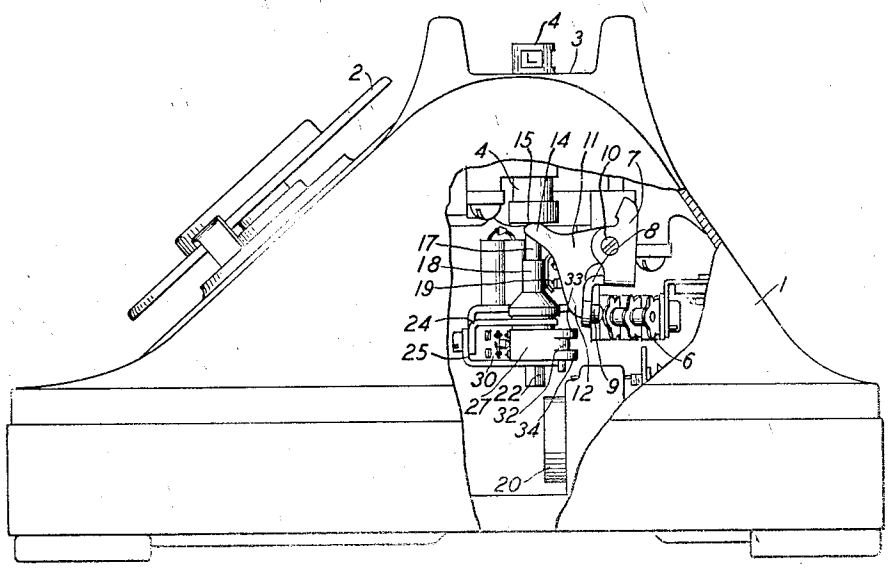
May 18, 1943. C. F. SPAHN, JR 2,319,754

ELECTRICAL CONTACTING DEVICE

Filed Nov. 29, 1940 2 Sheets-Sheet 1

FIG. 1



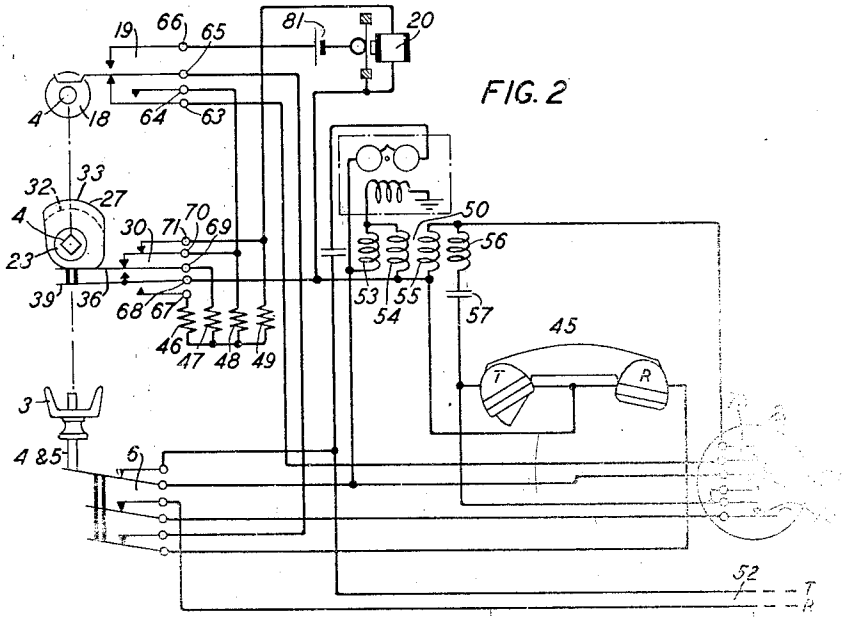


FIG. 2

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FIG. 3

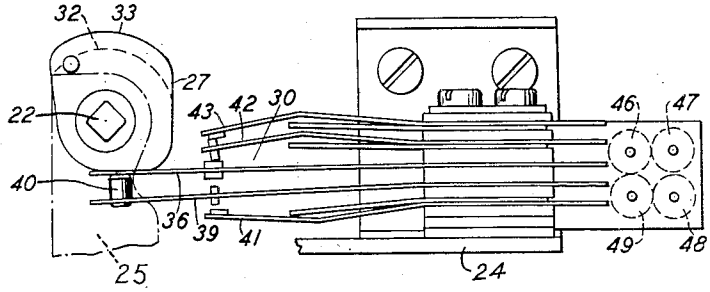


FIG. 4

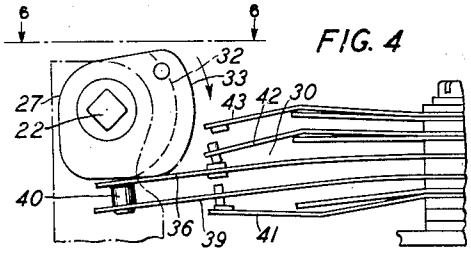


FIG. 5

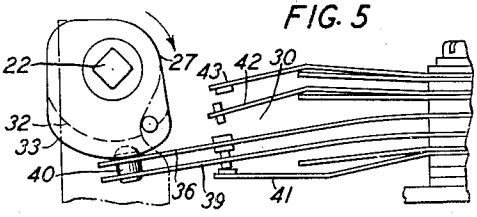


FIG. 7

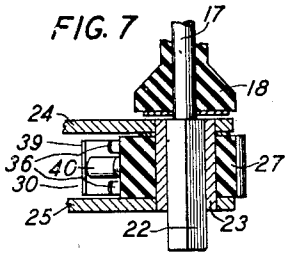
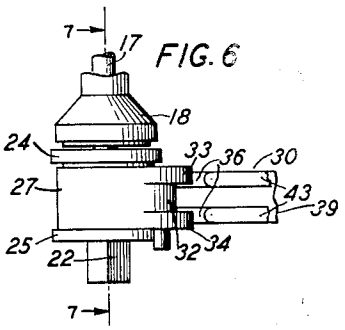


FIG. 6



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Patented May 18, 1943

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UNITED STATES PATENT OFFICE

2,319,754

ELECTRICAL CONTACTING DEVICE

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Application November 29, 1940, Serial No. 367,699

6 Claims. (Cl. 200—1)

This invention relates to electrical contacting devices and particularly to improvements in the operating mechanisms of such devices.

An object of the invention is to improve the construction of electrical contacting devices and particularly to simplify the manipulation and increase the utility of such devices.

Heretofore mechanisms have been provided for use for example in telephone apparatus such as telephone sets for controlling electrical contact switching devices to increase the utility of such sets by having buttons or plungers that may be rotated to various degrees to control contacts to establish desired circuit conditions. An example of a telephone set in which such plungers may be used is disclosed in a copending application by D. H. King, Serial No. 367,679, filed Nov. 29, 1940. In this telephone set a plunger mechanism is inserted in the cradle of the handset which may be lifted to control spring contacts to cut in or cut out an amplifying device in a telephone circuit. This plunger may also be rotated to different positions to operate contact to control volume control devices to cause various corresponding effects of the amplifying device on the receiver output.

It is a feature of the present invention to provide an electrical contacting device comprising a group of contact springs arranged in a single pile-up and a rotary member whereby two of said springs may be actuated in unison or independently during the rotation of said member to make or break connections between all of the springs in different combinations corresponding to different angular rotary displacements of said member.

The present invention may be incorporated in control systems such as those above-mentioned, but it should be understood that it is not limited to such use but may be applied in any electrical contact controlling mechanism where contacts may be variously operated.

The invention has been illustrated in the accompanying drawings in which Fig. 1 shows a typical telephone subscriber's desk set with a portion of the housing removed to show the details of the applicant's invention as applied in this set;

Fig. 2 shows a typical circuit diagram that may be employed in connection with the applicant's invention as applied to this type of desk set;

Fig. 3 is a bottom view of the applicant's invention comprising a plunger and cam mechanism and spring combination that may be employed in this set;

Figs. 4 and 5 show the applicant's invention as in Fig. 3 except that the cam mechanism has been shown operated to actuate the contact springs in different combinations;

Fig. 6 is a side view of the applicant's invention showing the plunger and cam mechanism and a part of the spring combination; and,

Fig. 7 is a cross-section taken on lines 7—7 of Fig. 6.

Referring now to the drawings, Fig. 1 shows a typical telephone set comprising a housing 1, a dial 2 mounted thereon and a cradle 3 containing among other apparatus a plunger 4 which forms part of the applicant's invention extending upwardly in the cradle in the position the plunger would occupy when the usual handset is removed from the cradle. For the various details in regard to the complete telephone set that may be employed in connection with the applicant's invention, reference may be made to the above-mentioned application by D. H. King. This telephone set, according to King, may have in addition the plunger 4 of this general type another plunger 5 in the cradle shown diagrammatically in Fig. 2. This other plunger 4 controls the usual switching contacts such as 6 for connecting up the telephone to a line. These switching contacts 6 are operatively associated with a cradle member 7 through an extension 8 and an insulation stud 9 so that when the handset is removed from the cradle the switching springs 6 are closed as shown in Fig. 2. On a shaft 10 on which the member 7 is mounted, there is also mounted a separate operating member 11 having an extension 12 normally engaging the extension 8 of the operating member 7 and through an extension 14 a shoulder 15 on the plunger 4 so that the plunger 4 will be raised slightly as shown in Fig. 1 when the handset is removed from the cradle. The plunger 4 and associated mechanism may therefore also be employed for operating the switching contacts 6. This plunger 4 may in addition be used for controlling an amplifier and sound volume control device in accordance with the King application. For this purpose the plunger 4 is connected to a shaft 17. On this shaft is slidably mounted an insulating bushing 18 for controlling a set of contacts 19 partially shown in Fig. 1 and in detail in Fig. 2. This bushing has a cone shaped lower portion for controlling the contacts 19 when the plunger 4 is lifted. The contacts 19 may be employed for inserting and removing the amplifier 20 from the telephone circuit shown in Fig. 2. Shaft 17 at its lower end is enlarged and of a square cross-

section as shown at 22 and this enlarged portion 22 is slidable in a metal bushing 23 which is journaled to rotate in a support comprising brackets 24 and 25 secured to the housing. On the bushing 23 is mounted a cam 27 between the brackets 24 and 25 so that the rotation of the shaft 17 will rotate the bushing 23 and the cam 27 while this shaft may be removed longitudinally in the bushing 23. This cam 27 may be employed to control the sound volume control springs 30. These springs are insulatedly mounted on the bracket 24 which in turn is mounted in the housing 1.

The Figs. 3 to 7, show the construction details and the operating characteristics of the plunger 4, the cam 27 and its operating parts and the springs 30. The plunger element 4 may be rotated from a normal position to either of two other positions. The normal position at the plunger in regard to its rotary movements is shown in Fig. 1. This position is marked by the letter L, while the other positions to which the plunger 4 may be rotated may be marked correspondingly by letters M and H, to indicate low, medium and high control positions of the volume control springs 30 for regulating the amplification of the amplifier 20 accordingly. The cam 27 may be shaped to comprise a central portion 32 and two outer identical portions 33 and 34, these three portions being shaped as shown in Figs. 3 to 7. The spring element 36 may be bifurcated as shown in Figs. 6 and 7 and adapted to engage the surfaces of cam portions 33 and 34 with its respective members and will consequently be engaged by and controlled by these surfaces as the cam is rotated from the normal position in the clockwise direction as indicated in Figs. 3 to 5. On the other hand the spring element 39 is provided with a button or knob 40 of insulation material that is adapted to engage the surface of cam portion 32 by passing between the two bifurcated members of the element 36. In Fig. 3 the springs 30 are in their normal relation with spring element 39 in a position in relation to element 36 so that it will not engage element 36 nor will it engage the spring element 41, while the spring element 36 is so located that it will engage spring element 42 and cause this element 42 to engage spring element 43. In Fig. 4 the cam 27 has been shown rotated 45 degrees in a clockwise direction from the position shown in Fig. 3. In this case both spring elements 36 and 39 have been moved downwardly but they are still in position not to engage each other but element 39 now engages element 41 and element 36 still engages element 42 while element 43 has been separated from element 42. In Fig. 5 the cam 27 has been shown rotated in a clockwise direction a further distance of 45 degrees from the position shown in Fig. 4. In this case the element 36 will be moved further downwardly, whereas element 39 will be free to move upwardly and come into engagement with the element 36 as the knob 40 will enter the space between the surfaces of the cam portions 33 and 34 towards the surface of cam portion 32. In this position element 39 will still engage element 41 and in addition engage element 36 so that these elements 36, 39 and 41 are connected electrically. However, as element 36 has been moved further downwardly, it will separate from the element 42 which of course is still separated from element 43.

The operation of these sound volume control springs 30 in this manner will now be described in connection with the circuit diagram of Fig. 2. As stated, the applicant's invention may be employed in a telephone set in which an amplifier such as 20 is employed for amplifying the output of the receiver by manipulation of the plunger 5 to control springs 19 and 30. To this end, Fig. 2 has been included to illustrate a circuit arrangement in which the applicant's invention may be applied. It should be understood, however, that the applicant's invention is not limited for use in such an arrangement but may be readily applied to any switching system in which various combinations of switching positions of contact springs may serve other purposes. Fig. 2 shows a typical circuit arrangement and is similar to that disclosed in the above-mentioned copending application to D. H. King. However, a description of this circuit may be included as follows. In this Fig. 2 if the handset 45 is removed from the cradle at 3, the plunger 4 as well as the plunger 5 operating switching contacts 6 will be raised a short distance to permit the switching contacts 6 to operate to connect the telephone set to the line 52. In this case the amplifier contacts 19 are arranged to normally have the amplifier disconnected. The transmitter circuit extends from the tip conductor of the line 52, switching contacts 6, windings 53 and 54 of the induction coil 50, the transmitter, contacts 75 of dial 2, switching contacts 6 to the ring conductor of line 52 and the receiver circuit extends from the receiver, switching contacts 6, contacts 65 and 63 of the springs 19, contacts 73 of the dial 2, winding 55 of the induction coil 50, back to the receiver, and an inductive path through the coils 55 and 56 of the induction coil 50, condenser 57, and the transmitter back to the coil 55. Normally the amplifier 20 will therefore not be included to effect the output of the receiver. If, on the other hand, it is desired to include the amplifier 20 in the receiver circuit, the operator will lift the plunger 4 to operate the contact springs 19 and if the plunger 4 is not rotated to include any of the resistances 46 to 49 in the receiver circuit to modify the receiver output, the amplifier would effect the receiver output to amplify it to the fullest capacity of the amplifier. The circuits for the receiver and the amplifier would then be traced as follows. From the receiver, switching springs 6, contacts 65 and 66 of the springs 19, battery 81, carbon button and diaphragm of the amplifier 20, back to the receiver and other circuits through the winding of the amplifier 20, contacts 71 and 70 of the springs 30, contacts 64 and 63 of the springs 19, contacts 73 of the dial 2, winding 55 of the induction coil 50 back to the winding of the amplifier 20. Thus the speech current as induced in coil 55 of the induction coil 50 from the line 52 would energize the coil of the amplifier 20 accordingly and effect the circuit through the receiver, carbon button and diaphragm of the amplifier 20 over the circuit described to amplify the sound output of the receiver accordingly. As none of the resistances 46 to 49 are included in the circuit for the coil of the amplifier at this time, the amplifier would operate at its full capacity, that is a so-called high amplification would be produced in the receiver.

If it is decided to have the amplifier included but with medium amplifying effect on the receiver output, the plunger 4 may be rotated at an angle of 45 degrees to operate the spring 30 into the positions shown in Fig. 4. In this case the amplifying circuit would extend from the coil

20, winding 55 of the induction coil 50, contacts 73 of dial 2, contacts 63 and 64 of springs 19, resistances 48 and 49 in series back through the winding 20 with resistance 47 in parallel with resistance 48 through contacts 70 and 69 of springs 30 and resistance 46 in parallel with coil 20 and resistance 49 through contacts 67, 68 of springs 30. Thus this arrangement causes the amplifier 20 to be effected by speech currents at a medium rate and consequently the receiver circuit will be correspondingly effected to amplify the current at the corresponding medium rate.

On the other hand if it is desired to have the amplifier included but with a lower or minimum amplifying effect on the receiver output, the plunger 4 would be rotated another 45 degrees to operate the springs 30 into the position shown in Fig. 5. In this case the amplifier circuit extends through the coil 20, induction coil winding 55, contacts 73 of dial 2, contacts 63 and 64 of springs 30, resistances 48 and 49 in series, back to coil 20 and with resistances 46 and 47 in parallel through contacts 69, 67 and 68 of springs 30 across the coil 20 and resistance 49. This arrangement causes the amplifier coil to be effected by speech currents at a lower rate and correspondingly the receiver circuit will be similarly effected to amplify the speech accordingly. A person who desires to have the speech currents amplified can therefore by lifting the plunger 4 and rotating it from the normal to the other positions cause the amplification to be correspondingly modified to produce corresponding amplifying requirements, while other persons such as secretaries that employ the telephone more frequently and do not require amplification may use the telephone without any manipulations of the plunger 4.

What is claimed is:

1. In a contacting device, supporting members, a group of contact making springs insulatedly mounted in a single pile-up on one of said supporting members, a cam mounted between two of said supporting members, an operating member rotatably mounted between said two supporting members for actuating said cam in different rotary positions, one of said springs being provided with an aperture, a stud member on another of said springs extending through said aperture, said first-mentioned spring and said stud member arranged in engagement with said cam, all of said spring members being so arranged and the cam so cut that all of said springs will make or break contact with each other in different combinations corresponding to different angular rotary displacements of said cam.

2. In a contacting device, supporting members, a group of contact making springs insulatedly mounted with one spring on top of another on one of said supporting members, a cam member mounted between two of said supporting members and having a slotted control portion of a different eccentric surface formation from that of the non-slotted portion of said cam, an operating member mounted between said two supporting members and extending through said cam for the rotation thereof in various positions, a stud on a first one of said springs, a second one of said springs engaging directly the non-slotted cam surfaces of said cam and the stud engaging the surface of the slotted portion of said cam, all of said springs and said cam surfaces being so arranged at different angles of rotary positions of said cam that said surfaces will cause said first spring through the stud and said second spring to be displaced in relation to each other and to the remaining springs so as to make or break contacts between them as controlled by said cam surfaces in said different respective positions.

3. In a contacting device, supporting members, a group of contact-making springs insulatedly mounted with one spring on top of another on one of said supporting members, a cam mounted between two of said supporting members, an operating member mounted between said two supporting members for displacing said cam to different angular positions, said cam and a pair of said springs being so arranged to cooperate during certain angular displacements of the cam that one of the springs of said pair is displaced by said cam to open a connection between two other springs and the other spring of said pair is displaced to make a connection with another spring and that during certain other angular displacements of the cam, said first-mentioned spring of said pair is displaced by said cam to open a connection between itself and one other spring and to establish a connection between itself and said other spring of said pair.

4. In a contacting device, supporting members, a group of contact springs insulatedly mounted in a single pile-up on one of said supporting members, a cam mounted between two of said supporting members, an operating member mounted between said two supporting members and extending through the cam for the rotation thereof to different angular positions, a pair of said springs engaging surfaces on said cam when in a normal position to keep said pair of springs from contacting with each other, said surfaces being further so shaped that when the cam is rotated to a first position by said operating member, said pair of springs will move in unison to control individual connections with other springs and so that when said cam is moved to a second position by said operating member, one of the springs of said pair will be moved independently to contact with the other spring of said pair and to control independent connections with other springs.

5. In a contacting device, supporting members, a set of flat contact-making springs insulatedly mounted in a single pile-up with one flat spring on top of another on one of said supporting members, a cam mounted between two of said supporting members, an operating member mounted between said two supporting members and extending through the cam for the rotation thereof to different rotary positions, said cam having two identical cam surfaces and an intermediate cam surface partially coinciding with said two cam surfaces and partially of a different radial distance from the axis of rotation, one of said springs having a bifurcated end with each prong engaging a corresponding cam surface of said two identical surfaces, a stud on another of said springs projecting between said prongs and engaging the intermediate cam surface when said cam is in a normal position and in a first advanced rotary position, said cam surfaces being so related that when the cam is rotated from said normal to said first position by said operating member, said two springs will be moved outwardly from the axis of rotation in unison an equal distance while other springs of the pile-up are so adjusted that said two springs when thus moved will control said other springs to make or break connections between them, said cam surfaces being further so related that when the cam

is rotated from said first position to a second position by said operating member, the bifurcated spring is moved further away from the axis of rotation and engages the spring provided with the stud to make electrical connection therewith and so that the stud on said spring will not be controlled at this time by the intermediate surface of the cam, said bifurcated spring in its fully advanced movement causing other connections to be opened between other springs in the pile-up.

6. In a contacting device, supporting members, a group of contact-making thin flat springs arranged with one spring on top of the other for flexing in one direction, means for insulatively holding said springs at one end thereof in fixed relation to each other on one of said supporting members, a shaft mounted at right angles to said springs near the free ends of said springs and between two of said supporting members, a cam on said shaft mounted between said two supporting members for rotation by said shaft from a normal to a first and a second angular position for controlling a pair of said springs to flex in the same direction, said cam having a cam surface so cut that when the cam is rotated by said shaft from the normal position to the first position, said pair of springs are moved the same distance in the same direction simultaneously and independently by said cam surface to control independently connections with other springs in the group, said cam having other cam surfaces so cut that when the cam is rotated by said shaft from said first position to said second position one of said springs is moved by said cam surfaces further in the same direction to make contact with the other spring of said pair and control further connections with other springs in the group.

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