

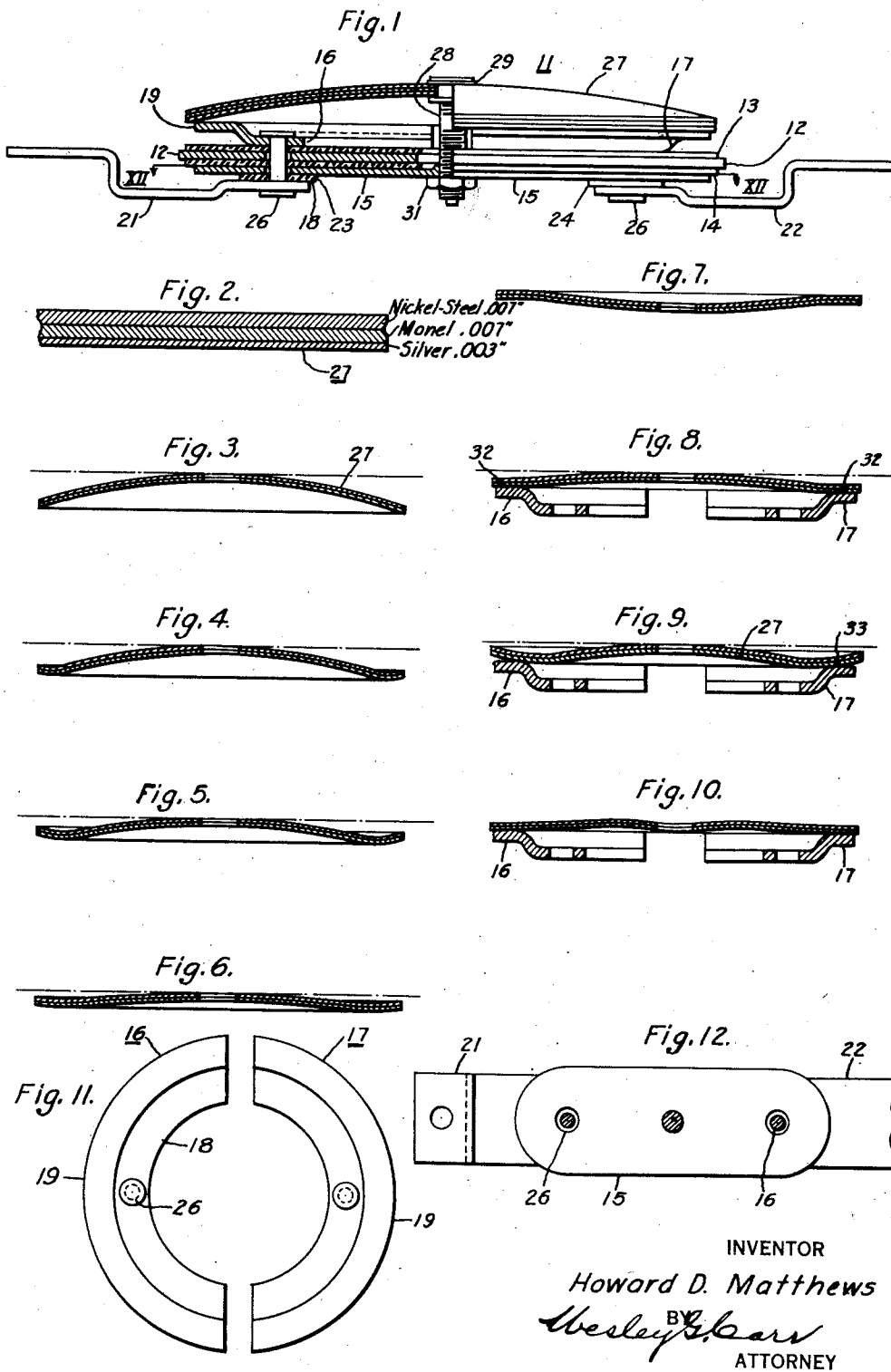
June 9, 1931.

H. D. MATTHEWS

1,809,304

THERMAL RELAY

Filed March 6, 1929



UNITED STATES PATENT OFFICE

HOWARD D. MATTHEWS, OF MANSFIELD, OHIO, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA

THERMAL RELAY

Application filed March 6, 1929. Serial No. 344,734.

My invention relates to temperature control devices and particularly to thermally actuatable switches.

An object of my invention is to provide a relatively simple, compact and highly efficient thermally actuatable switch.

Another object of my invention is to provide a thermally actuatable switch embodying a snap-acting disk constituting the current-carrying element.

Another object of my invention is to provide a snap-acting disk embodying three welded materials of which one is of relatively low electric resistance and adapted to carry the current traversing the disk.

In practicing my invention, I provide a substantially circular base plate, insulating means at each side thereof, together with a supporting bar at one side and a pair of arcuate fixed contact members on the other side, in combination with a tri-metallic cupped disk mounted at its central portion only on the supporting bar, with the edge or rim portions thereof only in engagement with the semi-annular contact members.

In the single sheet of drawings:

Figure 1 is a view, partially in side elevation and partially in radial section, of a thermal relay embodying my invention,

Fig. 2 is a fragmentary sectional view of the snap-acting disk,

Figs. 3 to 7 are sectional views of different positions of a free snap-acting disk,

Figs. 8 to 10, inclusive, are sectional views, under different conditions of operation, of a disk when associated with the other parts of the structure shown in Fig. 1.

Fig. 11 is a top plan view of the fixed contact members only and

Fig. 12 is a view, in radial section, taken through the device shown in Fig. 1 on line XII—XII thereof.

Referring more particularly to Fig. 1 of the drawings, a thermal relay 11 comprises a base plate 12 of metal having a disk 13 of electric-insulating material, such as mica, located adjacent to one surface thereof, and a second disk 14, which may also be of mica, located adjacent to the other surface thereof. A supporting box 15 is located adjacent to the outer

surface of the disk 14 and has a centrally located threaded opening therein.

Two substantially semi-annular contact members 16 and 17 are located adjacent to, and against, the outer face of the disk 13 of electric-insulating material. These substantially fixed contact members are disked, to provide an inner arcuate portion 18 which operatively engages the outer face of the mica disk 13 and an outer raised portion 19. The outer surfaces of the members 16 and 17, and particularly of the rim portions 19 thereof, are silvered in order to provide a highly conducting surface.

Contact terminals 21 and 22, of bar shape, are located, respectively, against small pieces or disks 23 and 24 of mica located against the outer surface of the supporting bar 15. A rivet 26 extends through the inner part of the terminal bar 21, the disk 23, one end of the support 15, the mica strip 14, the base 12, the second mica strip 13 and the inner portion 18 of the contact member 16. The rivet is headed over in order to hold all of these members in their proper operative positions relative to each other, it being understood that the openings provided in the supporting bar 15 and the base 12 are large enough to provide clearance between these members and the body of the rivet 26 so that the terminals and the contact members rigidly mounted on the base 12 and the bar 15 are electrically insulated therefrom.

A cupped bimetal disk 27 is loosely mounted on a stud 28 which has screw-threaded engagement with the intermediate portion of the support 15. Suitable shoulders 29 are provided at one end of the stud 28 to hold the disk 27 thereon.

The disk 27 is to be traversed by an electric current and I, therefore, make it of three welded metals, substantially as shown in Fig. 2 of the drawings. As there shown, the outer layer is of nickel steel, the intermediate layer is of the alloy called Monel metal, which is a mixture of copper and nickel, and the innermost layer is of silver, the silver having a higher electrical conductivity than the other metals. In manufacturing a disk of this kind, a bar or slab of nickel steel, containing ap-

proximately 36% to 42% of nickel, a bar of Monel metal of substantially the same thickness and a bar of silver of approximately three-sevenths of the thickness of either of the other two are welded at a relatively high temperature in any suitable or desired manner, and the resulting ingot is then rolled and heat treated until the thickness of the resulting strip is approximately .017 inches and has the proper degree of hardness for the intended purpose.

Disks are then punched out of this material of the desired diameter and are cupped to a desired degree in accordance with the operating temperature thereof, with the rolled silver surface on the concave side of the disk.

After the disk is mounted on the stud 28, it is assembled with the other members or portions of the thermal relay, and Fig. 1 of the drawings shows the disk before its initial degree of curvature or cupping has been varied by turning the stud 28 further into the central threaded opening in the bar 15. A lock nut 31 is provided on the stud 28 in order to hold it in its adjusted position.

Referring particularly to Figs. 3 to 7 of the drawings, I have there illustrated a disk 27 in various positions, as determined by a varying temperature. Fig. 3 shows the position of the disk when supported by its central portion only (the support not being shown) when the temperature is relatively low.

Fig. 4 shows the curling action of the periphery of the disk incident to an increase in the temperature. Figs. 5 and 6 illustrate the shape of the disk with increasing temperature. Fig. 6 illustrates the shape of the disk (shown, of course, schematically in section only) just before it snaps over into the shape shown in the broken lines in Fig. 7. Upon a sufficient reduction of the ambient temperature, the disk will assume the shape shown by the full lines in Fig. 7, the position there being that of the disk just before snapping back to the position or shape of Fig. 3.

Figs. 8 to 10, inclusive, show positions of the disk (shown in section, but without supporting means) when operatively associated with fixed contact members. It is obvious that any snap-acting cupped disk of this kind will have a relatively large temperature differential, when not mounted on, and operatively associated with, fixed contact members, that is, the temperatures at which the disk is actuated with a snap action from one limiting position to the other will be relatively far apart. It is possible to reduce the high or upper limit of temperature at which the disk will snap over, by screwing the stud 28 further into the supporting bar 15, whereby the disk is flattened.

Fig. 8 shows the shape of the disk when

it has been thus partially flattened and when the temperature is relatively low. It is desired to call particular attention to the fact that the point of contact (as shown in Fig. 8) is at the point designated by numeral 32.

Fig. 9 shows the same adjustment of the disk 27 but when subjected to a higher temperature, and I have found that the point of contact travels radially inwardly, as referred to any radius of the disk, so that the point of contact will be as shown by the numeral 33, that is, nearer to the inner edge of the contact members 16 and 17.

Fig. 10 shows a disk 27 when mounted on a thermal relay, as shown in Fig. 1 and when subjected to an extreme degree of flattening, in order to lower the snap-over temperature.

A snap-acting device or disk of this kind, when subjected to changes of temperature, will have initial slow movement of the disk to effect a change in its shape, these changes being shown in Figs. 3 to 7, inclusive, for a free disc and, in Figs. 8 and 9, for actual operating conditions. It is obviously highly desirable that the disk and the annular or semi-annular contact members shall have engagement under or with some degree of pressure in order to reduce the energy loss at the point of contact when traversed by an electric current. This contact pressure can be obtained and the temperature differential be reduced and I have found it possible to interrupt a circuit carrying a relatively large electric current on the order of not less than 10 amperes without danger of arcing and without deterioration of the rolled silver contact and current-conducting surface of the disk.

If oxidation should occur, the oxide of silver is electrical-conducting and there will, therefore, be little or no change in the contact resistance. I attribute a large part of the successful operation of this device to the fact that the layer of silver is welded against the Monel metal layer when all of the layers are relatively thick and that it is rolled a large number of times in order to obtain the required thinness. While I have shown a layer of rolled silver located against, and welded to, a layer of Monel metal, I do not desire to be limited to this particular combination, as other pairs of metals effective for the desired purpose may be utilized.

The initial main area of contact when the disk is cold is towards the outer peripheral rim portion of the parts 19 of the contact members 16 and 17 and this area of engagement moves radially inwardly with but slight decrease in the pressure between the two surfaces until the instant of sudden disengagement of the disk from the contact members.

The device embodying my invention thus provides a relatively simple, compact device embodying a minimum number of parts, in which a tri-metallic disc, having initial slow

movements under changes of temperature, is in direct operative engagement with semi-annular contact members, in one of its operative positions. An inwardly-moving area of contact surface is maintained until the sudden disengagement of the contacting members.

Various modifications may be made in the device embodying my invention without departing from the spirit and scope thereof and I desire, therefore, that only such limitations shall be impressed thereon as are imposed by the prior art or are set forth in the appended claims.

I claim as my invention:

1. In a thermal switch, in combination, a substantially circular base, a supporting bar insulatedly mounted adjacent to one surface of the base, a pair of substantially semi-circular, dished, contact members insulatedly mounted against the other surface of the base, contact terminals extending through the base, supporting bar and one each of said contact members to securely clamp them in proper operative positions, and a thermally-actuable cupped disk supported on said bar and having rim portions only thereof engaging the semi-circular contact members at a predetermined temperature and maintaining an inwardly-moving line of engagement therebetween with change of temperature until a sudden separation thereof occurs.

2. In a thermal switch, in combination, a substantially circular base, a supporting bar insulatedly mounted adjacent to one surface of the base, a pair of substantially semi-annular dished contact members insulatedly mounted against the other surface of the base, a pair of contact terminals, clamping members extending through the base, supporting bar and one each of said contact members and contact terminals to securely clamp them in proper operative positions, and a bimetallic disc supported on said bar and having a co-extensive layer of rolled silver welded against one surface thereof, predetermined rim portions only of the silver layer engaging the semi-annular contact members at a predetermined temperature and maintaining an inwardly-moving line of engagement therebetween with change of temperature until snap-separation of the contact members and the disc occurs.

3. In a thermal switch, in combination, a supporting bar, a pair of spaced substantially semi-circular dished contact members insulatedly supported on one face of said bar, a plural-layer thermally-actuable cupped disk having rim portions only of one face thereof operatively engaging the dished contact members at temperatures below a predetermined value, and adjustable means for supporting the cupped disk on the bar so that the radial extent of the engaging surfaces of the disk and the dished contact members de-

creases radially inwardly as the operating temperature approaches the predetermined value and snap separation of the contact members and the disc occurs at said predetermined temperature value.

4. In a thermal switch, the combination with a base, of a pair of semi-annular dished contact members insulatedly mounted thereon, and a plural-metal cupped disc mounted on said base and constituting the direct current-conducting means between the contact members over a predetermined temperature range, the line of contact therebetween moving radially inward with the initial changes of temperature to maintain substantial pressure therebetween up to the instant of snap separation when said temperature range is exceeded in one direction.

In testimony whereof, I have hereunto subscribed my name this 16th day of February, 1929.

HOWARD D. MATTHEWS.