

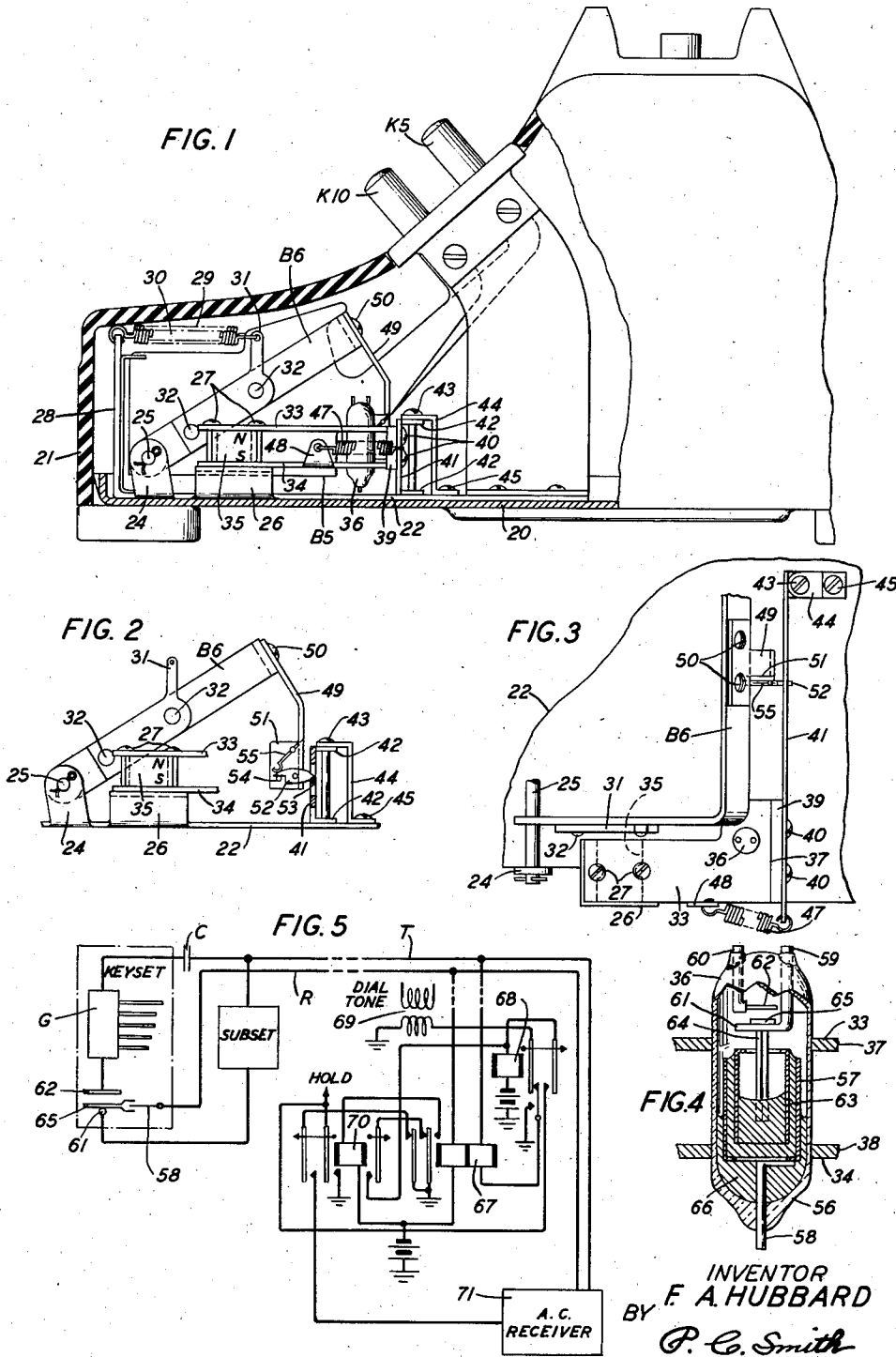
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TELEPHONE CALL TRANSMITTER

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TELEPHONE CALL TRANSMITTER

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8 Claims. (Cl. 179—90)

This invention relates to telephone call transmitters and is an improvement over the telephone call transmitter disclosed in an application filed in the name of R. F. Mallina, March 22, 1940, Serial No. 325,347.

In the transmitter described in that application a set of key members is used for actuating U-shaped bars in predetermined combinations for releasing normally pretensioned vibrative elements in similar combinations, by the operation of latch members or pawls normally holding the vibrative elements in their pretensioned positions, the operation of the vibrative elements in the magnetic field of a generator being effective to transmit signals corresponding to the numerical values of the successively operated key members.

In the transmitter of the Mallina application a U-shaped pivotally mounted bar is held by a retractile spring in operable relation to each of the ten digit key members so that when any one of the key members is depressed, such bar is operated to cause the operation of off-normal contacts which are instrumental in disconnecting the talking circuit of the subset from the line extending to the central office and in connecting the field winding of the generator with the line. Thus during the time that any key member is held depressed, the generator is held connected to the line and the talking circuits of the subset are rendered ineffective.

In the circuit disclosed in Patent 2,232,398, granted on February 18, 1941, to A. A. Lundstrom, it has been proposed to provide the substation set with a copper-oxide rectifier bridge which in conjunction with the application to the line at the central office of current of a particular polarity serves in effect to disable the talking equipment of the subset when the generator is being employed under the control of the keyset key members to transmit digit signals over the line.

There are some conditions, particularly in step-by-step type dial systems, in which it is difficult to provide that the same battery potential shall always be used on incoming calls, which would preclude the effective use of substation equipment of the type disclosed in the aforementioned patent. An off-normal contact arrangement such as is disclosed in the application of Mallina, above referred to, could be used in such step-by-step systems but such contacts would disrupt the talking circuit to the central office for an unduly long period each time a keyset key is depressed,

whereby the established connection might become released.

It is therefore the object of the present invention to provide a simple and efficient off-normal switch mechanism whereby the talking equipment of the subset is disabled and the signaling generator is enabled upon the depression of any keyset key for a timed interval of only sufficient duration to enable the transmission of the digit signal by the generator.

A further object of the invention is to provide substation equipment so arranged that during the signaling interval there is no direct current bridge of the line at the subset through the transmitter and no circuit through the receiver and therefore no possibility of any interference between the talking and signaling circuits of the subset.

A further object of the invention is to provide substation equipment so arranged that the usual type of dial tone may be transmitted to the substation upon the initiation of a call and prior to the start of keying but which dial tone is readily removed as soon as a digit key is depressed to transmit the first digit signal.

These objects are attained by the provision of a timed mercury contact switch element of the transfer type disclosed, for example, in Patent 2,295,602, granted September 15, 1942, to C. E. Pollard, Jr., which switch element is arranged upon its operation to be fast to break its back contact and to make its front contact, but upon its release to be slow to break its front contact. For controlling the operation of the switch element, it is mounted in aligned holes in two parallelly disposed pole-pieces secured to the opposite polar ends of a permanent magnet. Normally the flux generated by the permanent magnet is shunted away from the magnetic circuit through the switch element by a soft iron armature normally held under the tension of a spring and also by magnetic attraction in engagement with the ends of the pole-pieces. To permit the operation of the switch element, the armature is mounted to be cammed out of engagement with the ends of the pole-pieces by a cam member pivotally mounted on the end of an arm secured to the U-shaped off-normal bar which is depressed whenever any one of the ten digit keys of the keyset is operated. The cam member is so pivoted with respect to a stop pin and to an associated leaf spring that the member only momentarily moves the armature away from the pole-pieces during the depression movement of any key but moves idly when the off-normal bar is restored by its associated retractile spring upon

the release of the operated key without recamming the armature away from the pole-pieces. The tubular armature of the switch element is thus attracted only momentarily during the depression of a digit key to transfer the line loop from the talking equipment of the subset to the generator but since the switch element is of the type which is slow to open its front contact and slow to close its back contact following the release of its armature the generator is maintained connected to the line loop and the subset is disconnected from the loop only for the interval determined by its slow-to-release characteristic.

To further insure that there shall be no undesirable direct current bridge across the line loop through the generator at the substation, a condenser is interposed between that conductor of the line loop which is not disassociated from the generator by the off-normal switch assembly and one terminal of the generator, thus during the time that the generator is being operated to transmit a signal, the severing of all direct current bridges at the subset may be utilized to discontinue the usual dial tone and as a signal that the voice frequency signals may be expected.

For a clearer understanding of the invention, reference may be had to the following detailed description taken in connection with the single sheet of drawings in which:

Fig. 1 is a side elevation of the telephone call transmitter embodying the invention, the casing being shown with a portion broken away;

Fig. 2 is a side elevation of the off-normal switch assembly with a portion thereof broken away to disclose the operating cam member;

Fig. 3 is a top plan view of the off-normal switch assembly and a portion of the off-normal U-bar;

Fig. 4 is a side view partly in cross section of the mercury switch element constituting a part of the off-normal switch assembly; and

Fig. 5 is a circuit diagram showing the application of the off-normal switch thereto.

The transmitter to which the invention is applicable is provided with a base 20 having upturned edges to which the molded casing 21 is attached. Secured to the base 20 is a mounting plate 22 having upturned ears 23 and 24, of which only ear 24 is disclosed, for supporting a shaft 25 on which the key members K1 to K10, inclusive, are pivotally mounted; an upturned and then intumed bracket 26 on the horizontal intumed end of which the off-normal switch assembly is secured as by screws 27; and an upturned plate 28. Ten key members K1 to K10 are provided but only two of such members K5 and K10 appear in the drawing. Each of the key members is normally and yieldably maintained in the position disclosed by a retractile spring 29, each of which springs is hooked at one of its ends to a key member and at the other of its ends to the upper edge of the plate 28.

Also pivotally mounted on the shaft 25 are five U-bars B1 to B5, inclusive, only the bar B5 appearing in the drawing, which are operable in different combinations upon the depression of the key members to pluck the vibrative reeds of the generator G, disclosed schematically in Fig. 5, in the manner fully described in the Mallina application hereinbefore referred to. Inasmuch as the present invention is not specifically concerned with the reed plucking mechanism, such mechanism has not been disclosed.

Also pivotally mounted on the shaft 25 is a U-shaped off-normal bar B6 which is held in

operable relation with each of the ten key members, such as K5 and K10, by a retractile spring 30 which is hooked at one end to the arm 31 secured by rivets 32 to one arm of the bar B6 and hooked at its other end to the plate 28.

The off-normal switch assembly secured to the bracket 26 has two parallelly disposed pole-pieces 33 and 34 clamped at one of their ends to the opposite pole-faces of a permanent bar magnet 35 by the screws 27. The pole-pieces 33 and 34 are L-shaped, as disclosed in Fig. 3, and have aligned holes in their inwardly extending arms in which the mercury contact switch element 36 is positioned. Cooperating with the end faces 37 and 38 of the pole-pieces is a soft iron armature 39. The armature is secured in any desired manner as by screws 40 to the outer end of a member 41, the inner end of which is provided with parallelly disposed ears 42 by which such member is pivotally supported on the pivot screw 43. The screw 43 extends through a hole in the bracket 44 secured to the mounting plate 22 by the screw 45, through aligned holes in the ears 42 of the member 41 and into a threaded hole in the plate 22. For holding the armature 39 normally in engagement with the pole faces 37 and 38 of the pole-pieces 33 and 34, a retractile spring 47 is hooked at one end to the outer end of member 41 and at its other end to the ear 48 extending upwardly from the outer edge of the pole-piece 34.

For camming the armature 39 away from the pole faces of the pole-pieces, the off-normal bar B6 is provided with a depending arm 49 secured thereto in any suitable manner as by screws 50, the lower end of which is provided with a portion 51 bent at right angles therefrom to lie in a vertical plane. Pivotaly secured to the portion 51 of arm 49 is a cam member 52, the camming portion of which, as disclosed in Fig. 2, extends through an opening in the member 41 and engages with the upper edge of a camming portion 53 of the member 41. Normally the other end of cam member 52 is held against the stop pin 54 secured to the portion 51 of arm 49 by a leaf spring 55 also secured to the portion 51.

The mercury contact switch element 36 of the off-normal switch assembly, as previously stated, may be of the type disclosed in the patent to Pollard hereinbefore referred to, having an envelope 56 of glass or other suitable material within which is a guide sleeve 57 entirely open at its upper end and partially closed at its lower end to add rigidity thereto and supported on and secured to the upper end of terminal wire 58. The wire 58 is sealed through the bottom of the envelope 56. The guide sleeve 57 is made of a material such as nickel which is wettable by mercury. Sealed through the upper end wall of the envelope are two parallelly disposed contact members 59 and 60 having their ends which extend into the envelope bent at right angles toward each other to form two stationary contact portions 61 and 62, the upper one 62 of which serves as a front contact and the lower one 61 of which serves as a back contact. The contact portion 62 is wide but the contact portion 61 is narrow. Movable within the guide sleeve 57 is a cylindrical tubular armature 63 the ends of which are entirely open. The armature is made of magnetic material but its surfaces are such that they are readily wetted by mercury. Secured to the inner surface of the armature and movable therewith is a contact member 64 which may be formed by doubling a length of wire, bending the looped

end at right angles and flattening the same to provide a widened contact portion 65 for engagement with the contact portions 61 and 62 of the back and front contact members 59 and 60. A contact of this type has the property of conducting mercury along the capillary ducts formed therein to its upper contact portion from which a small amount of mercury is transferred to the surfaces of the contacts with which it cooperates.

To complete the switch element a measured amount of mercury 66 is deposited in the bottom of the envelope. The envelope is then evacuated, refilled with a gas such as hydrogen to a required operating pressure and then sealed. With the measured amount of mercury in the envelope, the mercury rises within the guide sleeve 57 and within the tubular armature 63 to the positions illustrated in Fig. 4 and the mercury is also conducted by the capillary action of the inner surface of the guide sleeve 57 and the outer surface of the armature 63 to fill the entire space between such surfaces. The surface tension of the mercury between the upper edges of the guide sleeve 57 and armature 63 and the surface tension of the mercury within the armature exerts a downward pull upon the armature to normally hold the contact portion 65 firmly against the contact 61 of the back contact member 59. The mercury within the armature also engages the lower end of the contact member 64 whereby mercury is carried along such member to its upper contact portion 65 and in the normal position of the armature to the contact portion 61 thereby establishing a mercury contact between the contact members 65 and 61 and thus between the terminal wire 58 and the back contact member 59.

When the armature 39 of the off-normal switch assembly is cammed away from engagement with the pole-pieces, most of the flux generated by the permanent magnet 35 is permitted to pass through the armature 63 of the switch element and the armature rises within the guide sleeve 57 to center itself within the magnetic field thus created, but will be restrained by the pull of the surface tension of the mercury pool and the surface tension of the film between the armature 63 and the sleeve 57, but this restraint is not so great but that the film of mercury between the contact portion 61 of the back contact member 59 and the contact portion 65 of the armature contact member 64 will disrupt quickly since the cross-sectional area of the film adjacent to the contact portion 61 is small. The armature will therefore move the contact portion 65 of the contact member 64 quickly out of engagement with the contact portion 61 of the back contact member 59 and into engagement with the contact portion 62 of the front contact member 60. Mercury adhering to the contact member 65 is now transferred to the front contact member 62 to establish a film of mercury therewith.

Since the armature 39 is cammed away from the pole-pieces 33 and 34 only momentarily, it is quickly restored to establish a low reluctance shunt of the armature 63 of the switch element whereupon with the magnetic pull on the armature 63 greatly reduced the surface tension of the mercury pool tends to pull the armature 63 back into its normal or retracted position, but since the contact areas of the contact portions 62 and 65 are both relatively large, the film of mercury between them will persist unbroken due to mercury drawn into the film up the ducts of the member 64 while the armature 63 moves in its retractive movement under the influence of its weight and

the surface tension of the mercury pool until the film finally breaks whereupon the contact portion 65 snaps quickly into engagement with the contact portion 61 of the back contact member 59. This switch element therefore effects a quick make and a slow break of its front contact closure which break should be in the order of 30 or 40 milliseconds and a quick break and slow make of its back contact closure.

The application of the improved call transmitter to a telephone system has been schematically illustrated in Fig. 5 in which the box marked "Subset" illustrates the usual talking equipment of the substation instrument and the apparatus within the dot-dash rectangle illustrates the key-set equipment of the substation instrument including the signal generator G having five selectable reeds pluckable in different combinations by the key members of the keyset and the contacts 61, 62 and 65 of the off-normal switch assembly. One terminal of the generator G is connected to the tip conductor T of the substation line through the condenser C and the other terminal is disconnected from the ring conductor R of the line at the normally open contacts 62 and 65. The subset is normally bridged across the tip and ring conductors of the line through the normally closed contacts 61 and 65.

When the subscriber lifts the handset from the cradle of the substation instrument, a circuit is established through the subset and over the line which in the usual manner is instrumental in causing a line finder at the central office to find the calling line and to cause the extension of a connection from such line to an idle central office sender which may be employed to control the establishment of a connection from the calling line in accordance with the digits of a called line number keyed by the calling subscriber. Upon the establishment of a connection from the calling line to the sender, a circuit is established from battery through the left winding of relay 67 over the ring conductor R of the line through the subset, contacts 61 and 65 of the off-normal switch assembly, tip conductor T of the line, through the right winding of relay 67 and over the normal contacts of relay 68 to ground through the primary winding of the dial tone coil 69. Relay 67 thereupon operates and establishes an obvious circuit for slow-to-release relay 70 which operates to close the usual holding circuit for the sender. The calling subscriber also receives dial tone transmitted from the dial tone coil 69 over the previously traced circuit to inform him that he may proceed to key up the wanted subscriber's number.

Upon the depression of a key in accordance with the first digit of the wanted line number, the off-normal bar B6 is operated thereby moving cam member 52 carried thereby downwardly and, since the cam member engages with the upper edge of the cam portion 53 of the armature supporting member 41, such cam member tends to rotate in a counter-clockwise direction. Since, however, the cam member 52 is prevented from rotating in a counter-clockwise direction by the stop pin 54, the cam member is effective in its downward movement to cam over the cam portion 53 and thereby move the member 41 to move the armature 39 carried thereby away from its bridging engagement with the pole-pieces 33 and 34. The armature 63 of the switch element 36 is thereupon quickly moved to a position in which the contact portion 65 is disengaged from the contact 61 of the back contact member 59 and is

engaged with the contact portion 62 of the front contact member 60. The loop circuit through the subset is now opened and the keyset generator G is bridged across the substation line through the condenser C.

With the direct current bridge of the line now interrupted, relay 67 releases but relay 70 being slow to release remains operated for an interval determined by its slow-to-release characteristic whereby the circuit of the dial tone removal relay 68 is established from ground over the inner left back contact of relay 67, over the right contact of relay 70 through the winding of relay 68 to battery. Relay 68 upon operating locks over its outer contacts to ground over the inner left contacts of relay 70, disconnects the primary winding of the dial tone coil 69 from the previously traced circuit through the right winding of relay 69 and substitutes a direct ground connection therefor. A circuit is also established at this time over the outer back contact of relay 67 and the outer left front contact of relay 70 to prepare the receiving circuit 71 for receiving signals transmitted by the generator G in response to the keying of digits of the wanted line number.

As the cam member 52 continues its downward movement in response to the depression of the keyset key, it moves past the cam portion 53 of the member 41 thereby permitting the spring 47 to restore the member 41 to reengage the armature 39 with the pole-pieces 33 and 34. The armature 63 of the switch element 36 being now magnetically shunted by the armature 39 tends to retract to its normal position and to move the contact portion 65 out of engagement with the contact portion 62 of the front contact member 60 but this retraction is delayed sufficiently by the retarded breaking of the mercury film between such contact portions as to insure that sufficient time is allowed to permit the generator G to transmit the alternating current signal under the control of the depressed key of the keyset. As soon as the mercury film becomes sufficiently attenuated it erupts and the contact portion 65 moves into engagement with the contact portion 61 thereby disconnecting the generator G from the line and reconnecting the subset therewith. Relay 67 is thereupon reoperated to reestablish the circuit of relay 70. The interval during which relay 67 is thus deenergized is not sufficient to permit the release of relay 70 so that the holding circuit of the sender is maintained closed.

When the depressed key is released, the off-normal bar B6 is restored to normal by the spring 30 thereby raising the cam member 52, the end of which now engages the lower edge of the cam portion 53 of the member 41 and the cam member 52 is thus caused to rotate in a clockwise direction against the tension of spring 55 without camming the member 41 out of its normal position. The armature 39 carried by the member 41 therefore remains in engagement with the pole-pieces 33 and 34 during the restoring movement of the operated key and off-normal bar B6 and the off-normal switch is not reoperated.

The use of the timed mercury off-normal switch assembly thus eliminates the copper-oxide rectifiers from the subset; avoids the necessity of a particular polarity of the central office battery during conversation as was necessitated when rectifiers were used; permits the use of the ordinary dial tone and its removal when

signals are being transmitted by the generator; simplifies the equipment for receiving the voice frequency signals, which equipment has heretofore required separate detecting circuits to recognize the presence of key signals, by providing an independent indication through the release of relay 67 of the sender while relay 70 remains operated that signals are to be expected and minimizes the possibility of false operation or distortion of signals.

What is claimed is:

1. In a telephone system, a subscriber's line and a substation on said line comprising a telephone subset, a key-controlled multifrequency current generator, and a transfer switch operable in response to the depression of any key to first disconnect said subset from said line, to thereafter connect said generator to said line for a predetermined interval regardless of the length of time the key is held depressed and to then reconnect said subset to said line.

2. In a telephone system, a subscriber's line and a substation on said line comprising a telephone subset, a key-controlled multifrequency current generator, a condenser and a transfer switch assembly operable in response to the depression of any key to first disconnect said subset from said line, to thereafter connect said generator through said condenser to said line for a predetermined interval regardless of the length of time the key is held depressed and to then reconnect said subset to said line.

3. In a telephone system, a subscriber's line and a substation on said line comprising a telephone subset, a key-controlled multifrequency current generator and a transfer switch assembly including a mercury contact switch operable upon the depression of any key to first disconnect said subset from said line, to thereafter connect said generator to said line for a predetermined interval regardless of the length of time the key is held depressed and to then reconnect said subset to said line.

4. In a telephone system, a subscriber's line and a substation on said line comprising a telephone subset, a key-controlled multifrequency current generator and a switch assembly for transferring said line from said subset to said generator, said assembly comprising a magnetic circuit including a permanent magnet, a magnetically controlled switch included in said magnetic circuit, a shunt of magnetic material normally positioned to shunt flux generated by said magnet away from said switch, and means controlled by the depression of any key for moving said shunt to permit the operation of said switch.

5. In a telephone system, a subscriber's line and a substation on said line comprising a telephone subset, a key-controlled multifrequency current generator and a transfer switch assembly including a mercury contact switch element operable to first disconnect said subset from said line, to thereafter connect said generator to said line for a predetermined interval and to then reconnect said subset to said line, and means for controlling a single timed cycling of said switch element in response to the depression of any key and irrespective of the length of time said key is held depressed.

6. In a telephone system, a subscriber's line and a substation on said line comprising a telephone subset, a key-controlled multifrequency current generator and a switch assembly for transferring said line from said subset to said generator, said assembly comprising a magnetic

circuit including a permanent magnet, a magnetically controlled mercury switch element included in said magnetic circuit, and a shunt of magnetic material normally positioned to shunt flux generated by said magnet away from said switch element, and a cam member operable only in response to the depression movement of any operated key to momentarily move said shunt away from said magnetic circuit to permit the operation of said switch element.

7. In a telephone system, a subscriber's line and a substation on said line comprising a telephone subset, a key-controlled multifrequency current generator and a switch assembly for transferring said line from said subset to said generator, said assembly comprising a magnetic circuit including a permanent magnet, a magnetically controlled mercury switch element included in said magnetic circuit and a shunt of magnetic material normally positioned to shunt flux generated by said magnet away from said switch element, an off-normal bar in said keyset operable upon the depression of any key, and a cam member associated with said bar operable upon the operation of said bar to momentarily cam said shunt away from said magnetic circuit to permit the operation of said switch element, but inoperative to cam said shunt away during the restoring movement of said bar.

8. In a telephone system, a subscriber's line and a substation on said line comprising a telephone subset, a key-controlled multifrequency current generator and a transfer switch assembly comprising a magnetic circuit including a permanent magnet, two parallelly disposed pole-pieces connected to the pole faces of said magnet and having aligned holes therethrough, a mercury switch element supported in said holes having an armature, a contact member carried thereby and fixed front and back contact members, said armature upon its attractive movement moving its contact member quickly out of engagement with said back contact member into engagement with said front contact member and upon its retractive movement moving its contact member out of engagement with said front contact member after a predetermined interval, and a shunt of magnetic material normally positioned to shunt flux generated by said magnet away from the armature of said switch element, and means controlled by the depression of any key for momentarily moving said shunt whereby said armature is momentarily attracted and released to transfer said line from said subset to said generator for a predetermined interval and to then transfer said line back to said subset.

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