Oct. 31, 1950 W. F. BORGERD 2,527,790

REFRIGERATION APPARATUS CONTROL

Filed April 3, 1946 2 Sheets-Sheet 1

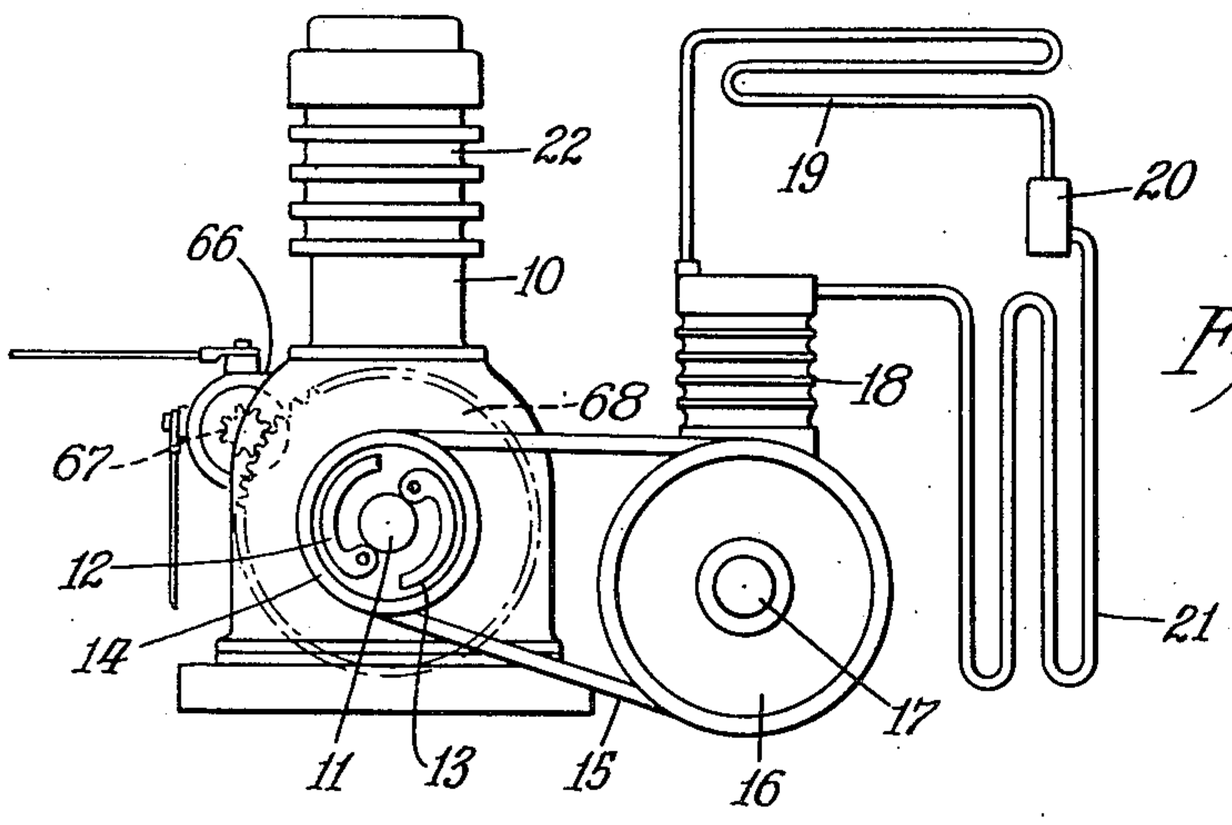

Fig. 1.

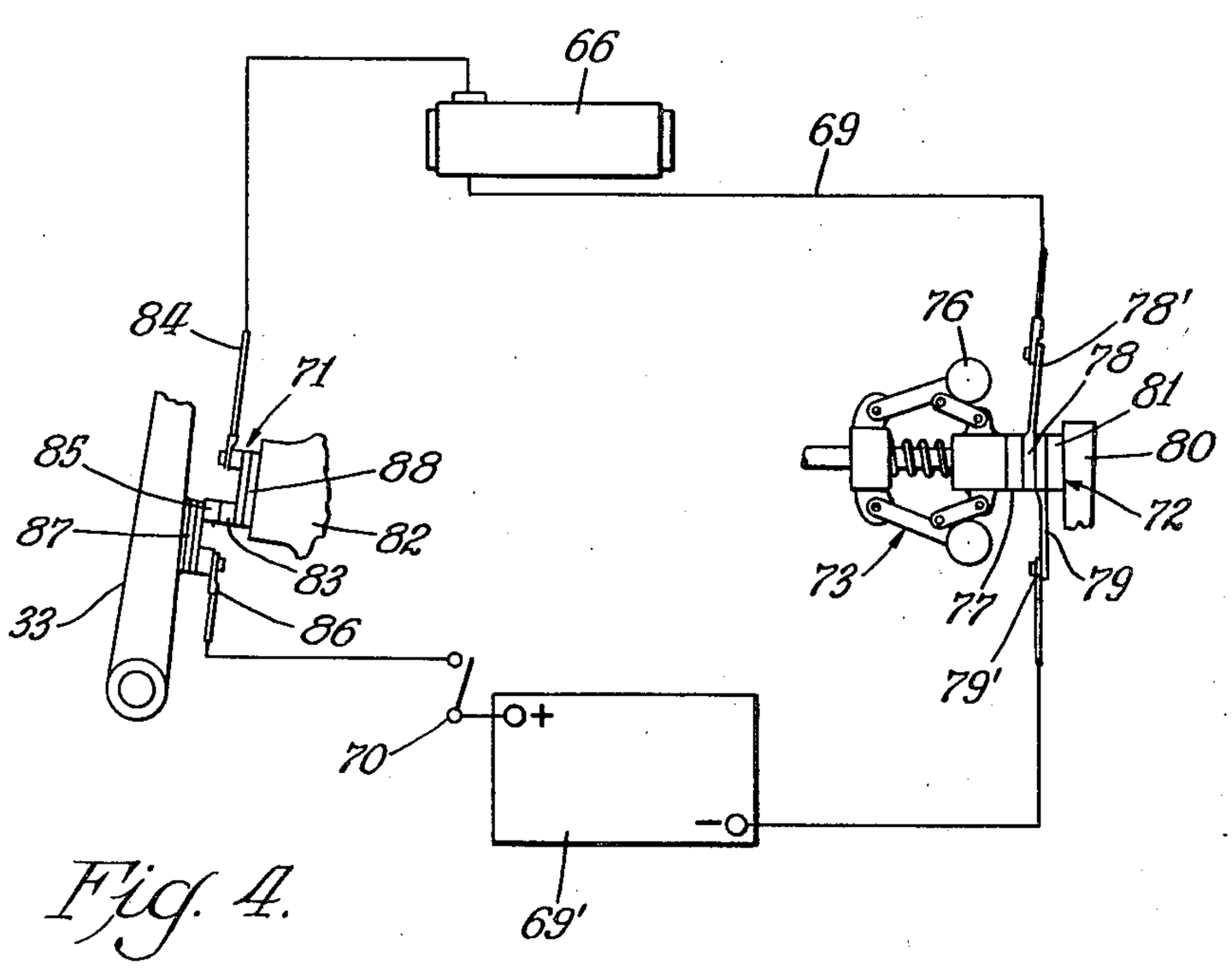

Fig. 4.

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Fig. 2.

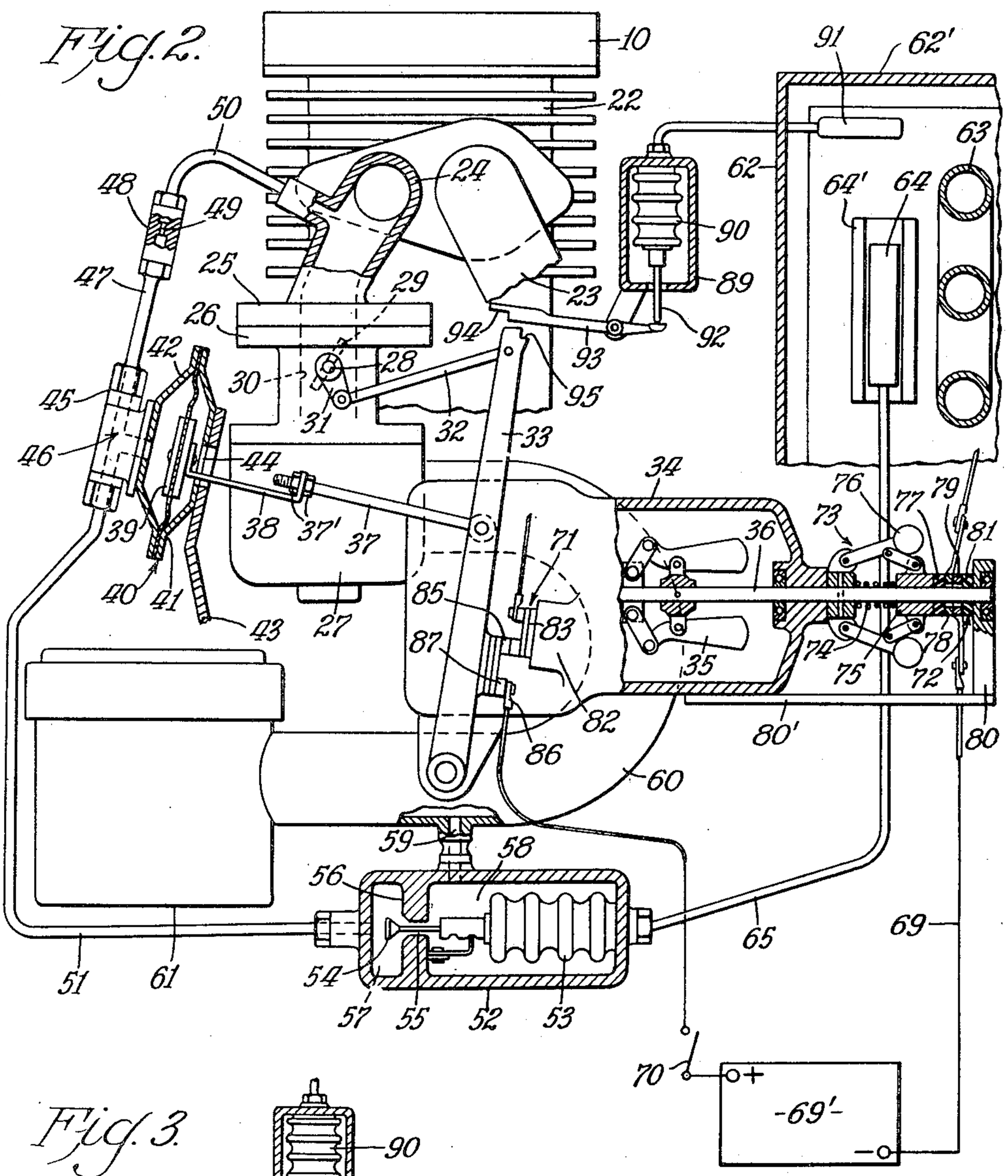
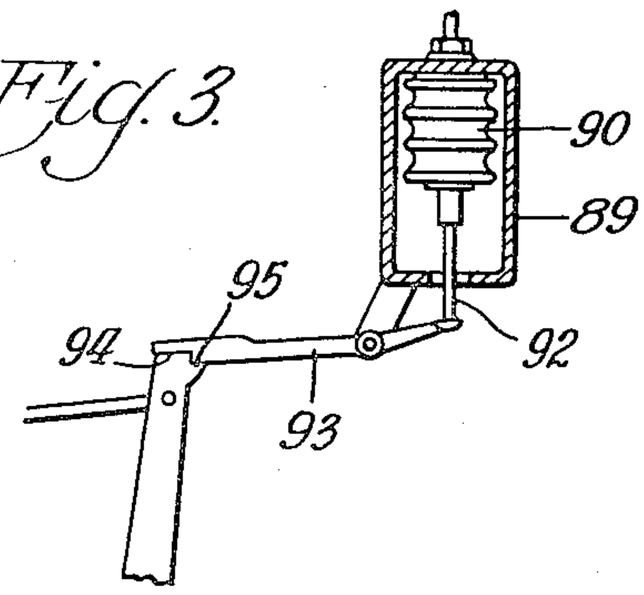


Fig. 3.



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REFRIGERATION APPARATUS CONTROL

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5 Claims. (Cl. 62—4)

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This invention relates to a refrigeration system. More particularly, the invention relates to an automatic starting device for an internal combustion engine of the type used to drive the compressor of a refrigeration system.

This invention may be used with a refrigeration system of the type shown in the patent to Phillip E. Cary, No. 2,435,493. In that application the speed of an internal combustion engine is regulated by a governor which is directly controlled by a temperature responsive device associated with a cooling chamber. In a speed controlling device of that type, it is desirable to set the governor so that it will close the throttle of an internal combustion engine thereby stopping said engine when the cooling chamber reaches a predetermined low temperature.

In order to assure continued refrigeration, however, it is also necessary to have a positive automatic means for starting the engine and the refrigeration system upon a predetermined rise in temperature of the cooling chamber.

It is an important object of this invention, therefore, to provide an automatic starting device for a refrigeration system.

Another object is to provide an automatic electrical starting system for an internal combustion system of a type used in combination with a refrigeration system.

Another object of the invention is to provide a starting device for an internal combustion engine controlled by a temperature responsive device associated with the cooling chamber of a refrigeration system.

Another object is to provide an automatic electric starting system for an internal combustion engine, said system being controlled by the governor control of the internal combustion engine.

Another object is to provide for the stopping of an internal combustion engine of a refrigeration system by means of a temperature responsive device positioned within the chamber to be cooled.

A still further object is to provide a centrifugal clutch drive between an internal combustion engine and a refrigeration compressor, said clutch drive being associated with an electrical starting system.

Other objects of the invention and various additions and characteristics thereof will become apparent from a consideration of the following detailed description.

In the drawings:

Figure 1 is a schematic or diagrammatic view of a refrigeration apparatus of a type in which the invention may be embodied.

Figure 2 is a side elevational view of an engine showing the governor control mechanism and a portion of an electrical starting device.

Figure 3 is a fragmentary view of a control

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means, said control means being shown in functional connection with a part of a governing mechanism.

Figure 4 is a diagrammatic view of an electrical circuit for the starting motor of a refrigeration system showing the source of electrical energy and points of interruption of said circuit.

A conventional refrigerating apparatus is indicated in Figure 1. An air-cooled internal combustion engine 10 is illustrated and outlined as having a crank-shaft 11 on which two centrifugal actuated clutch shoes 12 are pivotally connected for engaging a clutch 13. Said clutch 13 is freely rotatable on the crank-shaft 11 and carries a pulley 14 for driving a V-belt 15 which is connected to a drive pulley 16 carried on a shaft 17 of a compressor unit 18. The discharge from said compressor passes through a condenser 19 to an expansion valve 20 which supplies compressed refrigerant to an expansion coil 21. From said expansion coil 21 the refrigeration gas is drawn back into the compressor 18. Figure 1 shows merely a representative gas engine type of refrigerating apparatus in a diagrammatic manner to illustrate the invention which resides in an automatic starting device for said internal combustion engine.

In Figure 2, which shows a cylinder 22 of the engine 10 in greater detail, an exhaust conduit 23 and an inlet conduit 24 are shown connected to the side of the engine. The inlet conduit 24 is connected by a flange 25 to a flange 26 of a conventional carburetor 27. Said carburetor is provided with a throttle shaft 28 and a throttle 29 which is shown in dotted lines as being positioned in the throat of a mixture passage 30 of the carburetor. An actuating arm 31 on the throttle shaft 28 is connected by an actuating link 32 with a governor arm or throttle control means 33. Said arm is pivotally mounted on a governor housing 34 which contains a centrifugal governor 35 mounted on a shaft 36. The governor 35 is of the conventional type used with internal combustion engines of the type disclosed.

The governor arm or throttle control means 33 is connected intermediate its ends with a link 37 which is adjustably connected by jam nuts 37' to a connecting member 38 secured to a diaphragm 39. The diaphragm 39 forms a part of a fluid pressure responsive device 40 which includes, in addition to the diaphragm, an inner housing member 41 and an outer housing member 42 which are joined at their edges to secure the diaphragm in position, and which are spaced at their inner portions to permit necessary movement of the diaphragm. The housing member 41 is secured to a supporting bracket 43 for holding said device in position. An aperture 44 in said housing member 41 permits free passage and movement of the member 38. The

outer housing member 42 is secured to a fitting 45 which is suitably formed with a conduit 46, communicating with the interior of the fluid pressure responsive device 40, and a conduit 47. The conduit 47 is connected with a fitting 48 in which a restricted bleed opening 49 is formed. The bleed opening 49 is in communication with a conduit 50 which in turn is in communication with the inlet conduit 24.

A conduit 51 is in communication with the conduit 46 and communicates with a control element 52. The control element 52 contains a bellows-like element 53 which contains a volatile fluid, causing said bellows to expand or retract in response to temperature changes. A valve member 54 is connected to the bellows-like element 53 for movement therewith. The valve 54 is adapted to close an opening 55 formed in a wall 56, said wall separating chambers 57 and 58. A conduit 59 is connected for communication with an air inlet conduit 60, which in turn is connected to the carburetor 27 at one end and to an air cleaner 61 at the other end.

A portion of a refrigerator cabinet or chamber to be cooled is illustrated by walls 62 and 62'. Expansion coils 63 are illustrated and are similar to the evaporator 21 shown in Figure 1. A temperature responsive element 64 is illustrated as being located in the compartment to be refrigerated. Said element 64 is jacketed by a material having a high specific heat value or relatively low conducting value, whereby there will be a lag in the transfer of heat to and from the element 64, thereby giving a delayed action in response to said element to the temperature change in the refrigerator compartment. The temperature responsive element 64 is connected by a conduit 65 to the bellows-like element 53. Said element 53 is adapted to expand or contract upon temperature changes within the cooling chamber in response to the temperature responsive element 64.

A starting system is provided to automatically start the engine upon a predetermined increase in the temperature within the cooling chamber, and this automatic starting system will now be described.

As best shown in Figure 1, a starter motor 66 is connected to the engine 10 and includes a pinion 67. Said pinion 67 is adapted to engage and drive a ring gear 68 shown in dotted lines, said ring gear being connected to the shaft 11 and rotatable therewith. As best shown in Figure 4, the starter 66 is connected to an electrical circuit 69 which receives electrical energy from a battery or any other suitable electric source 69'. The circuit 69 is adapted to be manually closed or broken by a manually operated switch as indicated at 70. During the operation of the engine 10, the circuit may also be opened or closed with electrical contact switches generally designated by the numerals 71 and 72.

The electrical contact switch 72 includes a centrifugal mechanism 73 which is rigidly attached to the shaft 36 for rotation therewith, as best shown in Fig. 2. The centrifugal mechanism includes a spring 74 which is in abutment with a collar 75 to which are connected centrifugal weights 76. The collar 75 is adapted to slide on the shaft 36 as the weights 76 swing outwardly or inwardly. Connected to the end of the collar 75 and properly insulated by an element 77 is an electrical contact 78 in communication with a terminal 78'. The contact 78 is adapted to abut against another contact 79 having a terminal 79' which is in communication with the circuit 69. The contact 79 is insulated from a bracket 80 by an insulating element 81. The bracket 80 supports the shaft 36 at one end and is connected by a support 80' to the governor housing 34.

The contact switch 71 is mounted on a projecting portion 82 of the governor housing 34. Said contact switch consists of a contact member 83 and a terminal 84 which is in communication with one end of the circuit 69. Another contact element 85 is mounted on the governor element 83 and is adapted to engage the contact element 83. A terminal 86 is connected to the contact element 85 and is in communication with the end of the circuit 69.

To make certain that proper functioning of the starting system is assured, a second control element 89 is provided. As best shown in Figure 2, the control device 89 consists of a bellows-like element 90 which is in communication with a temperature responsive device 91 mounted within the chamber to be cooled. A stem 92 is connected to the bellows-like element 90 and projects out of said control element 89 abutting one end of a control lever 93 which is pivotally connected to the control element 89. The control lever 93 is provided at one end with an undercut portion 94 which is adapted to engage a notch 95 formed in the governor arm 33.

The operation is as follows:

With the engine running at full speed, the centrifugal weights 76 of the centrifugal switch 73 are at their most outward positions and the electrical contacts 77 and 78 are out of engagement with one another. The governor 35 is free to function in its customary manner in controlling the speed of the engine.

As the engine is running as a speed sufficient for the compressor to supply refrigerant to the cooling chamber, the temperature in said cooling chamber will, of course, decrease. As the temperature decreases, the bellows-like element 53 will contract in response to the function of the heat responsive element 64, thereby closing the valve 54 over the opening 55. A depression will now result in the inlet conduit 24 depending upon the load of the engine which in a system of this type is substantially uniform.

Normally, air will be drawn through conduit 50, bleed opening 49, and conduits 46, 47, 51, and 59 from the air inlet conduit 60. The bleed opening 49 in the fitting 48 restricts this air flow to a very small volume and reduces possible lowering of pressure in the chamber 58 of the control element 52 so as not to influence the action of the bellows-like element 53.

The depression existing within the conduits causes the diaphragm 39, of the fluid pressure responsive device 40, to be drawn toward the housing member 42, and the link 37 will move the throttle control arm 33 in a counter-clockwise direction. By means of the actuating link 32, the throttle valve 29 will thereupon be closed in the throat of the carburetor. When the throttle is completely closed, the engine is stopped and compression within the compressor no longer takes place. The clutch shoes 12 are disengaged from the clutch 13 and the governor arm 33 is now in its extreme counterclockwise position. The centrifugal weights 76 of the centrifugal switch 73 are at their innermost position and the contacts 77 and 78 are in engagement with one another.

Since the possibility exists that the valve 54 might leak, it is necessary to provide an addi-

tional positive control so that all danger of "short cycling" is removed. Leaking of the valve **54** while the engine is at rest would permit the arm **33** to return to its extreme clockwise position whereupon electrical contact would be made, thus starting the engine and permitting "short cycling" or premature starting though the cooling chamber is at its intended temperature. The control element **89** provides a positive control and prevents this undesirable operation of the engine.

The expansion or contraction of the bellows-like element **90** is controlled by the temperature responsive element **91** positioned within the cooling chamber. When the cooling chamber is down to the temperature desired, the volatile fluid within the element **90** causes said element to contract, thus permitting the control lever **93** to rotate about its axis until the undercut portion **94** of said lever is in its extreme downward position. Thus, if the valve **54** leaks and the governor or throttle control arm **33** thereupon moves toward its counter-clockwise position, the undercut portion **94** will engage notch **95** of the governor arm **33** and retain said arm from making the electrical contact which would start the engine.

When the temperature of the cooling chamber rises to a predetermined high, the element **90** will expand thus moving the control arm **93** away from the throttle control arm **33**, the valve **54** will open, and air will once more flow to the air inlet conduit of the carburetor; the diaphragm **39** will move to its normal position, and the arm **33** will now be free to move to its extreme clockwise position. Since the electrical contacting elements **77** and **78** are in engagement as well as the contact elements **83** and **85**, the electrical circuit **69** is closed. Electrical energy will now flow to the starter **66** and the engine again will be set into operation. When the cooling chamber is again at its desired low temperature, the arm **33** will move, the electrical contacts will be disengaged and the cycle of operation is repeated.

The link **37** and the connecting member **38** can be adjusted relatively to one another by jam nuts **37'** so that the throttle will remain partially open when continuing idling operation of the engine is intended and the starting system is not used.

Thus it can be seen from the description of the invention as disclosed that an automatic starting device is provided for the internal combustion engine of a refrigeration system. Control means is provided to positively actuate said starting system whenever the refrigeration chamber reaches a predetermined low temperature. It is to be understood that applicant contemplates as his invention all modifications falling within the scope of the appended claims.

What is claimed is:

1. For a refrigeration system, said system including a cooling chamber, an evaporator for said cooling chamber, a compressor for supplying compressed refrigerant to said evaporator, a power unit for driving said compressor, said power unit having a carburetor and a throttle valve therefor, a mixture intake conduit in communication with said carburetor, a throttle control arm connected to the throttle valve for regulating the same, a fluid-pressure responsive device connected to the throttle control arm and communicating with the intake conduit, said fluid-pressure responsive device being operable upon the application of intake conduit pressure thereto to move said control arm to a first position for closing said throttle valve, and a temperature responsive device positioned in the cooling chamber, said device including means operable to control the application of pressure in the intake conduit to the pressure responsive device: a starting system comprising a starting motor, a source of electrical energy, an electrical circuit connected to said starting motor, and an electrical switch connected to said throttle control arm, said switch being movable to close said electrical circuit upon the release of pressure in said fluid-pressure responsive device and the movement of said throttle control arm to a second position.

2 For a refrigeration system, said system including a cooling chamber, an evaporator for said cooling chamber, a compressor for supplying compressed refrigerant to said evaporator, a power unit for driving said compressor, said power unit having a carburetor and a throttle valve therefor, a mixture intake conduit in communication with said carburetor, a throttle control arm connected to the throttle valve for regulating the same, a fluid-pressure responsive device connected to the throttle control arm and communicating with the intake conduit, said fluid pressure responsive device being operable upon the application of intake conduit pressure thereto to move said control arm to a first position for closing said throttle valve, and a temperature responsive device positioned in the cooling chamber, said device including means operable to control the application of pressure in the intake conduit to the pressure responsive device: a starting system comprising a starting motor, a source of electrical energy, an electric circuit connected to said starting motor, an electric switch for said circuit, said switch including a stationary contact member positioned adjacent the control arm, and a contact member connected to and movable with said control arm, said movable contact member being engageable with said stationary contact member for closing said switch and actuating said starting motor upon the release of pressure in said fluid-pressure responsive device in response to said temperature responsive device and upon movement of said control arm to a second position.

3. For a refrigeration system, said system including a cooling chamber, an evaporator for said cooling chamber, a compressor for supplying compressed refrigerant to said evaporator, a power unit for driving said compressor, said power unit having a carburetor and a throttle valve therefor, a mixture intake conduit in communication with said carburetor, a throttle control arm connected to the throttle valve for regulating the same, a fluid-pressure responsive device connected to the throttle control arm and communicating with the intake conduit, said fluid-pressure responsive device being operable upon the application of intake conduit pressure thereto to move said control arm to a first position for closing said throttle valve, and a temperature responsive device positioned in the cooling chamber, said device including means operable to control the application of pressure in the intake conduit to the pressure-responsive device: a starting system comprising a starting motor, a source of electrical energy, an electric circuit connected to said starting motor, an electric switch for said circuit, said switch including a stationary contact member positioned adjacent the control arm, a contact member connected to and movable with said control arm, said movable contact member being engageable with said stationary contact member for closing said switch and actuating said starting motor upon the release of pressure

in said fluid-pressure responsive device in response to said temperature responsive device and upon movement of said control arm to a second position, and a centrifugal switch connected to said circuit, said switch including contact elements normally closed during the inoperative position of said power unit, rotatable means connecting said centrifugal switch to said power unit, said switch being movable by said power unit for disengaging said contact elements thereby breaking the electric circuit upon a predetermined speed of operation of said power unit.

4. For a refrigeration system, said system including a cooling chamber, an evaporator for said cooling chamber, a compressor for supplying compressed refrigerant to said evaporator, a power unit for driving said compressor, said power unit having a carburetor and a throttle valve therefor, a mixture intake conduit in communication with said carburetor, a throttle control arm connected to the throttle valve for regulating the same, a fluid-pressure responsive device connected to the throttle control arm and communicating with the intake conduit, said fluid-pressure responsive device being operable upon the application of intake conduit pressure thereto to move said control arm to a first position for closing said throttle valve, and a temperature responsive device positioned in the cooling chamber, said device including means operable to control the application of pressure in the intake conduit to the pressure responsive device: a starting system comprising a starting motor, a source of electrical energy, an electric circuit connected to said starting motor, a first switch for said circuit, said switch being normally closed during the operation of said power unit, means on said throttle control arm for opening said second switch upon movement of said arm in response to the pressure responsive device, a second switch in said circuit, movable means connecting said second switch to said power unit, said means being constructed and arranged to open said second switch upon a predetermined speed of operation of said

power unit whereby the circuit to said starting motor is broken.

5. For a refrigeration system, said system including a cooling chamber, an evaporator for said cooling chamber, a compressor for supplying compressed refrigerant to said evaporator, a power unit for driving said compressor, said power unit having a carburetor and a throttle valve therefor, a mixture intake conduit in communication with said carburetor, a throttle control arm connected to the throttle valve for regulating the same, a fluid-pressure responsive device connected to the throttle control arm and communicating with the intake conduit, said fluid-pressure responsive device being operable upon the application of intake conduit pressure thereto to move said control arm from a relatively operative position to an inoperative position, and a temperature responsive device positioned in the cooling chamber, said device including means operable to control the application of pressure in the intake conduit to the pressure responsive device: a starting system including a starting motor, an electrical circuit connected to said starting motor, and an electrical switch in said circuit, said switch being normally closed during the operative position of said throttle control arm, and means on said control arm for opening said switch during the inoperative position of said control arm.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,796,627	Schmieding	Mar. 17, 1931
1,943,962	Hulse	Jan. 16, 1934
1,943,964	Hulse	Jan. 16, 1934
1,943,965	Hulse	Jan. 16, 1934
2,286,758	Nelson	June 16, 1942
2,318,893	Smith	May 11, 1943