April 27, 1965 R. L. NEUHAUSER 3,180,325

THERMALLY RESPONSIVE CLUTCH ASSEMBLY

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FIG. I

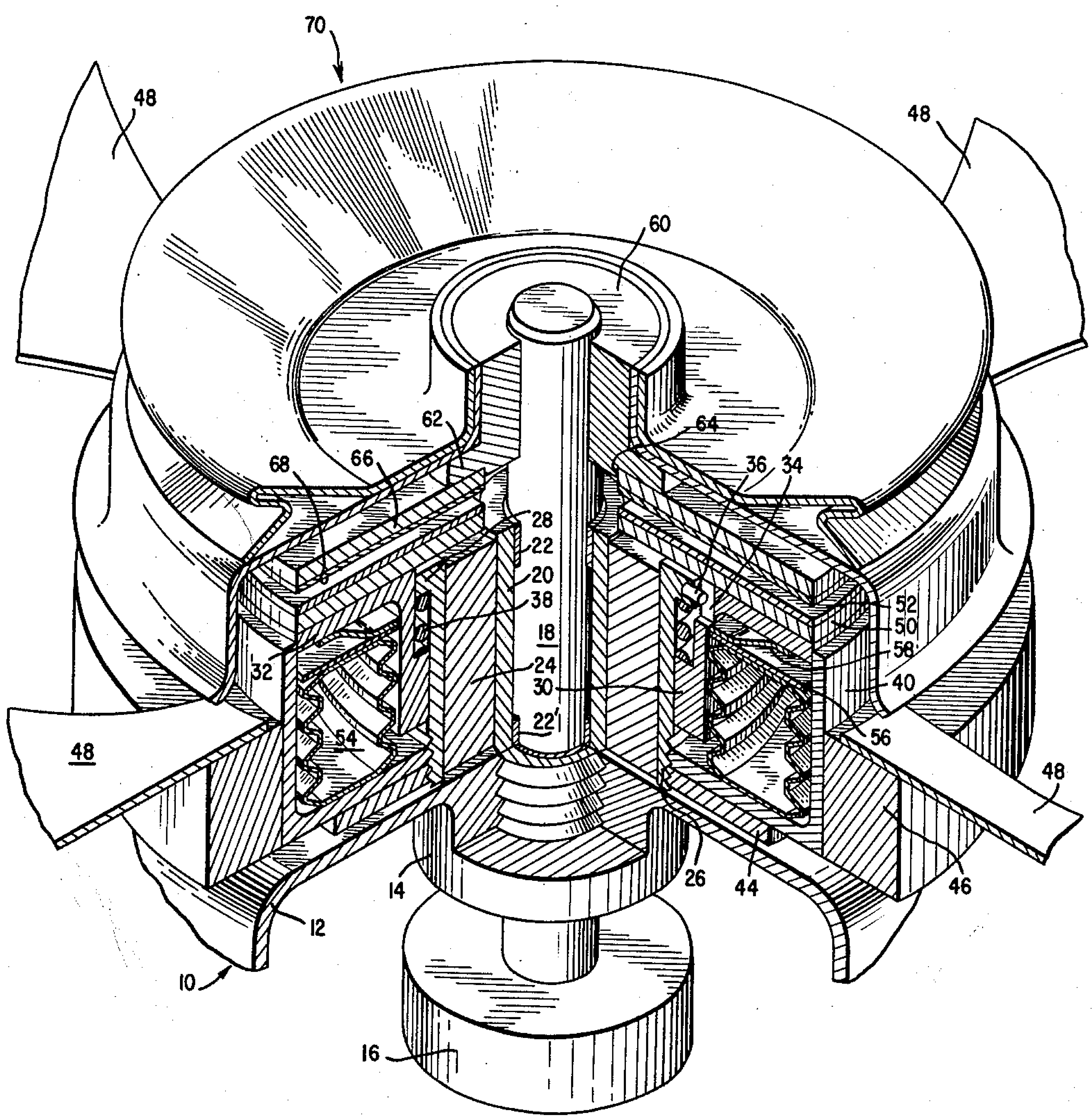

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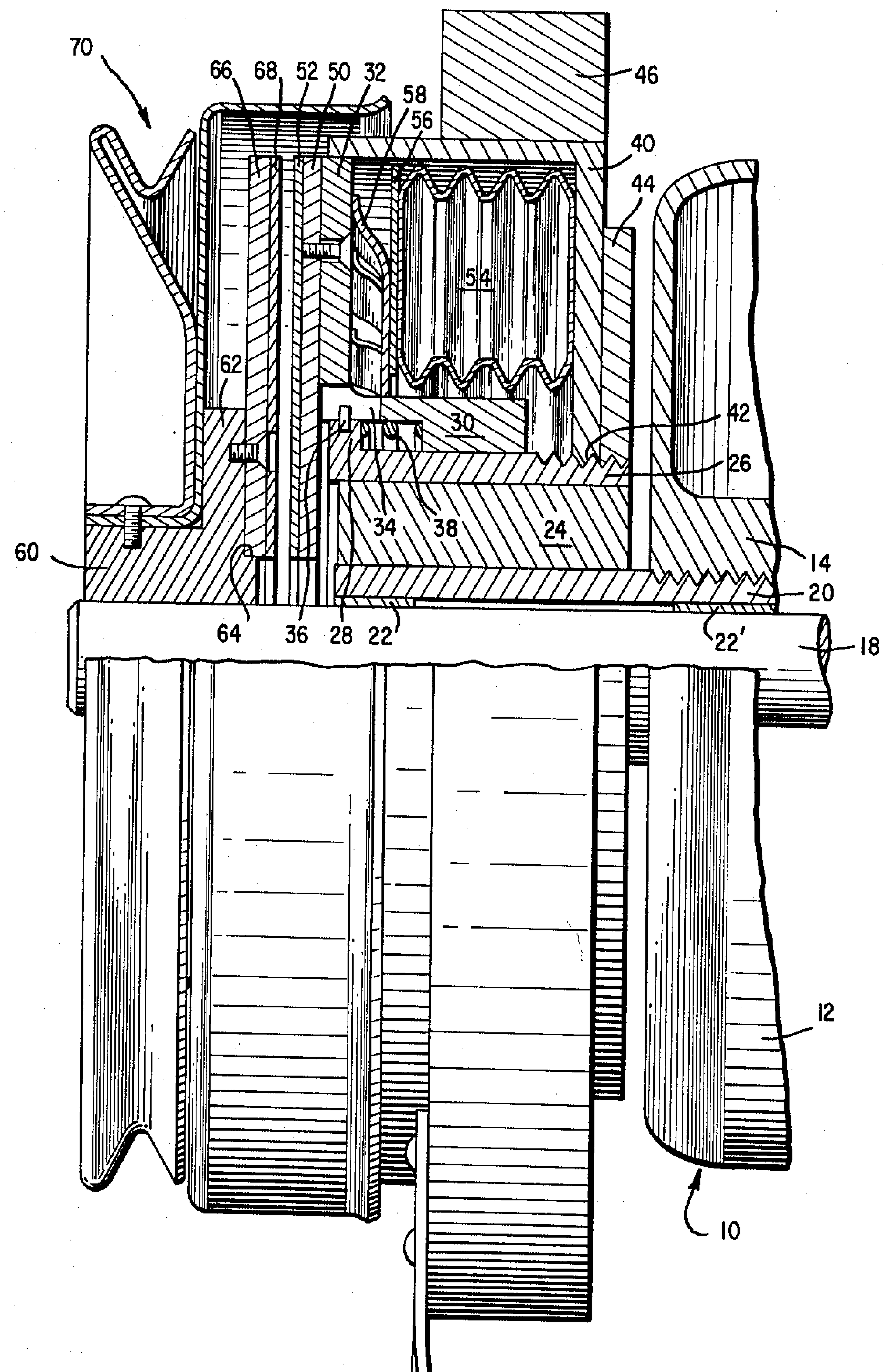
FIG. 2



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THERMALLY RESPONSIVE CLUTCH ASSEMBLY

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The present invention relates to an improved temperature controlled clutch means and, more specifically, to such means for controlling rotation of a fan for the cooling system of an internal combustion engine or the like in response to the temperature of the cooling fluid thereof.

In the operation of an internal combustion engine it is desirable under certain circumstances that the fan means for effecting the cooling of the engine be rendered inoperative. For example, in starting an internal combustion engine in cold weather it is desirable that the fan be disengaged so that its cooling action will not prevent the engine from quickly reaching its most efficient operating temperature. The engine with the fan means disengaged will thus more quickly reach its operating temperature after which it may be desirable to effect operation of the fan to cause a stream of cooling air to flow through a radiator or the like through which the cooling fluid from the engine is caused to be circulated to maintain a predetermined operating temperature or as close thereto as other factors permit for most efficient operation of the engine.

It is further desirable that when an internal combustion engine does not require the fan means for cooling there would be no cold air stream to interrupt the uniform heat rise of manifolds and carburetion parts.

It is further desirable to provide a cooling system in which an internal combustion engine or the like does not require the fan means for effecting cooling of the cooling fluid, which may happen during air impact, cool surrounding temperature or the like, excess horsepower will not be utilized needlessly.

It is an object of my invention therefore to provide means for controlling operation of a fan of an internal combustion engine or the like in response to the temperature of the cooling medium thereof.

A further object of my invention is to provide a driving means, a driven means carrying a fan for cooling the fluid in a circulatory system for an internal combustion engine or the like, and a means responsive to the temperature of the fluid in the circulatory system for actuating a clutch disposed between the driving and driven means to cause rotation of the fan at a predetermined temperature of the fluid in the circulatory system.

Other objects and advantages of the invention will be appreciated from the following detailed description of a preferred embodiment of the invention considered in connection with the attached drawings in which:

FIG. 1 is a perspective view of the invention with a portion removed to clearly illustrate the internal components thereof; and

FIG. 2 is a fragmentary side elevational view of the structure illustrated in FIG. 1.

Referring to the drawings, there is shown a water pump assembly, generally indicated by reference numeral 10, for an internal combustion engine. The water pump assembly 10 includes a housing 12 having an inwardly extending, internally threaded base 14 and an impeller 16 which is shown rather diagrammatically. The impeller 16 is suitably mounted on an impeller shaft 18 which is adapted to extend through and journalled within the boss 14 of the housing 12. A tubular or cylindrical bushing or bearing housing 20 having the external threads formed on one terminal end thereof is threadably engaged within

the threaded portion of the boss 14 of the water pump housing 12. A pair of spaced bushing elements 22 and 22' are force fitted within the interior of the bearing housing 20 and are adapted to journal the impeller shaft 18.

Any axial movement of the impeller shaft 18 is restrained by the use of means such as snap rings or the like which are normally employed with the impeller shafts in water pump housings and are not shown in the drawings for the purpose of simplicity.

The portion of the bearing housing 20 which extends outwardly from the housing 12 is adapted to receive a bearing element 24 which may be any suitable type of bearing such as, for example, a ball or thrust bearing which is suitably restrained from avial movement. On the outer surface of the bearing 24, there is force-fitted a tubular member 26 having a radially extending flange 28 formed at one end thereof while the external surface of the opposite end portion is suitably threaded.

An annular sliding member 30 is disposed so that one end will slide on the outer surface of the tubular member 26; while the opposite end is provided with a radially outwardly extending annular flange 32. The internal portion of the end of the sliding member 30 adjacent the radial flange 32 is counterbored to a diameter sufficient to present a sliding fit with the radially outer surface of the flange 28 of the tubular member 26.

Also, it will be noted that a slot 34 is formed in the sliding member 30 which extends inwardly from the flange 32. The slot is adapted to receive a detent pin 36 which is integral with and extends from the radially outer surface of the flange 28 of the tubular member 26.

It will be appreciated that the tubular member 26 is free to rotate on the bearing 24 which in turn is fitted on the bearing housing 20. The sliding member 30 is then adapted to slide axially on the tubular member 26 within the limits defined by the cooperating slot 34 and the detent 36. The cooperation between the slot 34 and the detent 36 prevents any relative rotation movement between the tubular member 26 and the sliding member 30. Although only a single pair of cooperating slot 34 and detent 36 is illustrated, it may be found advantageous to use more than one.

The internal portion of the end of the sliding member 30 adjacent the radial flange 32 which is counterbored defines, in cooperation with the outer surface of the tubular member 25 adjacent the flange 28, a chamber adapted to receive a compression spring 38 which exerts a force tending to move the sliding member 30 toward the threaded end of the tubular member 26.

A cup-shaped housing 40 having a threaded aperture 42 formed in the center of the base thereof is screwed on to the threaded end of the tubular member 26 and is properly locked or secured in place by a lock nut 44. The cylindrical section of the cup-shaped housing 40 is so dimensional that its inner surface will permit the passage of the flange 32 of the sliding member 30 to pass therethrough without interference, but which nevertheless militates against the entrance of foreign matter and allows the entry and exit of air as the sliding member 30 is caused to move back and forth.

The outer surface of the cylindrical portion of the cup-shaped housing 40 is adapted to receive a blade ring 46 which is attached rigidly thereto. On the forward surface of the blade ring 26, fan blades 48 are securely attached. The fan blades 48 are of the type that are commonly employed as automobile cooling fan blades.

On the axially outer face of the flange 32 of the sliding member 30, there is a clutch plate 50 which is typically faced with a clutch facing 52. The clutch plate 50 is circular in shape and is substantially coextensive with the flange 32. The diameter of the clutch plate 50 obviously should not exceed the diameter of the flange 32 to assure free motion of the sliding member 30 so that there is no interference between the radially outer surface of the clutch plate 50 and the inner surface of the cup-shaped housing 40.

Between the axially inward surface of the flange 32 of the sliding member 30 and inner surface of the base of the cup-shaped housing is located an annularly shaped bellows 54. One surface of the bellows 54 is in intimate contact with an annular pressure plate 56 which is spaced from the inner surface of the flange 32 by a compression spring 58. The opposite surface of the bellows 54 is seated on the inner surface of the base of the cup-shaped housing 40.

The diameter of the pressure plate 56 is smaller than the diameter of the inner surface of the cylindrical portion of the cup-shaped housing 40. The compression spring 58 is located on the opposite side of the pressure plate 56 from the bellows 54 and acts against the pressure plate and the inner surface of the flange 32 of the sliding member 30. The compression spring 58 may be disk-shaped and veined, as illustrated in the drawings, or may take other forms such as, for example, a standard helical spring with ends squared and ground.

The bellows 54 has a substantially flat annular surface at each end and also has an inner and an outer folding surface which are concentric with one another. The inside diameter of the inner folding surface of the bellows 54 is larger than the diameter of the outer cylindrical surface of the sliding member 30; while the diameter of the outside of the outer folding surface of the bellows is smaller than the diameter of the inner surface of the cylindrical portion of the cup-shaped housing 40.

A hub 60 is rigidly attached to the impeller shaft 18 on the forward or outward end thereof. The end of the hub 60 facing the water pump assembly 10 is provided with a radially outwardly extending annular flange 62. Concentric with the annular flange 62 of the hub 60 and integral therewith is a plinth-like extension 64. The plinth-like extension 64 is adapted to receive a clutch plate 66 which is typically faced with a clutch facing 68. The clutch plate 66 is a disk of approximately the same size as the cooperating clutch plate 50.

A pulley and dust protector housing assembly 70 is attached to the hub 60. Manifestly, the pulley and dust protector housing may be made as a single integral unit or may, as well, be made as independent elements. The cylindrical section 72 of the dust protector portion of the assembly 70 is larger in diameter than the outside diameter of the cup-shaped housing 40 and extends over it for a relatively short distance, as well as over the two clutch plates 50 and 66.

The bellows 54 is preferably filled with a fluid which expands in volume when it experiences an increase in temperature. The exact amount of expansion which occurs depends upon the particular fluid employed and the amount of the change in temperature. That is, although each fluid has an index of expansion which determines the rate of change per unit volume, per degree of temperature change, the total change in volume depends upon the original volume of the fluid and the total change in temperature. It will be appreciated that where a fluid is enclosed in the sealed bellows 54, the bellows will expand with a rise in the temperature thereof and will contract with a drop in temperature. Therefore, if the bellows is filled and sealed while the fluid is at a given temperature, it will occupy that volume at that temperature at all times and will decrease in volume at a lower, and increase at a higher temperature within the mechanical limits of the bellows 54. Likewise, the axial length will decrease with a drop in temperature and increase with a rise in temperature. It will be seen from the above description that while the two clutch-plates 50 and 66 are not in contact (that is, when a gap exists between them) the hub 60 and the attached parts are free to rotate without having any effect on the rest of the assembly (that is, the hub 60 and attached parts and the impeller shaft 18 running through the bearing bushing housing 20 are free to turn when a torque is applied without turning the rest of the assembly). Since the water pump housing 12 is to be located on an engine in the same general location as any ordinary water pump, the belt which normally drives the water pump is placed in the V of the pulley 70 and causes it to turn just as with an ordinary water pump. This will necessitate only minor relocations of the drive pulley when this apparatus is employed on the conventional internal combustion engine. It can now be seen that while the clutch plates 50 and 66 are not in contact and the belt (not shown) is driving the pulley 70, the impeller shaft 18 will be turning, causing the water pump to operate by turning the impeller 16. It should be noted that at this time the bellows 54 will be in a state of least expansion. It is assumed at this time that the engine has just been started and has not been running long enough to get up to its normal operating temperature. When the engine heats up and approaches its normal operating temperature, the water passing through the water pump assembly 10 rises in temperature. The hot water heats the impeller shaft 18, the water pump housing 12, and the bearing bushing housing 20, thereby heating the bellows 54 by conduction and some radiation. When the fluid in the bellows 54 warms up, the bellows expands, thus imparting a forward motion to the sliding member 30 through the pressure plate 56 and the compression spring 58. This brings the clutch-plate 50–52 in contact with the rotating clutch plate 66–68 causing a rotary motion to be imparted to the clutch plate 50–52 which in turn causes the entire sub-assembly that is mounted on the bearing 24 to rotate with the impeller shaft 18. Since the fan blades 48 are attached to this sub-assembly they rotate with it. When the engine temperature has reached its equilibrium point with the blades 48 rotating, the compression spring 58 will be partially compressed to prevent chatter between the clutch plates 50 and 66 and allows a safety factor on the expansion of the bellows 54. After the engine is turned off and consequently cools the bellows 54 will contract and the compression spring 38 will force the sliding member 30 to move back toward the bottom of the cup-shaped housing 40 and thus causes the clutch plate 50 to disengage from clutch plate 66.

According to the patent statutes, I have explained the principles and mode of operation of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. In a thermally responsive clutch assembly including a rotatably mounted shaft, driving means fixed to said shaft and rotatably supported thereby, driven means rotatably mounted on said shaft, clutch elements associated with said driving means and said driven means, spring means mounted on said driven means normally maintaining said clutch elements out of frictional engagement, and thermally responsive means for urging said clutch elements into frictional engagement against the action of said spring means.

2. The invention defined in claim 1 wherein said clutch means associated with said driven means is mounted for axial movement along the axis of said shaft.

3. The invention defined in claim 2 wherein said thermally responsive means comprises an expansible chamber containing a fluid capable of varying its volume upon a change in temperature.

4. The invention defined in claim 2 wherein said thermally responsive means comprises bellows means containing a fluid capable of varying its volume upon a change in temperature.

5. The invention defined in claim 4 wherein said bellows is annular in shape and surrounds said shaft in spaced relation therewith.

6. The invention defined in claim 5 wherein said bellows includes corrugated side walls.

7. In an internal combustion engine having a fluid circulatory cooling system and a pump housing therefor, the combination of a driving member including a shaft, a pump disposed in said housing and connected to said driving member through said shaft, a first frictional clutch element carried by said driving member, a driven member including a fan for directing a cooling medium for cooling the fluid in said circulatory system, a second frictional clutch element carried by said driven member and adapted for axial movement toward and away from said first clutch element, spring means mounted on said driven member and cooperating with said second clutch element for normally maintaining said clutch elements out

of frictional engagement, said spring means disposed on a side of said second clutch element opposite to that facing said first clutch element, and thermally responsive annular expansible chamber means for urging said clutch elements into frictional engagement against the force of said spring means.

8. The invention defined in claim 1 wherein said thermally responsive means is mounted on said driven means.

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