

March 7, 1944.

V. I. ZUCK

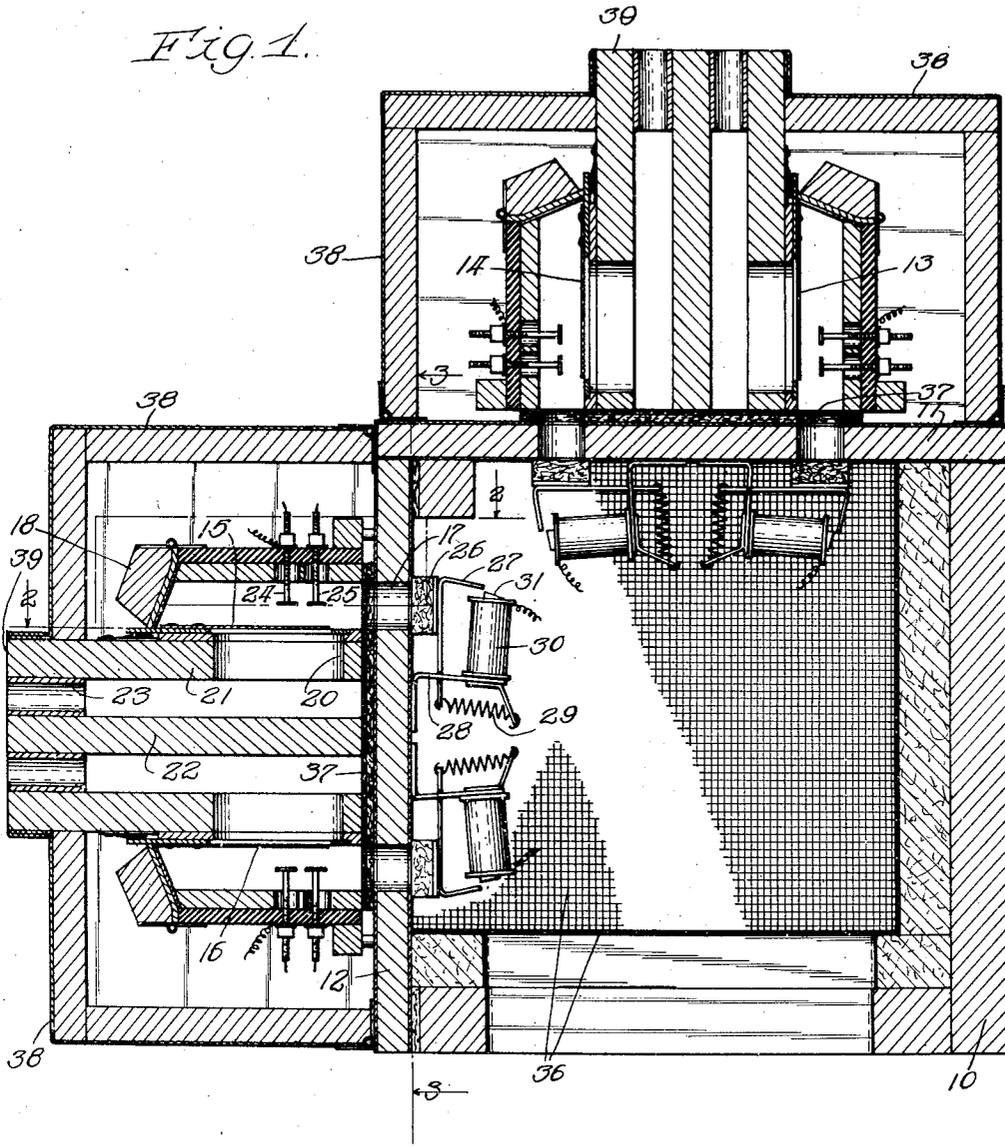
2,343,728

ELECTRIC INSTRUMENT

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2 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

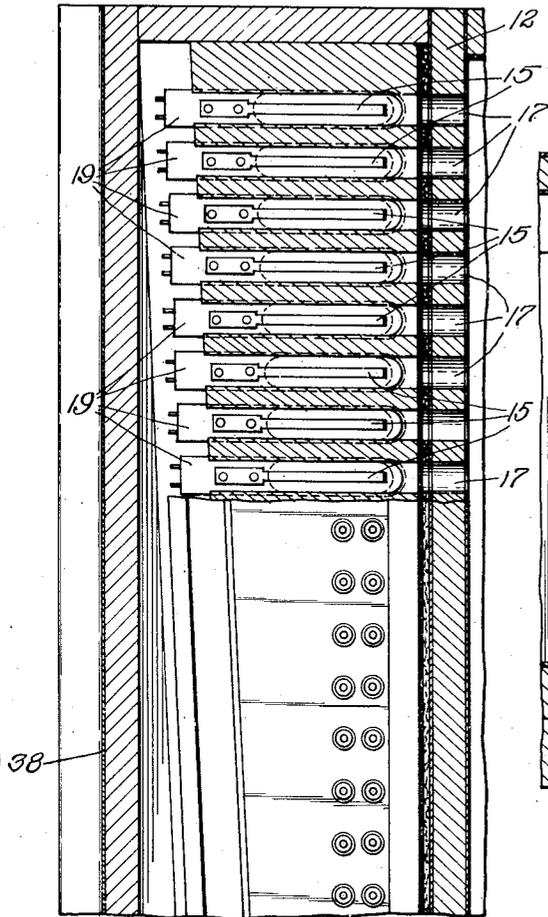


Fig. 3.

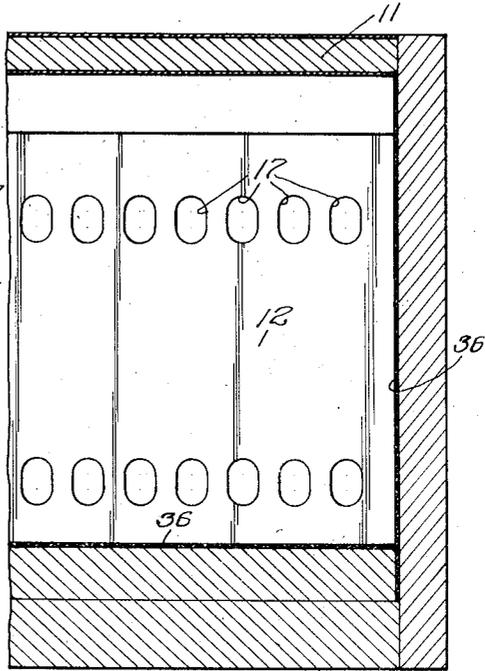
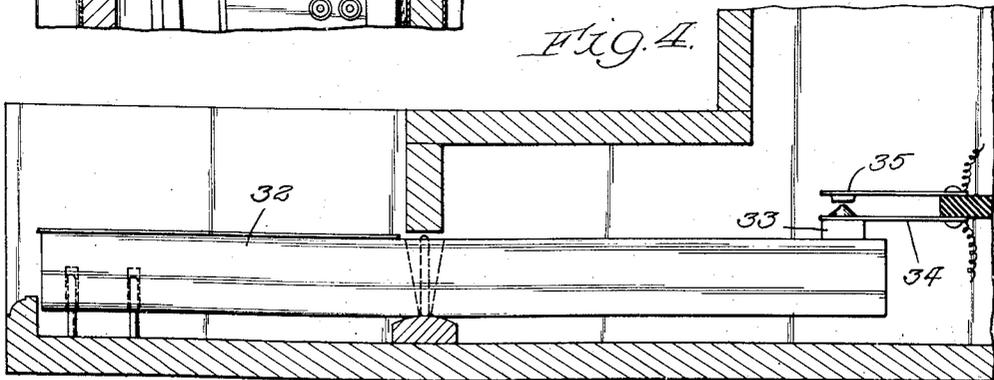


Fig. 4.



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UNITED STATES PATENT OFFICE

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ELECTRIC INSTRUMENT

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8 Claims. (Cl. 84—1.09)

This invention relates to an electric instrument and more particularly to a reed organ wherein mechanical vibrations of the reeds are translated into corresponding electric waves and these waves are then amplified and converted into sound waves.

One feature of this invention is that it provides an improved electric reed organ; another feature of this invention is that it employs an electric action for actuating a reed when a corresponding key on a keyboard is depressed, particularly in a reed organ with an electrostatic or electromagnetic pick-up for converting mechanical vibration of the reeds into corresponding electrical waves; another feature of this invention is that it enables the use of greater distances between centers of the reeds and reed cells; a further feature of this invention is that it achieves all the advantages of the use of an electric action while preventing any undesired electrical interference from the operation thereof; yet another feature of this invention is that it enables the air actuating the reeds to move against the tip or free ends thereof; other features and advantages of this invention will be apparent from the following specification and the drawings, in which:

Figure 1 is a transverse sectional view through the windchest pallet boards and reed cells of an organ embodying my invention; Figure 2 is a fragmentary horizontal view of a reed set, along the line 2—2 of Figure 1; Figure 3 is a partial view of a pallet board, along the line 3—3 of Figure 1; and Figure 4 is a transverse view, principally in section, through a keyboard.

The present invention relates to electric organs of the type wherein movement of a key on the keyboard effects vibration of a metal reed; wherein the vibration of the metal reed is converted into a voltage wave, which is then amplified and passed through various controls; and wherein the final output electric wave is converted into sound, as by loud speakers, to produce the desired music. Organs of this general type have heretofore been known and used, the general system of such an organ being more fully shown in my co-pending application Serial No. 339,557 filed June 8, 1940 which issued as Patent No. 2,300,609. Such organs have heretofore effected vibration of the reeds by mechanical interconnection between the keys and the air valves, in accordance with conventional reed organ practice. I have provided an improved instrument, and overcome a number of difficulties and limitations inherent in former organs, by using an elec-

tric action, electric interconnections between the keys and the air valves controlling actuation of the reeds. Moreover, I have taken advantage of the flexibility permitted by this combination to increase the distance between reed centers, and to cause actuating air flow to be toward the tip or end of the reed, heretofore impossible, which has resulted in improved smoothness and quality of vibration.

In the particular embodiment of my invention illustrated herewith a console, which may be of conventional type provided with two manual keyboards and a pedal keyboard, may be used. This is not here shown, forming a known part of the present invention, except insofar as part of the console and one of the keyboards is illustrated in Figure 4. In the back of the console is a windchest 10 to which air under pressure is delivered by a centrifugal blower or other desired conventional means. This windchest is provided with an upper pallet board 11 and a rear pallet board 12, each being provided with openings being controlled by pallets or valves, so that air is admitted to the reed cell only as and when desired. The instrument is here shown as having four sets of reed cells and reeds. For example, a set of flute reeds 13; a set of viola reeds 14; a set of diapason reeds 15; and a set of celeste reeds 16. Each set, of course, consists of a sequence of notes; and the various sets are all voiced differently. That is, the flute reeds 13 are so voiced as to produce a sound having the musical quality of that of a flute; and the other sets are voiced to produce sounds similar to those of corresponding organ pipe sets.

Inasmuch as the general construction and operation of the various notes of the various sets is the same, only one will be described in detail. Referring more particularly to the diapason reeds 15 and to Figures 1 and 2, each reed will be seen to be housed in a cell having side and top walls, one end of the cell communicating with the opening 17 in the pallet board 12 and the other end of the cell being closed by the mute or rail 18. The reed, as may be best seen in Figure 2, is a thin, vibratile, brass piece mounted for vibration through an opening of only slightly larger size in a brass base 19.

The reed lies immediately over a long opening 20 in an exhaust divider board 21, as may be best seen in Figure 1, this and another divider board 22 forming an exhaust passage 23 through which air which has activated the reed 15 may be exhausted. Inasmuch as the windchest pressure is higher than that in the exhaust passage,

air enters through the pallet opening 17 whenever the valve permits it, to strike the end of the reed 15. The air then passes by the reed and out through the opening 20 in the exhaust passage 23, this movement past the reed causing vibration thereof so long as air continues to flow.

Immediately above the reeds are mounted pick-up members, here shown as flatheaded screws 24 and 25. These are locked in place in the top of the reed cell, so spaced from the reed as not to be struck thereby during its vibration, but sufficiently close to provide a good condenser action when there is a voltage between the reed and the pick-ups. In operation a desired voltage is applied between a desired set of reeds and the pick-ups and the playing of certain notes causes the creation of corresponding voltage waves which may be amplified and translated into audible music. Wave generating and amplifying circuits adapted to be associated with the reeds and pick-ups are known to the art and will not be described in detail here, one such circuit arrangement being illustrated in Hoschke Patent 2,113,347. In view of the electrical nature of the instrument, the pallet boards, reed cells, exhaust dividers and the like are preferably made of a dielectric plastic material, although they may be made of wood impregnated with paraffin, shellac, or the like.

Turning now more particularly to the means for controlling the flow of air past the reed 15, it will be seen that the opening 17 in the pallet board 12 is normally closed by a pallet or valve member 26, which may be of felt or similar material. This is carried on an armature 27 pivotally mounted near one end on a bracket 28, the armature being normally biased to closed position by a spring 29. A magnet 30, having a pole face 31 adapted to cooperate with the armature 27, is also carried by the bracket 28. When a circuit is completed through the winding of the magnet 30 the armature is pulled down, to the right in speaking of the particular one now referred to in Figure 1, to permit air from the windchest to pass through the opening 17 and activate the reed 15.

If it be assumed that the key illustrated in Figure 4 corresponds to the reed 15 illustrated in Figure 1, and that the stops of the organ are so arranged as to cause the particular keyboard in which this key is located to actuate the diapason reeds, depressing the key 32 will energize the magnet 30 to activate the reed 15. The key 32 is pivoted near its center in conventional manner, and at its back end is adapted to cooperate with switch means for closing a circuit to the windings of the magnet 30. That is, downward movement of the forward end of the key 32 causes upward movement of the rear end thereof, and this, through a rubber or felt bumper 33, moves a spring contact 34 up into engagement with another spring contact 35. This completes a circuit including a source of power, as a battery or power pack, and the winding of the magnet 30, and thus each time the key 32 is struck the pallet 26 swings open and the reed 15 is actuated, resulting in complex vibration corresponding to the particular pitch and timbre of this reed. It will be understood, of course, that there is a separate magnet and circuit for each reed cell; and that there is a separate key and circuit closing means in connection with each such magnet at any given time, although various arrangements of the stops

may cause the same key to operate different magnets at different times.

In order to enable the desired span of notes to be encompassed with one hand, keys have always been made of a given standard width, or center spacing, and this cannot be changed. This spacing of centers is one-half inch, for the white keys of a keyboard. If mechanical actuation of the pallets or valve members has been used, as has been the case heretofore, the spacing of the key centers has always been a limiting factor on the spacing of the reed centers, so that the reed centers have always been one-half-inch apart also. In at least one case this has been increased slightly by flaring the keys so that a spacing of $\frac{1}{4}$ inch between reed centers was attained; but any spacing beyond this seemed unattainable. Inasmuch as it is necessary to occupy some of the space between reed centers with the walls between adjacent reed cells, this left quite narrow reed cells, heretofore never exceeding $\frac{1}{8}$ inch; and since it is undesirable, from a tone quality standpoint, to have too high a reed cell, the air opening at the end of the cell was necessarily restricted in size. This restriction was such that heretofore it has been impossible to activate a reed by blowing the reed toward its tip, instead of the reed bases facing in the opposite direction from that shown here, and being activated from the rear. The outlet opening through the exhaust divider is not a limiting factor, as this can be made as long as may be desired. By freeing the pallets and keys from mechanical interconnection I have been able to make my pallet boards and reed cell blocks as long as desired, and use at least $\frac{3}{8}$ inch between centers of the reeds. Since the walls between cells do not need to be any thicker, this gives $\frac{1}{2}$ to $\frac{1}{8}$ inch greater width to the air inlet holes in the pallet board 12, as may be seen in Figure 3. Thus without detracting from the acoustical qualities of the cell chamber, by increasing its height, I am enabled to greatly increase the effective area of the air inlet opening, and to activate the reed from the front end, which results in improved quality of vibration where a sufficient volume of air is available. It is obvious that, with an electric action, there is no limitation whatsoever on the width between reed centers, since each set of reeds could be arranged in two banks if it was desired to have such a distance between centers that a single row would exceed the desired console length.

Energization and de-energization of the magnets, of course, causes undesirable electro-magnetic effects which would result in noise and static in the music if they were not in some way subdued or kept out of the final output. It is desirable, of course, to shunt the key-closed switches and magnets with condensers; but something further must be done to keep undesired electrical impulses out of the pick-ups. I have accomplished this by shielding the magnets completely from the metallic reeds and their associated pick-ups.

As can perhaps be best seen by referring to Figure 1, the interior of the windchest is lined with a metal-shielding screen 36. The pallet boards are separated from the reed cells and exhaust dividers by a metal screen 37 interposed between these parts, the parts being held together by screws driven through the pallet boards and screens into the material of the reed cells and exhaust dividers, rather than by conventional gluing together of parts. It is preferable to have the screens extend across the air inlet openings,

as 17, although they may be cut out at this point if desired. The reed cells are also, as may be best seen in Figure 1, enclosed in shield boxes which have a layer of metal 38 on the exterior thereof; and shielding lead foil is used, as at 39 over the outer ends of the exhaust divider boards, to complete the enclosure of the electric action parts. All of these metal shielding parts are, of course, connected together and to a ground, which may be an actual ground or merely an artificial ground, as the frame of the console.

While I have described and claimed certain embodiments of my invention it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims.

I claim:

1. Apparatus of the character described, including: a plurality of vibratile metallic reeds arranged in a row; means coupled to each of said reeds for creating voltage variations corresponding to mechanical vibrations of the reeds; means for converting the voltage variations into corresponding sound waves; a keyboard; means for effecting movement of air past the reeds; valve means associated with each reed for controlling the movement of the air; and means for electrically actuating the valve means, each being actuated by movement of a corresponding key on the keyboard.

2. Apparatus of the character claimed in claim 1, wherein the reeds are in cells and the air inlet openings are adjacent the tips of the reeds and have a width of at least $\frac{1}{4}$ inch.

3. Apparatus of the character claimed in claim 1, wherein the reeds are in cells provided with air openings adjacent the tips of the reeds, the incoming air moves against the tips of the reeds, and the cells have air inlet openings having a width in excess of $\frac{1}{4}$ inch.

4. Apparatus of the character described, including: a plurality of vibratile metallic members; means electrically coupled to each of said members for creating voltage variations corresponding to mechanical vibrations of the members; means for converting the voltage variations into corresponding sound waves; means for selectively effecting vibration of the members, this

means including electrical connections; and means for shielding the members and the means electrically coupled thereto from undesired electrical impulses in the connections.

5. Apparatus of the character described, including: a plurality of vibratile metallic reeds; means electrically coupled to each of said reeds for creating voltage variations corresponding to mechanical vibrations of the reeds; means for converting the voltage variations into corresponding sound waves; a keyboard; air openings adjacent the reeds for effecting movement of air past the reeds; valve means associated with each reed for controlling the movement of the air; means for electrically actuating the valve means, each being actuated by movement of a corresponding key on the keyboard; and means for shielding the voltage creating means from undesired electrical impulses in the actuating means.

6. Apparatus of the character claimed in claim 5, wherein the electrical actuating means is substantially completely enclosed in the shielding means and the shielding means includes screen portions extending across said openings.

7. Apparatus of the character claimed in claim 5, wherein the reeds are in cells and the valve means are operatively associated with openings in a pallet board, and wherein the shielding means includes a metallic screen interposed between the pallet board and reed cells and extending across said openings.

8. Apparatus of the character described, including: a plurality of vibratile metallic reeds arranged in a row; means electrically coupled to each of said reeds for creating voltage variations corresponding to mechanical vibrations of the reeds; means for converting the voltage variations into corresponding sound waves; a keyboard, the distance between reed centers being substantially greater than the distance between key centers; air openings adjacent the tips of the reeds and so arranged that air passing there-through moves against the tips of the reeds; valve means associated with each reed for controlling the movement of the air; magnet means for moving the valve means; and circuits for energizing the magnet means, each circuit being completed by movement of a corresponding key on the keyboard.

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