Jan. 21, 1958 J. W. JACOBS 2,820,440

COOLING APPARATUS

Filed April 28, 1955 4 Sheets-Sheet 1

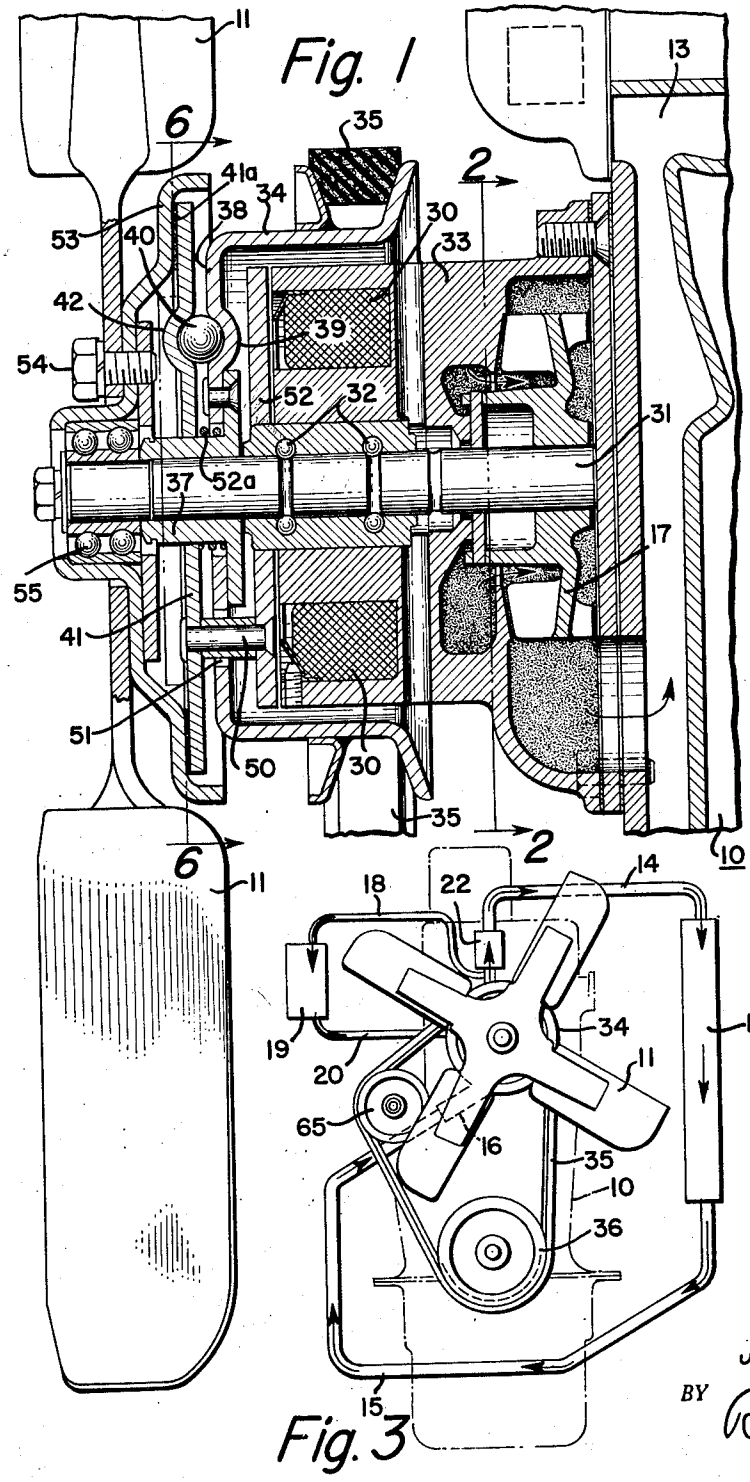


Fig. 3

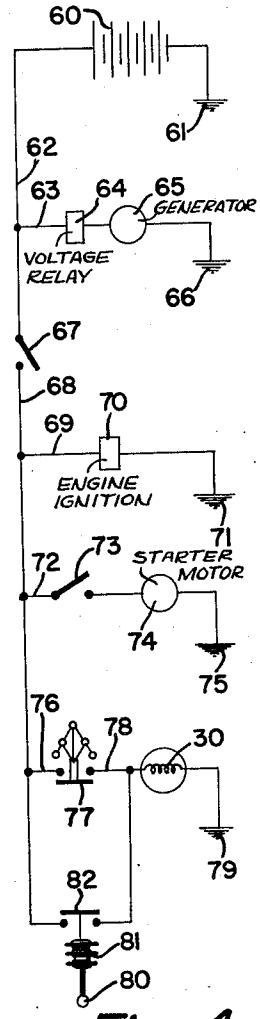


Fig. 4

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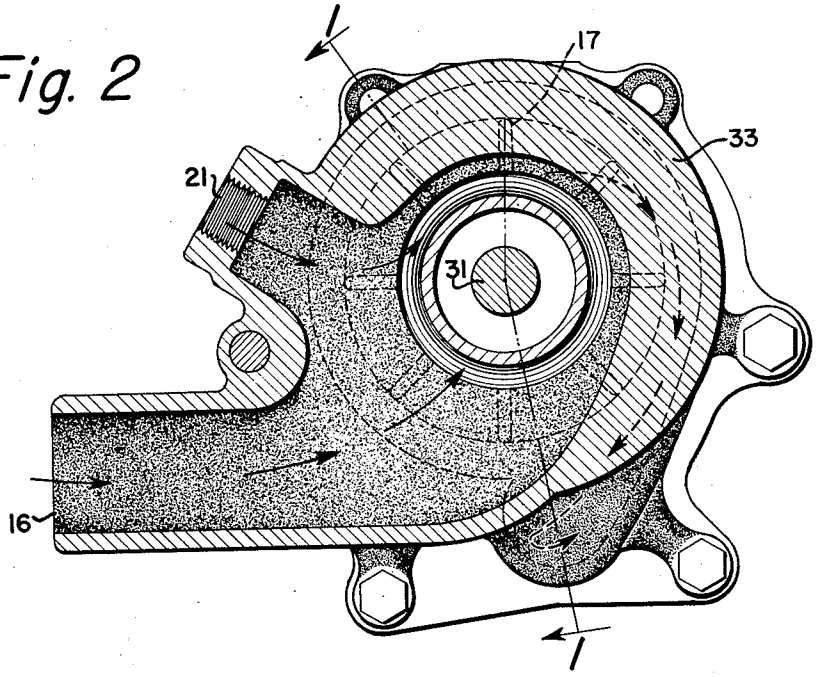
Fig. 2



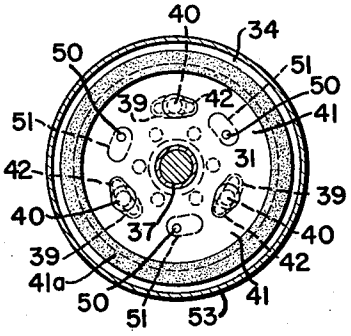




Fig. 6

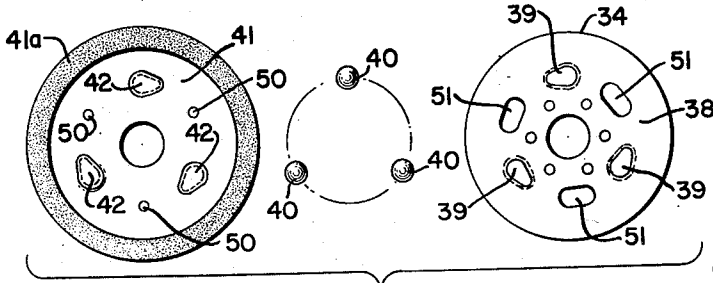



Fig. 5

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COOLING APPARATUS

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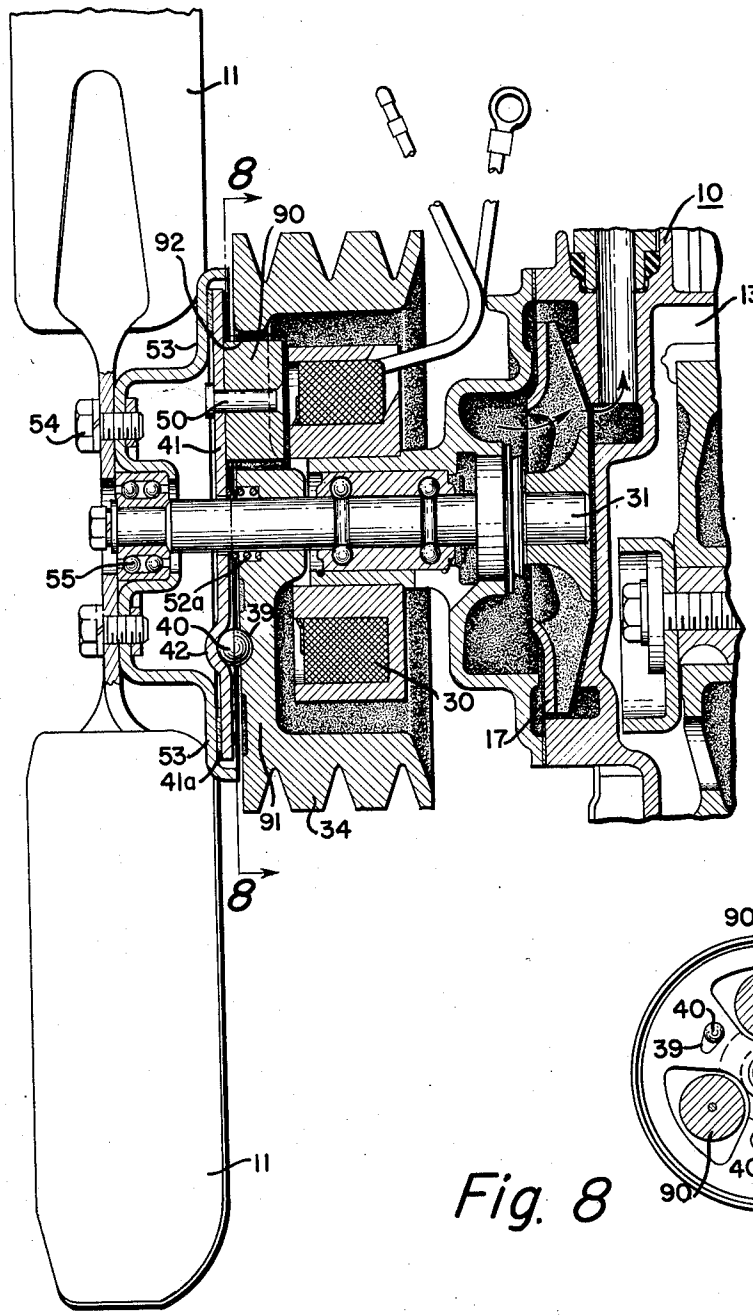


Fig. 7

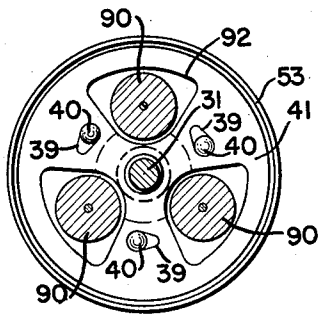


Fig. 8

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COOLING APPARATUS

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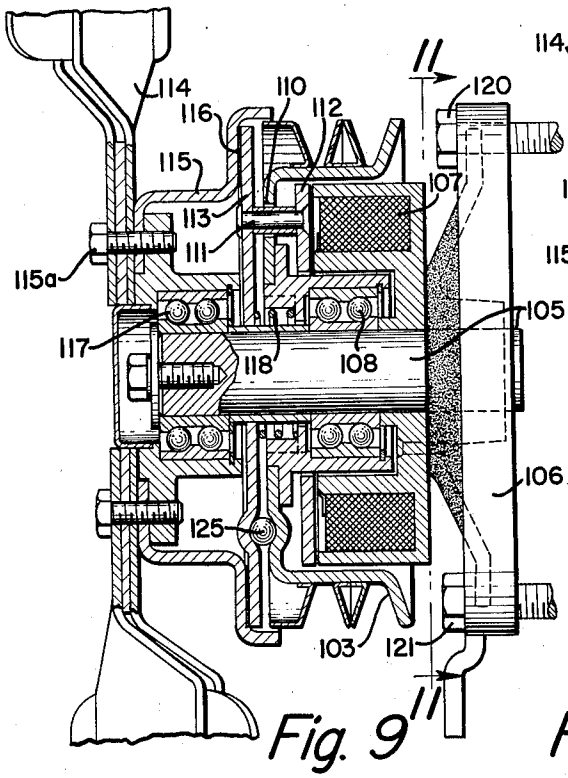



Fig. 9

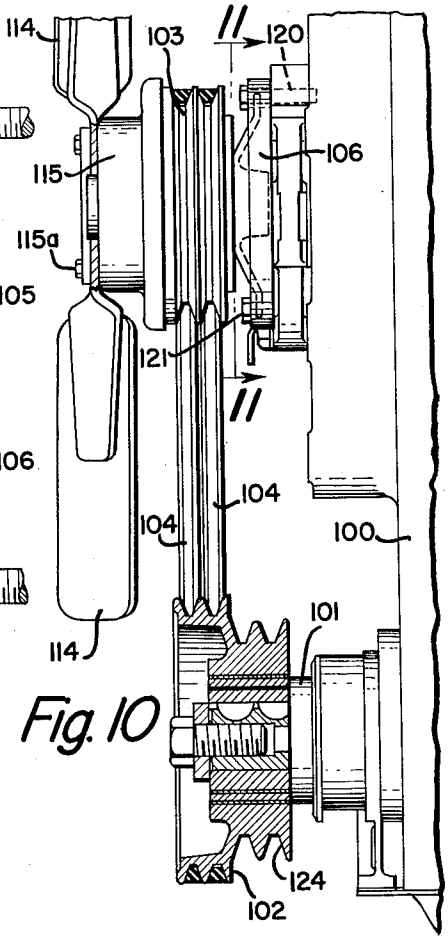
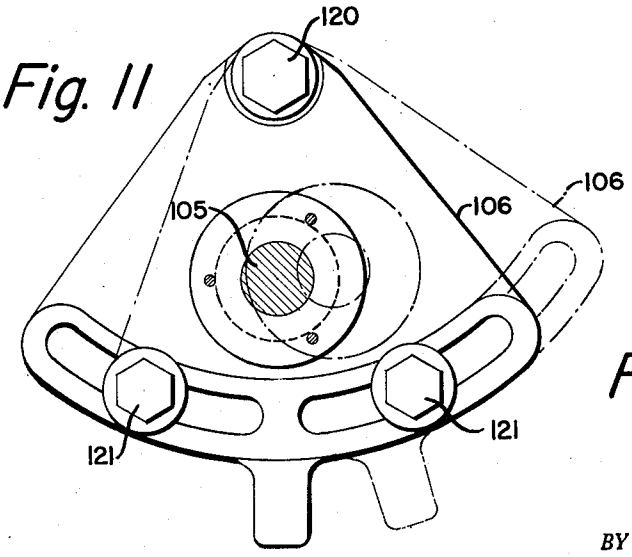



Fig. 10

Fig. 11



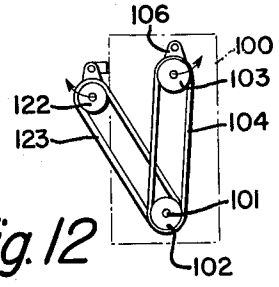




Fig. 12

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United States Patent Office 2,820,440 Patented Jan. 21, 1958



2,820,440

# COOLING APPARATUS

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Application April 28, 1955, Serial No. 504,650

10 Claims. (Cl. 123—41.11)

This invention relates to cooling apparatus and more particularly to a clutch for driving, for example, the cooling fan of an internal combustion engine.

An object of this invention is to provide a clutch for the cooling fan of an internal combustion engine, or the like, which is actuated by an electromagnet in such a manner that the fan is driven when the electromagnet is deenergized and the fan is not driven when the solenoid is energized.

Another object of this invention is to provide a clutch of the character described in the foregoing object in which the electromagnet is stationary.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of the invention is clearly shown.

In the drawings:

Figure 1 is a vertical cross-section of a fan and water pump unit embodying my invention.

Figure 2 is a transverse cross-section taken along the line 2—2 of Figure 1.

Figure 3 is a front elevation, somewhat diagrammatic, of the internal combustion engine.

Figure 4 is a wiring diagram showing the control.

Figure 5 is a diagrammatic exploded view of certain portions of the clutch.

Figure 6 is a cross-section on reduced scale taken along the line 6—6 of Figure 1.

Figure 7 is a view similar to Figure 1 showing a slight modification.

Figure 8 is a transverse cross-section, on reduced scale, taken along line 8—8 of Figure 7.

Figure 9 is a cross-section, somewhat similar to Figure 1, for a unit not using a water pump.

Figure 10 is a side elevation, with some parts in cross-section, showing the drive for Figure 9.

Figure 11 is the cross-section taken along the lines 11—11 in Figures 9 and 10.

Figure 12 is a front elevation, somewhat diagrammatic, of the engine shown in Figure 10.

An engine 10, for an automobile or the like, is shown in Figures 1 through 6, which is provided with a cooling fan 11 for blowing air past the radiator 12, shown diagrammatically in Figure 3 at the side but which actually is in front of the fan. Water from the engine cooling jacket 13 flows through the pipe 14 through the radiator 12 and through the pipe 15 to the inlet 16 of the water pump 17. A branch conduit 18 takes a certain portion of water from the conduit 14 and delivers it to a passenger compartment air heater 19 from which the water returns through the conduit 20 to the water inlet 21 of the pump 17. A thermostat 22 is provided to throttle the flow of water leaving the pump, when the water is below a desired temperature.

A clutch is provided to drive the fan 11 whenever the electromagnet 30 is deenergized and to release the fan drive when the electromagnet 30 is energized. To this end, the water pump 17 is provided with a cantilever



rotatable shaft 31 to drive the water impeller, and having a bearing 32 in the engine pump housing extension 33. A pulley 34 is driven by the belt 35 from the engine crankshaft pulley 36. The pulley 34 is secured to the shaft 31 through the medium of a hub 37. Preferably the pulley is cup-shaped and has a central portion 38 provided with teardrop depressions 39 for receiving the balls 40 which are part of a spreader and relative rotation locking means. A teaser disk 41 having a friction face 41*a* is rotationally and axially free on the shaft 31 and the hub 37. It is provided with teardrop constructions 42 to cooperate with the balls 40 to form the remainder of the spreader and relative rotation locking means.

The disk 41 is commonly referred to as a teaser disk in the clutch art since a relatively small force exerted by the spring 50*a* against the disk 41 when the electromagnet 30 is deenergized causes the friction face 41*a* to contact the clutch disk 53 carried by the fan so as to cause relative rotation between the teaser disk 41 and the pulley 34 whereby the balls 40 come into action to force the friction face 41*a* into firm non-slipping contact with the clutch disk 52 secured to the fan 11.

Pins 50 are secured to the teaser disk 41 and extend freely through openings 51 in the pulley 34 and are secured to the electromagnet armature disk 52. The disk 52 is rotationally and axially free. A compression spring 52*a* is interposed between the pulley 34 and the disk 41 which pushes the disk 41 against the clutch disk 53 which is secured to the fan 11 through the medium of bolts 54. The fan 11 and clutch disk 53 are axially fixed but rotationally free on the shaft 31 through the medium of ball bearings 55.

The electromagnet 30 is annular and stationarily mounted within the pump housing 33. It is energized by wire connectors, not shown, which are part of the wiring diagram shown in Figure 4.

In Figure 4, the automobile or engine battery 60 is grounded at 61 and is connected to the line 62. A branch 63 leads to the voltage relay 64 and generator 65 which is grounded at 66. An ignition switch 67 opens and closes the line 68 which has a branch 69 leading to the engine ignition system 70 which is grounded at 71. A branch 72 is provided with a starter switch 73 which energizes and deenergizes the engine starter motor 74 grounded at 75. Another branch 76 is connected to a centrifugal governor switch 77 which is closed when engine speed rises above a predetermined limit and is open when the engine speed falls below such limit. The line 78 leads to the solenoid 30 which is grounded at 79. Whenever the engine speed rises above the predetermined limit, the solenoid 30 is energized, and when the engine speed falls below a predetermined limit the solenoid is deenergized provided the water temperature in the jacket 13 is above a predetermined temperature. A thermostat 80 responsive to the water temperature in jacket 13 expands bellows 81 and opens the switch 82 whenever the engine temperature rises above a predetermined limit and closes the switch whenever the temperature falls below such predetermined limit. Consequently, the solenoid 30 is energized, and the fan 11 is not driven, whenever the engine speed is above a predetermined limit and/or whenever the water temperature is below a predetermined limit. The solenoid 30 is deenergized, and the fan 11 is driven, whenever the engine speed is below a predetermined limit and the engine temperature is above a predetermined limit.

In the operation of the embodiment shown in Figures 1 through 6, the engine is started by closing of the switches 67 and 73 and the crankshaft pulley is rotated, driving the clutch pulley 34. If the solenoid 30 is deenergized, for reasons apparent in Figure 4, the spring 52*a* pushes the

teaser disk 41 against the clutch disk 53, and the friction face 41a on the disk 41 causes the two disks to be frictionally united. If the fan 11 is stationary or moving slowly while the pulley 34 rotates at a higher speed, movement of the disk 41 to the left tends to cause relative rotation between the teaser disk 41 and the pulley or driving member 34. This causes the ball receiving recesses 39 and 42 to move out of relative alignment whereby the balls 40 force the members 38 and 41 apart and this increases the frictional contact between disks 41 and 53 whereby the fan 11 is caused to rotate in unison with the pulley 34. The mechanism for spreading the members 38 and 41 requires the exertion of very little initial force or power and once these members are spread apart by the initial teasing force set into motion by the spring 52a, the clutch surfaces are effective to drive the fan and the members 38 and 41 are prevented from rotating relative to one another as long as the solenoid 30 is energized. Thus, it is apparent that the deenergization of solenoid 30 causes the tear and ball construction 39, 40 and 42 to produce a spreader and relative rotation locking reaction which increases the frictional contact between disks 41 and 53 and drives the fan 11. When the solenoid 30 is energized, for reasons apparent in Figure 4, then armature 52 is pulled rightward in Figure 1 and the drive connection between disks 41 and 53 is released, so that the fan 11 is not driven.

In Figures 7 and 8, the parts corresponding to Figures 1 through 6 are numbered by the same reference numerals. In this case, the pins 50 on the teaser disk 41 are secured to cylindrical armature members 90 adjacent to the solenoid 30. The pulley 34 has the teardrops 39 formed in the face of the end wall 91 which also is provided with openings 92 which permit the armature blocks 90 to pass therethrough. The openings 92 are sufficiently large to permit a slight relative rotation between the pulley 34 and the teaser disk 41. Whenever the solenoid 30 is energized, the armatures 90 are pulled rightward together with the teaser disk 41, so that frictional contact with the clutch disk 53 is stopped and the drive of the fan 11 is terminated. Other parts of the construction shown in Figures 7 and 8, while of a slightly different shape from those shown in Figures 1 through 6, are substantially the same in function and operation and hence are not further described.

In the modification shown in Figures 9, 10, 11 and 12, the engine 100 is provided with a crankshaft 101 having a crankshaft pulley 102 which drives the clutch pulley 103 through the medium of belts 104. A stationary shaft 105 is secured to the adjustable plate 106. An annular solenoid 107 is stationarily mounted on the plate 106. The pulley 103 is axially fixed but rotationally free on the shaft 105 through the medium of ball bearings 108. The pulley 103 is cup-shaped and has openings 110 through which the pins 111 pass and connect the armature disk 112 with the teaser disk 113. The fan 114 is secured to a clutch disk 115 by bolts 115a, and has frictional contact through the friction face 116 secured to the teaser disk 113. The fan 114 and disk 115 are rotationally free but axially fixed on the shaft 105 through the medium of ball bearing 117. A compression spring 118 pushes disk 113 against clutch disk 115 when the solenoid 107 is deenergized and produces a spreading action between the pulley 103 and the teaser disk 113 as heretofore described with respect to Figures 1 through 6.

The plate 106 is hinged on the bolt 120 which is secured to the engine 100 by any suitable means. The plate 106 can swing to the right or left by loosening the bolts 121 to tighten the belts 104. If desired, the generator 122 may be driven by a separate set of belts 123 riding over the grooves 124 of the pulley 102.

In the operation of the device shown in Figures 9 through 12, whenever the solenoid 107 is energized due to engine speed or engine temperature similarly to Figure 4, the armature 112 is pulled rightward and the frictional contact at 116 is broken so that the fan is not driven. Whenever the solenoid 107 is deenergized, as indicated in Figure 4, the teaser disk 113 is moved leftward by the spring 118 against fan clutch disk 115, tending to hold the disk 113 stationary, and this creates a relative rotation between the disk 113 and pulley 103 which causes the tear and ball construction 125 to spread the pulley 103 and disk 113 apart and to tighten the frictional drive at 116 to drive the fan 114. The tear and ball construction 125 may be similar to that previously described with respect to Figures 1 through 6.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted as may come within the scope of the claims which follow.

What is claimed is as follows:

1. In combination: an engine for an automobile or the like; a water cooling system for said engine including a water pump; a water pump shaft on said pump; a pulley drivingly connected to said pump shaft; belting between said engine and pulley; a fan mounted rotationally free on said shaft and arranged for circulating air in thermal exchange relationship with water in said system; a clutch between said fan and pulley; a stationary electromagnet coaxial with said shaft; means locking and unlocking said clutch when said electromagnet is deenergized and energized respectively; and means for energizing and deenergizing said electromagnet.

2. In combination: an engine for an automobile or the like; a water cooling system for said engine including a water pump; a cantilever water pump shaft on said pump; a driving pulley rotatable and axially fixed on said pump shaft; a teaser disk rotatable about and longitudinally movable on said pump shaft; spread reaction locking means between and responsive to relative rotation between said pulley and teaser disk; a fan axially fixed and rotationally free on said shaft and arranged for circulating air in thermal exchange relationship with water in said system; a clutch disk on said fan engageable by said teaser disk; a stationary electromagnet; and means causing said teaser disk to engage said cltuch disk when said electromagnet is deenergized and to disengage said clutch disk when said electromagnet is energized.

3. In combination: an engine for an automobile or the like; a water cooling system for said engine including a water pump; a cantilever water pump shaft on said pump; a driving pulley rotatably and axially fixed on said pump shaft; a teaser disk rotatable about and longitudinally movable on said pump shaft; a spread reaction locking means between responsive to relative rotation between said pulley and teaser disk; a fan axially fixed and rotationally free on said shaft and arranged for circulating air in thermal exchange relationship with water in said system; a clutch disk on said fan engageable by said teaser disk; a stationary annular electromagnet coaxial with said shaft and magnetically attracting said teaser disk longitudinally toward said pulley; and spring means moving said teaser disk into engagement with said clutch disk when said electromagnet is deenergized.

4. In combination: an engine for an automobile or the like; a water cooling system for said engine including a water pump; a cantilever water pump shaft on said pump; a driving pulley rotatably and axially fixed on said pump shaft; a teaser disk rotatable about and longitudinally movable on said pump shaft; a spread reaction locking means between and responsive to relative rotation between said pulley and teaser disk; a fan axially fixed and rotationally free on said shaft and arranged for circulating air in thermal exchange relationship with water in said system; a clutch disk on said fan engageable by said teaser disk; a stationary annular electromagnet coaxial with said shaft and magnetically attracting said teaser disk longitudinally toward said pulley; spring means moving said

teaser disk into engagement with said clutch disk when said electromagnet is deenergized; and means energizing said electromagnet in response to speed.

5. In combination: an engine for an automobile or the like; a water cooling system for said engine including a water pump; a cantilever water pump shaft on said pump; a driving pulley rotatably and axially fixed on said pump shaft; a teaser disk rotatable about and longitudinally movable on said pump shaft; a spread reaction locking means between and responsive to relative rotation between said pulley and teaser disk; a fan axially fixed and rotationally free on said shaft and arranged for circulating air in thermal exchange relationship with water in said system; a clutch disk on said fan engageable by said teaser disk; a stationary annular electromagnet coaxial with said shaft and magnetically attracting said teaser disk longitudinally toward said pulley; spring means moving said teaser disk into engagement with said clutch disk when said electromagnet is deenergized; and means energizing said electromagnet in response to temperature.

6. In combination: a driven shaft; a driving member drivingly connected to said shaft; a clutch disk rotatable about and longitudinally fixed on said driven shaft; a teaser disk rotationally and axially free on said driven shaft and drivingly engaging said clutch disk and having an axial spacing limit with respect to said driving member; spreader and relative rotation locking means between said teaser disk and said driving member energized by a small initial relative rotation of said teaser disk and driving member; a stationary annular electromagnet coaxial with said driven shaft axially moving said teaser disk toward said driving member when said electromagnet is energized; and spring means moving said teaser disk against said clutch disk when said electromagnet is deenergized.

7. In combination: a radiator; means including a water pump for circulating water through said radiator; a water pump shaft; a driving pulley drivingly connected to said shaft; a clutch disk rotatable about and longitudinally fixed on said shaft and drivingly connectable with said pulley; a teaser disk mounted rotationally and axially free on said shaft and drivingly engaging said clutch disk and having an axial spacing limit with respect to said pulley; a fan for circulating air in thermal exchange relationship with said radiator and rotationally fixed to said clutch disk; spreader and relative rotation locking means between said teaser disk and said pulley energized by a small initial relative rotation of said teaser disk and pulley; a stationary annular electromagnet coaxial with said shaft and magnetically attracting said teaser disk longitudinally toward said pulley when said electromagnet is energized; and spring means moving said teaser disk against said clutch disk when said electromagnet is deenergized.



8. In combination: a radiator; means including a water pump for circulating water through said radiator; a water pump shaft; a driving pulley drivingly connected to said shaft; a clutch disk rotatable about and longitudinally fixed on said shaft and drivingly connectable with said pulley; a teaser disk mounted rotationally and axially free on said shaft and drivingly engaging said clutch disk and having an axial spacing limit with respect to said pulley; a fan for circulating air in thermal exchange relationship with said radiator and rotationally fixed to said clutch disk; spreader and relative rotation locking means between said teaser disk and said pulley energized by a small initial relative rotation of said teaser disk and pulley; a stationary annular electromagnet coaxial with said shaft and magnetically attracting said teaser disk longitudinally toward said pulley when said electromagnet is energized; spring means moving said teaser disk against said clutch disk when said electromagnet is deenergized in response to speed.

9. In combination: a radiator; means including a water pump for circulating water through said radiator; a water pump shaft; a driving pulley drivingly connected to said shaft; a clutch disk rotatable about and longitudinally fixed on said shaft and drivingly connectable with said pulley; a teaser disk mounted rotationally and axially free on said shaft and drivingly engaging said clutch disk and having an axial spacing limit with respect to said pulley; a fan for circulating air in thermal exchange relationship with said radiator and rotationally fixed to said clutch disk; spreader and relative rotation locking means between said teaser disk and said pulley energized by a small initial relative rotation of said teaser disk and pulley; a stationary annular electromagnet coaxial with said shaft and magnetically attracting said teaser disk longitudinally toward said pulley when said electromagnet is energized; spring means moving said teaser disk against said clutch disk when said electromagnet is deenergized in response to temperature.

10. In combination: an automobile engine for driving said automobile; a cooling system on said engine including a radiator and an air circulating fan adjacent said radiator; a clutch of the self-energizing type between said engine and fan; a stationary electromagnet; and means initiating self-energization of said clutch when said electromagnet is deenergized, and initiating deenergization of said clutch when said electromagnet is energized.


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