United States Patent

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[54] **BLEED-TYPE THERMOSTAT**
4 Claims, 5 Drawing Figs.

[52] U.S. Cl. 236/93, 73/363.5, 236/101, 337/111, 337/379
[51] Int. Cl. G05d 23/02
[50] Field of Search 236/87, 101, 93; 73/363.5; 337/111, 379

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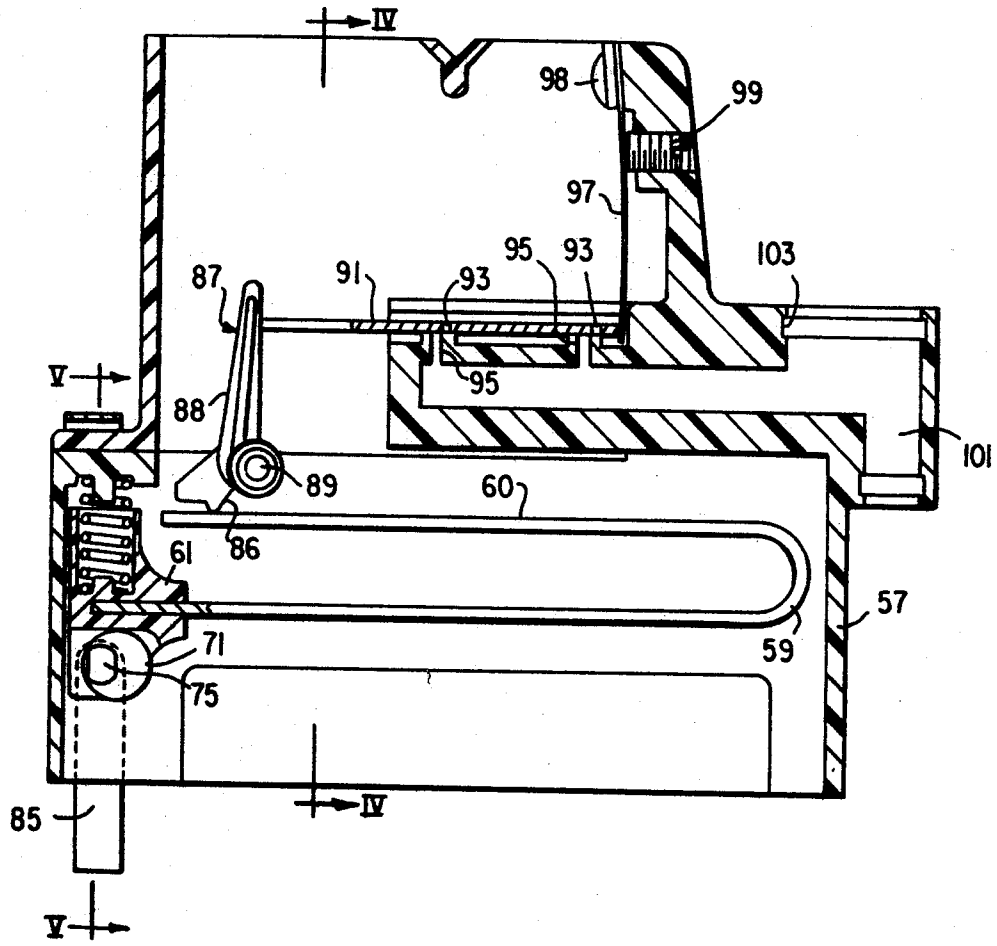
ABSTRACT: A ceiling air terminal serving as part of an air-conditioning system for a building adapted to discharge conditioned air into an area to be treated. The terminal is provided with a bleed-type thermostat employing a perforated bimetallic element movable in response to temperature variations in the air passing through the perforations from the area served by the air terminal to regulate the quantity of air bled from the thermostat and thereby control the quantity of conditioned air discharged from the terminal.



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SHEET 1 OF 2

FIG. 1

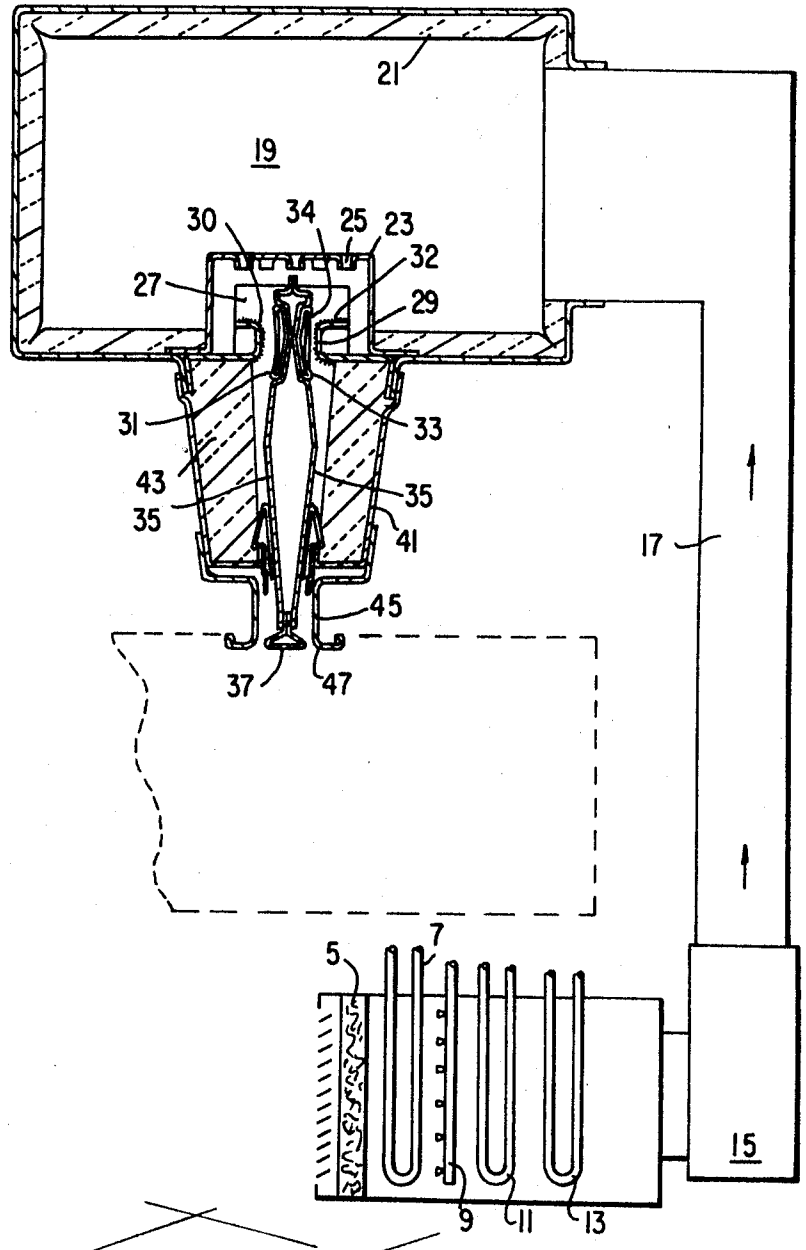

FIG. 2

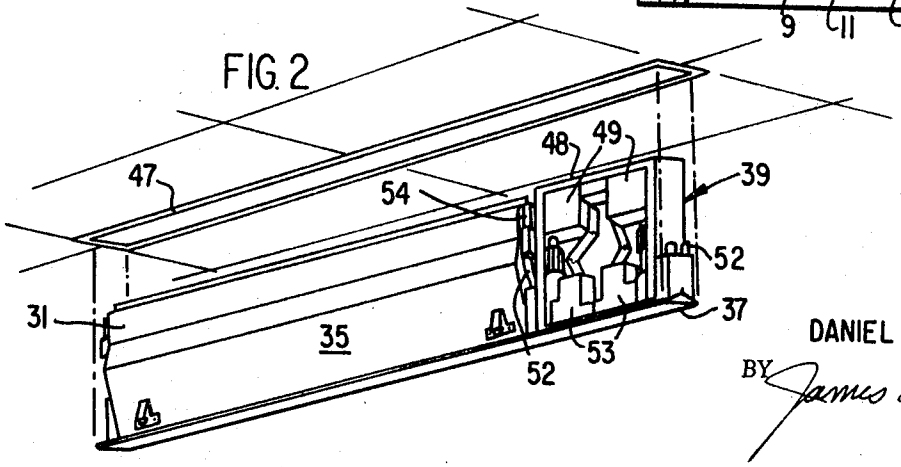

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FIG. 3

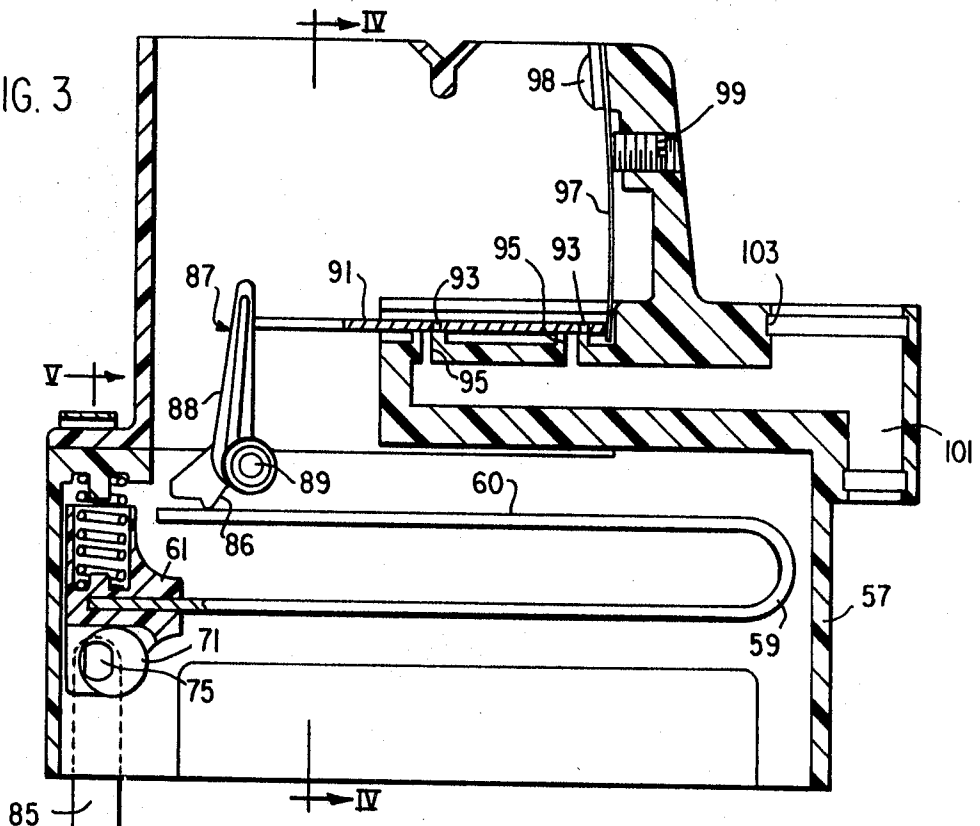


FIG. 4

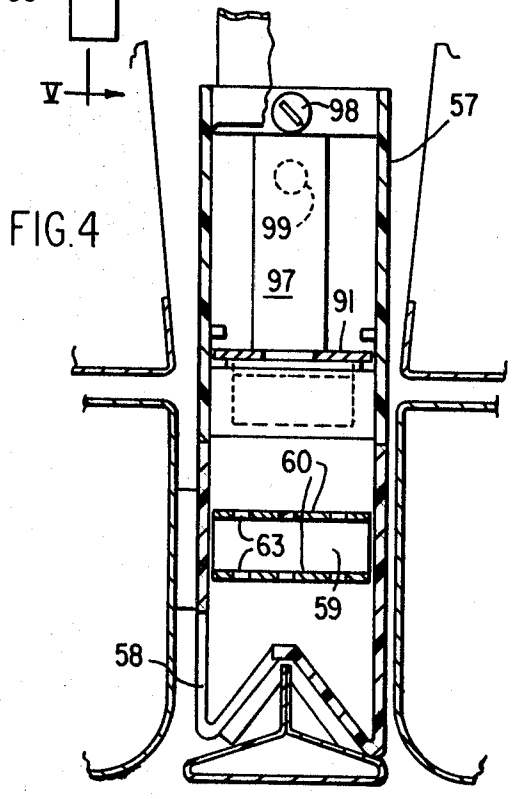
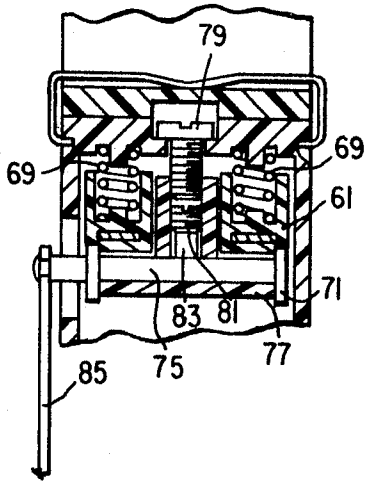


FIG. 5



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BLEED-TYPE THERMOSTAT

BACKGROUND OF THE INVENTION

In many air-conditioning installations, it is desirable to utilize air-conditioning terminals employing a portion of the conditioned air supplied thereto as a control medium to avoid the necessity of a separate control system. When a portion of the conditioned air is utilized as a control medium, the terminal can be supplied with a self-contained control system. The resulting simplification of the air-conditioning system reduces installation, maintenance and repair costs.

In order to provide an air-conditioning terminal which is as inconspicuous as possible, the exterior dimensions must be minimized while the airflow passages within the terminal must be maximized for quiet operation and maximum airflow therethrough. These design criteria may result in a minimum amount of space within the terminal for the terminal controls.

SUMMARY OF THE INVENTION

This invention relates to a ceiling air terminal employing a bleed-type thermostat adapted for use in an air-conditioning system. The thermostat, mounted within the terminal, is provided with a perforated bimetallic element. The bimetallic element, which is mounted in the thermostat housing on an adjustable support, acts on a pivot arm to slide a bleed port blocking plate relative to the thermostat bleed ports to regulate the quantity of control air bled therefrom in response to room temperature variations sensed by the bimetallic element.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic of a portion of an air-conditioning system illustrating an air terminal employing the thermostat of the present invention;

FIG. 2 is a perspective view illustrating the air-conditioning terminal of FIG. 1 installed in a ceiling with the control section thereof removed therefrom;

FIG. 3 is a cross-sectional view of the bleed-type thermostat of the present invention;

FIG. 4 is a cross-sectional view of the thermostat taken along line IV–IV of FIG. 3; and

FIG. 5 is a partial cross-sectional view of the thermostat taken along line V–V of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, there is illustrated a central air-conditioning apparatus of the type employed in large multistory buildings including a system of ductwork, a filter **5**, a cooling coil **7**, spray means **9**, a cooling coil **11**, a heating coil **13**, and a fan **15** for heating, cooling, humidifying and filtering the air as desired to provide conditioned air for passage to the areas within the building equipped with an air-conditioning system incorporating the apparatus.

A supply air duct **17** is illustrative of the plurality of ducts provided to supply conditioned air to ceiling air terminals disposed in areas throughout the building. The ceiling terminal includes a primary chamber **19** lined with a sound absorbing material **21** such as a glass fiber blanket. The primary chamber is ordinarily open at both ends for connecting a series of terminals end to end to provide a complete air discharge system. Suitable end pieces, not shown, are utilized to cap the end terminals in the series. An air supply distribution plate **23** having a plurality of collared openings **25** therein is provided to evenly distribute the supply air from primary chamber **19** into a distribution chamber **27** which is defined by the top and sidewalls of distribution plate **23**.

The bottom of distribution chamber **27** includes aligned cutoff plates **29** which are provided with a curved surface **30** for engagement by bladders **31** and **33** on an airflow control unit to form a damper. The curved surfaces smooth the flow of air through the damper to minimize the pressure drop therethrough and minimize noise generation within the terminal. The surface **30** is covered with felt **32** to further minimize noise. By varying the inflation of the bladders, the area of the openings between the bladders and the cutoff plates can be varied to regulate the quantity of air discharged into the area being conditioned.

The bladders **31** and **33** are adhesively mounted on a central partition comprised of opposed generally convex plates **35**. The plates have a V-shaped recess therein so that the bladders are completely recessed within the plates when deflated. This provides a large area between the active walls **34** of the bladders and the cutoff plates for maximum airflow therebetween. Further, the recessed bladder provides a smooth surface along the plate **35** to minimize air turbulence.

The damper mechanism is disposed a substantial distance upstream from the discharge openings in the terminal to provide sufficient space therebetween to absorb any noise generated by the damper mechanism. For maximum sound absorption, downwardly extending walls **41** which form narrow, vertical air discharge passages in conjunction with plates **35** are lined with a sound-absorbing material such as glass fiber blankets **43**. Outlet members **45** having outwardly flared lower portions **47** thereon are affixed as by welding to the walls **41**.

The damper-control module assembly illustrated in FIG. 2 is comprised of convex plates **35**, bladders **31** and **33**, and a control module **39** mounted on triangular diffuser member **37**. The control module consists of a frame **48** having filters **49** pressure regulators **51** and thermostats **53** mounted therein. The filters **49** are provided with openings (not shown) in the top surface thereof for communication with primary chamber **19** when the damper-control module assembly is inserted into the air terminal for receiving conditioned air from chamber **19**. Filtered air from filters **49** is supplied to pressure regulators **51**. Control air from pressure regulators **51** is supplied to thermostats **53** and to bladders **31** and **33**. For a complete description of the operation of the control system, reference may be had to U.S. Pat. 3,167,253, granted Jan. 26, 1965, in the names of Richard A. Church and Boris W. Haritonoff.

The illustrated control module is provided with two filters, two regulators, and two thermostats to control bladders **31** and **33** independently. This may be desired when the air terminal is disposed above a room partition for individual temperature control on each side of the partition. It should be understood that a single set of control elements could be employed to control both bladders simultaneously.

The thermostat **53** is mounted in the damper-control module assembly as illustrated in FIG. 2 to position the thermostat within the ceiling terminal as illustrated in FIG. 4. By mounting the thermostat and the associated controls in this manner, an assembly which is easily removed for cleaning, calibration, or repair, is obtained. The damper-control module assembly is extremely narrow to provide a ceiling air terminal as unobtrusive as possible. This results in a very narrow control section which must be provided with room air for the thermostat to maintain the conditioned area at the desired temperature. The thermostat must be designed so as to provide minimal resistance to the passage of room air into the control module for contact with the temperature sensing bimetallic element of the thermostat.

Referring more particularly to FIGS. 3, 4 and 5, the thermostat **53** includes a housing **57** having an opening **58** formed in the lower portion thereof for passage of room air therethrough into the interior of the housing. A U-shaped bimetallic element **59** is mounted within housing **57** on an adjustment block **61**. In order to assure maximum contact of room air with the bimetallic element and to provide a bimetallic element large enough to actuate the movable members of the thermostat, the bimetallic element **59** is provided with a plurality of perforations **63** extending throughout its axial extent in both legs **60** thereof. This allows the use of a bimetallic element having a width slightly less than the interior width of housing **57** since the room air can pass into the housing through the perforations of the bimetallic element. The perforations in bimetallic element **59** allow maximum contact between room air and ele-

ment 59 for rapid and accurate response of the thermostat to variations in room temperature. The adjustment block 61 which mounts bimetallic element 59 is slidably mounted within housing 57 for vertical movement relative thereto. Springs 69 are provided to bias block 61 against temperature adjustment cams 71 formed on adjustment shaft 75. Shaft 75 is journaled in a calibration block 77 which is secured to housing 57 by calibration screw 79. The position of calibration block 77 may be adjusted relative to the housing 57 by calibration screw 79 for reasons to be hereinafter explained. A setscrew 81 and friction block 83 are provided within calibration block 77 for frictional engagement between block 83 and shaft 75 to prevent free rotation of shaft 75 while allowing rotation thereof by rotational force applied manually or otherwise through adjustment lever 85 which is affixed to the end of shaft 75.

A lever 87 pivotable about a shaft 89, journaled in the sidewalls of housing 57, is provided to convert the vertical movement of bimetallic element 59 caused by temperature variations thereof into horizontal movement. A bleed plate 91 having openings 93 therein is provided to overlie bleed ports 95 formed within housing 57. To obtain an extremely compact thermostat, a very short bimetallic element is utilized. The lever 87 is therefore provided with arms 86 and 88 of unequal lengths measured from the pivot 89. The short arm contacts bimetallic element 59 while the long arm contacts bleed plate 91. This provides a relatively large horizontal movement of bleed plate 91 to compensate for the relatively small vertical movement resulting from the use of a short bimetallic element. To obtain the necessary force against arm 86, the bimetallic element 59 has a greater thickness than bimetallic elements normally employed in a thermostat of this type. A leaf spring 97 suitably affixed to housing 57 as by fastener 98 is provided to bias plate 91 toward lever 87. An adjustment screw 99 in housing 57 is provided to adjust the biasing force exerted by spring 97 against plate 91.

The bleed ports 95 communicate with an air passage 101 within housing 57. An opening 103 within housing 57 communicating with passage 101 is provided for receiving pressure regulator 51 to provide regulated control pressure to the thermostat bleed ports 95. The regulator communicates with the bladders 31 through suitable piping including tubes 52 and bladder connectors 54 to supply conditioned air to the bladders at a pressure less than the pressure in the primary chamber 19. Air is bled from the regulator through bleed ports 95 to provide variable air pressure at the bladders in response to temperature variations in the area being treated. For a description of a suitable pressure regulator, reference may be had to U.S. Pat. No. 3,434,409, granted Mar. 25, 1969, to Daniel A. Fragnito.

The thermostat is preferably factory calibrated by adjustment of screw 79. It can be seen by reference to FIG. 5 that rotation of screw 79 will vary the position of calibration block 77 and the adjustment shaft 75 journaled therein. This will vary the vertical position of adjustment block 61 and the bimetallic element affixed thereto and, in turn, vary the position of bleed plate 91. For comfort-conditioning installations, it is preferable to calibrate the thermostat to maintain a 75° room temperature when the lever 85 is vertically oriented. This will provide temperature adjustment range above and below 75° to suit individual temperature preferences by movement of lever 85 from the vertical position.

Considering the operation of the thermostat, temperature variations in the room air passing through opening 58 of housing 57 cause vertical movement of the free end of the bimetallic element which pivots lever 87 about shaft 89 to slide bleed plate 91 relative to bleed ports 95. This will vary the quantity of control air bled from regulator 51 which in turn will control the degree of inflation of bladders 31 to regulate the quantity of conditioned air discharged from the terminal.

It can be seen from the foregoing that a very narrow, accurate thermostat adapted for use in the control module of a ceiling air-conditioning terminal is obtained through the use of the horizontally disposed perforated bimetal and the linkages associated therewith.

While I have described a preferred embodiment of the invention, it is to be understood the invention is not limited thereto since it may be otherwise embodied within the scope of the following claims.

I claim:

1. A bleed-type thermostat comprising:

a housing;

means forming a bleed port associated with said housing;

blockage means operably associated with said bleed port for regulating the flow of air through said port;

adjustable support means mounted on said housing;

a U-shaped perforated bimetallic element, one end of said perforated bimetallic element being affixed to said adjustable support means for adjusting the location of said bimetallic element relative to said housing;

means associated with the other end of said bimetallic element for moving said blockage means in response to movement of said other end of said bimetallic element, passage of ambient air through the perforations in said bimetallic element causing movement thereof in response to ambient temperature variations to regulate the flow of air through said bleed port.

2. A bleed-type thermostat according to claim 1 wherein said blockage means comprises a bleed plate overlying said bleed port, movement of said bleed plate relative to said bleed port regulating the flow of air through said port; and

said means associated with said blockage means including motion amplifying means disposed between the other end of said bimetallic element and said bleed plate to amplify movement of said bimetallic element for positioning said bleed plate.

3. A bleed-type thermostat according to claim 2 wherein said bimetallic element is adapted for movement in a plane perpendicular to the movement of said bleed plate, said motion amplifying means including a pivoted lever having unequal length arms, the shorter arm being adapted for contact with said bimetallic element and the longer arm being adapted for contact with said bleed block.

4. A bleed-type thermostat according to claim 3 further including biasing means associated with said bleed plate to bias said bleed plate toward the longer arm of said lever.