June 6, 1950 E. S. STEPHENS 2,510,608

RHEOSTAT SWITCH

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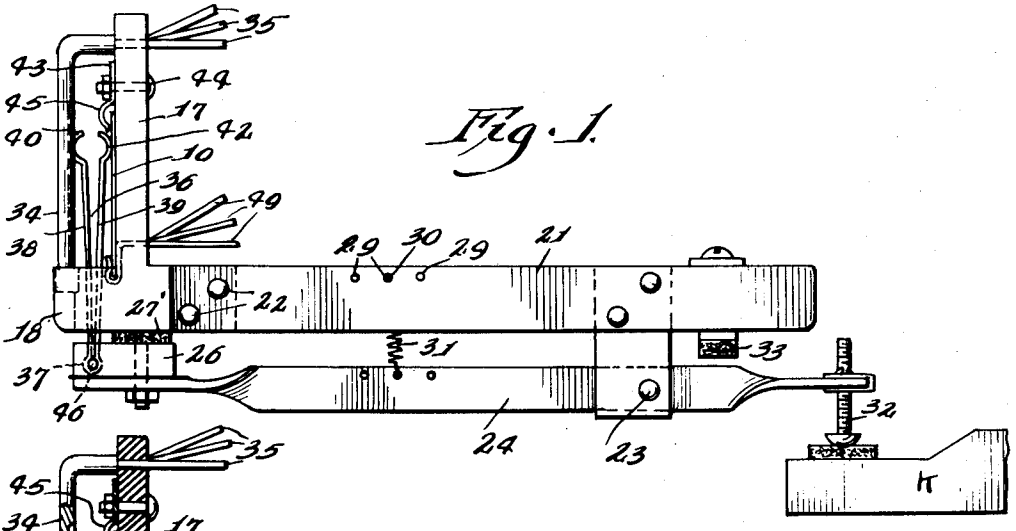


Fig. 1.

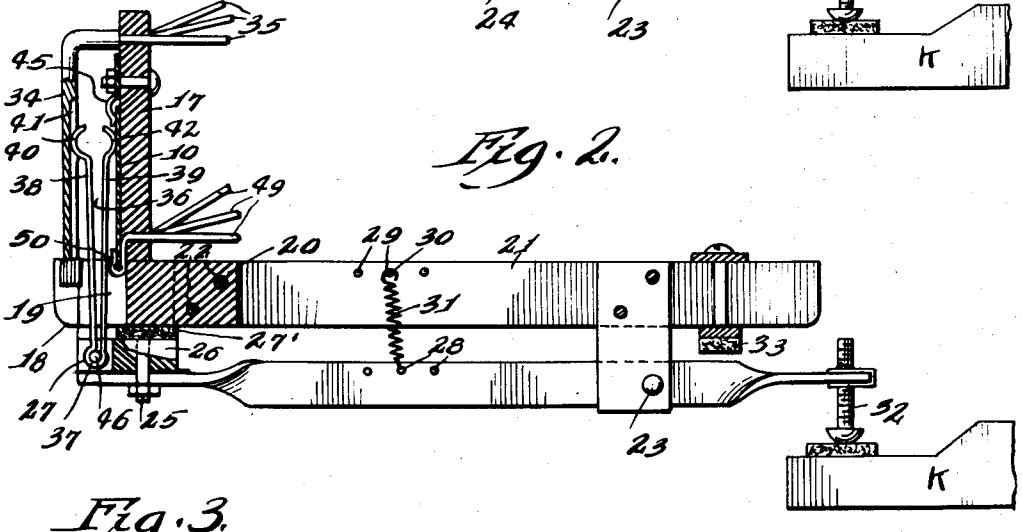


Fig. 2.

Fig. 3.

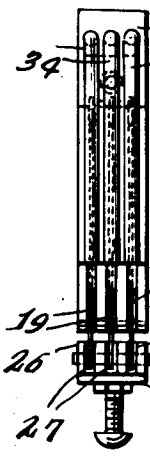
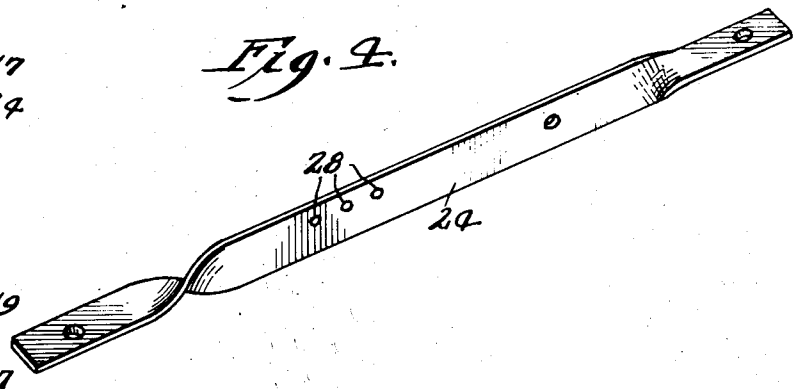


Fig. 4.



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Fig. 5.

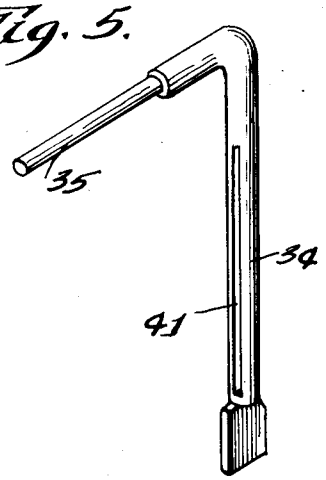


Fig. 6.

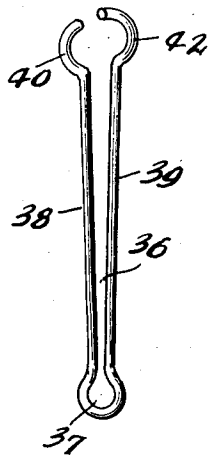


Fig. 7.

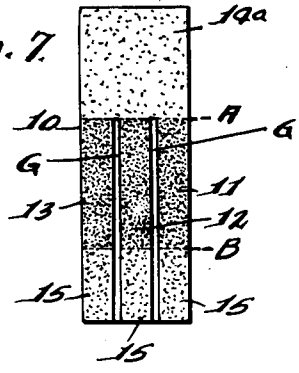


Fig. 8.

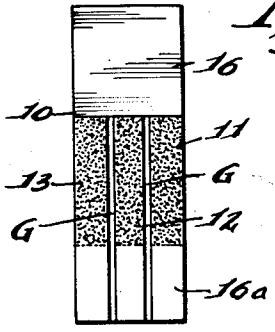
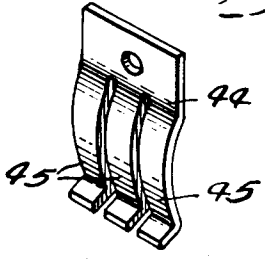


Fig. 9.



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UNITED STATES PATENT OFFICE

2,510,608

RHEOSTAT SWITCH

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Application November 27, 1948, Serial No. 62,387

5 Claims. (Cl. 201—48)

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This invention relates to electric switches and more particularly to improvements upon the switch described and shown in the application of Merwin J. Larsen and James A. Koehl, for which application for Letters Patent Serial No. 61,160, was filed November 20, 1948.

A primary object of the invention finds expression in the simplification of a switch employing a resistance which is variable in response to motion of an actuator and adapted to be connected in a signal transmission network to suppress noise commonly called "key thump," caused by sudden surge of signal voltage when close circuiting a source of signal voltage with the input circuit of an electroacoustical translating device in the output of said transmission network.

The invention is primarily, but not necessarily designed for use in the keying circuit of an electronic organ employing sources producing tone signals at the vibration frequencies of notes of the chromatic scale. An organ of this general class is described and disclosed in Letters Patent, No. 2,403,093 to M. J. Larsen, dated the 2nd day of July, 1946. In the Larsen patent, each playing-key of the organ is adapted selectively to actuate an electric switch, which, when close circuited upon depressing the key impresses signal voltage on a transmission network from a selected source of signal voltage for activation of a signal translating device such as a loud speaker.

In pipe organs, the term "ciphering" means the sounding of a pipe of the organ when the key associated with the pipe is not touched. This is most always the result of failure of the key to return to a position necessary to disconnect the wind chest from the pipe, which, in turn, results in either insufficient upward spring pressure on the key or failure of the relay controlled key contactors to function as intended. Substantially the same condition can arise in an electronic organ by failure of a key actuated switch of the manual of the instrument to break the circuit between a source of signal voltage and the input circuit of an electroacoustical translating device. Accordingly, it is an important object of my invention to provide an electric switch which is characterized by electrically coactive elements that are positive in their action to break the circuit between said source of signal voltage and the input circuit of said translating device upon the release of applying pressure from the key.

A still further object is the provision of an electric switch which is noiseless in action and consists of electrically coactive parts of such

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form, design and construction as to lend themselves to expedient fabrication and whereby any individual part of the switch can be readily removed and replaced by a new part conveniently and at slight cost.

A still further object is the provision of an electric switch in which the impedance value of the resistance in a signal transmission path is determined by the depth of depression of a tiltable actuator or selector such as the playing-key of an electronic organ and means providing a continuous signal conductor which is coactive with the resistance to insure a flow of signal voltage in which the amplitude progressively increases as the key is depressed and in like manner progressively decreases as the key returns to a normal elevated position, in which latter position, signal voltage from a source of supply will be positively prevented by a positive "off" position of the switch.

Playing-keys of the manual of an electronic organ are most always urged to elevated positions by springs, such that each separate key is responsive to playing pressure applied thereto, the pressure ranging from two and a half to four or more ounces. In the instant embodiment of my invention, the switch is provided with resilient means having a dual purpose, namely (1) means coactive with a playing-key to urge same to an elevated position and render the key actuable in response to any playing pressure thereon, and (2) means for insuring a return of the switch parts to an "off" condition of the switch when pressure is removed from the key.

Other objects and advantages of the invention will be manifest upon reference to the following description and accompanying drawing, wherein:

Figure 1 is a view in side elevation of the switch showing same in an "off" position.

Figure 2 is a longitudinal section thereto showing parts in elevation.

Figure 3 is a rear end view of the switch.

Figure 4 is a perspective view of the tiltable arm.

Figure 5 is a perspective view of one of the conductor and guide rails.

Figure 6 is a perspective view of one of the contactors.

Figure 7 is a plan view of the resistive strip showing one step in the process of producing same.

Figure 8 is a view similar to Figure 7 showing the strip in its complete form, and

Figure 9 is a perspective view of the grounding element.

In the aforementioned application of Merwin J. Larsen and James A. Koehl, a resistive element is employed as shown at Figures 7 and 8 of the accompanying drawings, said element comprising a flat strip 10 of suitable well known electrical insulating material such as Bakelite. The front or electrically active face of said strip has parallel, laterally spaced apart lanes 11, 12 and 13, each consisting of a resistive coating compound such as carbon or other well known resistive coating material, such that each separate lane is preferably but not necessarily of the same predetermined impedance value between points A and B. The lower end of each of said lanes merges into a low resistive coating 15, such that for each separate high impedance coated portion there is individual thereto a low resistive coating 15 forming the signal output end of the strip for transmission of signal voltage to the input circuit of a power amplifier from an associated or conjoined high impedance lane 11, 12 or 13. The upper ends of lanes 11, 12 and 13 merge into a carbon coating 14a which is common to all of said lanes. The carbon coatings above referred to may be sprayed or painted upon said strip 10 and either air or heat dried so that said coatings form hard surfaces that will not be easily penetrated by contacting members to be described presently. The coating 14a is preferably covered with a thin film of metallic paint 16. The lower ends of said lanes are also preferably faced with a thin film of metallic paint 16a.

Strip 10 is placed flatwise against the vertical face of a mounting 17 of electrical insulating material, the lower end of which has a rearwardly extending guide lug 18 formed with horizontally disposed slots 19, such that for each of said lanes 11, 12 and 13 there is a slot individual thereto. A forwardly extending lug 20 at the lower end of said mounting 17 is attached to and between the rear ends of parallel metallic strips 21, 21, as at 22, the lug serving to hold said strips spaced apart from each other.

Fulcrumed at 23 to said strips 21, 21 is a lever arm 24, the rear end of which has fixed thereto at 25 a block 26 consisting of electrical insulating material which underlies lug 18 and is provided with longitudinally spaced apart slots 27 which are in vertical alinement with the aforementioned slots 19. Secured to the upper surface of block 26 is a strip of felt or cushioning material 27' adapted to contact the lower surface of lug 18 when returning arm 24 to an "off" position of the switch.

Formed in the lever arm 24 is a longitudinal series of openings 28. Formed in each of the strips 21 is a similar longitudinal series of openings 29, such that horizontally alined pairs of openings 29 are provided through the openings of any pair of which is adapted to be extended a pin 30. A coil retractile spring 31 is hung from said pin, and as shown, the lower end of said spring is engaged in one of said openings 28. In this manner, spring pressure upon the lever arm may be varied, as desired.

The forward end of said lever arm is provided with an adjusting screw 32 adapted to rest against the upper end of the back end of a playing-key K, such that when playing pressure is applied to front end of the key, tilting motion will be transferred to said arm in a direction opposite to the normal tendency of spring 31 to advance the felt 27' against the under surface of said lug 18, the front end of said arm is adapted to come against a cushioning material 33 at the front ends of said strips 21.

Rails 34 of electrically conductive material are spaced apart laterally from each other at the rear of and in spaced relation to the carbon coated face of strip 10, such that for each of the lanes 11, 12 and 13 there is a rail 34 individual thereto and electrically coactive therewith. These rails are firmly secured in the respective slots 19 in lug 18. Said rails are in parallel relation to said lanes 11, 12 and 13, and, as shown, the upper end of each separate rail passes through the upper end of mounting 17 to provide an electrical terminal 35 for connection to a tone signal supply source (not shown).

For each separate one of the lanes 11, 12 and 13 and its coactive rail 34 is a contactor 36, each of which comprises a single length of springy material such as German silver wire bent medially on itself to form a loop 37 and a pair of springy stretches 38 and 39, the former of which is formed with a half loop 40, presenting a smooth curved effective contact surface which is received in a longitudinal groove 41 in a respective rail 34 for vertical motion therein and with effective electrical contact with said rail. Stretch 39 is similarly formed as shown at 42 and is adapted for effective rubbing engagement with a respective one of said lanes 11, 12 and 13. When the switch is in an "off" position half loop is at the upper limit of its movement and loop 42 is in effective contact with the common ground 16, and as shown, a metallic clip 43 adapted to be connected to ground is secured at 44 to said mounting 17 and formed with yieldable tongues 45 which bear firmly against said common ground 16.

The loops 37 of said contactors 36 pass into said grooves 19 in lug 18 and are secured to said lug by a pin 46 of electrical insulating material.

Passing through the lower portion of mounting 17 are terminal connectors 49, such that there is one thereof for each of said lanes 11, 12 and 13. Each of these connectors has an end 50 firmly upset against the low resistive coating at the lower end of a respective one of said lanes. Each of these connectors is adapted to be connected to an electrical output conductor, which latter, in turn, is adapted to be connected to the power amplifier of an electroacoustical translating device.

Assuming now that the playing-key is in an elevated position, the loops 42 of contactors 36 will all thereof be in contact with the common ground 16 the current path to ground being through rails 41 and loops 40. When depressing the playing-key, the contactors will maintain yieldable contact with their coactive rails and with their coactive lanes 11, 12 and 13 and will progressively move rectilinearly and in rubbing contact along said rails with same and said lanes and will move toward the low resistive coatings at the lower ends of said lanes, thereby varying the effective resistance as a function of the motion of said key. By reason of the fact that the two stretches 38 and 39 tend always to spring apart from each other and that loop 27 connects with the back end of rocker 24, the pressure of the free ends of the stretches against the lanes and said rails increases slightly as the playing-key lowers. The surfaces are, therefore, self-cleaning.

The lanes 11, 12 and 13 between points A and B will preferably have an effective impedance value of 50,000 ohms. The effective impedance

of the common ground can be of any predetermined resistance, which is also true of the coatings at the lower ends of said lanes.

The essence of the invention is the coactive relationship of a resistive element which extends rectilinearly and is parallel to one or more rails of conductive material, in combination with one or more contactors, such that one stretch of a single length of spring wire has constant electrical contact with a coactive conductive rail, while the other stretch is in constant electrical contact with said resistive element, whereby the amplitude of signal voltage is progressively variable in response to rocking motion of said lever arm 24. Stress is placed upon such new and novel features as a contactor formed of springy conductive material in which separate portions of the same wire are urged always to positions of effective contact with their respective conductive rails and correlated resistive surfaces.

By the means herein disclosed the half loop portions of the respective stretches of a contactor bear only lightly upon their coactive rails and resistive elements and by reason of the smooth effective contact portions of said half loops, undue wear upon the resistive element is prevented while insuring a smooth, noiseless operation of the switch.

While I have given an example of the value of resistance of the aforementioned coating materials, this is for illustration only as it follows that the value of the resistance can be readily determined depending upon the use the switch is to serve in practice.

Stress is also placed upon use in an electric switch of a guide rail in coaction with a contactor, which rail is of conductive material and causes conduction of signal voltage across an impedance element via a contactor which is common to and coactive with said rail and a rectilinear resistive element.

While I have shown a resistive element characterized by a resistive coating material any other well known resistive material can, of course, be substituted therefor.

In order that the lanes 11, 12 and 13 will be insulated from each other, the strip 10 is grooved longitudinally along spaced parallel lines as at G to separate said lanes from each other.

What I claim as my invention, is:

1. An electric switch comprising a rocker arm having means of insulating material, an impedance element, a current conductor disposed in parallel relation to said impedance element, a contactor supported by said means for rectilinear motion between the resistive element and said conductor in response to rocking motion of said rocker arm, said contactor having resilient stretches tending always to move away from each other and respectively against said current conductor and said resistive element for effective rubbing contact therewith, means for yieldingly moving said rocker arm to one possible position of adjustment, and means for varying the tension on said last named means.

2. An electric switch according to claim 1, wherein said conductor is formed with a guide channel in which a free terminal of one of said stretches is movable.

3. An electric switch for actuation by the playing-key of a keyboard musical instrument, said switch comprising a mounting of electrical insulating material having a vertically disposed rectilinear surface of resistive material, an output terminal attached to said surface at one end thereof, means of electrically conductive material disposed in spaced parallel relation to the aforementioned surface, and supported thereby and insulated therefrom, a playing-key actuated rocker fulcrumed to said mounting, an input terminal connected to said means, and a contactor comprising a single length of springy wire bent on itself to form two similar legs in which one thereof has a free end in yielding sliding engagement with the aforementioned surface and the other is similarly provided with a free end which yieldingly engages the aforementioned means and is slidable along same, said contactor having said legs joined together at one end by a looped portion of said wire which is connected with said rocker and electrically insulated therefrom; and resilient means connecting the mounting to the rocker for urging the latter in a direction to position the free ends of said legs in one of two extreme positions.

4. An electric switch as set forth in claim 3, wherein said surface has a grounding connection with which the free end of the first mentioned leg of the contactor is engaged when the rocker is in the aforestated position.

5. An electric switch comprising a rectilinear impedance element having an output terminal at one end and a connection to ground at its other end, a rectilinear input conductor disposed in parallel relation to said impedance element, a contactor providing a constant conductive bridge between said element and said conductor and movable rectilinearly thereof and respectively onto and off of said ground connection, said contactor comprising a single length of springy metal having two stretches tending always to move laterally away from each other and respectively into electrical engagement with said element and said conductor, a rocker to one end of which the contactor is connected so that when moving the rocker in one direction the stretches are further urged respectively against said element and said conductor, and means for yieldingly urging the rocker in a direction to dispose the stretches in positions to form a path between said conductor and said ground connection.

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