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M. J. LARSEN

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CONDENSER

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Fig. 1.

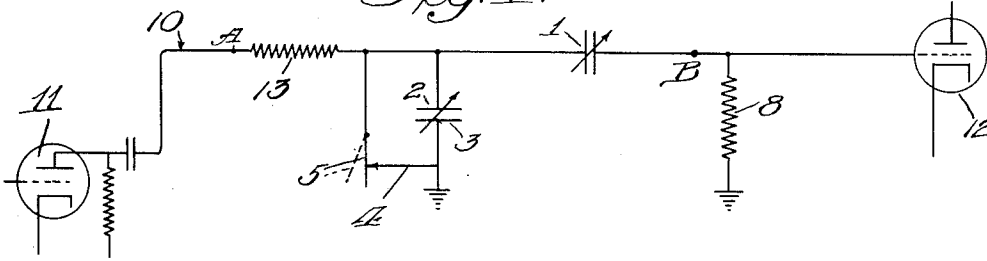


Fig. 2.

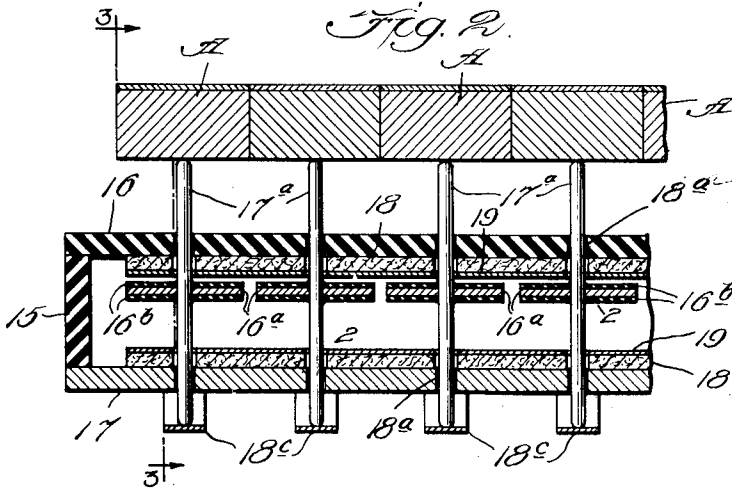
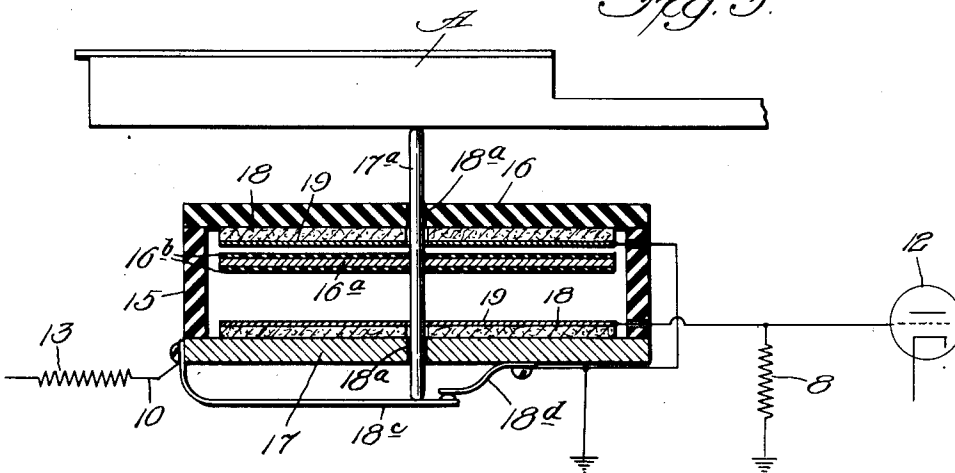


Fig. 3.



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CONDENSER

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6 Claims. (Cl. 171-97)

This invention relates to condensers and has particular reference to a type of reactants embodying features of an electric switch for controlling conduction of alternating current to a work circuit.

The invention is primarily designed, adapted and intended for use in electric organs wherein tone frequencies in the form of alternating current potentials are impressed upon the input circuit of an amplifier upon selective depression of the playing keys of the instrument's keyboard, thence converted into audible sounds for the purpose of musical expression, and an object of the invention is to provide means for suppressing noise known as "key-click" which heretofore has always accompanied actuation of said keys and which, upon entering the amplifier circuit is objectionably audible during conversion of said frequencies into sound waves.

A further object is to simplify the construction and reduce the cost of production of key switches employed in electrical musical instruments of the class stated and to render same decidedly more dependable than heretofore has been possible.

A still further object is to provide a common bank of switches adapted readily to be installed in the instrument and conveniently related to the playing keys so as to be actuable thereby.

The novel features of my invention are set forth with particularity in the hereto appended claims. The method itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will be fully understood from the following description of a specific embodiment, when taken in connection with the accompanying drawing, in which:

Figure 1 is a schematic circuit diagram of the invention showing same interposed in a circuit which connects a generator of oscillations with the input of an amplifier or control tube.

Figure 2 is a longitudinal section through a bank of condensers showing application of the individual condensers to the playing keys of a musical instrument, and

Figure 3 is a detail section through one of the condensers and taken substantially on the line 3-3 of Figure 2.

The novel characterizing features and functional advantages of my invention will be readily appreciated upon referring to the schematic illustration, Figure 1 of the accompanying drawing, wherein is shown a condenser-resistive path 10, one terminal of which is connected to an

output electrode of an oscillation generator 11 which, preferably, but not necessarily is a vacuum tube or its electrical equivalent, the other terminal of said path connecting with the grid of an amplifier or control tube 12. A grounded resistor 8 of .1 megohm is connected across the path 10 at the input side of tube 12 and a resistor 13 of from 5 to 10 megohms is connected in series in said path at the output side of said tube 11.

Interposed in the path 10 between said resistors 8 and 13 and connected in series with said path is a key-actuated variable condenser 1 of from 5 to 500 micromicrofarads, said condenser being completely closed when an associated playing key of the instrument is fully depressed, thereby offering maximum capacitance to current flow in said path 10 and causing minimum impedance between source 11 and said amplifier 12. The reactance of the capacitance between the relatively movable plates of the condenser is thus less than the resistance 13 in said path 10, which, as above stated, is from 5 to 10 megohms, the resistance functioning to provide a fixed attenuation between points A and B in said path.

Shunted across the path 10 and interposed between resistors 8 and 13 is a second key-actuated, variable condenser 2 which is also of from 5 to 500 micromicrofarads, the grounded plate 3 of which electrically connects with a contact element 4 which constitutes a part of an electric switch, the movable contact element 5 of which is connected to the path 10, as shown and thereby is adapted to engage element 4 when the playing-key is up. This shunts the current to ground from source 11 and insures a high impedance between said source and the aforementioned amplifier. In consequence thereof, the output current is reduced to a negligible fraction of that of the output when the contact elements of the switch are disengaged from each other and "key-click" noises which otherwise would be produced are effectively suppressed and rendered inaudible during motion of the playing key.

In practice, the system of key-actuated condensers shown in Figure 2 comprises a rectilinear, light weight, hollow structure 15, preferably of wood or some suitable well known composition of matter which is a non-conductor of electricity. To the inner surface of each the upper and lower walls 16 and 17 of the structure 15 is a sheet of felt 18 which is approximately coextensive with said wall and is faced with a continuous strip of metal foil 19. Thus there is provided within said structure a pair of oppositely disposed,

spaced apart condenser plates which are in parallelism.

For and individual to each playing-key A of the instrument and situated in said hollow structure 15 between said fixed condenser plates is a vertically movable plate 16^a, the opposite flat faces of which are covered with Cellophane 16^b to insure against electrical contact of said movable plate with the capacitatively related fixed plates.

Each movable plate 16^a is securely attached to a vertical pin 17 of electrically conductive material, the same freely passing through large diameter, coincident openings 18^a in the upper and lower walls of said structure 15, the arrangement being such that the pin is thereby insulated from said fixed condenser plates. The upper end of the pin bears against the under surface of an association playing-key, whereas the lower end of the pin rests lightly upon the upper surface of the free end of a leaf spring 18^c, the latter constituting the movable element of the key-actuated switch, first above described. It is important to note that under the normal urging tendency of the spring, contact of the spring is established with the fixed contact element 18^d of the switch and that the pin is urged yieldingly upward so that when the playing-key is elevated, the movable plate of the condenser is disposed very close to upper, coating fixed plate.

By employing felt 18 as an element of my condenser, close spacing of the parts is possible, due to the resiliency of the felt, thereby increasing the capacitance and avoiding otherwise necessary costly machining, while, at the same time, eliminating entirely any shock or electrical vibration which, if generated, would create electrical disturbances in the work circuit.

Having fully described the essential elements of the invention and their functional relationship, the theory of operation is as follows: When a playing-key of the instrument is down, the movable plate of the condenser associated with said key is close to the fixed lower plate of the condenser with resulting maximum capacitance which causes minimum impedance between the oscillation generator or frequency source and the grid of the amplifier or control tube. Thus, the reactance between said movable plate and said lower fixed plate is less than the resistance 13 in the circuit herein shown. When the key is up, as shown in Figure 3, the generated current from said oscillation generator is shunted largely to ground through the contacts 18^c and 18^d and the impedance between said generator and the amplifier tube is very high. By test, the output is reduced in the "off" position to 1 or 2 per cent of the output when in the "on" position. When the key is entirely up, the oscillation generator or frequency source is grounded through the contacts 6 and 7 and no current passes to the amplifier. In consequence of the arrangement and the forms of parts employed, no "click" is audible when the contacts engage each other because of the low level thus provided.

I stress particularly the simplicity and dependability of the above described device and in addition to the aforementioned structurally and functionally novel features, point to the feature which consists in the provision of contact or make and break elements 18^c and 18^d which are purposely designed to flex and to come in effective rubbing or wiping engagement with each other during actuation of a respective play-

ing-key, thereby keeping the contact surfaces clean at all times.

What I claim as my invention is:

1. A capacitance switch for signal current transmission paths comprising spaced apart plates providing fixed capacity areas and a movable plate coating therewith and providing a capacity area which is selectively adjustable relative to either of said fixed plates, a selectively adjustable actuator of electrically conductive material for and attached to said adjustable plate, a fixed contact element, and a movable contact element in constant electrical engagement with said actuator and adapted respectively to engage and disengage said fixed contact element according as said actuator is in one or another selected position of adjustment.

2. A capacitance switch for signal current transmission paths comprising a pair of fixed capacity areas and means of electrically conductive material coating with said areas and adjustable towards a selected one of said areas and away from the other of said areas to provide maximum capacitance between said means and said selected area and to render said means non-capacitative relative to said other area; an actuator for said means; a movable contactor controlled by said actuator and having constant electrical connection with said means; and a contactor adapted respectively to engage and disengage said movable contactor according as said actuator is in one or another selected position of adjustment.

3. A variable electrical condenser comprising a structure having condenser sides spaced apart from each other; an element of electrically conductive material selectively adjustable between said sides from a position of capacitative relation thereof to one of said sides to a position of capacitative relation to the other of said sides; and a switching system including a constant leak to ground from one of said sides, a signal input terminal always electrically connected with and actuable by said element to make electrical connection with said leak when the element is in one possible position of adjustment and to break said connection when said element is in another possible position of adjustment.

4. A variable electrical condenser comprising a structure having condenser sides spaced apart from each other; an element of electrically conductive material selectively adjustable between said sides from a position of capacitative relation to one of said sides to a position of capacitative relation to the other of said sides; and a switching system including a constant leak to ground from one of said sides, a resilient, signal current input terminal always electrically connected with and actuable by said element to make electrical connection with said leak when the element is in one position of possible adjustment and to break said connection when the element is in another position of possible adjustment, said resilient, signal current, input terminal, tending always to urge said element to a position to establish electrical connection of said terminal with said leak.

5. A variable electrical condenser comprising a structure of electrical insulating material having effective, oppositely disposed condenser sides and an element of electrically conductive material adjustable upon said structure from a position of capacitative relation to one of said sides, to a position of capacitative relation to the other thereof; a polarizing terminal always electrically

engaging said element; and a constant leak to ground from said one side of the condenser and including a contactor engageable with said terminal when the element is capacitatively related to said side and disengageable therefrom when said element is capacitatively related to the other side of said condenser.

6. A variable electrical condenser comprising a structure having a permanently grounded side and a signal current output side, said sides spaced apart from each other; an element of electrically conductive material selectively adjustable between said sides from a position of capacitative relation to one thereof to a similar position relative to the other side thereof; a sig- 15

nal current input terminal always electrically connected to said selectively adjustable element; a signal current output terminal for the output side of said condenser; and means electrically coacting with said signal current input terminal, said selectively adjustable element, and the permanently grounded side of said condenser for causing transmission of signal current to said output terminal when said element is capacitatively related to said output side and for shunting said current to ground whenever said element is capacitatively related to said permanently grounded side of said condenser.

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