Nov. 8, 1960 J. A. DEREUX 2,959,083

ELECTRICAL MUSICAL INSTRUMENTS

Filed Feb. 11, 1957 2 Sheets-Sheet 1

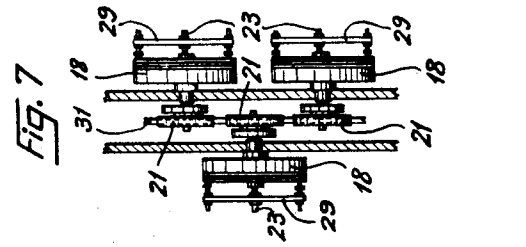


Fig. 7

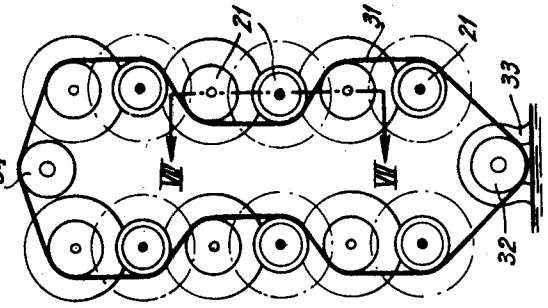


Fig. 6

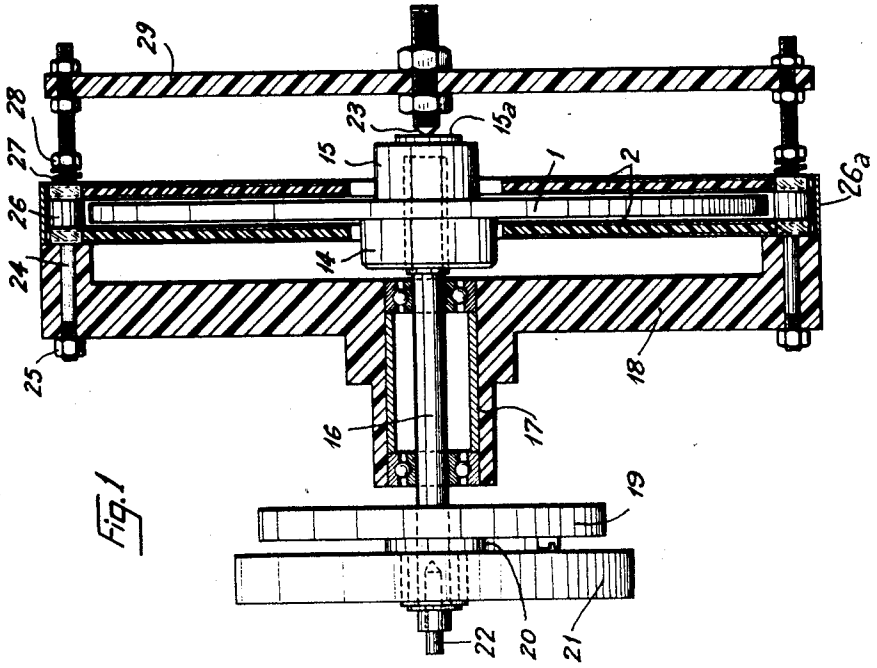


Fig. 1

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ELECTRICAL MUSICAL INSTRUMENTS

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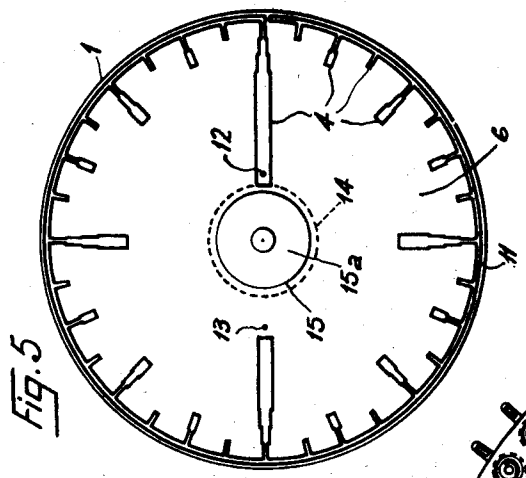


Fig. 5

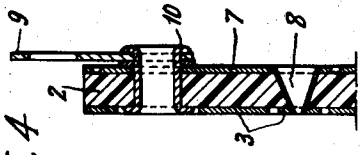


Fig. 4

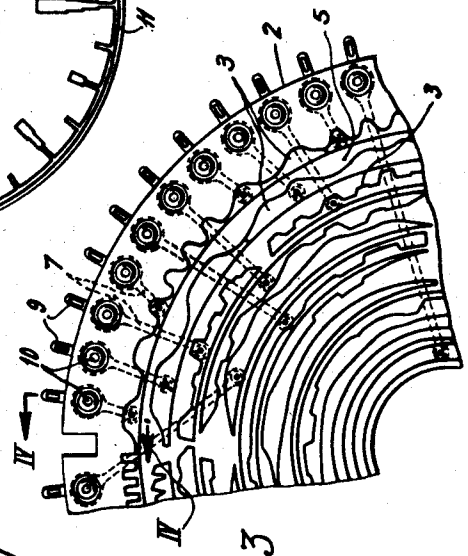


Fig. 3

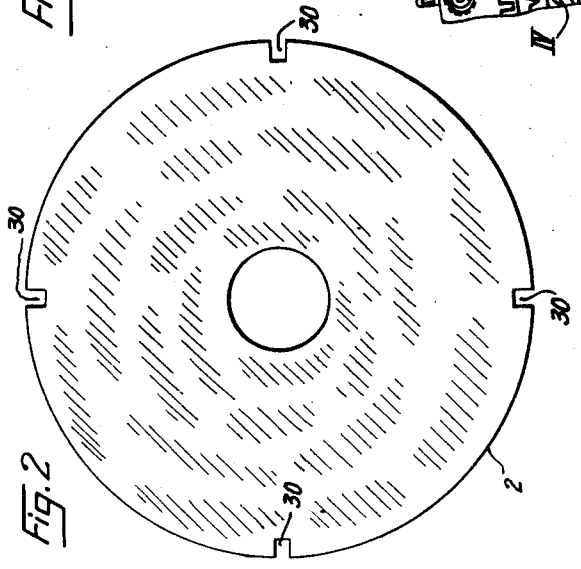


Fig. 2

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ELECTRICAL MUSICAL INSTRUMENTS

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Claims priority, application France Feb. 16, 1956

3 Claims. (Cl. 84—1.28)

The present invention has for its object an electrostatic musical instrument of the kind having rotary sound-generators.

It is known that instruments of this kind comprise one or a number of sets of twelve wheels corresponding to the twelve notes of the scale, each wheel rotating opposite a member which forms a capacity with the said wheel, the variation in capacity due to the relative movement being converted to variations of current of a frequency and form desired, and then into sounds of corresponding pitch and quality.

The present invention relates to various improvements which have for their object to eliminate or to reduce the numerous defects which may arise with instruments of this type, and which are especially due to the extremely small tolerances of construction and assembly, which are such that any bending or any asymmetry result in non-admissible parasitic noise. The same thing is true of undesirable electric charges which may be induced on any exposed insulating part.

In the improved musical instrument in accordance with the invention, each sound-generator comprises essentially a disc rotating between two small fixed plates equi-distant from and parallel to the said disc and being provided on their internal faces opposite the disc with marks or metallic surface elements having a profile and position determined as a function of the sounds desired, the elements appearing on these plates being symmetrical with respect to the disc. The latter is provided on its opposite faces with radial metal tongues of different sizes.

In accordance with one form of embodiment of the invention, the small plates and also the disc are formed by a support of insulating material covered with a film of metal, the surface elements of the plates and the radial tongues on the disc being defined and isolated by thin grooves cut through the metallic film into the insulating core. The remainder of the metallization located beyond the grooves, and which is not utilised, is earthed in a permanent manner, whilst the surface elements of the plates can be put under tension at will by the intermediary of the keys of a keyboard acting as switches, as is well known in this type of instrument. The electric signals generated by the variations in capacity due to the radial tongues of the disc passing in front of the excited surface elements are collected on the hub of the disc and are transmitted to a system of amplifiers and loud-speakers.

The profiles of the surface elements of the plates are obtained from an oscillogram of the sound desired, and the various elements are distributed over circles which are concentric with the axis of rotation of the disc. Large-scale production of plates provided with surface elements having precisely-determined profiles and positions can be effected in accordance with the invention by processes of printing and chemical engraving.

The reference-marking of the various surface elements and the keying in position of the small plates so as to ensure a perfect symmetry of these elements are effected

by means of peripheral notches, for example four in number, at the extremities of two diameters at right angles, these notches forming reference axes, whatever may be moreover the ultimate deformation of the plates, which could arise for example due to expansion.

The description which follows below with reference to the accompanying drawings (which are given by way of example only, and not in any sense by way of limitation) will make it quite clear how the invention may be carried into effect, the special features which are brought out, either in the drawings or in the text, being understood to form a part of the said invention.

Fig. 1 is an axial diagrammatic cross-section of an improved sound-generator in accordance with the present invention.

Fig. 2 shows a bare plate with its four reference notches.

Fig. 3 is a partial view of the same plate provided with its metallic surface elements, together with the connections.

Fig. 4 is a cross-ection to a larger scale, taken along the line IV—IV of Fig. 3.

Fig. 5 is a view of the rotating disc provided with radial tongues.

Fig. 6 is a diagrammatic view showing the arrangement of an assembly of twelve rotors driven by a single pulley.

Fig. 7 is a cross-section taken along the line VII—VII of Fig. 6, showing the staggered arrangement of the sound-generators.

As can be seen from the drawings, the sound-generator of the musical instrument comprises essentially a disc or chopper member **1** rotating between two identical circular plates **2—2**, disposed parallel to the disc and at equal and very small distances from the said disc.

The plates **2** are provided on their inner faces with marks or metallic surface elements **3** (see Fig. 3) in the form of tonal patterns such as toothed, sinusoidal or other form, the profile of which is determined as will be explained later. These metallic surface elements or marks **3** are distributed along concentric circles, and the marks of one of the plates **2** form the plane mirror images of the marks of the other plate; in other words, the marks of the two plates which face each other are strictly symmetrical with respect to the disc **1**.

This latter is provided on both its faces with radial tongues **4** having different lengths and thicknesses.

The disc **1** and also the plates **2—2** are formed by a support of insulating material, for example of the material known under the name of "Plexiglas," these supports being completely metallized, the metallic film being of the order of a few microns. The useful parts of the plates and of the disc, that is to say the metallic marks **3** and the radial tongues **4**, are defined and insulated from the remainder of the metallic coating **5**, **6** by thread-like grooves which pass through the metallic film and lay bare a very thin line of insulator.

The metallic marks **3** of the plates **2** are connected to metallic strips **7** provided on the rear face of the plates, through the medium of holes **8** (see Fig. 4) of flared form, converging towards the inner face of the plate, that is to say towards the face which carries the surface elements **3**. These strips **7** are also defined and insulated from the remainder of the metallic coating of the rear faces of the plates **2** by grooves passing through the metallic coating. The wall of the flared holes **8** is itself also metallized, which ensures the continuity of the conductor formed by a mark **3** and a strip **7**. The latter terminates in a connection terminal **9** which is riveted at **10** to the periphery of the plate.

In the same way, the radial tongues **4** of the disc **1** are inter-connected at their peripheral extremities by a circular strip **11**, the whole of the tongues of the two

faces being connected by a hole 12 with a metallized wall similar to the hole 8. The non-employed metallization 6 of the two faces of the disc is also connected by a similar hole 13. This unused metallization is connected to one extremity 14 of the hub of the disc, whilst the opposite extremity 15 of this hub is connected to the tongues, the extremities of the hub being coated for that purpose with a coating of metallic film, the metallization being extended over the free face 15*a* of the hub on the one hand and, on the other hand up to the contact of the shaft 16 with the rotor.

This shaft rotates in a roller bearing 17 housed in the center of a cross-shaped side-plate 18 and is extended beyond this bearing. On the part of the shaft 16 which passes out of the bearing 17 is keyed a fly-wheel 19 driven through the intermediary of a spiral spring 20, by a pulley 21 freely mounted on the shaft 16, the spring coupling being provided to damp out any possible shocks or jerks in the rotation of the pulley 21.

A mercury contact 22 is provided in the axis of the free extremity of the shaft 16, whilst a carbon contact 23 is applied against the centre of the face 15*a* of the hub, the relative movement at these two points being practically nil. The mercury contact 22 enables the rotor to be connected to earth together with the non-employed metallization 6 of the disc 1. The carbon contact 23 constitutes the source of sounds coupled to the active parts of this disc, that is to say to the radial arms 4, this carbon 23 being connected to the system of amplifiers and loud-speakers of the instrument. The assembly of the rotor shaft, its driving system and the contacts have already been described in French Patent No. 1,085,939 of June 16, 1953.

The two plates 2 are fixed to the end-plate 18 by means of threaded rods 24 and nuts 25, small spacing rods 26 separating the two plates and keeping them at the desired distance apart. The coupling preferably comprises a spring 27 surrounding the threaded rod and supported on the one hand against a nut 28 and on the other hand against the adjacent plate 2, the contacts and the parallelism of the plates being ensured by the spacers 26 which are regularly spaced apart and which, in one example of construction, are forty-four in number. The threaded rods 24 carry in addition a connecting strip 29 at the centre of which is mounted the carbon contact 23.

A transparent adhesive strip 26*a* is applied round the casing thus formed and prevents centrifugal action on the air and in consequence the penetration of dust into this casing.

The marks or metallic surface elements 3 of the plates 2 are obtained by engraving from the photograph of a model produced with great precision by means of oscillograms of the sounds desired, this method of reproduction being closely similar to the printing process known as "offset."

As has been stated above, it is absolutely essential that the symmetry of the elements of the two plates facing each other should be perfect, that is to say the concentric rings which carry the signals 3 must be absolutely centered and identical. This precision is obtained by means of four notches 30 at the periphery of the plates 2 and spaced 90° from each other, these notches forming two reference axes at right angles which are not liable to deformation during, for example, any expansion of the plate. The calibrated rectangular notches thus give at their imaginary intersection, a centre which is independent of the coefficients of expansion. It is this perfect reference which enables the offset printing and in consequence the printed circuits to be employed, these being produced in the same operation.

The apparatus which has just been described operates in the following manner:

The rotor having been set in rotation by the pulley 21, and one or a number of the marks 3 being put under tension by depressing the corresponding keys of the keyboard which act as switches in the circuits connected to the terminals 9, there is produced a periodic variation of capacity due to the radial analyser arms 4 of the disc 1 which pass in front of the excited marks. The frequency of these variations is a function on the one hand of the number of arms which analyse the mark in question or, in other words, of the ring on which this mark is located. It can be seen in fact from Fig. 5 that a mark located close to the centre will only be analysed by the single arm 4 which extends as far as this, whilst the marks located towards the periphery will be analysed by all the arms. As the distance from the centre increases, the number of active arms increases in geometric progression to the factor of 2, which gives the successive octaves of the note corresponding to the speed of rotation of the disc. The different widths of the arms result from a compromise between the usual tone of the standard organ and the fineness of reading.

Any defects in constancy of the widths of the analyser have an adverse effect on the quality of the reproduction. In addition, a correct tone requires a signal of constant amplitude from the low notes to the high notes. The tone is restored by doubling the recordings of 16 and 32 teeth located in the peripheral zone and by putting the identical recording on each face in parallel. In this way, for the effective width, there is established the average of the widths of four teeth, which facilitates the problem of accuracy in the engraving of the teeth of the metallic marks 3.

The unit which has just been described corresponds to one of the notes of the scale. The instrument must therefore comprise twelve similar units for the twelve notes of the middle scale.

The twelve generators are grouped as shown in Figs. 6 and 7. A single pulley 31 passes over the twelve pulleys 21 of the generators, these pulleys being located in the same plane in two parallel rows. The pulley 31 is driven by the driving pulley 32 of an electric motor 33 and passes over a tension roller 34.

The successive generators are placed in staggered relation as shown in Fig. 7. This enables the overall size of the assembly to be considerably reduced.

As has been stated above, the variations in capacity are translated into signals of corresponding form and frequency which are collected by the sound collector 23 and are led to the amplifiers, these signals being finally transmitted by loud-speakers. The sounds emitted have a pitch and quality which depend on the frequency and on this form of the signals, which in turn depend on the form and the position of the metallic marks 3 which are analysed by the disc 1.

In the apparatus which has just been described, defects which might arise due to a slight bending of the analyser disc are eliminated, whilst a similar bending would render the known types of instrument with phonic wheels unusable. In fact, the use of the two parallel plates 2 located on each side of the disc 1 of constant thickness, and the symmetry of the metallic elements 3 of the two plates produce a perfect compensation for any slight ultimate bending, since the sum of the distances between the analyser arms 4 of the disc 1 and the identical marks 3 of the plates 2 is strictly constant.

In addition, the apparatus according to the invention does not suffer from a further very general defect in instruments of the phonic wheel type: the production of parasitic sounds due to charges generated by induction on the exposed insulating parts, It will be noted that in the sound generator in accordance with the invention, such parasitic charges cannot be produced in practice in consequence of the absence of insulating parts liable to become so charged, the two faces of the analyser disc 1 and the plates 2 being entirely metallized, except for the thin border grooves, and the metallized surface which is not used is connected to earth in a permanent manner.

What I claim is:

1. For use in an electrical musical instrument, a tone generator comprising a disc-like chopper member having a disc-like tone pattern member closely adjacent each side thereof, each of said tone pattern members having a plurality of concentric tone patterns thereon, at least the outside row of said tone patterns on both disc-like members having opposed tone patterns which are mirror images of each other, thereby to compensate for any unevenness in the disc-like chopper member.

2. For use in an electrical musical instrument, a tone generator comprising a disc-like chopper member having a disc-like tone pattern member closely adjacent each side thereof, each of said tone pattern members having a plurality of concentric tone patterns thereon, at least the two outside rows of said tone patterns on both disc-like members having opposed tone patterns which are mirror images of each other, thereby to compensate for any unevenness in the disc-like chopper member.

3. For use in an electrical musical instrument, a tone generator comprising a disc-like chopper member having

a disc-like tone pattern member closely adjacent each side thereof each of said tone pattern members having a plurality of concentric tone patterns thereon, said concentric tone patterns being of increasing frequency proceeding from the inner rows of said tone patterns to the outer rows of said tone patterns, at least the outside row of said tone patterns for both disc-like members having opposed tone patterns which are mirror images of each other, thereby to compensate for any unevenness in the disc-like chopper member.

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