Dec. 25, 1956 H. C. HARRISON 2,775,662

ELECTRICAL KEY

Filed Nov. 4, 1952 3 Sheets-Sheet 1

FIG. 3

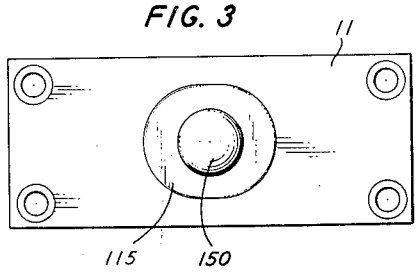


FIG. 1

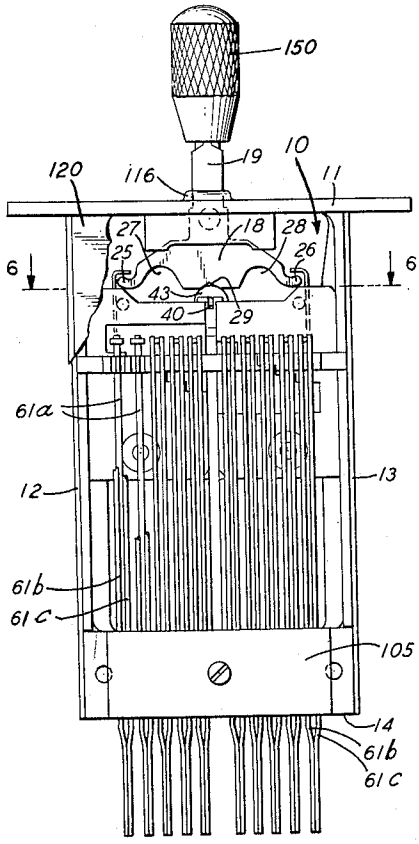
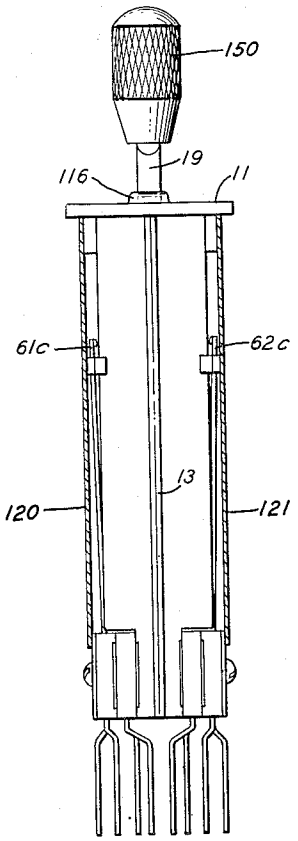


FIG. 2



INVENTOR
H. C. HARRISON
BY John E. Carrick
ATTORNEY

Dec. 25, 1956 H. C. HARRISON 2,775,662

ELECTRICAL KEY

Filed Nov. 4, 1952 3 Sheets-Sheet 2

FIG. 4

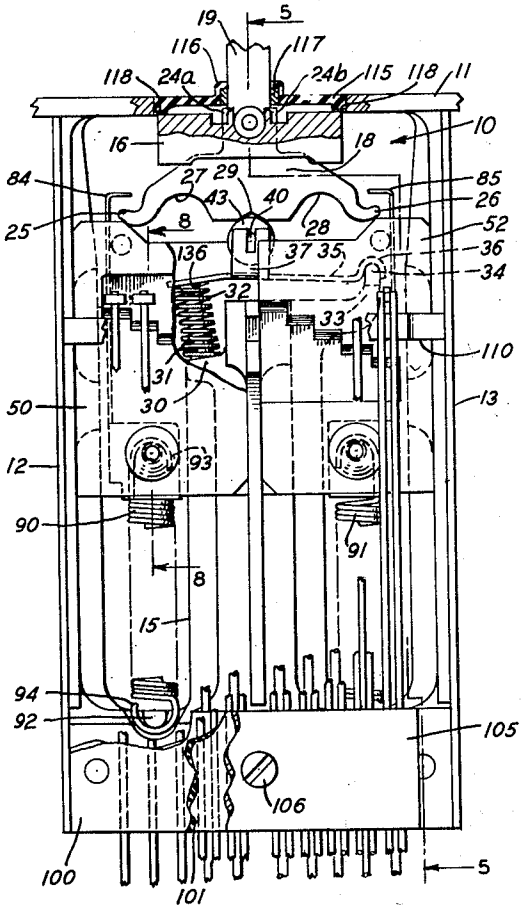
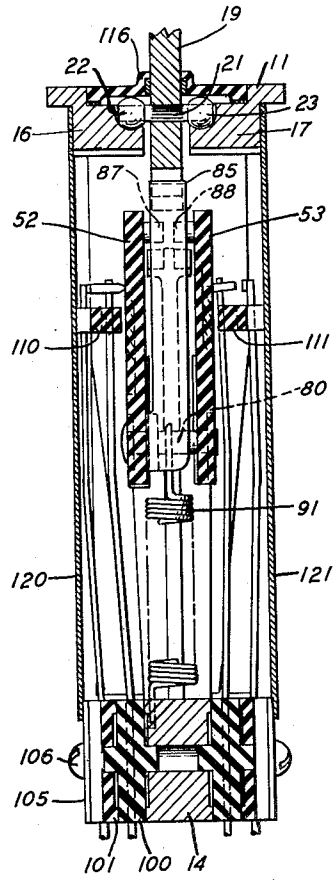


FIG. 5



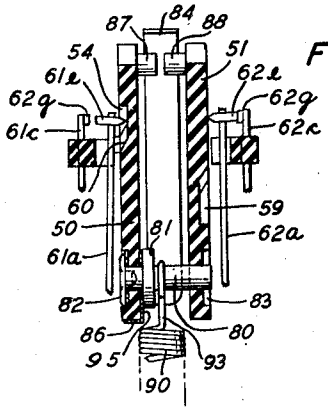


FIG. 8

INVENTOR
H.C.HARRISON

BY John E. Cassidy

ATTORNEY

Dec. 25, 1956 H. C. HARRISON 2,775,662

ELECTRICAL KEY

Filed Nov. 4, 1952 3 Sheets-Sheet 3

FIG. 6

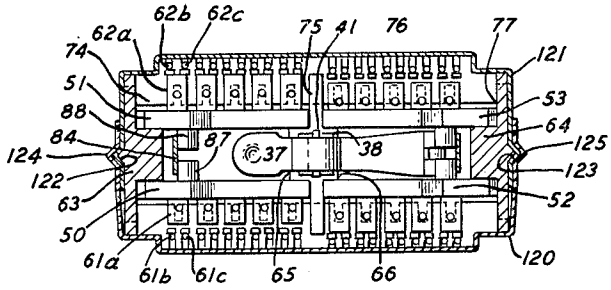
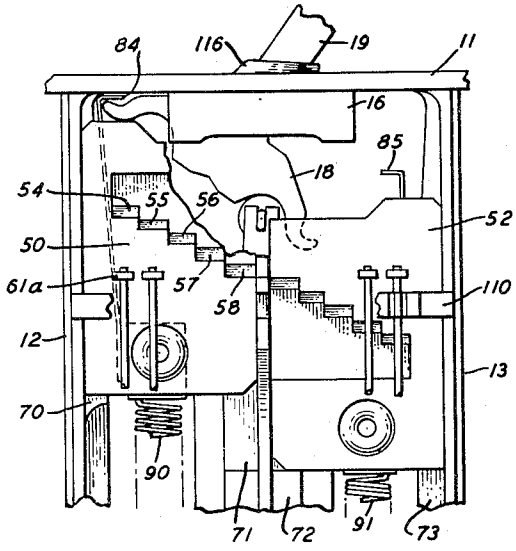


FIG. 7



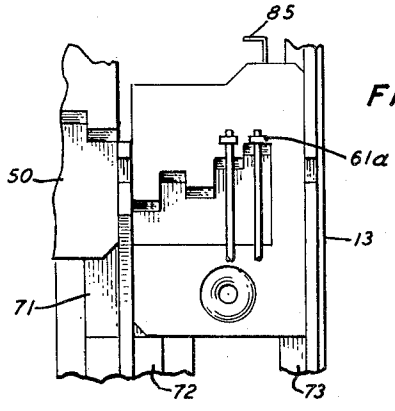


FIG. 9

INVENTOR
H. C. HARRISON
BY John E. Cassidy
ATTORNEY

United States Patent Office 2,775,662 Patented Dec. 25, 1956

2,775,662

ELECTRICAL KEY

Henry C. Harrison, Port Washington, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application November 4, 1952, Serial No. 318,718

3 Claims. (Cl. 200—1)

The present invention is an improved electrical key type switch for use in establishing and breaking the flow of electrical current in a circuit.

An object of the invention is the improvement of electrical switches.

In its essence the switch of the present invention is an arrangement comprising a plurality of sets of contacts and means for actuating them in any predetermined sequence and in any predetermined time relationship, the latter within limits fixed by the time of operation of the key.

These are various means well known in the art for performing the foregoing functions all of which are more expensive relative to the present arrangement. Many thousands of devices to perform these functions are required in the electrical industry annually, particularly in the communications branch of the industry, where the present arrangement will be introduced widely, because of its economy.

The present key switch features a contact actuating element displaceable in a plane substantially parallel to the plane of the longitudinal axis of wire springs on which electric contacts are mounted. The displaceable element may have an irregular surface, the irregularities registering with the juxtaposed formed wire springs to actuate the springs and the contacts carried on the springs to cause the contacts to make and break with other adjacent contacts. The displaceable element may be slidable or rollable on a uniplanar track or in a recessed way, for instance, and may be actuated, for instance, by a lever, plunger, rotatable button, or other means as desired through a suitable linkage. In the present embodiment a lever type actuator is employed to control a slideable element which moves in longitudinal uniplanar guide ways. However, it is to be understood that the invention is not so limited and the employment of plunger and the other types of actuator for the displaceable element is contemplated.

The pattern of the surface irregularities of the displaceable element may take any desired form. For instance, in its simplest form the irregularities may be identical depressions or identical protuberances on the sliding or rolling element in such alignment as to actuate the springs registering therewith to open or close their individual contacts simultaneously. The irregularities may be disposed so as to actuate the opposed wire springs in an ordered sequence in which the time spacing between the actuation of sequentially actuated springs is uniform or non-uniform. The surface irregularities of the displaceable element may be so disposed that in response to a single actuation of the lever or plunger, for instance, all, or certain, of the contacts controlled by the springs may be opened and closed or closed and opened a plurality of times. Obviously instead of providing irregularities on the surface of the displaceable element, the indentations and protuberances may be formed in the wire spring per se and the displaceable element may be provided with a single common projection or a plurality of projections as

desired to engage the formed springs so as to actuate them in any desired pattern.

A feature of the invention resides in a construction wherein the spring mounted contact elements are operated to contacting position and vice versa by being actuated in a direction substantially at right angles to the plane in which the camming elements move.

Another feature consists in a construction wherein a sequence of spring mounted contact elements are moved to open or closed position in a predetermined consecutive order by actuation of the key operating member and to closed or open position in a converse consecutive order by restoration of the key operating member.

The coadjuvant result of these two features produces a key which is far less susceptible to erroneous opens or closures of contacts or erroneous sequences of opens or closures of contacts incident to variable adjustments of the fixed or movable contact elements than is the case with keys of usually employed known construction.

Another feature resides in a key including the above-mentioned and other desirable features which may be designed to be mounted and fit in the space provided for keys of commonly used known construction.

The invention may be understood from the following description when read with reference to the associated drawings which taken together disclose an exemplary and presently preferred embodiment in which the invention is incorporated. It is to be understood, however, that the invention is not limited to incorporation in the exemplary embodiment, but may be incorporated in others such as outlined in the foregoing or suggested by the present disclosure to those skilled in the art.

In the drawings, Fig. 1 is a front elevation of the key with the cover broken away to disclose certain of the details;

Fig. 2 is a right-hand end view of the key, with the key casing shown in section;

Fig. 3 is a top view of the key;

Fig. 4 is an enlarged front elevation of the key, partly in section and with portions broken away;

Fig. 5 is an enlarged vertical sectional view of the key on a plane through 5—5 of Fig. 4;

Fig. 6 is a horizontal sectional view of the key through 6—6 of Fig. 1;

Fig. 7 is an enlarged view of a portion of Fig. 1 showing the actuating element or key handle in one of its limiting positions when the key handle lever is fully actuated clockwise or toward the right;

Fig. 8 is an enlarged view partly in section showing two displaceable elements or slides, portions of two sets of wire springs and their cooperating contacts, one of which contacts is closed and one of which is open as a result of the camming action of the irregular surface of the displaceable elements; and

Fig. 9 shows another displaceable element having its irregular surface arranged in a particular pattern, and different from that of Fig. 4, to afford a different predetermined sequence and time relation of contact actuation.

Refer now to Figs. 1, 2, 3, 4, 5 and 6. In the figures, a key frame 10 is shown which may, for instance, be an aluminum die casting and preferably an integral unit. For purpose of description the frame may be considered to comprise a horizontal top plate 11, a left vertical end piece 12, a right vertical end piece 13, a bottom horizontal crosspiece 14, a vertical center post 15, shown best in Fig. 4, projecting upwardly from the crosspiece 14 and extending approximately two-thirds way to the top plate 11. Projecting downwardly from the top plate 11, at its middle portion, and integral with it, are a front and a rear substantially rectangular, top center block 16 and 17, respectively, their inner faces being spaced one from another to form an opening to permit limited rotation of

the lower enlarged portion 18 of the handle, which handle may be of hard brass, for instance, and has integral therewith and part thereof a vertical stud 19, which may be machine threaded along a portion of its length to receive a cap 150 of hard rubber or other insulating material.

The handle has projecting therethrough a shaft 21, best seen in Fig. 5, which may be of steel and the center portion of which may be knurled, for instance, so that when the shaft is pressed into a circular opening in the handle it forms an integral unit. The two ends of the shaft 21 project into circular openings drilled in balls 22 and 23, which may be of bronze, for instance, and which serve as sockets or bearings in which the handle is rotatable. The center blocks 16 and 17 have substantially hemispherical indentations formed therein to accommodate the bronze balls. Each of the center blocks 16 and 17 is provided with vertically projecting tabs, such as 24*a* and 24*b*, formed in block 16. The tabs in each block may be crimped around its respective bronze bearing, such as 22, after the handle and the bearings are inserted, so as to lock the handle assembly in position while permitting its rotation in the bearings.

The enlarged lower portion of the handle is provided with two projecting toes 25 and 26 on its left and right ends respectively. The lower periphery of the lower portion of the handle has an irregular contour, being provided with two large, substantially semicircular indentations 27 and 28, to the left and right respectively of a smaller central arcuate indentation 29.

The center post 15 has on its left-hand side near its top a projection 30 at the top of which projection is a cylindrical button 31 the longitudinal axis of which is inclined upwardly slightly toward the left. The button 31 is inserted in and serves to secure the lower portion of a helical spring 32. The center post 15 has also near its top a projection 33, extending to the right, formed in the upper portion of which projection is a vertical riser 34, the top of which riser is formed into a half-cylinder with its longitudinal axis extending in a direction from front to rear as seen in Fig. 4. A detent arm 35 which may be a formed flat strip of steel has its right-hand end 36 formed to conform with the half-cylindrical surface on the top of vertical riser 34. The cylindrical surface may have a projection registering with a slot punched in the coacting surface of the detent arm to prevent lateral movement of the arm. The left-hand end of arm 35 has depressed therein a hemispherical button 136 projecting downwardly into the axial opening of the upper convolutions of spring 32, so that the spring is locked in position between cylindrical button 31 and hemispherical button 136. At the middle portion of detent arm 35, and along its front and rear edges, two generally rectangular ears are formed, one individual to each edge, which ears extend upwardly. One ear 37 is shown in Fig. 4, on the front edge of detent arm 35 and an identical ear 38, the top of which is indicated in Fig. 6, is on the rear edge of detent arm 35. A rectangular opening 40 is formed in the middle portion of the top edge of each of ears 37 and 38. The openings are in alignment. Supported in the openings, such as 40, is a cylindrical pin 41, the front and rear ends of which are formed into reduced rectangular projections to conform to the openings, such as 40, in the front and rear ears 37 and 38, to lock the cylindrical pin 41 in position. The pin 41 projects through an axial opening in a cylindrical roller 43, which rotates freely on the pin 41. The roller 43 is normally urged into engagement with the arcuate central indentation 29 in the bottom surface of the handle, by means of spring 32, which tends to rotate the left-hand end of detent arm 35 clockwise, in a limited arc about the half-cylindrical surface of the top of riser 34, thus pressing the top surface of roller 43 against the surface of central arcuate indentation 29.

When cap 150 and lever 19 are actuated to the right in a clockwise rotation, the lower portion 18 of the handle is rotated to the left in a clockwise direction about shaft 21 as a center. Roller 43 is pressed downwardly, imparting its motion through its pin 41 and the projecting ears 37 and 38 to the arm 35 which rotates in a counterclockwise direction about the top of riser 34 as a center. Spring 32 is compressed to permit the motion. As the handle continues in its motion the roller 43 of the detent arm follows the contour of the bottom right-hand portion of the lower portion 18 of the handle until the roller is located substantially concentrically in the half circular indentation 28 which serves to prevent further clockwise rotation of the handle. The handle, cap 150 and lever 19 may be actuated to the left in a counter-clockwise direction to rotate the lower portion 18 of the handle to the right in a counter-clockwise direction about shaft 21. In this case, as should be understood from the foregoing, semicircular indentation 27 serves as the limiter to prevent further rotation beyond an extreme permissible position of rotation.

The handle lever therefore may be locked in a predetermined extreme clockwise and counter-clockwise position. It is apparent that the lower surface of the bottom portion 18 of the handle may have a different contour, if desired, to provide a locking condition for one direction of operation and a non-locking condition for the opposite direction of operation. If the handle is required to be non-locking in both positions the detent assembly, that is the detent arm, spring, roller and pin may be omitted.

The handle actuates the slide assemblies which include the slide elements having irregularities on their surfaces which elements in turn actuate the wire springs carrying the contacts. How this is performed will now be described.

The slides or displaceable elements 50, 51, 52 and 53 are best shown in Figs. 6, 7 and 9. There are four slides arranged in two slide unit assemblies. Slides 50 and 51 are combined with other elements in one integral unit, to be described hereinafter, which is actuated as a first slide unit assembly on the left side of the key.

Slides 52 and 53 are combined with other corresponding elements, in a second integral unit, which is actuated as a second slide unit assembly on the right side of the key.

Centrally located between the front and rear edges of the end pieces 12 and 13, projecting inwardly toward the center post 15, and extending substantially along the lengths of the end pieces 12 and 13 and integral with the end pieces are projections 63 and 64 respectively of substantially rectangular section. Correspondingly, centrally positioned between the front and rear edges of center post 15 on its left and right-hand sides and extending substantially along the length of the post and integral therewith are projections 65 and 66 of substantially rectangular section. Slide 50 is mounted between the left end piece 12 and the center post 15 so that its interior surface, near its left and right edges, abuts the front surface of projections 63 and 65. Slide 51 is correspondingly mounted on the left rear of the key so that its interior surface, near its left and right edges, abuts the rear surface of these same projections 63 and 65. Slides 50 and 51 are connected by a rivet 80, best shown in Fig. 8, having a flange 81, a washer 82 on the front surface of slide 50 and another washer 83 on the exterior surface of slide 51. A link 84 which may be, for instance, of flat sheet nickel silver formed in a manner to be described is used to couple the left-hand slide assembly to the handle. Link 84, for instance, near its top, as shown in Fig. 4, may be bent inwardly to the right at about a right angle to provide a means of engaging toe 25 of the handle. A projection 95 from the lower left-hand edge of link 84, as seen in Fig. 8, may be bent upwardly at right angles and perforated so that rivet 83 may project through the opening. The bottom edge of the projection may then be folded to the left at right angles as at 86 under slide 50 to provide

rigidity for the assembly. Small, cylindrical guide elements **87**, **88** for link **84** may be moulded, for instance, projecting from the upper left-hand interior surfaces of slides **50** and **51**.

Slides **52** and **53** may be interconnected together and coupled through a link **85** to toe **26** in a corresponding manner.

Each slide assembly is connected by means of an individual helical spring **90** and **91** to the bottom crosspiece **14**. Each spring has an upper hook, such as **93** in spring **90**, which is looped around the rivet such as rivet **80** and a lower hook such as **94** in spring **90**, which is looped around a boss **92**, for instance, moulded in the lower crosspiece **14** near the upper front edge of the crosspiece. Any other suitable means of securing the spring would, of course, be satisfactory.

In the normal positions of rest of the slide assemblies **90** and **91** the springs are tensioned slightly to insure that the slide assemblies are restored to a normal position of rest. When either assembly is raised by engagement of either of the toes of the handle and the right angle projection at the top of the corresponding link, the spring individual to the particular slide assembly will be subjected to tension. When the handle is restored to normal the tensioned spring will restore its associated slide assembly to normal by lowering the slide assembly to its original position.

Slide **50** controls the actuation of a plurality, such as of five sets of switch contacts on the front left-hand side of the key. Slide **51** controls the actuation of five sets of switch contacts on the rear left-hand slide of the key. Slide **52** controls the actuation of five sets of switch contacts on the front right-hand side of the key. And, slide **53** controls the actuation of five sets of switch contacts on the rear right-hand side of the key.

The slides **50**, **51**, **52** and **53** may be, for instance, elongated prisms of insulating material of substantially rectangular section. The insulating material may be a nylon filled phenolic moulding compound, for instance. Each slide may have any desired pattern of irregularities formed in its external operating surface to impart corresponding motion to each of a plurality of displaceable elements of a plurality of sets of switch contacts, to control the contacts, so that they close or open in any desired sequence and time relation. For purpose of illustration, the slides shown in Figs. 1, 4 and 7 have a relatively simple regular step pattern of surface irregularities in the form of surface depressions **54**, **55**, **56**, **57** and **58**. Fig. 9 shows another relatively simple irregular step pattern.

Reference to Fig. 8 shows, to enlarged scale, a vertical section through a pair of slides, such as **50** and **51**, to better disclose the manner in which they control their cooperating contacts. Surface depression **54** on the front surface of slide **50** and another **59** in slide **51**, in vertical alignment with depression **54** are shown. Slides **50** and **51** are shown in their lower or normal positions of rest. In such position, as shown in Fig. 6, the five sets of contacts controlled by slide **50** are open and the five sets of contacts controlled by slide **51** are closed. Each set of contacts comprises three wire springs, such as **61***a*, **61***b* and **61***c*, mounted on the front of the key, the tops of which are shown in Fig. 6, as are the tops of wire springs **62***a*, **62***b* and **62***c*, mounted on the rear of the key. Two of the wire springs of each set, such as **61***b* and **61***c* or **62***b* and **62**C are soldered together near their lower extremities, as shown in Fig. 1, so that electrically the two springs and their contacts constitute a single bifurcated contact, the two individual wire elements of which are individually flexible. The double contacts reduce contact resistance and double the probability of satisfactory engagement with their individual respective cooperating contacts, carried on springs **61***a*, and **62***a*, respectively. The springs may be, for instance, of nickel silver and of circular cross-section. Springs such as **61***a* on the front and springs such as **62***a* on the rear are displaceable by the irregularities on the surface of their respective cooperating slides and springs **61***b* and **61***c* on the front and **62***b* and **62***c* on the rear are substantially stationary, but flexible slightly upon engagement with and disengagement from the respective cooperating displaceable springs of their associated set. The wire springs such as **61***a* and **62***a* project through openings in cam follower elements **61***e* and **62***e*, which may be, for instance, of nickel silver and which generally resemble hammer heads and which are mounted near the upper ends of the springs and secured thereto by soldering, for instance. Each cam follower element has a reduced rounded projection which engages the surface of the slides and follows its irregularities.

In the positions shown in Fig. 8, the right-hand end of follower element **61***e* projects into depression **54** on the outer surface of slide **50**. The left-hand end of the follower **61***e* is sufficiently wide that it spans the two opposed wire spring elements **61***b* and **61***c*. The engageable opposed surfaces are covered with suitable contact metal. The corresponding contact sets, such as **62***a*, **62***b* and **62***c* on the left rear of the key are normally closed. As may be seen in Fig. 8 the contacts controlled by slide **51**, that is contacts **62***a* and **62***c*, contact **62***b* not being visible, are closed, since in the normal position of the slide, the left-hand end of follower element **62***e* rides on the right-hand surface of the slide rather than in depression **59** with which it is normally out of registry.

As the slide assembly comprising slides **50** and **51** is raised, the right-hand end of the follower, such as **61***e*, engages an inclined surface sloping downwardly to the left which urges it and spring **61***a* to the left. As the slide continues to rise, the right-hand end of the follower, such as **61***e*, engages with the outer surface of the slide, which urges the follower to the left and closes the left-hand end of follower **61***e* against the two opposed contacts, such as **62***g*, carried on wire springs **61***b* and **61***c*. When the slide assembly is lowered the reverse action takes place. Simultaneously on the rear of the key the normally closed sets of contacts carried on wire springs such as **62***a*, **62***b* and **62***c* are opened as the slide assembly comprising slide **51** is raised and reclosed as it is lowered while the left-hand end of follower **62***e* follows the slide contour, in a manner which should be apparent from the foregoing. Slides **52** and **53** control their respective adjacent contacts in a similar manner.

The ten individual wire springs corresponding to springs **61***a* on the front of the key are secured in position by moulding in an individual block **100** which may, for instance, be of phenol fibre. The twenty wire springs, comprising ten such as **61***b* and ten such as **61***c*, are secured by moulding in a single similar block **101**. Block **100** is mounted adjacent the front surface of element **14** and block **101** superimposes block **100** and the assemblies may be secured with a clamping plate **105** which is preferably bowed outwardly between its ends and secured by means of a machine screw which projects through openings in plate **105**, block **101** and block **100** into an internally threaded opening in bottom crosspiece **14** to lock the spring assemblies in position on the front of the key. The wire springs on the rear of the key are similarly arranged. Mounted near the top of the wire springs, on both front and rear of the key, is a spring spacer **110** and **111**, respectively, each of which may be, for instance, an elongated element of insulating material, such as nylon filled phenolic, of substantially rectangular section. The spring spacer is arranged to be secured in rectangular notches formed in the right and left vertical end pieces **12** and **13** and in the center post **15** both on the front and rear of the key. Ten laterally spaced rectangular notch openings project from the inner surface of the spacer to accommodate the ten wire springs such as **61***a* and **20** laterally spaced rectangular notch openings project from the outer surface of the spacer to accommodate the ten wire springs such as **61***b* and the ten wire springs such as **61***c*. The openings hold the springs in proper vertical alignment and permit flexing as the respective sets of

spring contacts engage and disengage. The wire spring spacer on the rear is similarly arranged.

The opening for the key handle in the top plate is provided with a seal 115 which may be of soft rubber. The seal may be substantially elliptical, as seen best in Fig. 3 and Fig. 4, projecting into a central elliptical opening in the top plate 11. In the middle portion of the elliptical seal, where it abuts the vertical stud 19 of the handle, there is a raised collar 116 which fits snugly about the stud 19 and moulded therein during the moulding process is an insert 117 which may be, for instance, of aluminum having an opening closely conforming to the cross-section of the stud 19 at the point of engagement therewith. The bottom lower portion of the seal near its outer edge has a moulded ring insert 118 which may be, for instance, a narrow flat aluminum ring generally conforming to the outer lower edge of the seal. The seal assembly comprising the collar insert and the ring insert are pressed into position to completely fill the opening about the projecting stud 19 of the key and to prevent the passage of foreign material into the interior of the key. The seal is effective also to reduce the hazard of explosions caused by sparks on opening and closing of the contacts in special applications of the key.

The key is preferably provided with a cover which may be of aluminum, for instance, comprising a front half 120 and a rear half 121 each of flat sheet metal and each bent into a substantially U-shaped section so that one may fit over the front half and the other over the rear half of the key as shown best in Fig. 5 and Fig. 6. The left vertical end piece 12 has formed on its outer surface substantially along its longitudinal central axis a small ridge 122 preferably of triangular section as shown in Fig. 6. The right vertical end piece 13 is similarly provided with a ridge 123. The left and right arms of each of the U-shaped cover sections have formed in them indentations, as shown at 124 and 125, respectively, conforming to the ridges on the vertical end pieces 12 and 13, respectively with which they engage to hold the front and rear cover sections in position.

What is claimed is:

1. A communication operator's key having a substantially rectangular frame and a center post integral therewith, uniplanar parallel opposed longitudinal slide ways formed in said frame and said post, a cam, said cam slidable in said ways, means for biasing said cam to a normal position in said ways, a plurality of longitudinal cam tracks spaced one from another laterally formed in said cam, an individual pair of elongated substantially straight wire contact springs for each of said tracks, said springs disposed parallel to said slide ways, each of said springs secured at one end to said frame and having a free end, an electrical contact on each free end, said contacts of each pair adapted to make and break, a cam follower on one spring of each pair engageable with its respective track, a handle secured to said frame, said handle having a first and a second means for arresting its motion in a normal position of rest and in an operated position, respectively, a projection on said handle, a link secured at one end to said cam and having a free formed end disposed in the path of said projection as said key is actuated between its rest and operated positions, to slide said cam in said ways from said normal to an operated position, each of said followers responsive to the motion of its respective track to control its respective contact pairs as said slide is actuated, and means in said tracks for opening and closing said contacts according to any desired predetermined sequence of openings and closings as said handle is actuated.

2. A communication operator's key, said key having a top plate and a bottom bar, a left end element and a right end element interconnecting said plate and said bar to form a rectangular key frame, a pair of longitudinal uniplanar slide guide ways parallel to said end elements integral with said frame, a cam slidable in said ways, a plurality of longitudinal cam tracks spaced one from another laterally in said cam, a pair of opposed longitudinal wire spring contacts individual to each of said tracks, each of said wires having one end secured to said bar and having a free end with an electrical contact thereon disposed to engage with and break from the other contact of its respective pair, a cam follower, secured to the free end of one of said wires of each pair, engageable individually with a respective one of said tracks, a key handle lever pivoted in said plate having a projection, a link having one end secured to said cam and a formed free end engageable with said projection as said handle is actuated, said cam slidable in said ways as said formed end is engaged, each of said tracks actuating its respective follower to control its individual contact, said tracks having means for controlling said contacts cooperatively according to any desired predetermined pattern of openings and closings.

3. A communication operator's key, said key having a top plate and a bottom bar, a left end element and a right end element interconnecting said plate and said bar bar to form a rectangular key frame, a longitudinal center post integral with said bar and spaced from said end elements, an individual front and rear longitudinal uniplanar slide way formed in the inner surface of each of said end elements and in the left-hand and right-hand side of said post to form four pairs of parallel uniplanar slide ways, two on front and two on rear of said frame, an individual cam element in each of said four pairs of slide ways, each adapted for longitudinal uniplanar sliding motion therein, means for interconnecting each of the two cam elements on the front of said frame individually with its respective opposing cam element on the rear of said frame to form a first and a second integral cam pair, a first and a second link secured to said first and said second cam pair, respectively, each said link having a formed free end, a handle secured to said plate and having a first and a second projection engageable with said formed ends in said first and said second links, respectively, spring means for biasing said cam units to a normal unoperated position, means for arresting said handle in a normal unoperated position and means comprising said projections and said free ends responsive to the alternate operation of said handle to a first and a second operated position for sliding said cam pairs alternately in said ways to a respective operated position, a plurality of longitudinal cam tracks spaced one from another laterally in each of said cams, a pair of longitudinal wire spring electrical contacts individual to each of said tracks secured at one end to said bar and projecting toward said plate, one wire of each of said pairs having a cam follower engaging its respective track, said cam tracks having means for controlling all of said contacts according to any desired predetermined pattern of openings and closings as said handle is actuated.

References Cited in the file of this patent

UNITED STATES PATENTS

585,915	Johnston	July 6, 1897
772,872	Davis	Oct. 18, 1904
1,951,530	Richter	Mar. 20, 1934
2,238,458	Waller	Apr. 15, 1941
2,261,809	Nesius	Nov. 4, 1941
2,319,593	Fisher	May 18, 1943
2,399,906	Bentley	May 7, 1946
2,579,169	Barry	Dec. 18, 1951
2,611,835	Mossman	Sept. 23, 1952

FOREIGN PATENTS

116,681	Australia	Mar. 8, 1943