April 30, 1963 H. P. NEHER, JR., ET AL 3,087,676

FLUID CONTROL APPARATUS

Filed Dec. 29, 1960

FIG-1

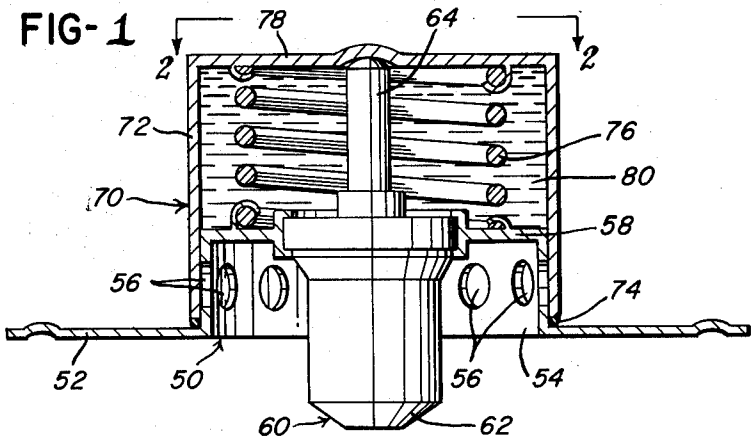


FIG-2

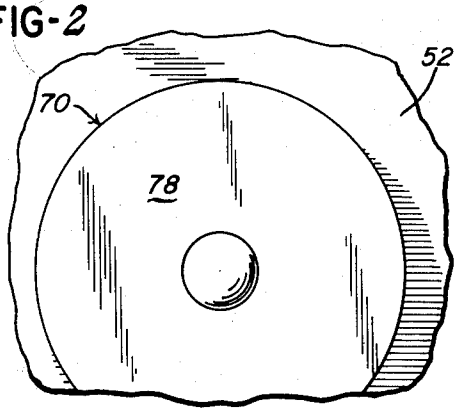


FIG-3

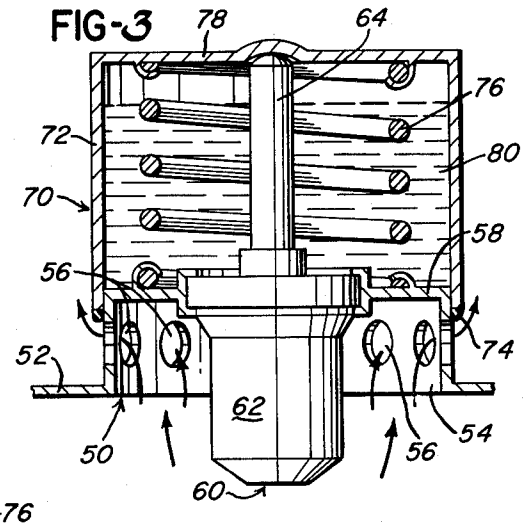


FIG-4

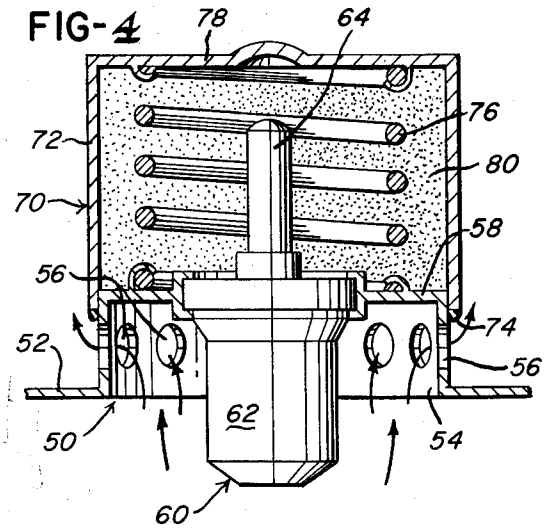
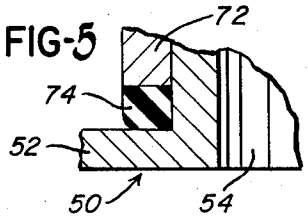


FIG-5



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FLUID CONTROL APPARATUS

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This invention relates to fluid control apparatus. The invention relates more particularly to valve mechanism for fluid control. The invention relates still more particularly to thermal responsive valve mechanism.

An object of this invention is to provide valve apparatus which is capable of controlling fluids having high pressures.

Another object of this invention is to provide such fluid control apparatus, the operation of which is not affected by high fluid pressures.

Another object of this invention is to provide thermal responsive fluid control apparatus which is capable of "failing safe."

Another object of this invention is to provide such fluid control apparatus which is capable of rapid response to temperature changes.

Another object of this invention is to provide such fluid control apparatus which is durable, long lived, and which may be produced at relatively low costs.

Other objects and advantages reside in the construction of parts, the combination thereof, the method of manufacture, and the mode of operation, as will become more apparent from the following description.

In the drawings:

FIGURE 1 is a sectional view of a modification of fluid control apparatus of this invention showing elements thereof in a valve closed position.

FIGURE 2 is a view taken substantially on line 2—2 of FIGURE 1.

FIGURE 3 is a sectional view similar to FIGURE 1 but showing elements of the apparatus in a valve open position.

FIGURE 4 is a sectional view similar to FIGURES 1 and 3 but showing elements of the apparatus in a valve open position under another condition of operation.

FIGURE 5 is a fragmentary sectional view of a portion of the apparatus of FIGURES 1, 3, and 4.

Referring to the drawings in detail, fluid control apparatus of this invention is shown adapted for use in a cooling system such as the cooling system of an internal combustion engine.

FIGURES 1–4 show apparatus of this invention constructed in a manner to provide "fail safe" features as well as features for operation without affect by fluid system pressures.

An inner housing or casing **50** has a flange **52**. The inner housing **50** also has a side wall **54** provided with ports **56** therethrough. The inner housing **50** also has an end wall **58** to which is sealingly secured an actuator device **60** having a container **62** and an actuator rod **64**. The container **62** has thermally responsive force transmission material therewithin which may be of any suitable type. The container **62** and the thermally responsive material therewithin may be similar to that disclosed in Patent No. 2,806,375. However, the autuator **62** may be any other suitable thermal responsive actuator device. As stated in Patent No. 2,806,375 the container **62** preferably has therewithin a material which includes an element or any combination of elements giving the material physical property characteristics of a high rate of expansion over a given temperature range.

Slidably encompassing the inner housing **50** is an outer housing **70** which has a side wall **72** adapted to close the

ports **56** of the inner housing **50**. The lower edge of the side wall **72** is shown as being provided with an annular elastomeric sealing member **74** which is engageable with the flange **52** of the housing **50** to aid in preventing flow of fluid between the side wall **72** and the flange **52**.

A tension spring **76** is attached to an end wall **78** of the outer housing **70** and to the end wall **58** of the inner housing **50**. Thus, the housings **50** and **70** are resiliently urged one toward the other. The actuator rod **64** abuts the lower surface of the end wall **78** of the housing **70** for urging the housing **70** in a direction from the housing **50**.

The housing **70** is moved away from the housing **50** by the actautor rod **64** as fluid temperatures contacting the container **62** of the actuator **60** reach a given value. Thus, the ports **56** are uncovered, permitting flow of fluid therethrough as illustrated by arrows in FIGURE 3.

The end wall **78** of the housing **70** is closed, as shown in FIGURE 2 so that the housings **50** and **70** form a chamber **80** therebetween. As shown in FIGURES 1, 3, and 4, the chamber **80** contains a fluid. This fluid within the chamber **80** may be the same type of fluid which is controlled by the apparatus. In fact, in some devices, fluid of the cooling system is permitted to leak into the chamber **80** by flowing intermediate the side walls **54** and **72**. In other devices fluid or any other suitable thermal expansible material such as wax or the like is placed, as a charge, within the chamber **80**.

When the actuator **60** is functioning properly to open the ports **56** when the container **62** is subjected to increased temperatures, as shown in FIGURE 3, fluid within the chamber **80** has no effect upon operation of the apparatus. However, the fluid within the chamber **80** is heated by thermal transfer through the end wall **58** of the housing **50**. If the thermal responsive actuator **60** should fail to operate at a predetermined temperature to thrust the actuator rod **64** from the container **62**, the fluid or material within the chamber **80** is heated above the predetermined temperature and causes such expansive forces that the housing **70** is forced in a direction from the housing **50**, as shown in FIGURE 4.

In FIGURE 4 the fluid within the chamber **80** is shown as being vaporized and producing pressure which forces the housing members **70** and **50** one from the other against the resiliency of the spring **76**. In this manner the ports **56** are uncovered so that fluid is permitted to flow therethrough, as shown by arrows in FIGURE 4.

Therefore, it is understood that the fluid control apparatus "fails safe" due to the fact that if the thermal responsive actuator should fail to function properly the apparatus operates to permit fluid flow when high temperatures exist in the cooling system. Also, as discussed above, the apparatus functions readily under high pressure conditions and without being affected in operation by high pressure conditions.

Although the preferred embodiment of the device has been described, it will be understood that within the purview of this invention various changes may be made in the form, details, proportion and arrangement of parts, the combination thereof and mode of operation, which generally stated consist in a device capable of carrying out the objects set forth, as disclosed and defined in the appended claims.

Having thus described our invention, we claim:

1. Fluid control mechanism comprising a first cup shaped enclosure member, the first enclosure member having a side wall provided with an opening therethrough, a second cup shaped enclosure member, the second cup shaped enclosure member having a side wall closely slidably fitting over the side wall of the first enclosure member for closing the opening therethrough, each of the enclosure members having an end wall portion, pressure

insensitive thermal responsive means carried by the end wall portion of the first enclosure member, the thermal responsive means having a portion thereof in engagement with the end wall portion of the second enclosure member for urging the enclosure members one from the other, resilient means engaging the enclosure members and urging movement thereof one toward the other, there being a fluid tight chamber formed between the enclosure members for containing fluid which upon expansion thereof urges the enclosure members in a direction one from the other.

2. Fluid control apparatus comprising an inner tubular member and an outer tubular member, the inner tubular member being provided with an opening forming a fluid port, the tubular members being telescopically connected one to the other, each of the telescopic members having an end wall so that a fluid tight chamber which is adjustable in volume is formed by the telescopic members, thermal expansible material within the chamber and expansible to force the tubular members in a direction one from the other, and resilient means urging movement of the tubular members one toward the other.

3. Fluid control apparatus comprising an inner tubular member and an outer tubular member, the tubular members being telescopically connected one to the other, each of the telescopic members having an end wall so that a fluid tight chamber which is adjustable in volume is formed by the telescopic members, resilient means in engagement with the tubular members and urging relative movement therebetween, the chamber being adapted to contain fluid which is expansible to force the tubular members one from the other, and the inner tubular member having a side wall provided with an opening therethrough which is coverable by the outer tubular member, relative reciprocal movement of the tubular members causing opening and closing of the opening of the side wall of the inner tubular member.

4. Fluid control apparatus including a first annular valve member and a second annular valve member, the annular valve members being telescopically connected one to the other, the inner valve member having a fluid port therethrough which is closeable by positioning the other valve member over the fluid port, resilient means engaging the valve members urging movement thereof one toward the other to close the fluid port, each of the valve members having an enclosing wall portion so that an enclosed fluid tight chamber which is adjustable in volume is formed by the valve members, thermal responsive expansible-contractible material within the chamber and adapted to cause expansion of the chamber and cause movement of the valve members one from the other to open the fluid port.

5. Valve mechanism comprising a first housing, the first housing having a side wall provided with a fluid port therethrough, a second housing, the second housing having a side wall closely encompassing the side wall of the first housing and positionable to close the fluid port, each of the housing members having an end closure portion so that a fluid tight chamber which is adjustable in volume is formed by the housing members, thermally expansive means within the chamber causing opposed forces upon the closure portions to cause relative movement of the housing members one from the other when the thermally expansive means is heated to a given temperature value, and resilient means engaging the housing members urging relative movement one toward the other.

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