This invention relates to an electric circuit arrangement for thermostats having pointers adapted to act as contacts and for like instruments provided with a contact pointer and two adjustable contacts, and serving for the electrical control of temperatures.

According to the present invention, the arrangement is such that when the pointer touches one contact a switching operation is initiated and continues until the pointer touches the other contact. The arrangement of the present invention differs fundamentally from the known arrangements in that both the making and the breaking of the circuit are effected by the closing of the contacts of the instrument, that is to say, the control operation is not affected when one of the two contacts opens. On this account the slipping or sliding contacts in general use are not employed, these being known to possess considerable disadvantages, because the pressure needed to establish a slip contact imposes considerable demands on the torsional strength of the measuring unit, and the resulting friction leads to inaccurate and unreliable indications. It is also known that, in measuring instruments, slip and sliding contacts give rise to working troubles, also because parts of the track traversed by the contact member are scorched due to the inevitable sparking, as a result of which the passage of the current is impeded. Moreover, slip and sliding contacts necessitate a complicated construction of the instrument when the control is to be adjustable over the whole or a large portion of the scale.

In the arrangement of the present invention, on the contrary, simple mutually insulated contact levers, with simple setting mechanism are arranged on the glass front of the instrument, enabling the adjustment to be made to any desired point. Whereas, in all the known circuit arrangements, the opening of the contacts is a major operation, it no longer plays any part in the arrangement of the present invention. It is known that opening the contacts is the main cause of their premature wearing out, and the reason for the unreliability of present-day contact instruments. This is due to the destruction of the contacts by the considerable liberation of heat arising from sparking in breaking the circuit. The intensity of the sparking for a given current strength increases with the increase in voltage on the interruption of the current. In circuit arrangements in which the control operation is put into action by opening the contacts, an alteration in the value of the main circuit voltage occurs. With the arrangement of the present invention, on the contrary, only a slight change of voltage, if any, occurs in the circuit on the contacts being opened, and consequently, the burning of the contacts is very considerably reduced, and in some cases practically suppressed. In the known circuit arrangements attempts were made to reduce sparking by interposing condensers between the contacts. Applicant has found that this increases the force required to separate the contacts for instantaneous interruption. Applicant’s explanation being that the condensers cause the contacts to be loaded with a static charge. Since this additional force can only be generated in measuring instruments by an increased initial voltage in the measuring unit, the pointer jumps when the contacts are opened, resulting in a considerable oscillation of the pointer and fluctuation in the control operation. For this reason an arrangement of this kind is unsuitable where accurate control is desired, in which event there must be no jumping of the pointer.

For this reason, such an arrangement is inapplicable when accurate control is required and the pointer must not jump. According to the present invention, condensers are provided which serve, not for protecting the contacts of the instrument, but to prevent disturbance being set up by the installation, in order that the operation of the contacts may not cause any inconvenience to neighboring broadcast receptions and also protect the working contact. Since, on this account, the condensers do not lie parallel to the instrument contacts, the aforesaid inconveniences also disappear. It is characteristic for the circuit arrangement that the temperature recorder or thermostat lies in series with the resistance of the relay, on contact being made with the one limiting pointer, but parallel with the resistance of the relay when in contact with the other limiting pointer. The value of the resistance can be so selected that the switching entails a minimum of current consumption in the control circuit, the invention accordingly also meeting practical requirements in respect of economy, and constituting, in technical respects, a considerable improvement in the sphere of arrangements for switching contact instruments by reason of its reliability, simplicity and ease of inspection. A further advantage of the invention consists in that the pointer instrument can be set up separately from the relay. Thus, the relay can be situated in the immediate vicinity of the current consumer, the heavy-current wire between them...
being unnecessary. Owing to the small control current, the wire connecting the instrument to the relay may be of small cross section. Moreover, in consequence of this local independence of the two parts, control operations also can be performed in a simple manner.

In order more clearly to understand the invention reference is made to the accompanying drawing, which illustrates by way of example, two embodiments thereof and in which:

Fig. 1 is a diagrammatic representation of one embodiment; and

Fig. 2 shows a second embodiment.

Both figures represent the circuit arrangement for an electric radiator, the control operation of which is assumed to keep the heat of a room within a given range of temperature. Obviously, any other control operation could also be performed by means of said circuit arrangements, for example, the controlling of an electromotor driving a compressor, a pump, a fan, a valve, slide or the like. Moreover, a magnet or other electrical apparatus can be controlled instead of an electromotor.

In Fig. 1. A denotes the contact instrument or thermostat with the contact pointer $t_1$ and the two contact levers $t_2$ and $t_3$. B denotes an electric switch unit, in the present case a thermo relay having a heavy-current contact $k$ of which is laid mounted on a bimetallic strip and is actuated by the hot wire $h$ and connects the electric radiator $C$ across the main $r$ - $s$, or switches it off therefrom. Instead of a thermo relay, any other relay or a corresponding electric switch unit may also be employed. The circuit arrangement consists in connecting the two contact levers $t_2$ and $t_3$ to separate lines, or $r$ of the electric mains, whilst the contact pointer $t_1$ is connected to the resistance $w_l$. The other terminal of $h$ is connected to the hot wire $h$ and the resistance $w_l$. The second terminal of $h$ is connected with the resistance $w_l$, the second terminal of the latter being connected to the line $r$. The second terminal of $w_l$ is connected to the wire leading from the heavy-current terminal through the radiator $C$ to the line $r$. The second terminal of the heavy-current contact $k$ leads to the line $s$.

It is a characteristic feature of the arrangement of the present invention that the resistances are switched by the play of the contacts so that in all cases two resistances alternately are connected in parallel, one of which then serves as a joint series resistance, for example, $h$ and $w_l$ in the drawing being regarded as one resistance. Only when the contact pointer is open and the heavy-current contact closed, are the resistances $w_l$ and $w_2$ in series. The rational values of the resistances are a matter of simple calculation so that switching requires a minimum consumption of current in the control circuit, and therefore the arrangement of the present invention also satisfies practical requirements from the economic standpoint, whilst from the technical point of view, its reliability, simplicity and ease of supervision represent a considerable improvement in circuit arrangements for contact instruments.

For example, the contact lever $t_2$ is set on $8^\circ$ of the scale, and the contact lever $t_3$ on $27^\circ$ of the scale, the control operation in the example represented proceeds in such a manner that when the contact pointer $t_1$ touches the contact $t_2$, current is switched on to the radiator, which latter is switched off when the contact pointer $t_1$ touches the contact lever $t_3$. When $t_1$-$t_5$ are in contact, the course of the current is as follows:

The current from the line $s$ flows through the closed contact $t_1$-$t_5$ and by way of the resistance $w_l$ to the terminal $g$ where it divides. The heating current flows through $h$ and $w_l$ to the line $r$. The other branch of the current flows from the terminal $g$ through $w_l$ and also to the line $r$. The resistances $w_l$ and $w_2$ are so calculated that sufficient current for heating the relay now flows through $h$. By this means, the contact $k$ is closed, and a current now flows from the line $s$ through the radiator $C$ and to the line $r$. The heating of the room now proceeds and, in consequence, the contact pointer $t_1$ moves towards the right, thus separating from the lever $t_2$ and breaking the contact $t_1$-$t_5$. The path taken by the current in the control circuit is now as follows:

A current flows from $s$ through the contact $k$, resistance $w_l$, $h$ and $w_2$ to the line $r$. In this case also, the heating current is so calculated as to maintain the relay in the operative condition so that the radiator $C$ continues to function. Consequently, the temperature of the room continually increases until finally the contact pointer $t_1$ touches the contact lever $t_3$. In these circumstances a current flows from the terminal $g$ through the contact $t_1$-$t_5$, the resistance $w_l$ and $w_2$ and the contact $k$ to $s$. At the same time a current flows from $r$, through $w_2$, $h$, $w_2$ and $k$, to $s$. However, the heating current now flowing through $h$ is so small that it can no longer maintain the relay in the operative condition, the contact lever $t_3$ being consequently interrupted and the radiator $C$ disconnected from the main. The temperature of the room becomes cooler, and the contact pointer $t_1$ moves away in the dead circuit from the lever $t_1$, so the room becomes colder. The contact pointer $t_1$ bears against the contact lever $t_2$ and the cycle recommences. Each of the condensers $w_l$ and $w_2$ is connected with a contact lever and a line of the mains circuit and they serve chiefly for preventing disturbance to broadcast.

In the embodiment shown in Fig. 2, the contact $t_5$, with the resistance $w_l$ is applied to the line $s$, whilst the contact $t_5$ is applied to the terminal $g$ of the energizing resistance $h$. The contact $t_1$ is connected to the common terminal $t$ of $h$ and $w_l$, this latter being applied to the line $r$. The point $g$ is in electrical connection with the terminal $m$ of the resistance $C$. For the protection of the contact $k$, a condenser $u$ is provided in parallel therewith. In this arrangement, the working operation is similar to that according to Fig. 1. On $t_5$-$t_5$ being closed, a current flows through $w_l$, and $t_2$-$t_3$ to the point $i$, where it divides. One branch of the current flows through $w_l$, the other through $h$ and the loading resistance $C$ to the line $r$. The second branch current energizes the resistance $h$ and closes the contact $k$, so that a working current now flows from the line $s$, through $k$, $m$, and $C$, 65 to the line $r$. Said working current also passes when the contact $t_1$ is closed, the resistance $h$ still remains energized by the current flowing from the line $r$, through $w_l$ to $t_3$, and hence to $m$, by way of the contact $k$, to the line $s$. On the contact $t_1$-$t_5$ being closed, $h$ becomes dead, because the contact $t_1$-$t_5$ is now in parallel with $h$. By this means, the contact $k$ is opened and the working current interrupted.

The relay may be housed in the interior of a
cylindrical former on the outside of which the various resistances of the circuit arrangement are wound. By this means the relay is protected in a simple and reliable manner and also a saving in space is effected in the construction of the apparatus.

I claim:

1. In the controlling circuit for an electric current consuming device, a source of electric current, a thermostat having an angularly movable contact member responsive to temperature changes, a graduated temperature scale on said thermostat, contacts on said thermostat and adjustable along said scale, connections between said current consuming device and said source of electric current, a switch in one of said connections, a thermal relay operating said switch, connections between said source and each of said adjustable thermostat contacts, a connection between said movable contact member and said thermal relay, a current-limiting resistance included in one of said connections, a connection between said thermal relay and one of said connections to said current consuming device, and a connection through a current-limiting resistance between said thermal relay and said source of electric current.

2. In the controlling circuit for an electric heater, a source of electric current, a thermostat having an angularly movable contact member responsive to temperature changes, a graduated temperature scale on said thermostat, contacts on said thermostat and adjustable along said scale, direct connections between said heater and said source of electric current, a switch in one of said connections, a thermal relay operating said switch, direct connections between said source and each of said adjustable thermostat contacts, a connection including a resistance between said movable contact member and one end of said thermal relay, a connection including a resistance between the said end of said thermal relay and one of said connections to said heater, and a connection including a resistance between the opposite end of said thermal relay and said source of electric current.

3. In the controlling circuit for an electric heater, a source of electric current, a thermostat having an angularly movable contact member responsive to temperature changes, a graduated temperature scale on said thermostat, contacts on said thermostat and adjustable along said scale, direct connections between said heater and said source of electric current, a switch in one of said connections, a thermal relay operating said switch, a connection including a resistance between said source and one of said adjustable thermostat contacts, a connection between one end of said thermal relay and the other of said adjustable thermostat contacts, a connection between the first mentioned end of said thermal relay and one of said connections to said heater, and a connection including a resistance between the opposite end of said thermal relay and said source of electric current.

4. In the controlling circuit for an electric heater, a source of electric current, a thermostat having an angularly movable contact member responsive to temperature changes, a graduated temperature scale on said thermostat, contacts on said thermostat and adjustable along said scale, direct connections between said heater and said source of electric current, a switch in one of said connections, a thermal relay operating said switch, a connection including a resistance between said source and one of said adjustable thermostat contacts, a connection between one end of said thermal relay and the other of said adjustable thermostat contacts, a connection between said movable contact member and the opposite end of said thermal relay, a connection including a resistance between the opposite end of said thermal relay and said source of electric current.

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