tends to rise, with a corresponding increase in the pressure of the vapour. In order to restore the initial pressure, some of the vapour must condense.

Nevertheless, if the liquid evaporates almost instantaneously, as has been seen, automatically readjusting the pressure, the same does not apply to the opposite case of condensation.

In fact, experience proves that condensation is not an instantaneous phenomenon, but that it takes place with a certain amount of delay.

It follows from this that, when the volume of liquid in the hydraulic circuit increases, momentary excess pressure may be set up in the appliance, and may reach a high value.

The conventional appliance, as described, therefore does not react rapidly enough to the possible variations in pressure, more particularly when the volume in its hydraulic circuit increases, and consequently does not give regulation with maximum effect.

The present invention relates to a thermal excess-pressure device which enables the foregoing disadvantages to be overcome by encouraging condensation of the vapour. It is known that the temperature of the liquid in the hydraulic circuit is lower than the temperature of the liquid in the excess-pressure device, since the liquid in the excess-pressure device is heated in order to keep it at the saturation temperature corresponding to the pressure encountered in use.

The present invention is essentially characterized in that, in order to encourage condensation of the vapour, the major part of the liquid flowing towards the excess-pressure device as a result of an appreciable increase in the volume in the hydraulic circuit to be regulated is introduced by special means in the immediate vicinity of the free surface of the liquid in the excess-pressure device, the said liquid, being colder than that in the excess-pressure device, expediting condensation of the vapour in the said appliance to a considerable extent, thus producing a rapid fall in the vapor pressure, and consequently rapid regulation of the pressure in the hydraulic circuit.

In a first form of embodiment, the introduction of liquid due to an increase in volume in the hydraulic circuit takes place largely via the upper end of a tube which opens out above the free surface in the excess-pressure device. This end is advantageously equipped with a jet-deflector in order to disperse the liquid over a large surface area, and grids may furthermore be disposed in the vicinity of the said end and of the free surface so as to encourage droplets and liquid films to be placed in suspension, thus expediting condensation. The said tube comprises lateral orifices of small cross-section distributed chiefly towards its base, for the purpose of discharging liquid from the excess-pressure device when there is a decrease in volume.

The cross-section, arrangement and shapes of the small lateral discharge orifices and of the upper end of the tube are so calculated that when some liquid enters the excess-pressure device most of it is introduced via the said upper end, only a small fraction passing through the lateral orifices.

In another form of embodiment, the introduction of liquid due to an increase in volume may take place to a large extent via a parallel path laterally connected to the excess-pressure device and opening out in the vicinity of the free surface.

This connection is tapped into the hydraulic circuit in the vicinity of the point at which the central tube serving for discharge purposes is tapped into the said circuit. This system must not be confused with the conventional full-flow inlet, which is either fed by an independent pump system or connected to the circuit at a point of maximum pressure, for example at the outlet of the circulation pumps.

The same devices comprising deflectors and grids as those mentioned above may be used. Water is discharged from the excess-pressure device when a reduction in volume occurs via the usual fairly short central connecting pipe, in which are disposed one or more diaphragms which are suitably calculated and oriented so as heavily to limit the rate of flow in the said pipe during the phase in which there is an increase in volume. These asymmetrical diaphragms may be replaced by valves.

Guide-vanes of honeycomb shape for example, may be disposed in the vicinity of the free surface and associated with the gridding in order to reduce movement and oscillation of the said free surface, with a view to preventing too rapid mixing of the cold liquid introduced in accordance with the invention with the liquid in the excess-pressure device, which would reduce its action on condensation of the vapour situated directly above, and with a view to increasing the exchange surfaces between water and steam.

This arrangement will be useful in particular in mobile installations, for example propulsive reactors.

When there is a small increase in volume in the hydraulic circuit, the liquid does not reach the end of the parallel tube according to the invention, but disperses in conventional fashion via the base of the central tube, so that the excess-pressure device then operates as an appliance of the usual type, that is to say with a certain amount of delay in pressure-balancing, which however does not cause any trouble since in this case the amount of excess pressure is always small.

Two non-limitative examples of use of the thermal excess-pressure device to which the invention relates will be described hereinafter with reference to the appended diagrammatic FIGURES 1 and 2. The arrangements for embodiment which will be described in connection with these examples must be considered as forming part of the invention.

FIGURE 1 illustrates a vertical section through a thermal excess-pressure device according to the invention, comprising a central water inlet;

FIGURE 2 illustrates a vertical section through a thermal excess-pressure device according to the invention, comprising a lateral water inlet.

Only the elements required for an understanding of the invention are illustrated in the figures, corresponding elements in these figures bearing identical reference numbers.

As may be seen, FIGURE 1 comprises the tank **1** of the excess-pressure device whereof the interior is connected via a central tube **2** to the circuit **3** to be regulated containing water.

The said tube **2** reaches above the maximum level N_m of water in the excess-pressure device, and comprises orifices **4** of small dimensions and a jet-deflector **5**. Between the upper end **6** of the tube **2** and the maximum level N_m of the liquid there are three grids **7**, consisting for example of interlaced metal wires.

Electrical resistances **8** situated at the bottom of the tank **1** have the object of keeping the water at the saturation temperature corresponding to the pressure encountered in use.

In normal operation, the excess-pressure device contains a certain volume of water whereof the free surface N is in contact with saturated steam **9**.

When the volume of water in the hydraulic circuit **3** decreases, water from the excess-pressure device is discharged via the orifices **4**, and the level N falls, resulting in conventional fashion in instantaneous evaporation of the water, with immediate restoration of the balance pressure. This evaporation requires calories, and so the initial balance temperature is maintained in accordance with the conventional procedure by heat contributed by the electrical resistance **8**.

When the volume of water in the hydraulic circuit **3** increases by a considerable amount, most of the cold water originating from the said hydraulic circuit is conveyed directly to the top **6** of the tube **2**, only a very small fraction being dispersed via the small orifices **4**, whereof the cross-sections are calculated to suit.

The jet of water which forms at the top **6** is dispersed over a large surface area by the deflector **5**. This system is made still more effective by three grids **7** which keep water droplets in suspension, appreciably increasing the water-steam exchange surface and producing condensation nuclei.

These arrangements result in rapid condensation of the water-vapour **9**, with rapid establishment of pressure-balance.

When there is a small increase in volume in the hydraulic circuit, in which the excess pressure can only reach a small amount, the water does not reach the upper end **6** of the tube **2**, but disperses directly into the liquid in the excess-pressure device via the small orifices **4**, so that in this case the excess-pressure device operates like a conventional appliance.

FIGURE 2 shows a second form of embodiment of a thermal excess-pressure device according to the invention.

In this variant, the introduction of cold water due to an increase in volume takes place not via a central tube, but via a parallel path **10** laterally connected to the tank **1** of the excess-pressure device at **11**, and opening out at **12** above the maximum level N_m in the excess-pressure device. This tube **10** is equipped with a deflector **13** at the end. This form of embodiment also comprises grids **7** disposed at the end **12** and enabling droplets to be held in suspension, thus encouraging condensation.

As in the form of embodiment in FIGURE 1, these arrangements enable cold water to be conveyed directly to the vicinity of the free surface, expediting the condensation of water-vapour in the excess-pressure device, and consequently expediting the pressure-balance.

When there is a decrease in volume, water is discharged from the excess-pressure device via the usual short connecting tube **14** in which, however, there are two diaphragms **15**, suitably calculated and oriented so as to limit the rate of flow through the said tube during the phase in which there is an increase in volume.

When there is a small increase in volume in the hydraulic circuit, in which there is no fear of any excess pressure, the water does not reach the upper end **12** of the tube **10**, but enters in conventional fashion via the end **16** of the tube **14**, so that in this case the excess-pressure device operates like an appliance of the usual type.

The thermal excess-pressure device equipped with the improvements according to the invention confers rapid-response pressure regulation which is equally effective as regards both excess pressure and a drop in pressure.

In order to prevent the occurrence of thermal shocks due to relatively cold water coming into contact with the metal walls of the tank, a heat-screen may advantageously be placed in front of the said walls.

The invention is naturally not limited to the forms of embodiment illustrated and described, but covers all variants, in particular the case in which the excess-pressure devices take the form of cylinders having horizontal axes.

What is claimed is:

1. A thermal excess-pressure device comprising: means defining a closed chamber; conduit means for introducing water into said chamber and for draining water from said chamber; said conduit means including at least one tube extending into said chamber and having a nozzle portion in the upper region of said chamber, and drain means communicating with the lower portion of said chamber; means connecting said conduit means to a hydraulic circuit; and heater means in the lower portion of said chamber for heating water therein and maintaining a body of saturated steam in the upper portion thereof; said conduit means defining flow paths from said hydraulic circuit into said upper region and said lower portion of said chamber, respectively, the flow path leading to said lower portion being of such restricted area relative to that leading to said upper region that the major portion of incoming water is dispensed in the upper portion thereof, above the highest level of the free surface of liquid in said chamber, through said nozzle to rapidly condense steam therein.

2. A device as defined in claim 1 including deflector means in said chamber, adjacent said nozzle, arranged to disperse water emerging from said nozzle over a relatively wide area in said chamber.

3. A device as defined in claim 1 including a grid ex-

tending across said chamber between said nozzle and said lower portion.

4. A device as defined in claim 1 wherein said conduit means comprises a single tube extending upwardly through the bottom of said chamber and having said nozzle at its upper end; said drain means comprising small orifices through the wall of said tube adjacent the bottom of said chamber.

5. A device as defined in claim 1 wherein said conduit means comprises a first tube having said nozzle at the end thereof and a second tube extending upwardly through the bottom of said chamber and having an open end in the lower portion thereof.

6. A device as defined in claim 5 including at least one diaphragm in said second tube arranged to restrict flow of water therethrough toward the interior of said chamber.

References Cited in the file of this patent

UNITED STATES PATENTS

1,177,288	Teller	Mar. 28, 1916
2,051,657	Stiebel	Aug. 18, 1936
2,191,490	Mitterer	Feb. 27, 1940
2,561,528	Meyers	July 24, 1951
2,574,587	Pornes et al.	Nov. 13, 1951
3,095,012	McShane	June 25, 1963