June 17, 1941. H. M. STEPHENSON 2,246,148

MAGNETIC ADJUSTING APPARATUS

Filed May 25, 1938

Fig. 1.

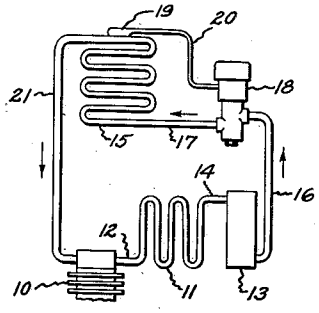



Fig. 2.

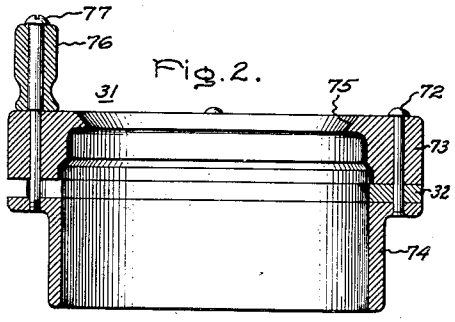



Fig. 3.

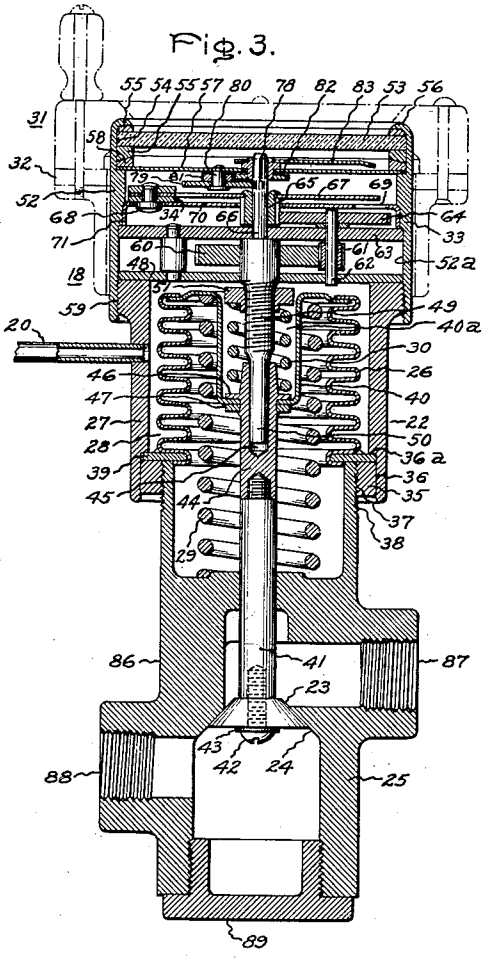
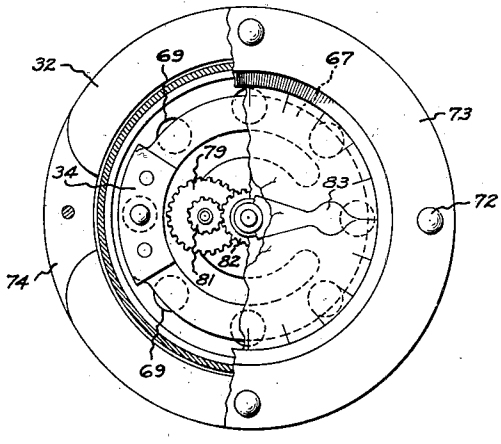



Fig 4.




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2,246,148

# UNITED STATES PATENT OFFICE

2,246,148

## MAGNETIC ADJUSTING APPARATUS

Hugh M. Stephenson, Fort Wayne, Ind., assignor to General Electric Company, a corporation of New York

Application May 25, 1938, Serial No. 210,086

8 Claims. (Cl. 172—284)

My invention relates to a magnetic adjusting apparatus.

It is an object of my invention to provide a simple and efficient adjusting means for an enclosed device which can be operated readily with the proper adjusting tool to adjust an adjustable device within the enclosure but which cannot be adjusted otherwise without breaking open the enclosure.

It is a further object of my invention to provide a tamper-proof adjusting means for an adjustable device.

It is also an object of my invention to provide an adjustable device with a sealed-in magnetic adjustment.

My invention is applicable to any adjustable device or component of a device which can be enclosed within a non-magnetic casing and contemplates adjustment of the device to one of a plurality of predetermined positions from the outside of the casing without requiring any parts to project through the casing. I provide a movable magnetic armature within the casing connected through suitable driving means to the member to be adjusted. To convey motion to the armature, I contemplate passing a magnet over the face of the casing in the direction in which it is desired to move the armature. For example, if rotary motion is desired, the magnet may be rotated about the casing; reciprocation of the armature can be achieved by reciprocating the magnet over the exterior of the casing, and so on. The magnet exerts sufficient force to convey motion in the same direction to the armature, and, therefore, to the member to be adjusted through the driving means. Latching means for the armature is provided to prevent the device from getting out of adjustment and I contemplate utilizing the magnetic attraction between the magnet and armature to unlatch the adjusting apparatus as well as to convey motion to the armature.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention reference may be had to the accompanying drawing in which Fig. 1 is a diagrammatic representation of a refrigerating system illustrating an application of my invention; Fig. 2 is a sectional view of the valve adjusting tool; Fig. 3 is a sectional view of a valve embodying my invention; and Fig. 4 is a plan view, partly broken away, of the embodiment shown in Fig. 3 with the adjusting tool in place.

In Fig. 1 I have shown a portion of a refrigerant compressor 10 connected to a condenser 11 through conduit 12. Liquid refrigerant from condenser 11 is received in a liquid receiver 13 through a conduit 14. Liquid refrigerant passes from the liquid receiver 13 to an expansion coil 15 through conduits 16 and 17 and an expansion valve 18 to which I have applied my invention. I have shown a thermostatic bulb 19 in thermal relationship with the outlet side of the expansion coil connected to the expansion valve 18 through a capillary tube 20. Vaporized refrigerant is withdrawn from the expansion coil 15 to the compressor 10 through a suction line 21.

The valve 18 includes a casing 22 of non-magnetic material such as brass or bronze. The flow of fluid through the valve is controlled by a valve member 23 which cooperates with a seat formed in the transverse partition 24 in the lower section 25 of the casing 22. Valve member 23 is operated by an expansible member or bellows 26 which is arranged within the middle section 27 of the valve casing 22. The chamber 28 surrounding the bellows 26 contains a volatile fluid which produces a rapid change in pressure in accordance with variations in the temperature at the point at which a desired temperature is to be maintained. A spring 29 is arranged within the bellows 26 normally tending to extend the expansible member 26 and urge the valve member 23 to a closed position. In order to regulate the resistance of spring 29 and accordingly to determine the temperature at which the valve will open, I have provided a spring 30 which normally urges the valve member 23 to its open position. The tension of spring 30 is varied through a suitable gearing and latch arrangement and magnetic adjusting means. When it is desired to adjust the valve an adjusting tool 31 carrying an annular magnet 32 of some highly magnetized material of high retentivity, such as an aluminum-nickel-cobalt alloy known to the trade as "Alnico," is fitted around the upper section 33 of the valve casing 22. The magnet 32 is so arranged that it will unlatch the armature 34 from its latching position by the magnetic attraction between the magnet 32 and the armature 34 as hereinafter described. Then, by rotating the adjusting tool 31 about the upper end of the valve casing the magnetic attraction will cause the armature to rotate with the adjusting tool 31. This rotational movement will be con-

veyed through the train of gears to adjust the resistance of spring 30. The armature 34 and gear train are completely enclosed so that adjustment can be made only by means of the tool 31.

The lower section 25 of the valve casing 22 comprises a valve body 86 having an inlet 87 and an outlet 88. Valve member 23 cooperates with its seat formed in the partition 24 to separate the inlet and outlet. A plug 89 is threaded into the lower end of the valve body 86 to permit access to the valve member 23.

In order to join the lower section 25 to the central section 27 of the valve casing 22, I have provided an annular ring 35 suitably secured in an annular counterbore 36 of the central section 27. The annular ring 35 is provided on its inside surface with screw threads 37 to accommodate corresponding screw threads 38 on the valve body 86. Expansible member 26 is suitably secured at its lower end to an annular ring 39 securely held between the shoulder 36*a* of the counterbore 36 and the annular ring 35. The other end of the expansible member 26 is suitably secured to a cup-shaped member 40 which is provided with a well 40*a* having a central aperture therethrough.

A valve stem 41 is secured to valve member 23 by a threaded bolt 42 and a washer 43. The opposite end of the valve stem 41 is threaded into shank 44. The upper end of shank 44 is provided with a counterbore 45. Shank 44 passes through the central aperture in the well 40*a* of the cup-shaped member 40 and is secured by flanges 46 and 47 extending from the shank 44 on either side of the cup-shaped member 40.

The upper end of the chamber 28 is closed by a plate 48. Chamber 28 thus defines a sealed chamber which I have filled with a volatile fluid. Chamber 28 communicates with a thermostatic bulb 19 through the capillary tubing 20 and the change of temperature of the thermostatic bulb 19 will produce a change in pressure of the volatile fluid within chamber 28.

A vertical threaded shaft 49 having an extension 50 of smaller diameter than the threaded portion extends downwardly into the counterbore 45 in the shank 44. Shaft 49 carries a running nut 51. The adjusting spring 30 engages the flange 46 in the well 40*a* in the cup-shaped member 40 as well as the nut 51.

The upper section 33 of the valve casing 22 includes a cylindrical casing 52 having a glass top 53 arranged within an annular counterbore 54. A calibrated indicating dial 57 is held in the bottom of the counterbore 54 by an annular ring 58. Packing material 55 is arranged on opposite peripheral sides of the glass top 53 and the casing 52 is spun over at the top or otherwise flanged at 56 to provide a hermetically sealed joint between the top of the casing and the glass cover. The casing 27 is secured within an annular counterbore 52*a* of the casing 52 by means of screw threads 59.

I have provided a suitable gearing and latch arrangement whereby shaft 49 can be turned so as to adjust the tension of the spring 30 which acts against the tension of the spring 29. This gearing and latch arrangement includes a gear 60 suitably secured to an enlarged extension of shaft 49 meshing with the pinion 61 which is rigidly secured to a shaft 62 suitably journaled in plates 48 and 63. Shaft 62 extends through the plate 63, the extension carrying rigidly thereon a gear 64 which meshes with a pinion 65 sleeved on an extension 66 of shaft 49. Pinion 65 is provided with a transversely flexible disk 67 having a soft iron armature 34 at one side. The lower side of armature 34 is provided with a projecting stud 68 which normally engages one of several holes 69 symmetrically spaced in a disk 70 which is rigidly supported within an annular counterbore 71 in the casing 52.

When it is desired to adjust the valve, a magnetic adjusting tool 31 is fitted over the upper end of the casing 52. As most clearly shown in Fig. 2, the adjusting tool comprises an annular magnet 32 suitably secured as by rivets 72 between an annular counterbored cap 73 and an annular flanged member 74 which is of slightly larger inside diameter than casing member 52. The cap member 73 is provided with an opening 75 through which the dial 57 may be viewed. I have provided a handle 76 secured to the adjusting tool by means of a threaded bolt 77 to permit convenient operation of the adjusting tool. The magnet 32 is so positioned in the adjusting tool 31 that it will be above armature 34 and exerts sufficient force to raise the stud 68 out of engagement with the holes in the disk 70 by flexing the disk 67. When raised in this position by the magnet 32 on the exterior of the casing 52, the disk 67 can be rotated in either direction to obtain the desired temperature adjustment of the valve, the rotation of disk 67 being conveyed through pinions 65 and 64, shaft 62, pinions 61 and 60 to shaft 49 to vary the resistances of the springs within central section 27 of the valve casing 22.

In operation it will be apparent that as the pressure in chamber 28 increases due to the increase in temperature of the thermostatic bulb 19, the bellows 26 will be compressed against the resistance of spring 29 and move the cup-shaped member 40 and valve stem 41 in a direction to open the valve. As the pressure within the chamber 28 decreases, the force of the spring 29 tending to close the valve will overcome the pressure on the bellows 26 tending to open the valve and therefore urge the cup-shaped member 40 and the valve stem 41 toward the closed position of the valve.

As spring 30 is compressed, the tendency of spring 29 to maintain the valve closed is neutralized to some extent. Therefore a lower pressure within chamber 28 acting against expansible member 26, and consequently a lower temperature at the point to be regulated, will overcome the valve-closing bias to open the valve. On the other hand, as the compression of spring 30 is lessened, the differential of the forces of springs 30 and 29 will become greater, thus increasing the bias tending to close the valve. Consequently a greater pressure must be developed within chamber 28 to overcome this bias before the valve will open. In other words, the valve will now open at a higher temperature than before the adjustment.

In order to indicate to the user of the valve the position of the magnetic armature 34, I have provided an indicating means. The upper end of extension 66 of shaft 49 is provided with axial grooves 78, the grooved shaft serving as a pinion which engages a gear 79 which is rigidly secured to a sleeve 80 which is rotatably secured to an indicating face plate or dial 57. Pinion 81 is also rigidly secured to sleeve 80 and engages a gear 82 which is sleeved on extension 66 and carries an indicating pointer 83 coacting with dial

57 to provide visual indication of the valve setting.

From the foregoing it will be seen that I have provided a tamper-proof, sealed valve which can be adjusted only with the proper adjusting means or by disassembling the valve. This construction affords ready means of adjustment at the factory or by a service man having an adjusting tool but prevents the user or some unauthorized person from adjusting the valve.

While I have shown a particular embodiment of my invention as applied to a thermostatic expansion valve, it will be apparent that the principle of my invention is not to be restricted to a temperature controlling valve but may find application wherever a member to be adjusted may be sealed in a non-magnetic casing to permit a tamper-proof adjustment of the member to be adjusted. Accordingly, I do not desire my invention to be limited to the particular construction shown and described and I intend in the appended claims to cover all modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A magnetically operable adjusting device including a casing, a member adjustable to a plurality of predetermined positions within said casing, a magnetic member within said casing and operatively connected to said member to be adjusted, means within said casing to normally prevent movement of said magnetic member in a direction to adjust said member to be adjusted, and magnetic means exterior to said casing for removing the restraint on said magnetic member and for conveying motion from said magnetic means to said magnetic member.

2. A magnetically operable adjusting device comprising a casing, a member adjustable to a plurality of predetermined positions within said casing, and magnetic adjusting means, one part of said magnetic adjusting means being located within said casing and operatively connected to said member to be adjusted, latching means for said one part normally preventing movement thereof, said magnetic adjusting means having a second part exterior of said casing adapted to unlatch said one part and convey motion from said second part to said one part.

3. A magnetically operable adjusting device comprising a casing, an adjustable member within said casing, a magnetic armature within said casing operatively associated with said adjustable member, a plurality of recesses on the interior of said casing, a projection on said armature, said projection being adapted to be retained within any one of said recesses to prevent movement of said armature, and a magnet on the outside of said casing adapted to withdraw said projection from the recess within which it is engaged to permit motion of said armature under the influence of said magnet to adjust said adjustable member.

4. In a tamper-proof magnetic adjusting device, a non-magnetic casing, a transversely flexible member therein adapted to drive a member to be adjusted, a magnetic armature associated with said flexible member, a projection on said flexible member, a plurality of depressions within said casing adapted to detainably receive said projection to prevent motion of said flexible member in a direction to drive said member to be adjusted, magnetic means outside of said casing adapted to flex said flexible member whereby said projection is prevented from engaging with any of said depressions and movement of said magnetic means may be conveyed to said member to be adjusted and means to indicate the position of said flexible member.

5. A magnetically operable adjusting device including a casing, a member adjustable to a plurality of predetermined positions within said casing, a magnetic armature within said casing operatively associated with said member to be adjusted, means within said casing to prevent movement of said armature in a direction to adjust said member to be adjusted, magnetic means exterior of said casing for removing the restraint on said armature and for conveying motion from said magnetic means to said magnetic armature and means for indicating the position of said member to be adjusted.

6. In a tamper-proof magnetically operable adjusting apparatus, a non-magnetic casing, a member to be adjusted within said casing, a flexible member within said casing, said flexible member being operatively connected to said adjustable member, restraining means within said casing to prevent movement of said flexible member in a direction to convey motion to said member to be adjusted, an armature associated with said flexible member, a magnet exterior of said casing cooperating with said armature to free said armature from the influence of said restraining means by flexing said flexible member and thereafter to convey movement to said armature for adjusting said member to be adjusted.

7. Magnetic adjustment means comprising in combination a casing, a member to be adjusted therein, a magnetic member within said casing and operatively associated with said member to be adjusted, a latch for said member to be adjusted, a magnetic cap adapted to be removably applied to the exterior of said casing whereby said member to be adjusted may be unlatched and moved under the magnetic influence of said cap to adjust said member to be adjusted.

8. A magnetically operable adjusting device including a casing, a member to be adjusted within said casing, a magnetic armature within said casing and adapted to impart motion to said member to be adjusted, latching means comprising a projection on said armature adapted to engage one of a plurality of spaced openings within said casing, magnetic means adapted for application to the exterior of said casing for removing said depending member from said one opening, said magnetic means also being movable on said casing whereby movement of said magnetic means will be conveyed to said armature to impart motion to said member to be adjusted.

HUGH M. STEPHENSON.