

Jan. 8, 1952

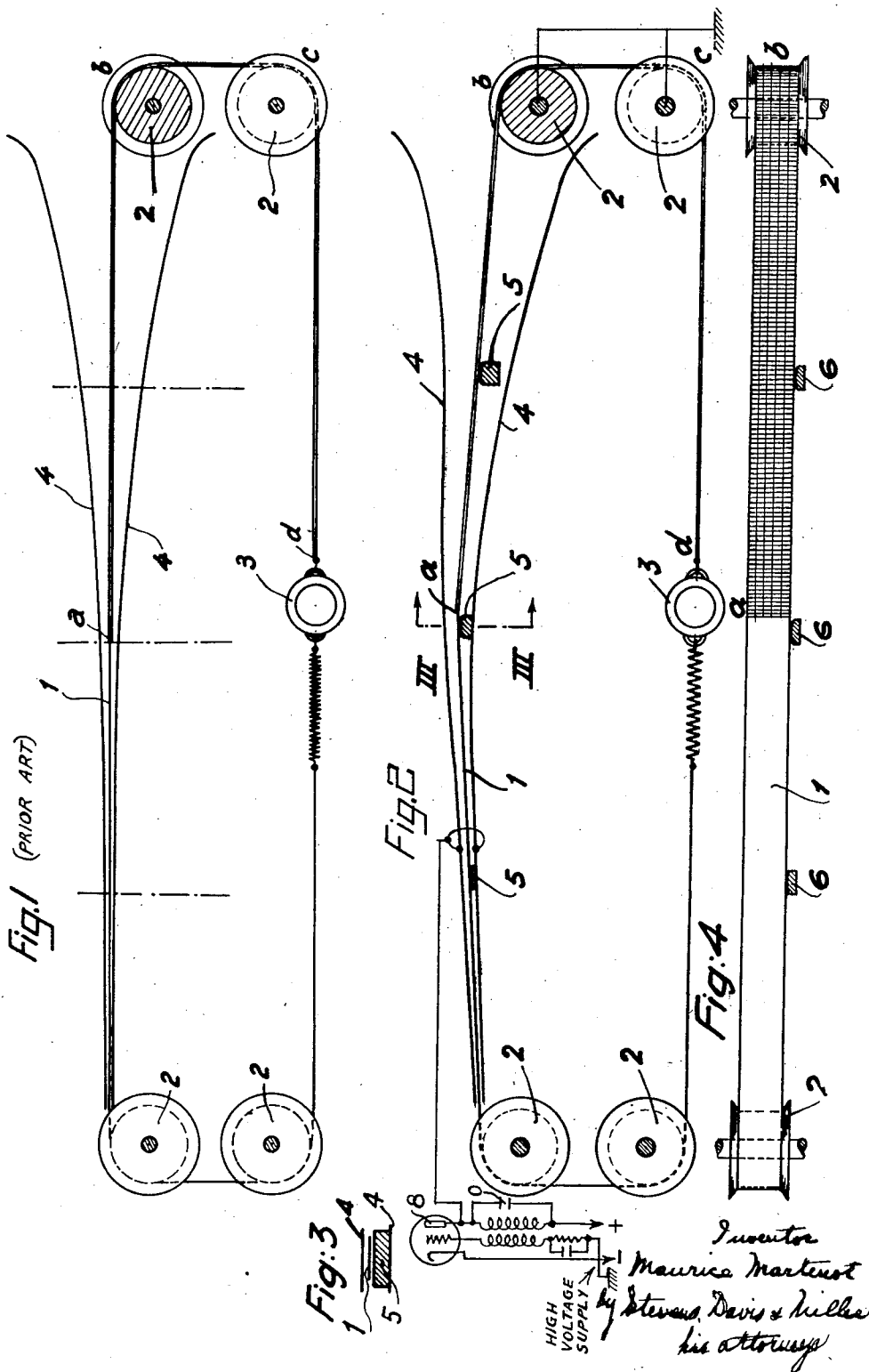
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2,581,680

MOVABLE TAPE CONDENSER FOR ELECTRONIC GENERATORS

Filed April 5, 1948

3 Sheets-Sheet 1



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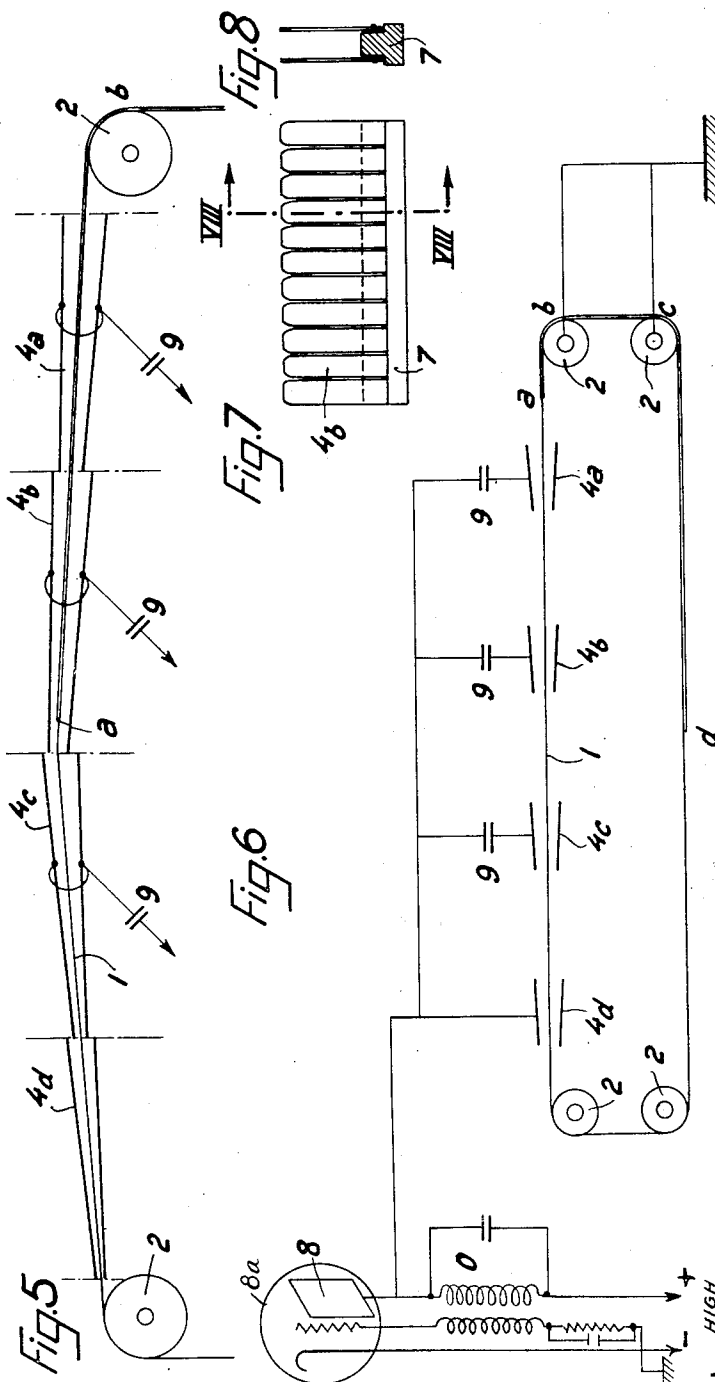
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3 Sheets-Sheet 2



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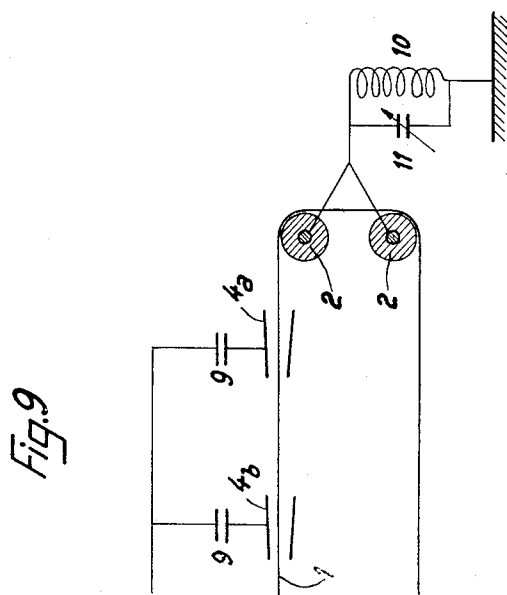
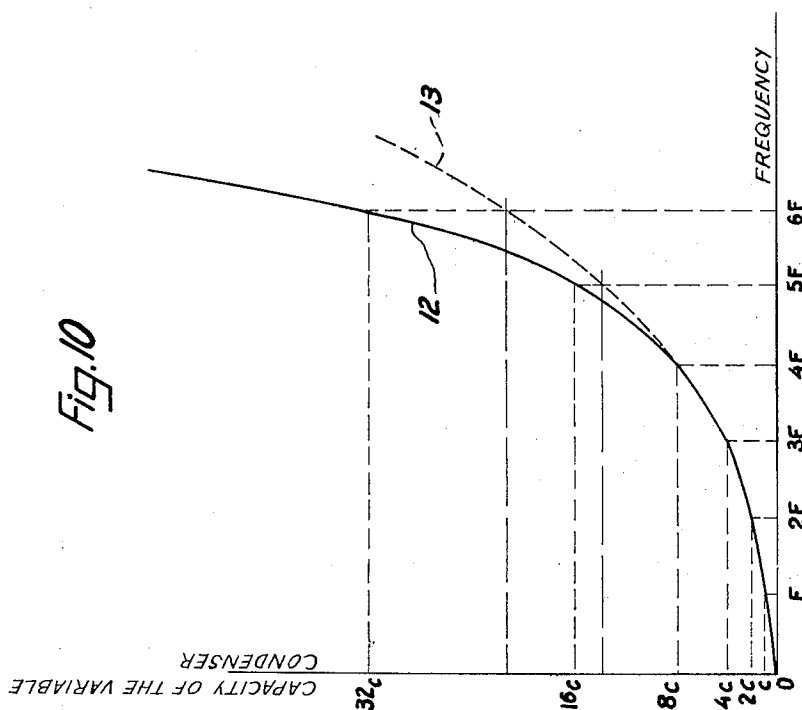
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UNITED STATES PATENT OFFICE

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MOVABLE TAPE CONDENSER FOR
ELECTRONIC GENERATORS

Maurice Martenot, Neuilly-sur-Seine, France

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7 Claims. (Cl. 250—40)

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In the electric or electronic musical instruments, the design of the elements ensuring to the performance an easy control of the frequency variations from which arise the musical sounds produced by the instrument is of fundamental importance. As a matter of fact, said variations should be obtained while taking into account the gesture conveniences as well from the point of view of the direction and magnitude of the gestures as from that of their possible velocity and the inertia to overcome.

Thus, for example, the oscillation generating circuits are usually designed to allow considerable frequency variations (the whole range of the musical sounds, if possible) with a minimum of weight and volume of the movable members. This is true in the case of the circuits using heterodyne beats between high frequency oscillators, feedback devices, and circuits using the discharge of gas-filled tubes, which may be controlled by rods, tapes, wires, etc., acting upon the frequency variation elements or constituting, per se, a part of said elements.

The known device which consists in using a tape of which a conducting portion acts as the movable plate of an air condenser presents, in particular, great advantages.

This invention has for its object improvements in this tape control device, particularly in order to ensure to said device a high operation reliability and to obtain a sufficient range of frequency variations without excessive motions.

One of said improvements consists in a tape guiding device comprising shoes on which the tape bears on its face and on its edge, so as to determine accurately the position of the movable plate constituted by said tape with respect to the stationary plate of the condenser.

Another improvement has for its object to reduce the volume of the stationary plates of the condenser while ensuring a satisfactory range of frequency variations. It consists in dividing the stationary plates into successive sections the spacing of which varies according to a law which is discontinuous from each section to the next one, said sections being parallel connected through fixed condensers suitably selected to correct the curve of the capacity variation as the tape moves in the various sections.

The stationary plates are preferably constituted by combs which allows to adjust very accurately the capacity variation for the various positions of the tape by slightly twisting the comb teeth.

Another improvement concerns the tape design

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proper in the purpose of obtaining a good surface continuity between the insulating portion and the conducting portion of said tape, at least in which concerns the parts of the tape which wipe on the guides. According to this improvement the metal is incorporated to the tape by weaving of metallic or metallized wires which may take the place of woof and warp threads of the insulating portion without modifying in a prejudicial manner its thickness.

The following description with reference to the accompanying drawing, given as an illustration which does not limit my invention, will make easy to understand how it may be realized, the features which result from the drawing and from the description pertaining, of course, to the scope of said invention.

Fig. 1 is a plan view of a known variable condenser with a movable tape.

Fig. 2 is a similar view and shows a surface guiding according to the invention.

Fig. 3 is a section of Fig. 2 along line III—III.

Fig. 4 is a front view of portion of the tape shown on the upper part of Figure 2, the stationary plate assembly of the condenser being removed for convenience of illustration.

Fig. 5 shows an embodiment of the stationary plates of the condenser according to the invention.

Fig. 6 is a wiring diagram showing the connection in the oscillator circuit of the various sections of the stationary plate.

Fig. 7 is a front view of a comb-like plate section.

Fig. 8 is a sectional view along line VIII—VIII of a plate section showing also the insulating support.

Fig. 9 shows another way of connecting the condenser plates in the oscillator circuit.

Fig. 10 is a diagram showing the curves of frequency variations which may be obtained by means of the circuits of Figs. 6 and 9, respectively.

The known movable tape condensers are similar to that shown in Fig. 1. The endless tape 1 is guided on the four rollers 2 and presents a conducting portion *a*, *b*, *c*, *d* shown in heavy line. A ring 3 that the operator holds in his hand, is used to move the tape between the two stationary plates 4 which together with the metallized portion *a*, *b*, *c*, *d* of the tape constitute the condenser. This device presents the drawback of a considerable span of the tape between the outer rollers from which may result lateral variations disturbing the value of the

capacity and affecting the sound qualities. In order to overcome said drawback, according to my invention, I add to the tape along its effective travel an accurate guiding device comprising (Figs. 2, 3 and 4) shoes 5 against which wipes the tape surface and which causes said tapes to take an incurved surface in order to ensure the bearing of the tape on said shoes owing to its tightening. As it will be understood said shoes avoid the lateral vibrations of the tape. Its vertical motions are also avoided by means of another set of shoes 6, which are disposed under the tape and on which said tape bears on its edge.

The known condensers shown in Fig. 1 presents further the drawback that if it is desired to produce therewith a capacity variation giving a frequency variation corresponding to the scale of the musical intervals, then for the same motion of the tape the capacity variation should be exceedingly small at one end of the condenser and very large at the other end. This leads to give the stationary plates 4 an outline similar to that shown in Fig. 1.

The construction of such a device presents the disadvantage of a too large size of the plates on the side of the smaller capacity; on the other hand, the capacity to be obtained on the opposite side is such that it is no more possible to use air as a dielectric. Moreover the use of a dielectric other than air does not provide a sufficient stability of the adjustment.

In order to overcome said disadvantages:

(1) The stationary plates are divided, according to the invention, lengthwise into a number of portions 4a, 4b, 4c, 4d . . . (Fig. 5).

(2) Each portion is constituted by two comb-like adjustable plates (Figs. 7 and 8) disposed on an insulating base especially shaped to give the desired curve. However the fine tuning is realized by slightly twisting the teeth of each comb to bring them more or less away from the tape.

(3) Each elements 4a, 4b, 4c, 4d so constituted is, per se, independent of any other one.

As shown in Fig. 6 said elements are interconnected in parallel and the whole is also parallel connected to the principal oscillating circuit O connected to the anode 8 of the oscillator tube. Fixed capacitors 9 are series connected respectively to the various elements except that or those of the high-pitches register such as 4d, said capacitors being suitably designed to correct the aspect of the frequency variation law and to give it that of the continuous plate condenser of Fig. 1.

In each element the spacing between both stationary plates decreases according to a law adapted to the frequency range which must be covered by said element but it is possible owing to the division of the elements and due to link capacitors 9 to obtain convenient intervals (neither too large nor too small) at both ends of the element.

According to a well-known arrangement the oscillator comprising the oscillating circuit O and the tube 8 shown in Fig. 6 which generates high frequency oscillations is coupled with a second oscillator, not shown, and the audio frequency beats thus produced are finally transmitted to a loud-speaker. It appears from Fig. 6 that in each element the end of the stationary plates nearer to the tape, is at a smaller distance from said tape than the adjacent end of the stationary plates in the adjacent element. For instance the left end of each stationary plate in the ele-

ment 4c is at a smaller distance from the tape than the right end of the stationary plates in the element 4d.

In the portion of the tape condenser which should produce the maximum of frequency variation (high-pitched register), in order to avoid the use of a dielectric other than air it has been found necessary to further modify the frequency variation curve by adding an inductance 10 (Fig. 9) of a suitable value to remain sufficiently near to the resonance point with the principal oscillating circuit so that in the second part of the travel of the variable condenser tape the frequency variation obtained becomes more considerable, according to the laws concerning the static coupled oscillating circuits. So that the value of this circuit should be easily adjusted and to eventually readjust the tuning of the high-pitched register an adjustable or trimming condenser 11 is used to shunt said inductance. There may be chosen, e. g., an inductance 10 of 10 millihenries shunted by a condenser 11 of 15 through 30 cm. for a principal oscillating circuit O having a capacity of 500 cm. and an inductance of 4 through 5 millihenries, the above values being given, of course, merely as an illustration.

Fig. 10 shows the result obtained with this arrangement. In this figure the variable condenser capacity is plotted on the ordinate axis, the frequency being plotted on the abscissa axis. 12 shows the curve obtained without inductance 10 and 13 shows the curve which may be realized with said inductance and which is, as it will be seen, more extended than the first one on the side of the higher frequencies.

In a condenser of the type described, the variable plate is constituted by a tape having a conducting portion and an insulating portion. Therefore such a plate was designed by juxtaposing an ordinary tape to a spangled tape. The juxtaposition was effected either by sewing edge-to-edge, either by means of pieces stuck or sewed on both sides of the joint. However such joints are too weak; moreover they cause differences in the thickness of the tape. Even if they are very small, such thickness differences produce a sudden lateral shift of the tape which ever they pass over the guiding shoes which results in a sudden capacity variation which does not correspond to the desired curve.

According to my invention, said disadvantage may be avoided as follows: On a warp of insulating thread having the total length of the tape there is added only in the portion which is to be conducting warp threads constituted by conducting wire or metal-lapped thread. The woof is then woven partly in ordinary thread, partly in conducting wire so that in thickness as well in width, the size of the tape is the same on the insulating portion, on which the woof threads are interconnected by the conducting warp threads, and on the conducting portion. In Figure 4 only the metallic warp and woof threads of the conducting portion a, b, c, d of the tape have been shown. A thickness difference may however be admitted under the condition that it concerns only the tape face remote from the guiding shoes 5 of Fig. 2, a width difference being also admitted if it concerns only the tape edge remote from holding shoes 6 of Fig. 4.

These conditions may be easily realized in the modern weaving art. In particular, it is well known that thick fabrics known, for example, as double-stuff, and comprising two woofs and two warps may be obtained. It is therefore pos-

sible for realizing the composite tape to make a thick fabric in the insulating portion then to replace in the metallized portion certain elements of the thick fabric by metallic wool and warp wires. By suitably choosing the size of the metallic wires, it is possible to obtain the same thickness and width for both portions.

The purpose of the conducting wire of the wool is to ensure the perfect electric conductivity of the metallized portion in the case where a break of continuity would occur in the metallic part of the warp, wire or wires.

It is also to be understood that the embodiments described have been given merely as illustrations and that they could be modified, particularly by substitution of technical equivalents within the scope of my invention.

What I claim is:

1. In a hand actuated frequency variation device particularly adapted to electric musical instruments and having a movable tape which is of insulating material on a portion of its length and of a metal containing material on the other portion, said tape being associated with a stationary plate so as to form therewith a variable condenser, and hand actuated means provided on said tape for reciprocating the same, the improvement wherein said stationary plate comprises a plurality of elongated metallic elements consecutively arranged in the direction of their larger dimension and in a position substantially parallel to said tape, said elements being curved to provide a variable space between each of said elements and said tape, said elements being further positioned with respect to said tape so that the end of each element nearer to the tape is at a smaller distance from said tape than the adjacent end of the adjacent element.

2. The improvement of claim 1 comprising further guiding means arranged along the path of the tape in front of said elements of the stationary plate and cooperating with said tape in order to maintain an unchangeable space between its surface and the surface of said elements.

3. The improvement of claim 1 comprising further at least two rollers respectively arranged near the opposite ends of said stationary plate for supporting said tape and guiding means arranged along the path of the tape between said rollers, said guiding means cooperating with said tape in order to maintain an unchangeable space between the surface of said tape and the surface of said stationary plate.

4. The improvement of claim 1 wherein said

tape is an endless band and means are provided for guiding said band for longitudinal movement, said guiding means comprising at least two rollers arranged near the ends of the stationary plate, and means acting between said rollers to offset said tape from a straight line path between said rollers, and other means acting between said rollers and arranged sidewise with respect to said tape to prevent lateral vibrations of said tape in its plane.

5. A frequency variation device according to claim 1 comprising further means for electrically connecting said elongated elements of the stationary plate to an electric oscillator, said means comprising a plurality of fixed condensers, each having one plate connected to one of said elements and the other plate adapted to be connected to said oscillator, said fixed condensers being adapted to correct the curve of the capacity variation of the variable condenser as the tape moves along said elongated elements.

6. A frequency variation device according to claim 1 comprising further means electrically connected to said variable condenser for connecting said variable condenser to an electric oscillator, said means comprising an inductance and a trimming condenser shunting said inductance, said inductance and said trimming condenser being adapted to extend the frequency variation curve on the side of the higher frequencies.

7. A frequency variation device according to claim 1 in which said tape is formed by an insulating fabric and said metal containing portion of said tape comprises metallic or metallized wires incorporated in said fabric.

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