April 17, 1956

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2,742,179

THERMAL SAFETY PLUG

Filed Jan. 21, 1955

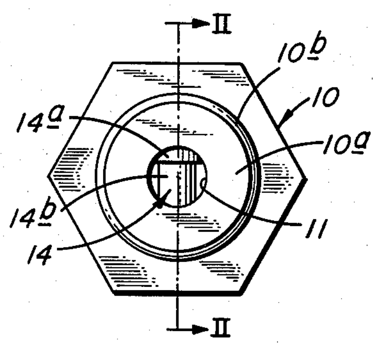

FIG. 1

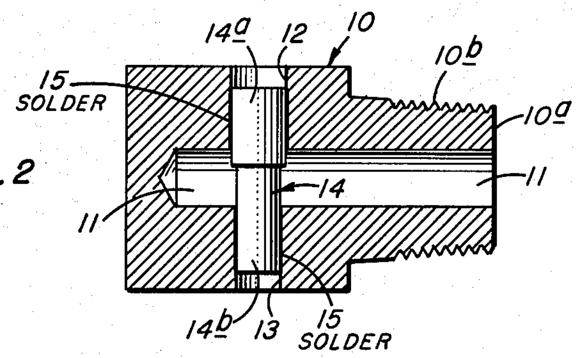

FIG. 2

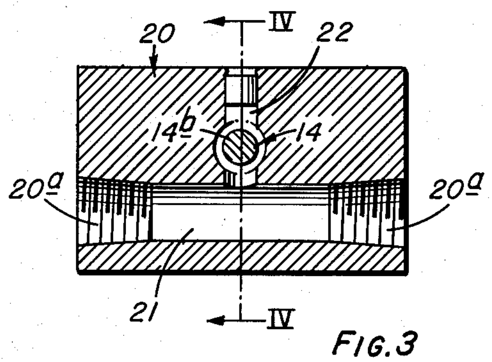

FIG. 3

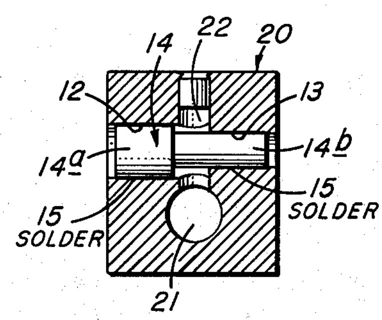

FIG. 4

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2,742,179

Patented Apr. 17, 1956

2,742,179

THERMAL SAFETY PLUG

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Application January 21, 1955, Serial No. 483,301

1 Claim. (Cl. 220—89)

This invention relates to safety plugs that blow out in response to a rise in temperature above a predetermined value to relieve pressure in a system and prevent damage thereto. The invention is particularly useful in, although not limited to, hydraulic power systems to unload the pump if the temperature of the fluid rises to a value such that continued operation under pressure might damage the pump.

An object of the invention is to provide a simple and reliable thermal safety plug that is relatively insensitive to pressure while at the same time providing a large passage for escape of fluid when it opens.

Other more specific objects and features of the invention will appear from the description to follow.

It is old to provide in pressure systems a vent hole normally closed by a loosely fitting plug soldered in place with a low-melting solder that melts in response to a dangerous rise in temperature to permit release of the plug in response to pressure thereon and vent fluid to reduce the pressure. In many instances, the vent hole must be quite large to handle the full fluid flow of the system and reduce the pressure to a safe value. The pressure force acting on the plug is proportionate to its area, and in a high pressure system this pressure force on a large plug may be so great that the solder fails below the desired temperature because of deterioration of the strength in response to aging and/or softening at a temperature below the fusing temperature.

This problem is solved in accordance with the present invention by providing two diametrically opposite vent holes of different diameters closed by a single plug having end portions of different diameters slidably fitting in the respective vent holes and soldered in place with a solder having the desired fusing temperature. With this construction, the total resultant pressure force tending to eject the plug is proportional to the differential area of the two end portions. Therefore, the vent holes can be made as large as necessary to handle the flow, while at the same time the blowout force can be made as small as desired by choosing the relative diameters of the two holes such as to yield a desired differential area.

A full understanding of the invention may be had from the following detailed description with reference to the drawing, in which:

Fig. 1 is an end view of one embodiment of the invention.

Fig. 2 is a longitudinal section taken in the plane II—II of Fig. 1.

Fig. 3 is a view similar to Fig. 2, but showing the invention incorporated in a through-flow fitting.

Fig. 4 is a sectional view taken in the plane IV—IV of Fig. 3.

Referring to Figs. 1 and 2, in the form there shown, the invention comprises a body member 10 defining a fluid chamber 11 which is adapted to be connected to the fluid circuit of a pressure fluid device to be protected. Thus, the chamber 11 extends through one end 10*a* of the body member, and the adjacent end portion 10*b* is threaded for

screw connection to the device to be protected. The main portion of the body member 10 may be of hexagonal external shape, as shown in Fig. 1, for application of a wrench. The construction disclosed provides both fluid connection between the chamber 11 and the pressure fluid circuit of the device to be protected, and thermal connection to insure that the body member 10 will follow the temperature of the device.

The body 10 is provided with two coaxial vent holes or passages 12 and 13, respectively, which are of different diameters and extend in opposite directions from the chamber 11 to the exterior of the body. These vent holes 12 and 13 are normally closed by a single plug 14 having a large cylindrical end 14*a* loosely fitting the passage 12 and a small cylindrical end 14*b* loosely fitting the passage 13. Each of the end portions 14*a* and 14*b* is secured in sealing relation with its associated passage 12 and 13 by a film of solder 15 filling the clearance space.

Pressure fluid in the chamber 11 exerts a pressure force on the plug 14 acting in upward direction (with reference to Fig. 2 of the drawing) and with force that is proportional to the pressure and the differential area of the two end portions 14*a* and 14*b* of the plug. This differential area can be made as small as desired by varying the relative diameters of the end portions 14*a* and 14*b* of the plug and their associated passages 12 and 13. In other words, the pressure force tending to eject the plug is not determined by the absolute area of the vent passages 12 and 13, and they can be made as large as desired to provide the desired free flow of fluid therethrough.

The differential area between the plug ends 14*a* and 14*b* is so chosen, relative to the pressure that is normally existent in the chamber 11, as to produce a resultant pressure force on the plug 14 that is ample to eject the plug when the solder 15 has melted in response to a dangerous rise in temperature, but insufficient to eject the plug prior to melting of the solder.

In practice, in a fitting as shown in Figs 1 and 2 in which the threaded portion 10*b* is of ⅛" pipe size, the large end portion 14*a* may have a diameter lying within the limits .131" and .132", and the diameter of the passage 12 may lie within the limits .133" and .134", thereby providing a minimum clearance of .001" and a maximum clearance of .003" to be filled with the solder 15. If this fitting is designed for a working pressure of 2000 p. s. i., the diameter of the small end portion 14*b* of the plug may be between the limits .113" and .114", and the diameter of the passage 13 held within the limits .115" and .116", thereby giving the same range of clearance to be filled with the solder as in the case of the large end of the plug. A perfectly free fit, when the solder has fused, is desirable to insure ejection of the plug in response to the pressure force resulting from the differential area between the two end portions. On the other hand, it is undesirable to have an excessive clearance to be filled by a large quantity of solder.

In manufacture, the surfaces of the passages 12 and 13 in the body member and the surfaces of the plug 14 are tinned with the solder prior to assembly. Then the plug is inserted in the body member and the assembly heated above the melting point of the solder to cause it to melt and flow between the plug and the passage surfaces by capillary attraction. While the assembly is heated, any necessary additional solder can be added at the outer ends of the plug to completely fill the clearance.

Solders of different compositions, having different fusing points, are well known, and a suitable composition is chosen according to the maximum temperature at which it is desired to have the plug blow out. In some hydraulic applications, it is desirable to have the plug respond to any temperature in excess of about 280° F., and a suitable solder composition for this temperature consists of:

	Percent
Tin	45
Lead	32
Cadmium	18
Bismuth	5

In the form of construction shown in Figs. 1 and 2, in which the chamber **11** is closed at one end, there would be little circulation of fluid between the chamber and the device to which it is connected, and thermal conduction is chiefly through the threaded connection between the safety plug and the device on which it is mounted. In some instances, the body **10** may be located within a pump housing or immersed in fluid in a sump or reservoir of a hydraulic system so that it is contacted externally by the fluid the temperature of which it is to be responsive to.

There is shown in Fig. 3 a different type of fitting which may be inserted in series in the fluid circuit of the device to be protected. In this instance, the body **20** is in the form of a coupling having internal threads **20***a* at opposite ends for connection into a pipe line, so that the fluid flows through the passage **21**, and the temperature of the body **20** is determined by the transfer of heat thereto from the fluid. The plug **14** can be extended through the passage **21** if the fluid velocity is low, but it is preferable to extend it through a lateral recess **22** which is in

communication with the passage **21**, thereby leaving the latter unobstructed. A high velocity flow past the plug **14** could apply a side thrust to it that would prevent its ejection when the solder melted.

Although for the purpose of explaining the invention a particular embodiment thereof has been shown and described, obvious modifications will occur to a person skilled in the art, and I do not desire to be limited to the exact details shown and described.

I claim:

A thermal safety plug comprising: a body member defining a chamber adapted to be connected to a pressure fluid device to be protected and having a pair of coaxial cylindrical vent passages of different diameters extending in opposite directions from said chamber through said body member; a plug member extending through said chamber and having opposite cylindrical end portions extending into said respective vent passages, each said end portion being of slightly smaller diameter than its associated vent passage, whereby it has a free sliding fit therein; and an annular body of solder of predetermined melting point lower than those of said body and plug members filling the clearance space between each end portion of said plug member and its associated body passage.

No references cited.