March 31, 1936. O. M. SUMMERS 2,035,575

REFRIGERATING APPARATUS

Original Filed Nov. 3, 1926 3 Sheets-Sheet 1

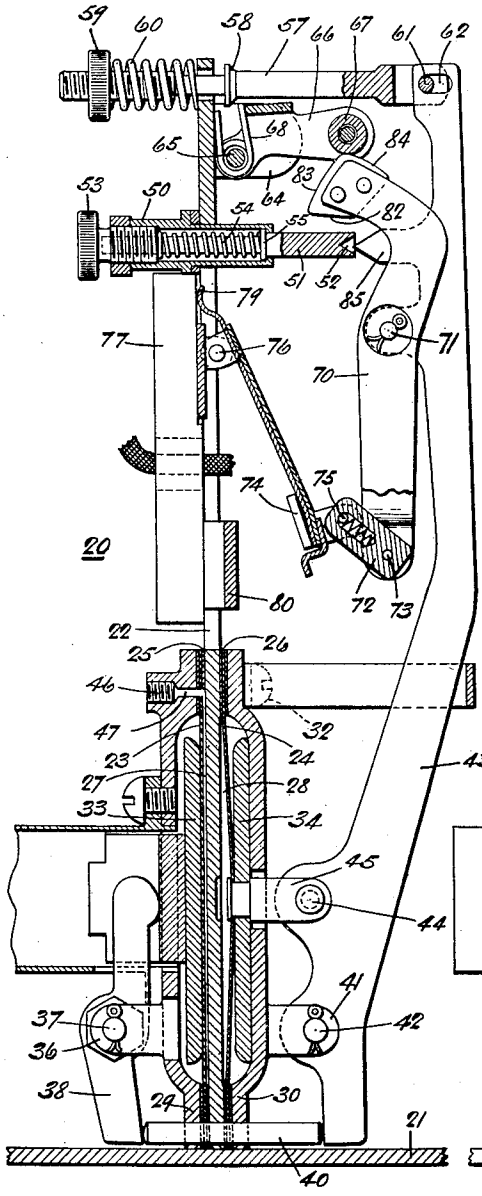


Fig. 1.

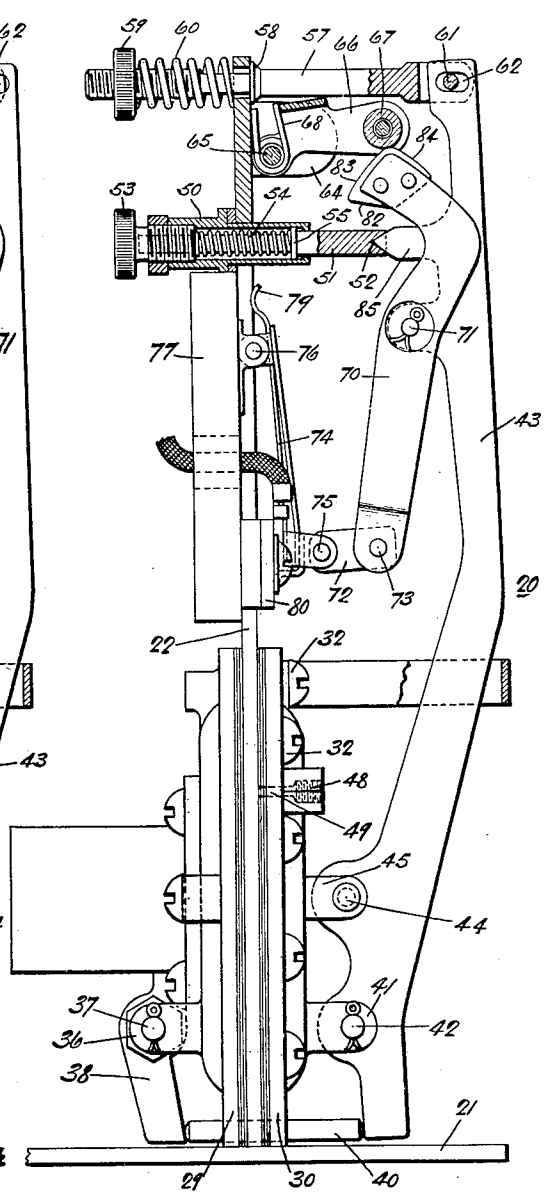


Fig. 2.

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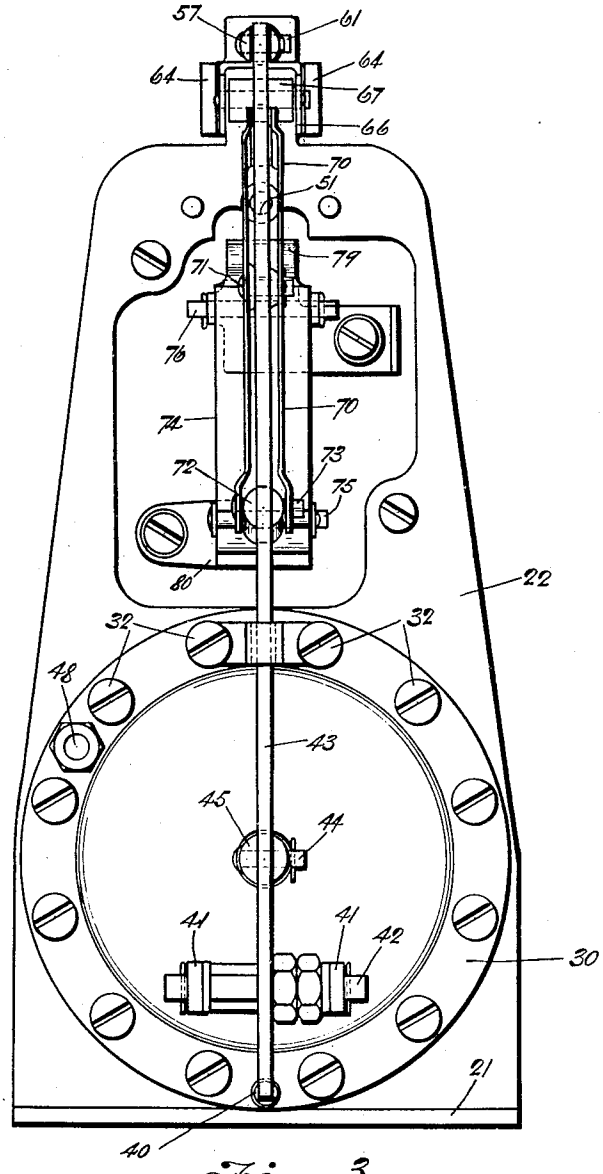


Fig. 3.

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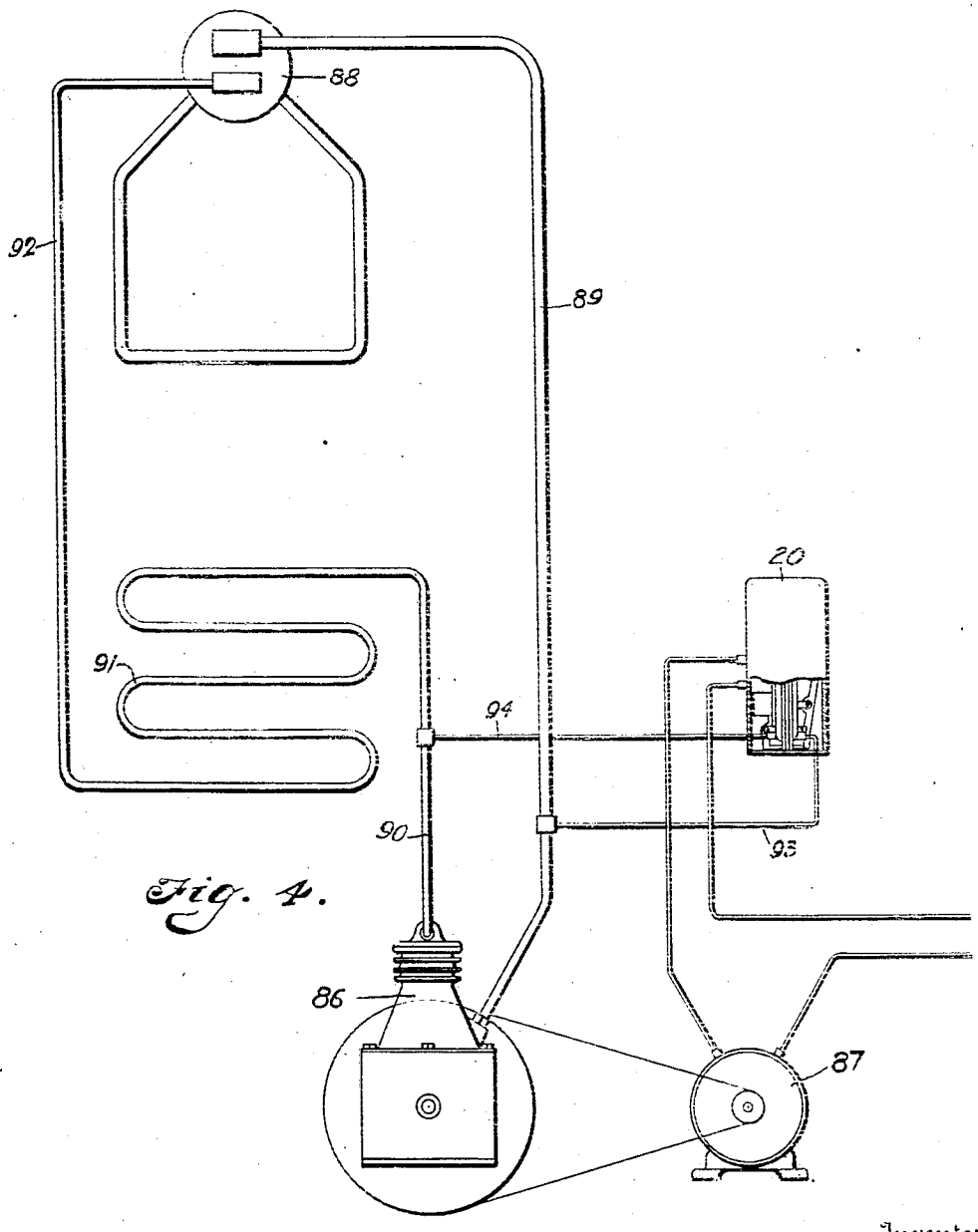


Fig. 4.

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2,035,575

REFRIGERATING APPARATUS

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Application November 3, 1926, Serial No. 145,950
Renewed November 22, 1934

5 Claims. (Cl. 200—83)

The present invention relates to controllers, and particularly to controllers of the pressure-responsive type.

In pressure-responsive controllers it is the usual practice to provide the controller with a pressure chamber having a wall adapted to be flexed by the pressure within the chamber, which flexing is utilized to actuate the device to be controlled. When such controller is included in a system in which there is present periodic pulsations in pressure, as, for example, in compression-type refrigerating systems, the flexible wall, due to said pulsations, continually vibrates and causes same to disintegrate quickly. One of the objects of the present invention is to prolong the life of such flexible wall by preventing the vibration thereof. One manner of carrying out this object is to subject the flexible wall to the mean pressure only within the system.

Another object of the present invention is to provide a controller which will perform a certain function under certain conditions and perform another function under another condition, and to construct and arrange said controller whereby it may be adjusted so that either of the conditions at which the functions take place may be varied independently of the other.

A still further object of the present invention is to combine into a simple, compact structure, a controller having means which is responsive normally to certain conditions for performing certain functions, as, for example, opening and closing a switch, and means which is responsive to abnormal conditions for rendering the first means inoperative to perform certain functions.

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 present invention is clearly shown.

In the drawings:

Fig. 1 is a front view partly in section, of the improved controller;

Fig. 2 is a view similar to Fig. 1, but showing certain elements of the controller in different positions;

Fig. 3 is a right side view of Fig. 1; and

Fig. 4 is a diagrammatic view of a refrigerating system, showing the improved controller applied thereto.

Referring to the drawings, the controller **20** includes a base **21** to which is secured an upright **22**. Adjacent the lower portion and on opposite sides thereof, there are provided diaphragms **23** and **24** which are spaced from the upright **22** by gaskets **25** and **26** to provide chambers **27** and **28**, respectively, between said diaphragm **23** and upright **22**, and between upright **22** and diaphragm **24**. Plates **29** and **30** are also disposed on opposite sides of the upright **22** and are arranged coextensive with the diaphragms **23** and **24**. The diaphragms, gaskets and plates are suitably secured to the upright **22** by screws **32**. A disc **33** is disposed between the plate **29** and the diaphragm **23**, and a disc **34** is disposed between the diaphragm **24** and plate **30**. Ears **36** are carried by the plate **29**, which ears support the fulcrum pin **37** upon which is pivotally mounted a lever **38**. One end of lever **38** is arranged to be engaged by the disc **33** and the other end of said lever engages a pin **40** which extends through the upright **22**. The plate **30** carries ears **41**, which ears support a fulcrum pin **42** which in turn carries an operating member or lever **43**. The lower end of said lever **43** is arranged to engage with pin **40**. A pin **44** pivotally connects lever **43** with ears **45**, which ears are secured to the disc **34**.

The plate **29** is tapped at **46** to receive a coupling which is connected with a source of pressure, and a passage **47** connects said tapped portion with the chamber **27**, said passage including a drilled hole within the plate **29** and diaphragm **23** and a cut-away portion in the gasket **25**. The plate **30** is tapped at **48** and is provided with a passage **49** similar to that of **47**, which passage connects with chamber **28**. Pressure within the chamber **27** causes the disc **33** to move outwardly and rotate the lever **38** in a counterclockwise direction, which will cause the lever **43**, by means of the pin **40**, to rotate in a counterclockwise direction. Pressure within the chamber **28** will cause the disc **34** to move outwardly and rotate the lever **43** in a clockwise direction.

Adjacent the upper portion of the upright **22** there is provided a sleeve **50** which extends through said upright and is suitably secured thereto. A plunger **51** extends through one end of said sleeve and the extreme end thereof is provided with a cone-shaped recess **52**. A screw-threaded bushing **53** is connected with the opposite end of the sleeve **50** and a spring **54** is located within the sleeve **50** and is disposed between the bushing **53** and a stop **55**, and normally tends to force the plunger **51** to the right. Stop **55** engages the end wall of a sleeve **50** and thus limits the movement of said plunger **51**.

A stem **57** is located above the pin **51** and extends through the upright **22**. Stem **57** is provided with a stop **58** to limit the movement of said stem toward the left. A nut **59** is provided

on said stem 57 and a spring 60 is interposed between said nut and the upright 22 and normally tends to move the stem toward the left. Stem 57 carries a pin 61 which is slidably movable within a slot 62 formed in lever 43. Ears 64 are provided by the upright 22 and extend parallel to the plunger 51 and the stem 57. A fulcrum pin 65 is carried by the ears 64, which in turn carries an actuating mechanism including parallel-spaced arms 66 which support a roller 67. A spring 68 is wound about the pin 65 and normally tends to rotate said roller 67 in a clockwise direction.

A switch lever 70 is bodily or translatively carried by the lever 43, by a pin 71. The lower arm of lever 70 is connected with a link 72 by pin 73, which link is connected to a pivotally-mounted contact 74 by a pin 75. Contact 74 is pivotally supported at 76 upon an insulating block 77. The contact 74 is provided with a stop 79 to prevent the counterclockwise movement of said contact 74 beyond a certain limit. Contact 74 is arranged to engage with contact 80 carried by the insulating block 77. The upper end of lever 70 is provided with a cam 82 having camming surfaces 83 and 84 either of which is arranged to cooperate with the roller 67. When the roller 67 engages the camming surface 84, the lever 70 will be in the position shown in Fig. 1, the stop 79 of the pivoted contact 74 limiting the movement of the lever 70. When the lever 43 is moving outwardly, carrying with it the lever 70, the camming surface 84 will move over the roller 67 and after the apex, formed by the camming surfaces 83 and 84, has moved beyond the roller, the roller 67 will engage the camming surface 83. When this occurs, the spring 68 will force the roller 67 downwardly, which in turn will quickly rotate the lever 70 in a clockwise direction. When the lever 43 moves in the opposite direction, lever 70 will be moved, so that the camming surface 83 will be moved beyond the roller and when said roller engages surface 84 the lever 70 will quickly rotate about pivot 71 in a counterclockwise direction. Fig. 1 shows the position of lever 43 while said lever is moving toward the right and the lever 70 is still in the position in which the roller 67 maintains contact 74 separated from contact 80. A still further movement of the lever 43 to the right is necessary before camming surface 83 engages roller 67. Fig. 2 shows the position of lever 43 while said lever is moving toward the left, the camming surface 83 being still in engagement with the roller 67. A further movement of the lever 43 to the left is necessary before surface 84 engages said roller. It will be noted that when the lever 43 is moving toward the right, the fulcrum pin 71 of lever 70 is farther to the right when the apex of cam 82 engages roller 67, than when the apex engages roller 67 while the lever 43 is moving toward the left. This is the result of the lever 70 being pivotally and translatively carried by the lever 43 since the lever 70 is at a different angle while said lever 43 is moving in one direction than the angle of lever 70 when lever 43 moves in the opposite direction. The movement of the lever 43 to the right is resisted by the spring 60 and the movement of the lever 43 to the left is resisted by the spring 54, there being a projection 85 on the lever 43 which is adapted to engage plunger 51 to compress the spring 54. The arrangement is such that the stop 55 on the plunger 51 will engage the end wall of sleeve 50 before the lever 43 has moved to such a position in which the camming surface 84 has moved beyond the roller 67, and the spring 54 is ineffective. The tension of the spring 60 can be adjusted and in this manner said spring individually controls the amount of pressure necessary for closing the switch contacts 74 and 80. As the pressure within the chamber 28 decreases, the lever 43 will move to the left and while the camming surface 83 is still engaging the roller 67, the stop 58 upon the stem 57 will engage the upright 22 and thus render the spring ineffective as regards to lever 43. While the camming surface 83 is still engaging roller 67, projection 85 on lever 43 will engage the plunger 51. Thus the spring 54 will resist the movement of the lever 43 to the left and the tension of this spring can be adjusted by the nut 53. Since spring 60 is now ineffective, the tension of spring 54 alone controls the pressure at which the contacts 74 and 80 are separated. Thus it is apparent from the foregoing description that there is provided high and low pressure adjustments which are entirely independent of one another, whereby the pressure at which the contacts are closed can be adjusted entirely independently of the pressure at which the contacts are opened and, likewise, the pressure at which the contacts are opened can be adjusted independently of the pressure at which the contacts are closed.

The present invention is particularly adapted to refrigerating systems in which it is desirable to render a motor operative when a predetermined high temperature is present, and render the motor inoperative when a predetermined low temperature is present. Fig. 4 shows one manner of connecting the present controller in a refrigerating system. The system includes a compressor 86 which is driven by a motor 87. The compressor 86 is adapted to withdraw refrigerant from an evaporator 88 through a pipe 89 and force the compressed refrigerant through a pipe 90 into a condenser 91, whence it passes by a pipe 92 to the evaporator 88. The chamber 28 of the controller 20 is connected by a pipe 93 with the low-pressure pipe 89. When the motor 87 and compressor 86 are idle, the evaporator becomes warmer and the refrigerant within the evaporator 88, pipes 89 and 93 will increase in pressure and when such pressure attains a predetermined value, contacts 74 will close with contact 80 to complete the electrical circuit to the motor 87. The operation of the compressor 86 will cause the pressure within the low-pressure side of refrigerating system to decrease and when said pressure falls to a predetermined value, which value is computed in accordance with the temperature desired in the evaporator 88, the controller 20 will separate contact 74 from contact 80 to thus render the motor 87 inoperative.

In case the refrigerating system does not operate satisfactorily, as, for example, the refrigerant in the condenser 91 is not cooled as required, the excessive pressure within the high-pressure side of the system will be transmitted to chamber 27 through the pipe 94, which pipe is connected on the high-pressure side of the refrigerating system. When an excessive pressure is present within the system, the pressure within the chamber 27 will force the diaphragm 23 outwardly and rotate the lever 38, which lever 38 will operate through the pin 40 to rotate lever 43 in a counterclockwise direction, whereby contact 74 is separated from contact 80.

In systems in which there is present periodic

pulsations such as those caused by the operation of a compressor and in which the diaphragm is subjected to these pulsations, said diaphragm is vibrated at a relatively high speed on each impulsation. This, in effect, will cause the diaphragm to fracture quickly. In the present invention this objection has been overcome by preventing the vibration of said diaphragm. The pipes **93** and **94** have a relatively small cross-sectional area and are of such length so as to provide a resistance to the flow of refrigerant to such an extent that the pulsations are not transmitted to the chambers **27** and **28**. By providing this resistance, the pressure values do not change rapidly within said chambers and said chambers are responsive only to the mean pressure within the respective high-pressure and low-pressure sides of the refrigerating system. By subjecting said diaphragms only to the mean pressure within the system, no pulsation is present within said chambers and, therefore, the diaphragms **23** and **24** will not vibrate.

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, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. An automatic switch including a plate, a pair of diaphragms located one on either side of the plate, said diaphragms having their edges sealed to the plate, passages connecting to each of the chambers formed between each of the diaphragms and the plate for extending said diaphragm, a follower for each of the diaphragms, a lever to be actuated and a link mechanism connecting each of the followers with the lever for causing the lever to be actuated by the movement of the diaphragms.

2. An automatic switch including a plate, a pair of diaphragms located one on either side of the plate, said diaphragms having their edges sealed to the plate, passages connecting to each of the chambers formed between each of the diaphragms and the plate for extending said diaphragm, a follower for each of the diaphragms, a lever to be actuated and a link mechanism connecting each of the followers with the lever for causing the lever to be actuated by the movement of the diaphragms, said lever having a second lever pivotally connected thereto with a cam nose on the one end and a switch mechanism connected to the other end, a spring pressed cam roller mounted upon said plate and having its roller in contact with said cam nose, a buffer type spring resistance means for resisting the movement of the lever in one direction and adjusting means for said spring means and a second spring means having a lost motion connection with the lever for resisting the movement of the lever in the opposite direction, said spring means having means for adjusting the same independently of the buffer type resistance means.

3. A pressure operated controller including means for controlling the flow of a medium through a circuit, pressure operated means for opening and closing said controlling means, snap acting means for controlling the opening and closing of said last mentioned means, a member connected to the pressure operated means, a plurality of springs adapted to act in opposite directions independently of each other upon the member, means for confining each of said springs so that each one can act upon the member only when the other springs cannot act upon the member, said member having a lost motion connection with one of the springs.

4. A control device including a pressure operated means, a member connected to and moved by said pressure operated means, a plurality of independent separately confined spring means, said spring means each having means located in the path of movement of and engaged by said member only near the extremities of movement of said member in each direction, one of said spring means being disengaged before the other spring means is engaged by the member during movement in each direction to provide a zone of movement free of said spring means, means operated by said pressure responsive means for controlling the flow of a medium through a circuit, and snap acting means for causing said last mentioned means to operate with a snap action.

5. A control device including a member, a plurality of separate pressure responsive means acting independently upon said member in opposite directions, a plurality of springs means acting upon said member, means for confining the spring means so that only one can act upon the member at a time, means for independently adjusting said spring means, means operated by said member for controlling the flow of a medium, snap acting means for controlling the movement of said member.

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