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C. S. SNAVELY ET AL

1,958,646

ELECTRICAL RELAY

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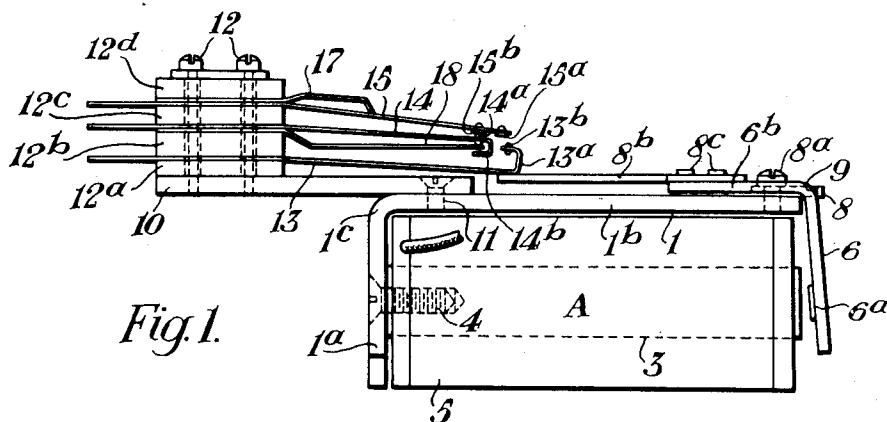


Fig. 1.

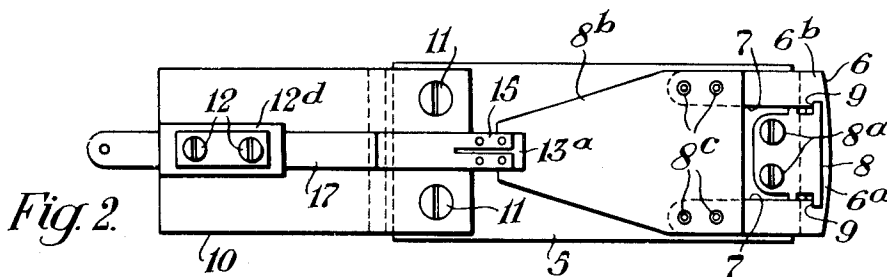


Fig. 2.

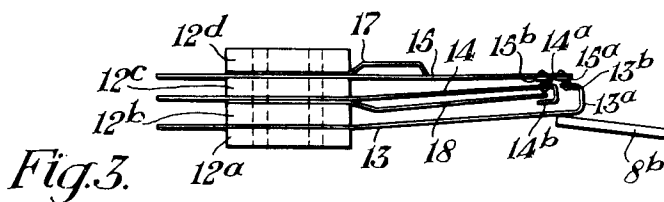


Fig. 3.

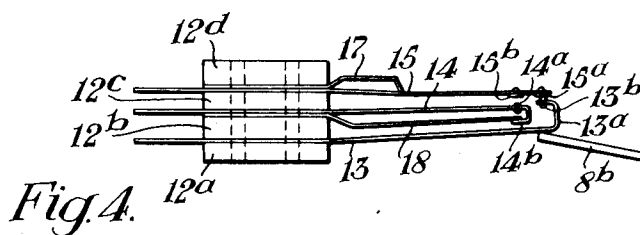


Fig. 4.

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ELECTRICAL RELAY

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6 Claims. (Cl. 200—1)

Our invention relates to electrical relays, and particularly to contact mechanisms for electrical relays. More particularly our invention relates to contact mechanisms for relays of the type usually referred to as L type or "telephone" type relays, and has for an object the provision of an improved continuity, or make-before-break, contact mechanism for relays of this type.

We will described one form of contact mechanism embodying our invention, and will then point out the novel features thereof in claims.

In the accompanying drawing, Fig. 1 is a view, showing in side elevation a relay A provided with one form of contact mechanism embodying our invention. Fig. 2 is a top plan view of the relay A and contact mechanism shown in Fig. 1. Figs. 3 and 4 are detail views showing the parts of the contact mechanism embodying our invention in the positions which they occupy when the armature of the relay is in mid-stroke and in its fully attracted position, respectively.

Similar reference characters refer to similar parts in all four views.

Referring first to Fig. 1, the reference character A designates an L or "telephone" type relay which, in the form here shown, comprises an L-shaped backstrap 1 of magnetizable material having a short leg 1^a and a long leg 1^b. A magnetizable core 3 is fastened to the short leg 1^a of the backstrap 1 by a machine screw 4, and this core extends parallel to the long leg 1^b and carries an operating winding 5. Pivottally mounted at the free or forward end of the long leg 1^b of backstrap 1 is an L-shaped armature 6, the legs 6^a and 6^b of which are substantially equal in length. The leg 6^a of the armature 6 coacts with the free end of the core 3, while the leg 6^b in the deenergized position of the armature, extends substantially parallel to the long leg 1^b of the backstrap 1. As here shown, the leg 6^b of the armature 6 is bifurcated to form two parallel arms 7. The armature 6 is pivottally attached to the backstrap 1 by means of a plate 8 which is fixed to the backstrap leg 1^b by screws 8^a, and which projects beyond the free end of the leg 1^b. The projecting portion of the plate 8 is provided with two oppositely disposed recesses 9 which receive the two arms 7 of the armature 6 whereby the armature is hinged to the backstrap 1 without trunnions.

A plate 8^b of insulating material is attached to the arms 7 of the leg 6^a of the armature 6 by means of eyelets 8^c, and this plate projects rearwardly from the armature and actuates contact mechanism embodying our present invention, which contact mechanism we will now describe.

As here shown, this contact mechanism is mounted on a metal plate 10 which is attached by means of screws 11 to the long leg 1^b of the backstrap 1, and which projects rearwardly beyond the bend 1^c of the backstrap. Secured to the plate 10 by means of screws 12 are a plurality of superposed blocks 12^a, 12^b, 12^c and 12^d of insulating material, and clamped between adjacent ones of these blocks in substantially parallel spaced relation are three flexible contact fingers 13, 14 and 15. The contact finger 13 cooperates with the insulating piece 8^b and is so adjusted that it presses against the insulating piece 8^b with sufficient force to swing the leg 6^a of armature 6 away from the free end of core 3 when winding 5 is deenergized. Formed on the free end of the finger 13 is an upstanding U-shaped return bend 13^a; the upper leg of which carries a contact button 13^b. When winding 5 is energized, the leg 6^a of armature 6 swings toward core 3, and the resultant upward movement of insulating piece 8^b moves the finger 13 upwardly, thereby causing the contact button 13^b to engage a contact button 15^a secured to the contact finger 15, the parts being so proportioned that the button 13^b will move into engagement with the contact button 15^a when the armature 6 has been moved to approximately its mid-stroke position, as shown in Fig. 3. It will be apparent, therefore, that when winding 5 becomes energized, the balance of the stroke of the armature after the contact button 13^b moves into engagement with the contact button 15^a will flex the finger 15 and bend it upwardly from the position in which it is shown in Fig. 1 to the position in which it is shown in Fig. 4, thus providing a considerable amount of slide between the contact buttons 13^b and 15^a, and at the same time causing a relatively high contact pressure, both of which features are highly desirable in contact mechanisms of this type for reasons which are obvious, and for other reasons which we will point out hereinafter. A relatively short and relatively stiff metal stop 17 is clamped between the blocks 12^c and 12^d directly above the finger 15, and this stop cooperates with the finger 15 to retain this finger in its normal position when winding 5 is deenergized, and to add stiffness to the finger when winding 5 is energized.

The contact finger 14 is provided at its free end with a contact button 14^a and with a depending U-shaped return bend 14^b. The contact button 14^a cooperates with a contact button 15^b secured to the finger 15, while the U-shaped bend 14^b

cooperates with a relatively long rigid stop 18 which is clamped between the blocks 12^b and 12^c below the finger 14. The contact fingers 13 and 14 are so adjusted that when winding 5 is deenergized, the contact button 15^b will engage the contact button 14^a and will move the finger 14 downwardly, in opposition to an upward bias which is provided in this latter finger, to the position in which the finger 14 engages the stop 18, thus providing both a high contact pressure and a considerable amount of slide between the contact buttons 15^b and 14^b. The uppermost position to which the finger 14 can move is limited by the lower leg of the U-shaped bend 14^b moving into engagement with the stop 18, as shown in Fig. 4, and this bend is of such size that its lower leg will engage the stop 18 when the finger 13 has been moved upwardly from its normal position about one-third of its total travel in response to energization of winding 5.

With the contact mechanism constructed in the manner just described, it will be apparent that when relay A becomes energized, the contact finger 13 must engage the contact finger 15 and push it away from the contact finger 14 before the contact formed by the fingers 14 and 15 and associated cooperating contact buttons can become opened, thus insuring that when relay A becomes energized, the contact formed by the fingers 13 and 15 and associated cooperating contact buttons will become closed before the contact formed by the contact fingers 14 and 15 and associated cooperating contact buttons become opened.

It will also be apparent that with the contact mechanism constructed in the manner just described, when relay A becomes deenergized, the contact formed by the contact fingers 14 and 15 and associated cooperating contact buttons will become closed before the contact formed by the fingers 13 and 15 and associated cooperating contact buttons become opened if the contact finger 13 remains in engagement with the contact finger 15 until after the contact finger 15 moves into engagement with the contact finger 14. In accordance with our invention, the finger 13 is prevented from moving out of engagement with the finger 15 before the finger 15 moves into engagement with the finger 14 when the relay becomes deenergized, by making the finger 13 longer than the finger 15, and by providing the finger 13 with the previously described U-shaped return bend 13^a on its free end where the weight is most effective to retard the motion of the finger, thus causing the finger 13 to return more slowly to its normal position than the finger 15 returns to its normal position upon deenergization of the relay.

In actual practice, the contact finger 13 and associated contact button 13^b is usually referred to as the front contact member of the contact mechanism, the contact finger 15 and associated contact buttons 15^a and 15^b as the heel contact member, and the contact finger 14 and associated contact button as the back contact member. Likewise, the contact formed by the fingers 13 and 15 and associated cooperating contact buttons is usually referred to as the front contact of the contact mechanism, and the contact formed by the fingers 14 and 15 and the associated contact buttons as the back contact. For convenience, we shall hereinafter refer to the various parts of the contact mechanism in the manner in which they are referred to in actual practice.

As was previously pointed out one of the chief

objects of our invention is to provide a contact mechanism whereby energy may be transferred from one circuit to another with a minimum amount of open circuit time element. One of the chief obstacles in the way of providing a perfect transfer of energy, especially when the contact mechanism is actuated by a relay, such as the relay A, which operates its armature rapidly in response to energization or deenergization of the relay, is the tendency of the contact members to overtravel and vibrate. It is obvious that if the heel member overtravels more than the front member when the relay becomes energized, or if the heel member and front member vibrate relative to each other, any circuit which is controlled by the front contact will become opened, and the flow of energy to this circuit will be interrupted during the time the contact buttons 13^b and 15^a are separated. It is also obvious that if the back contact member is allowed to overtravel more than the heel member when the relay becomes deenergized, or if the heel member and back members are allowed to vibrate relative to each other, any circuit which is controlled by the back contact of the contact mechanism will become opened and the flow of energy to this circuit will be interrupted during the time the contact buttons 14^a and 15^b are separated. This means that in many cases unless the tendency of the contact members to overtravel and vibrate relative to each other is properly controlled, the time during which the relay must be maintained energized in order to insure the satisfactory operation of auxiliary relays or other apparatus which are included in the circuits controlled by the front and back contact members is undesirably lengthened. Furthermore, any opening of the circuits controlled by the front and back contacts tends to cause arcing at the contact buttons and if the fingers are permitted to vibrate relative to each other, these circuits will be opened many times instead of only once as would be the case if a perfect transfer of energy were obtained. This arcing tends to burn the contact buttons, causing the contact buttons to fail by pitting or entire loss of contact. Any amount of burning is undesirable since it changes the contact adjustment and contact pressure. In accordance with our invention, the tendency of the heel member (the finger 15 and associated contact buttons) to overtravel more than the front member (the finger 13, U-shaped return bend 13^a, and associated button 13^b) is prevented by making the heel member with relatively less inertia than the front member, and the tendency of the heel member (contact finger 14, associated contact button 14^a, and U-shaped bend 14^b) is prevented from overtravelling more than the heel member by the rigid stop 18. The tendency of the heel and front members to vibrate relative to each other can not entirely be prevented, but it is obvious that if both of these members vibrate at the same frequency and amplitude and in step, vibration of these members will not cause the front contact to open. It is difficult, however, to accurately control the frequency and amplitude of vibrations of these members without making the cost of the contact mechanism prohibitive, and it is therefore preferable to make one member vibrate at a much higher frequency than the other so that when vibrations do occur, the contact opening will be minimized on any given vibration. Accordingly, we make the effective length of the heel member short by means of the stop 17 so that this member will have a tendency to vibrate at a

relatively high frequency, while the front member is made long so that it will vibrate at a relatively low frequency. Furthermore, we provide considerable contact pressure and slide between the heel and front members in the manner previously described, which quickly dampens out any vibrations which do occur. The tendency of the heel and back members to vibrate relative to each other when the relay becomes deenergized is controlled in the same manner that the tendency of the heel and front members to vibrate when the relay becomes energized is controlled. That is to say, the back member like the front member is constructed to have a relatively low frequency of vibration. The contact slide in this case is not quite as great as in the case of the heel and front members, although the contact pressure is of the same order.

When the contact pressure is made high, as pointed out, care must be taken that the internal stresses in the contact fingers do not exceed the "fatigue" limit; that is, the maximum stress which can be repeatedly applied to the contact fingers without the contacts changing adjustment over a period of time. The maximum stress in the heel member is the sum of two stresses, that is, the initial stress due to flexing the back contact member and developing back contact pressure, and the added one due to the fact that the end of the heel member is driven away from the back member when the relay picks up. The magnitude of each of these stresses is dependent upon the length of the stop 17 and the gage of the heel member. In accordance with our invention, the length of the stop 17 and the gage of the heel member are such that the fiber stress in the heel member is approximately minimum. These proportions of the parts also give minimum vibration as determined by means of an oscillograph.

Although we have herein shown and described only one form of contact mechanism embodying our invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of our invention.

Having thus described our invention, what we claim is:

1. A contact mechanism for transferring energy from one circuit to another with a minimum amount of open circuit time comprising a plurality of superposed blocks of insulating material, a first flexible contact finger clamped between two of said blocks and adapted to be moved upwardly through a predetermined distance by the operating member of a relay, said first finger being provided at its free end with an upstanding U-shaped return bend the upper leg of which is provided with a contact button, a second flexible contact finger clamped between another two of said blocks above said first finger and provided with a contact button which is adapted to be engaged by the contact button on said first finger when said first finger has been moved upwardly a predetermined part of its total movement, whereby during the latter part of the upward movement of said first finger said second finger is moved upwardly with said first finger, and a third flexible contact finger clamped between another two of said blocks and disposed between said first and second fingers and provided with a contact button which is engaged by a second contact button provided on said second finger except when said second finger has been moved up-

wardly a predetermined distance in response to the movement of said first finger.

2. A contact mechanism for transferring energy from one circuit to another with a minimum amount of open circuit time comprising a plurality of superposed blocks of insulating material, a first flexible contact finger clamped between two of said blocks and adapted to be moved upwardly through a predetermined distance by the operating member of a relay, said first finger being provided at its free end with an upstanding U-shaped return bend the upper leg of which is provided with a contact button, a second flexible contact finger clamped between another two of said blocks above said first finger and provided with a contact button which is adapted to be engaged by the contact button on said first finger when said first finger has been moved upwardly a predetermined part of its total movement, whereby during the latter part of the upward movement of said first finger said second finger is moved upwardly with said first finger, a third flexible contact finger clamped between another two of said blocks and disposed between said first and second fingers and provided with a contact button which is engaged by a second contact button provided on said second finger except when said second finger has been moved upwardly a predetermined distance in response to the upward movement of said first finger, the parts being so proportioned that when the contact button on said third finger is engaged by the second button on said second finger said third finger will be moved downwardly a certain amount in opposition to an upward bias in said third finger, a rigid stop clamped between the same two blocks as said third finger below said third finger for limiting the downward movement of said third finger caused by engagement of the second contact button on said second finger with the contact button on said third finger, and a depending U-shaped return bend provided on said third finger and having its lower leg cooperating with said fixed stop to limit the upward movement of said third finger due to its bias.

3. A contact mechanism for transferring energy from one circuit to another with a minimum amount of open circuit time comprising a plurality of superposed blocks of insulating material, a first flexible contact finger clamped between two of said blocks and adapted to be moved upwardly through a predetermined distance by the operating member of a relay, said first finger being provided at its free end with an upstanding U-shaped return bend the upper leg of which is provided with a contact button, a second flexible contact finger clamped between another two of said blocks above said first finger and provided with a contact button which is adapted to be engaged by the contact button on said first finger when said first finger has been moved upwardly a predetermined part of its total movement, whereby during the latter part of the upward movement of said first finger said second finger is moved upwardly with said first finger, a third flexible contact finger clamped between another two of said blocks and disposed between said first and second fingers and biased to an upper position and provided with a contact button which is engaged by a second contact button provided on said second finger except when said second finger has been moved upwardly a predetermined distance in response to the movement of said first finger, the parts being so proportioned that when the contact button on said third finger is engaged

by the second contact button on said second finger said third finger will be moved downwardly from its upper position a predetermined amount, a first fixed stop clamped between the same two blocks as said third finger below said third finger for limiting the downward movement of said third finger caused by engagement of the second contact button on said second finger with the contact button on said third finger, a depending U-shaped return bend provided on said third finger and having its lower leg cooperating with said first fixed stop to limit the upward movement of said third finger due to its bias, and a second fixed stop clamped between the same two blocks as said second finger above said second finger and cooperating with said second finger to produce a high contact pressure between the engaging contact fingers with a minimum amount of stress on said second contact finger.

4. A contact mechanism for transferring energy from one circuit to another with a minimum amount of open circuit time comprising a plurality of superposed blocks of insulating material, a first flexible contact finger clamped between two of said blocks and adapted to be moved upwardly through a predetermined distance by the operating member of a relay, said first finger being provided at its free end with an upstanding U-shaped return bend the upper leg of which is provided with a contact button, a second flexible contact finger clamped between another two of said blocks above said first finger and provided with a contact button which is adapted to be engaged by the contact button on said first finger when said first finger has been moved upwardly a predetermined part of its total movement, whereby during the latter part of the upward movement of said first finger said second finger is moved upwardly with said first finger, a third flexible contact finger clamped between another two of said blocks and disposed between said first and second fingers and provided with a contact button which is engaged by a second contact button provided on said second finger except when said second finger has been moved upwardly a predetermined distance in response to the movement of said first finger, the parts being so proportioned that when the contact button on said third finger is engaged by the second button on said second finger said third finger will be moved downwardly a certain amount in opposition to an upward bias in said third finger, a first fixed stop clamped between the same two blocks as said third finger below said third finger for limiting the downward movement of said third finger caused by engagement of the second contact button on said second finger with the contact button on said third finger, a depending U-shaped return bend provided on said third finger and having its lower leg cooperating with said first fixed stop to limit the upward movement of said third finger due to its bias, and a second fixed stop clamped between the same two blocks as said second finger above said second finger and cooperating with said second finger to produce a high contact pressure between the engaging contact fingers with a minimum amount of stress on said second contact finger, the parts being further so proportioned that said second finger has less inertia than said first finger, whereby movement of the second finger out of engagement with the first finger at the end of the upward travel of the first finger is prevented, and means for imparting to said second finger a higher natural period of vibration than said first or third fingers, whereby relative vibration of the fingers due to the first finger being moved into engagement with the second finger, or of the second finger moving into engagement with the third finger will not interfere with the closed contact formed by the engaging fingers.

5. A contact mechanism for transferring energy from one circuit to another with a minimum

amount of open circuit time comprising a plurality of superposed blocks of insulating material, a first flexible contact finger clamped between two of said blocks and adapted to be moved upwardly through a predetermined distance by the operating member of a relay, said first finger being provided at its free end with an upstanding U-shaped return bend the upper leg of which is provided with a contact button, a second flexible contact finger clamped between another two of said blocks above said first finger and provided with a contact button which is adapted to be engaged by the contact button on said first finger when said first finger has been moved upwardly a predetermined part of its total movement, whereby during the latter part of the upward movement of said first finger said second finger is moved upwardly with said first finger, a third flexible contact finger clamped between another two of said blocks and disposed between said first and second fingers and provided with a contact button which is engaged by a second contact button provided on said second finger except when said second finger has been moved upwardly a predetermined distance in response to the movement of said first finger, the parts being so proportioned that when said second contact button on said second finger is engaging the contact button on said third finger said third finger will be moved downwardly a certain amount in opposition to an integral upward bias, a first fixed stop clamped between the same two blocks as said third finger below said third finger for limiting the downward movement of said third finger caused by engagement of the second contact button on said second finger with the contact button on said third finger, a depending U-shaped return bend provided on said third finger and having its lower leg cooperating with said first fixed stop to limit the upward movement of said third finger due to its bias, a second fixed stop clamped between the same two blocks as said second finger above said second finger and cooperating with said second finger to produce a high contact pressure between the engaging contact fingers with a minimum amount of stress on said second contact finger, the parts being further so proportioned that said second finger has less inertia than said first finger, whereby movement of the second finger out of engagement with the first finger at the end of the upward travel of the first finger is prevented, and means for imparting to said second finger a higher natural period of vibration than said first or third fingers, whereby relative vibration of the fingers due to the first finger being moved into engagement with the second finger, or of the second finger moving into engagement with the third finger will not interfere with the closed contact formed by the engaging fingers.

6. A contact mechanism for transferring energy from one circuit to another without opening the one circuit until the other becomes closed and vice-versa, comprising a plurality of superposed blocks of insulating material, a first flexible contact finger clamped between two of said blocks and biased to a first position, said first finger being adapted to be moved upwardly from said first position to a second position by the operating member of a relay, an upstanding U-shaped return bend provided on said first finger, a contact button secured to the upper leg of said U-shaped return bend, a second flexible contact finger clamped between another two said blocks and provided with a first contact button which

is adapted to cooperate with the contact button of said first finger, a third flexible contact finger clamped between still another two of said blocks and disposed between said first and second fingers and provided with a contact button which is adapted to cooperate with a second contact button provided on said first finger, a rigid stop clamped between the same two blocks that said second finger is clamped between and cooperating at its free end with said second finger to exert a downward pressure on said first finger, a second stop clamped between the same two blocks that said third finger is clamped between below said third finger and cooperating with a downwardly extending U-shaped return bend on said second finger to limit movement of said second finger, the parts being so proportioned	that when said first finger occupies its first position the second contact button on said second finger will engage the contact button of said third finger and move said third finger downwardly to a position in which said third finger engages said second stop but that when said first finger is moved from its first position to its second position the button on said first finger will engage the first button on said second finger and move said second finger upwardly to a position in which the second button on said second finger is disengaged from the button on said third finger.	80 85
	CLARENCE S. SNAVELY. DAVID P. FITZSIMMONS. NORMAN F. AGNEW.	90
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