

- [54] **PUSHBUTTON SWITCH WITH RECIPROCATING CAM**
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- [22] Filed: **Aug. 17, 1973**
- [21] Appl. No.: **389,343**
- [30] **Foreign Application Priority Data**
 Aug. 23, 1972 Germany..... 2241346
- [52] U.S. Cl. **200/153 LA, 200/159 R**
- [51] Int. Cl. **H01h 13/52**
- [58] Field of Search **200/153 LA, 159 R, 159 A, 200/77, 160; 340/365 R**

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[57] **ABSTRACT**

A pushbutton switch having a shaft with first and second operating or cam surfaces for sequentially controlling the movement of a spring biased movable contact into engagement with the fixed contact as the shaft is reciprocated in a housing from a rest position to a second position characterized by the first cam surface forcing the movable contact away from the fixed contact during initial movement of the shaft from the rest position and the second cam surface subsequently enabling the movable contact to move into engagement with the fixed contact. The coaction of the first cam surface and the movable contact opposes the initial movement of the shaft from the rest position and the coaction of the movable contact with the second cam surface assist movement of the shaft after the initial movement to ensure that a contact is obtained.

10 Claims, 3 Drawing Figures

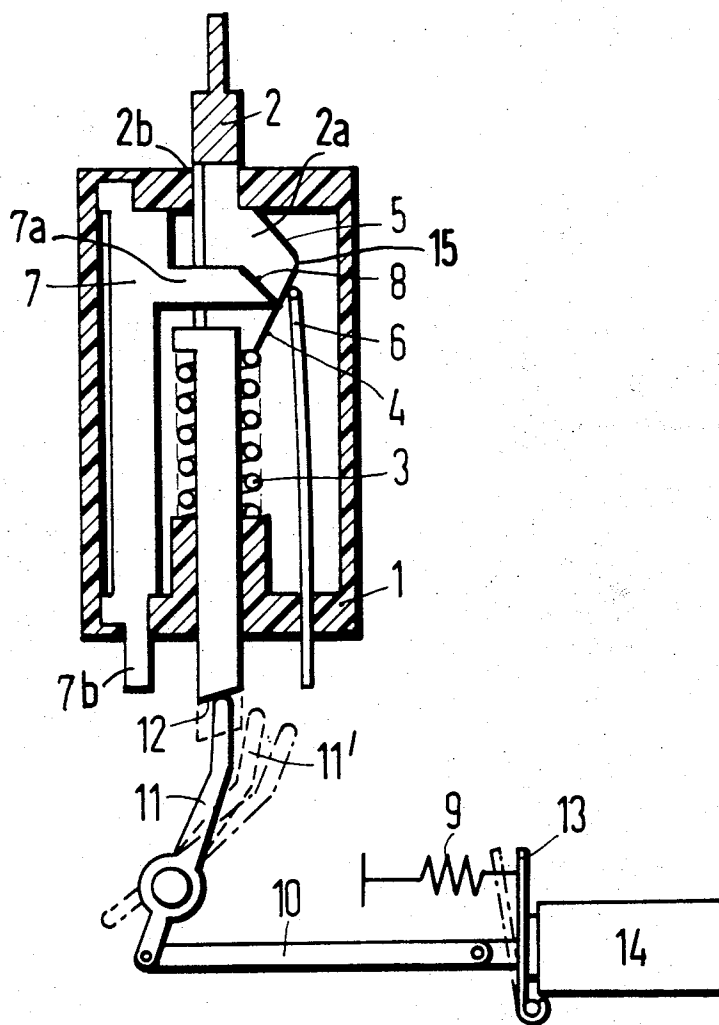


Fig. 1

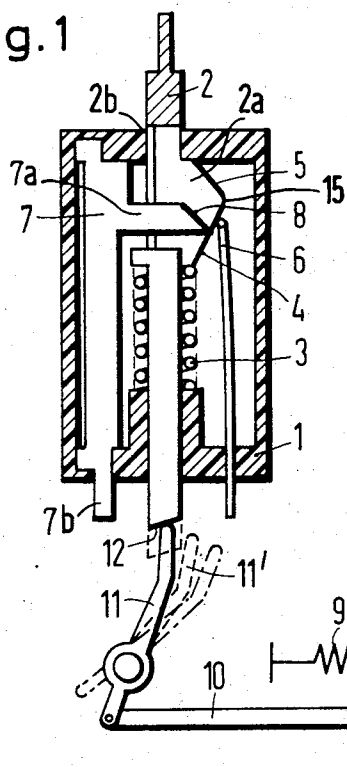


Fig. 2

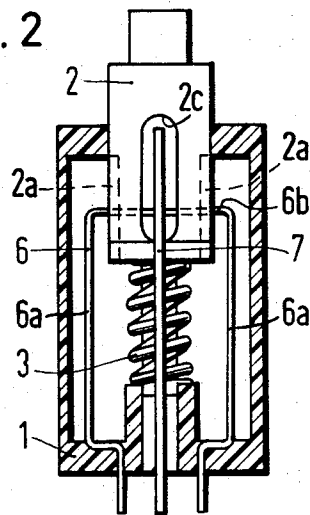
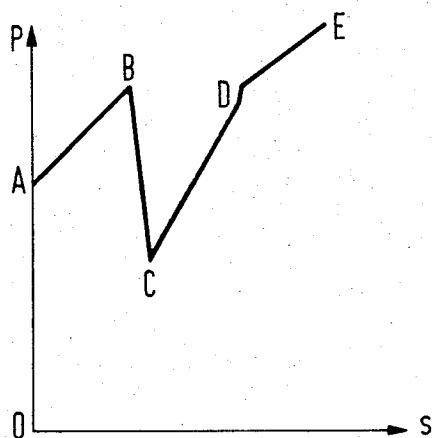


Fig. 3



PUSHBUTTON SWITCH WITH RECIPROCATING CAM

BACKGROUND OF THE DISCLOSURE

1. Field of the Invention

The present invention relates to a pushbutton switch particularly useful in keyboards for typewriters and similar machines for example, telex machines, where operation of the switch occurs against a spring force and the movable contact is spring biased towards the fixed contact.

2. Prior Art

A number of pushbutton switch arrangements or devices are known wherein contact spring assemblies are arranged parallel to a key shaft and are connected via a tapered or conical operating surface which is provided on the key shaft. Examples of these devices are disclosed in a German Printed Application (Auslegeschrist) No. 1,064,562 and Utility Model (Gebrauchsmuster) Nos. 608,428 and 1,926,774. The structure of these pushbutton switch arrangements offers the possibility of forming the pushbutton switch devices with a very slender configuration and enables the device to still use a leaf spring assembly as the movable contact arm which contact arm is easy to construct and has the desired switching behavior. With these known pushbutton switch devices, the direction of movement of the contact surface of the movable contact is in a direction perpendicular to the movement of the pushbutton and key shaft while the movable contact moves along a wedge-shaped operating surface on the key shaft. The movable contact arm, which is spring biased and adjacent to the tapered operating surface of the key shaft, is thereby directed in a straight line from one contact position which is either an open or closed position directly to the other contact position. The dimensions of the operating surface on the key shaft is chosen in such a manner that the contacts will be in the desired closed or open position when the key shaft is at either one of its end positions.

The above described pushbutton switch devices are used as components in typewriter keyboard systems or keyboard systems of similar machines which utilize an electronic control for the typewriters technique or the telex machine technique. In these systems, the pressing of the pushbutton actuates an electronic control which ensures the proper movement of the printing unit or ensures the proper coding of the character to be registered instead of relying on the mechanical force applied to the key being transferred by a mechanical linkage to a printing unit or coding unit. In this type of keyboard, it is found that the operators of the machine desire a counter pressure on the key to oppose any pressure of the fingers while resting on the keys that are in a rest position and this counter pressure must be overcome prior to actuating the pushbutton switch device.

With mechanically operated lever units, this is realized by means of respective construction of the individual interlocking functional levers and elements. For electrical pushbutton switches, an additional effort has to be made for achieving a so-called counter pressure which must be overcome.

For example, in the German Published application No. 1,655,733, a pushbutton switch is disclosed which is particularly adapted for teletype devices and similar keyboards which switch has a single ring-shape perma-

nent magnet surrounding a portion of the key shaft. In the rest position of the pushbutton switch, this permanent magnet is adjacent to a magnetized shoulder on the housing and produces an artificial pressure point which must be overcome to depress the key of the pushbutton switch. The key can be operated easily and rapidly after overcoming the magnetic attraction between the magnetized shoulder and the permanent magnet at the beginning of the actuation of the pushbutton.

SUMMARY OF THE INVENTION

The present invention is directed to providing a pushbutton switch which is simple in construction and which has characteristics which are required for use in keyboards for typewriters and similar machines. The pushbutton switch of the present invention provides a counter force which must be overcome to cause depression of the shaft of the pushbutton to actuate the contacts. After the shaft has been moved an initial portion of its movement from a rest or first position, this counter force is rapidly decreased to ensure that the shaft completes its movement towards a second position to ensure the making of contact between the fixed and movable contacts. This is accomplished by providing a shaft which is mounted for reciprocation in the housing and has first and second operating surfaces which surfaces are provided with oppositely directed inclination to the direction of reciprocation. In the rest position and during initial movement, the first operating surface engages the movable contact and moves it against a force biasing it towards the fixed contact to force it further from the fixed contact. At an intermediate position in the travel, the movable contact engages the second operating surface which enables the force biasing the movable contact towards the fixed contact to move the movable contact into engagement with the fixed contact. Due to the arrangement of the two operating surfaces, any bouncing or chattering of the key as it is being returned to the rest position cannot cause inadvertent engagement between the movable and fixed contact. Preferably, the movable contact has a U-shaped configuration with a pair of legs interconnected by a bight portion with the legs being mounted in the housing and the bight portion forming the contact surface which engages the fixed contact of the switch and engages the operating surfaces.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side cross-sectional view with parts in elevation of a pushbutton switch according to the present invention;

FIG. 2 is a cross-sectional view with parts in elevation taken at a plane extending 90° from the cross-sectional view of FIG. 1; and

FIG. 3 is a schematic diagram illustrating forces opposing movement of a shaft of the pushbutton switch with respect to displacement of the shaft from a rest position.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The principles of the present invention are particularly useful in a pushbutton switch as illustrated in the figures. The pushbutton switch includes a housing 1 which receives a shaft 2 which is mounted for reciprocation between a first or rest position illustrated in the

figures and a second position. The shaft 2 has one end extending out of the housing for receiving a key which an operator can depress. The other end of the shaft has a surface 12 and extends out of the other side of the housing 1. To biasing the shaft to the rest position, a biasing means comprising a helical spring 3 is provided which opposes movement of the shaft 2 from the rest position towards the second position and will return the shaft 2 to the rest position when the operator releases the key attached to the one end.

As illustrated, the shaft has a complex configuration including a pair of projections or wings 2a which are spaced apart by web portion 2b which is provided with an aperture 2c. Each of the projections 2a terminate in edges providing an operating surface or cam surface 4 and an operating surface or cam surface 5 which intersect at a point 15.

A movable contact 6 has a U-shaped configuration with a pair of legs 6a which are interconnected by a bight portion 6b. The contact 6 is mounted in the housing 1 by the legs 6a whose ends extend out of the housing to form terminals for the movable contact. A fixed contact 7, which is mounted in the housing in a stationary position, has an extension or protrusion 7a terminating in a contact surface 8 and a terminating portion 7b that extends through the wall of the housing 1. As illustrated the protrusion 7a extends through the aperture or openings 2c to position the contact surface 8 between the projection 2a of the shaft 2. The movable contact 6 is biased towards the contact surface 8 by means of its natural resilience and is held from engaging the contact surface 8 of the fixed contact 7 by the first or operating surface 4 which engages the bight portion 6b when the shaft 2 is in the rest position.

In operation of the switch, depressing the key connected to the shaft 2 causes the shaft 2 to move against the spring 3. As the shaft is depressed, the movable contact 6 rides on the cam surface 4 and is forced away from the contact surface 8 of the fixed contact 7 until it reaches the point 15 of intersection which occurs at an intermediate position of the shaft 2 during movement from the first to the second position. When the shaft 2 is at the intermediate position, the bight 6b of contact 6 passes over point 15 on to the second operating surface or cam surface 5. During movement of the shaft 2 from the intermediate position to the second position, the cam surface 5 allows the movable contact 6 to move towards the contact surface 8 of the stationary contact 7 and the movable contact 6 will make contact with the surface 8 prior to the shaft reaching the second position which is the completely depressed position.

As illustrated, the surface 8 is inclined at an angle to both the projection 7a and the direction of movement of the bight portion 6b of the movable contact 6. This inclination of the surface 8 prevents contact chatter or bounce when making contact between the bight portion 6b and the surface 8 regardless of the pressure being applied to the movable contact to urge it into engagement with the fixed contact to complete the circuit.

In the digram of FIG. 3, the force (P) resisting movement of the shaft 2 from the rest position is plotted with respect to the distance (S) of displacement of the shaft 2 from the rest or first position. While the shaft 2 is in the rest position, its displacement is resisted by the spring 3 and the resilient nature of the movable contact 6. The combined force of these two biasing means is

represented by point A in FIG. 3. When the operator depressed the key connected to shaft 2, the initial movement of the shaft 2 is opposed by the sum of the force of the spring 3 and the resilient force of the movable contact 6 as it is deflected away from the fixed contact by the cam surface 4. Thus, during initial displacement, the combined forces resisting displacement increases until the intermediate position is reached and this increase in the forces is shown by line AB with point B representing the counter force or force resisting movement of the shaft when it reaches the intermediate position. The force represented by point B is often referred to as the pressure point.

As the bight 6b moves from surface 4 across point 15 onto surface 5, the energy stored in the deflected spring-like movable contact 6 is transferred from opposing the displacement of shaft 2 to act on surface 5 to aid displacement. With the transition of the application of the force of the deflected movable contact 6, the counter force or pressure opposing depression of the shaft 2 rapidly decreases to a value represented by point C.

Further displacement of the shaft 2 passed the intermediate position toward the second position is resisted by the force of spring 3; however, the energy stored in the movable contact 6 applies a force which is opposite to the force of spring 3 and aids further displacement until the bight 6b contacts surface 8 to complete the circuit. Since the force of spring 3 is constantly increasing and the force of movable contact 6 is constantly decreasing, the force opposing displacement of the shaft 2 increases up to the value by point D which is the value at the time the contact 6 engages the surface 8. After the contact 6 is engaged on surface 8, only the spring 3 opposes the movement of the shaft 2 to its second or final position and this force increases to the value shown by point E in the diagram.

When the operator of the keyboard applies a sufficient force to the key to overcome the pressure point which is the force at point B, the operator instinctively maintains this force. Due to the rapid drop of the value of the resisting force between points B and C, an acceleration in the rate of displacement of the shaft 2 under the force applied by the operation will occur and insures sufficient movement of the shaft beyond the point at which the contact 6 engages the surface 8. Thus, the sudden reduction of the resisting force at the point of transition insures the making of the circuit between the fixed and movable contacts.

When the operator releases the key actuated to shaft 2, the spring 3 returns the shaft 2 to the rest position and thus moves the contact 6 out of engagement with the surface 8. If the force applied by spring 3 causes the shaft to bounce upon reaching the rest position, the inclination of the contact surface 4 insures that an accidental making of a contact between the fixed and movable contacts is prevented.

With the cam or operating surface 4 having an angle of inclination of approximately 28° to the axis or the direction of reciprocation of the shaft 2, a normal key operating speed of 0.3 to 0.4 m/s produces a desired counter pressure at the pressure point. Thus, with the inclination at approximately 28° , a pleasant effect is provided for the operator of the keyboard. It is also found desirable that the cam or operative surface 5 has an angle of inclination of approximately -28° to the direction of reciprocation of the shaft 2. In other words,

the slope of surfaces 4 and 5 are substantially the same inclination but in opposite directions. With a normal key operating speed of 0.3 to 0.4 m/s, the movement of the contact along the cam surfaces 5 ensures sufficient movement to ensure engagement of the bight portion 6b of the movable contact 6 with the contact surface 8.

With pushbutton switches used in keyboards, it is desirable to provide a means for locking individual pushbutton switches to prevent depression of two pushbuttons at the same time and thus cause a jamming of the printing mechanism. As illustrated in FIG. 1 a mechanism for locking the shaft 2 in the rest position is arranged below the housing 1. This mechanism consists of a locking lever 11 which is pivotably mounted below the housing 1 and movable from a position for engaging the end surface 12 of shaft 2 to a position withdrawn from the path of the shaft 2. The lever 11 is connected by a link 10 to an armature 13 which is pivoted in one direction by an electromagnet 14 and is pivoted in an opposite direction by a spring element 9. In a rest position, the electromagnet 14 is deenergized and the spring 9 moves the armature 13 and lever 11 to the position illustrated in broken lines. If one of the other keys on the keyboard is depressed to activate a switch, the electromagnet 14 is energized and the armature 13 is pivoted against the spring to pivot the locking lever 11 into the path of the shaft 2. Thus, depression of the key associated with the shaft 2 is prevented.

If pressure is applied to depress shaft 2 while the lever 11 is in a locking position, the frictional force between the end surface of the shaft and lever 11 may prevent spring 9 from withdrawing the lever 11 when the electromagnet 14 is deenergized. To overcome the problem of this frictional force, the end surface 12 of shaft 2 is provided with a slight incline. This inclination creates a force component which acts in a release direction of the lever 11 to counteract the frictional force. In providing the inclination of surface 12, care must be exercised. The inclination should be sufficient to provide a force component which overcomes the frictional force but not large enough to force the lever 11 out of the locking position by exceeding the force of attraction of the energized electromagnet 14.

In most keyboard constructions, a joint locking lever comb is provided for each row of keys and each comb is operated by a single electromagnet system. In order to guarantee that an operation of one of the keys in the row does not prevent the entire locking comb from being pivoted into a locking position under the remaining keys, the individual locking levers of the comb are constructed to be resilient in a direction extending perpendicular to the movement of the shaft 2 and therefore resilient in the direction of their swinging movement during the locking procedure. When the key shaft 2 is pushed to the position illustrated in dotted lines, the assigned locking lever 11 for the depressed shaft 2 due to its resiliency will assume a position designated 11'. Preferably, the spring-like levers of the comb would oppose forcible operation of a lock key by its own spring action. Thus, the slight yielding of the spring comb will cushion the application of pressure to any of the locked keys.

Although various minor modifications may be suggested by those versed in the art, it should be understood that I wish to employ within the scope of the patent warranted hereon all such modifications as reason-

ably and properly come within the scope of my contribution to the art.

I claim:

1. A pushbutton switch for use in keyboards which are utilized in typewriters and telex machines, said switch comprising a housing, a shaft mounted in the housing for reciprocation between a first and second position, means biasing the shaft towards the first position, a fixed contact mounted in said housing, a movable contact mounted in said housing, means biasing said movable contact towards the fixed contact, said shaft having a first operating surface inclined to the direction of reciprocation and a second operating surface inclined in an opposite direction to the direction of reciprocation, said first surface being disposed on the shaft to engage the movable contact to hold it out of engagement with said fixed contact and to move the movable contact in a direction away from the fixed contact as the shaft moves from the first position to an intermediate position during movement towards the second position, said second operating surface engaging the movable contact when the shaft reaches the intermediate position to enable the means biasing the movable contact to urge the movable contact along the second operating surface and into contact with the fixed contact as the shaft moves from the intermediate position towards the second position, whereby initial movement of the shaft between the first position through the intermediate position is opposed by both biasing means and subsequent movement from the intermediate position towards the second position is aided by the biasing means acting on the movable contact.

2. A pushbutton switch according to claim 1, wherein a contact surface on the fixed contact is inclined at an angle to the direction of movement of the movable contact.

3. A pushbutton switch according to claim 1, wherein the first operating surface has an inclination of approximately 28° to the direction of reciprocation of the shaft.

4. A pushbutton switch according to claim 3, wherein the fixed contact has a contact surface inclined at an angle to the direction of movement of the movable contact.

5. A pushbutton switch according to claim 3, wherein the second operating surface has an angle of inclination of approximately -28° to the direction of reciprocation of the shaft.

6. A pushbutton switch according to claim 5, wherein the fixed contact has a contact surface inclined at an angle to the direction of movement of the movable contact.

7. A pushbutton switch according to claim 1, wherein the movable contact has a U-shaped configuration with a pair of legs interconnected by a bight portion, said legs being mounted in the housing with the bight portion sequentially engaging the first and second operating surfaces as the shaft is reciprocated from between the first and second positions and said bight portion engaging a contact surface on the fixed contact to form a circuit therebetween.

8. A pushbutton switch according to claim 7, wherein the contact surface of the fixed contact is inclined at an angle to the direction of movement of the bight portion of the movable contact to prevent chatter during the making of contact therebetween.

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9. A pushbutton switch according to claim 7, wherein a first operation surface is inclined at an angle of approximately 28° to the direction of reciprocation of the shaft.

10. A pushbutton switch according to claim 9, 5

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wherein the second operating surface is inclined at an angle of approximately -28° to the direction of reciprocation of the shaft.

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