

July 11, 1939.

C. T. JACOBS

2,165,707

APPARATUS FOR THE PRODUCTION OF MUSIC

Filed April 23, 1937

3 Sheets-Sheet 1

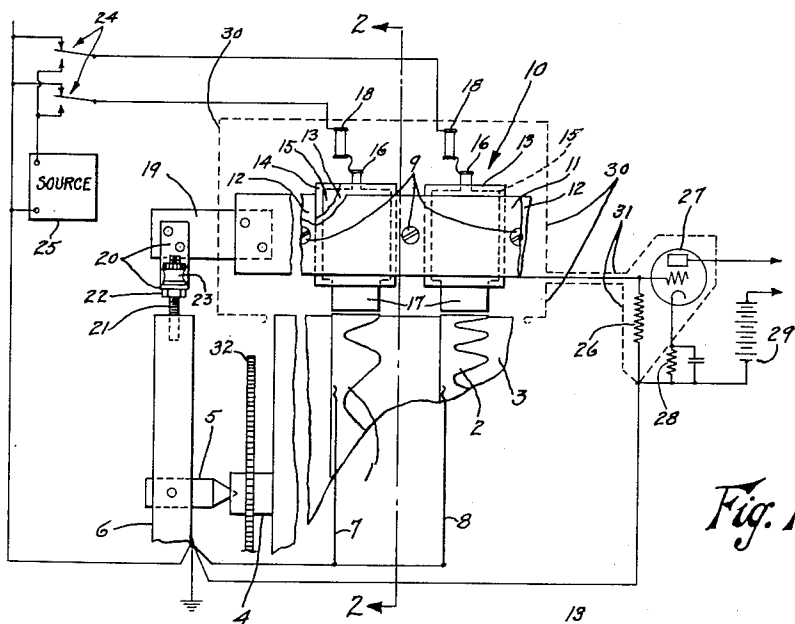


Fig. 1

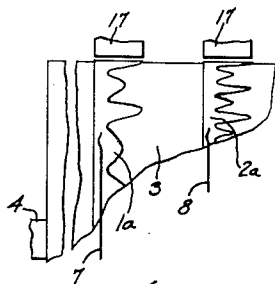


Fig. 1a

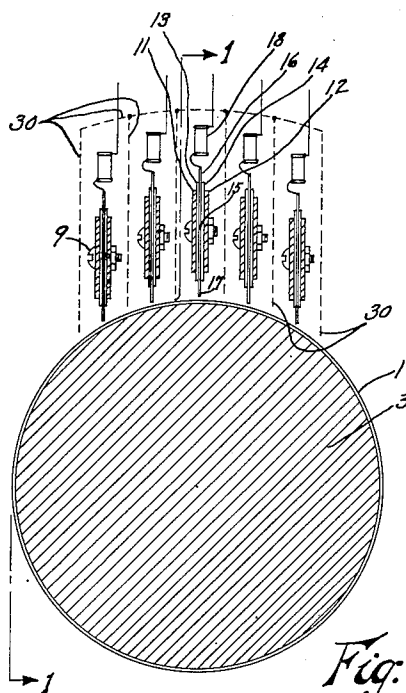


Fig. 2

INVENTOR:-

Charles T. Jacobs

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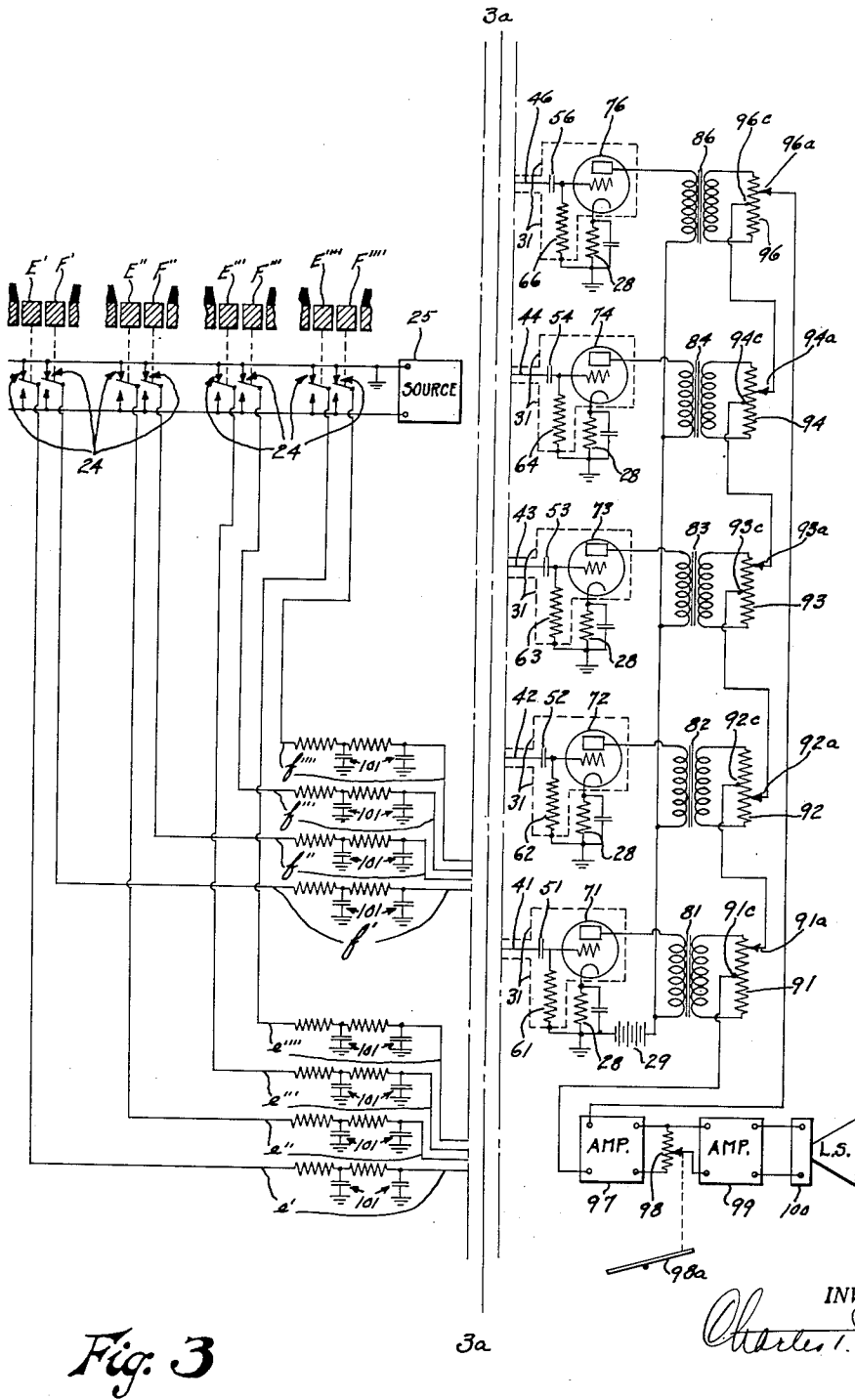
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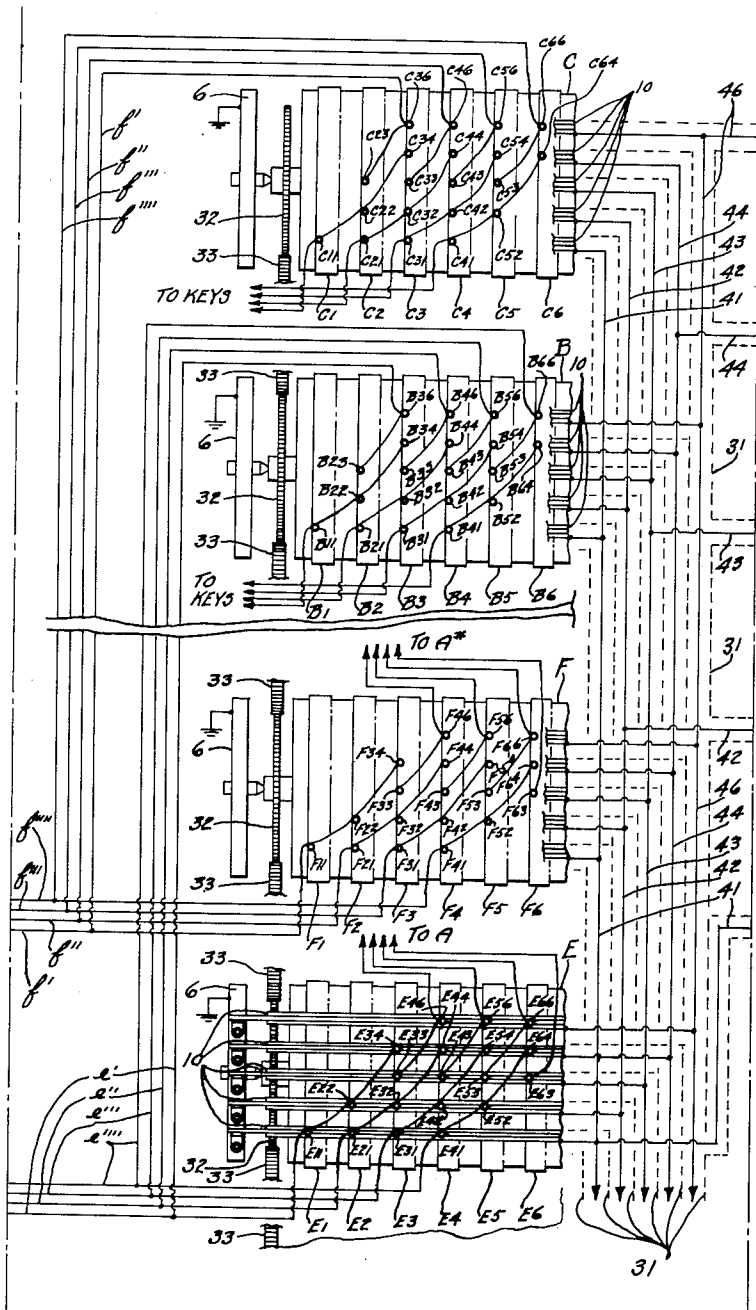


Fig. 3a

INVENTOR:-
Charles T. Jacobs

UNITED STATES PATENT OFFICE

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APPARATUS FOR THE PRODUCTION OF MUSIC

Charles T. Jacobs, New Providence Township, Union County, N. J., assignor to Miesner Inventions, Inc., Millburn, N. J., a corporation of New Jersey

Application April 23, 1937, Serial No. 138,562

19 Claims. (Cl. 84-1)

This invention relates to the production of music, and more particularly to that production from a plurality of continuously operating generators, these producing electric oscillations and these oscillations being translated, after suitable amplification, into output tones.

It is an object of my invention to provide improved means, method and instruments for such production.

10 It is an object to provide simplified means, methods and instruments for such production.

It is another object to provide improved or simplified arrangements of the generators and their output means in such instruments.

15 It is another object to provide in such instruments improved or simplified arrangements of the generators, with their output means, and the keying means.

It is another object to provide advantageous groupings of the output means of the generators in such instruments.

Another object is the provision of improvements or simplifications in instruments of the class described which are adapted for very complete control over their output tone quality.

25 It is an especial but non-limitative object to provide such improvements or simplifications in instruments wherein the generators operate capacitatively, or by the effecting of recurrent or periodic capacity variations.

Another object is the provision of improved or simplified arrangements of a plurality of capacitative generators with their output electrodes in such an instrument.

35 Still another object is the provision of an advantageous plural-electrode unit for employment in such generators.

It is still another object to simplify the control of the tone "attack" and "release" in instruments of the class described which are adapted for very complete output tone quality control.

Other and allied objects will more fully appear from the following description and the appended claims.

45 In the description hereinafter set forth reference is had to the accompanying drawings, of which:

Figure 1 is a generally elevational view of a portion of a plurality of generators for an instrument according to my invention, certain of the components of the figure being schematically shown;

50 Figure 1a is a fractional view, intended for optional substitution for a corresponding portion

of Figure 1, illustrating an optional modification of a portion of each of the generators;

Figure 2 is a vertical cross-sectional view taken along the line 2-2 of Figure 1 and illustrating the simultaneous use of a plurality of the output electrode units one of which appears in Figure 1, the line 1-1 of Figure 2 indicating the relationship of Figure 1 thereto; and

Figures 3 and 3a together comprise a partially plan but largely schematic view of an instrument wherein my invention has been incorporated, the showing having been simplified to some extent in the interest of readability of the drawings: Figure 3a comprises the central portion of the showing, intended for insertion between the portions of Figure 3 respectively to the right and to the left of the line 3a-3a.

My invention involves the use, itself well known, of a plurality of continuously operating generators, for example one for each note of a musical scale—each generator with appropriate output means operative, for example, when sensitized (as by an electric voltage or current) under the selective control of the playing keys. According to one aspect of the invention, however, I employ in the sensitizing means therefor a plurality of conductors (for example, one per note) each arranged for the sensitization in common of a group of output devices—each such group comprising, for example, an output device on each of a plurality of generators harmonically related in frequency. I may make the devices of each such group peculiar to the conductor therefor, or distinct from those of any other such group, for that purpose employing for each of at least a large number of the generators a plurality of output devices.

According to another aspect of the invention, I group the output devices for combination of the outputs from devices for generators of consecutive notes, and I otherwise group the output devices for simultaneous sensitization of devices for generators of harmonically related notes; the first-mentioned grouping may be in manner to facilitate the control of quality (e. g., harmonic structure) of the output tones. I may make both these distinct groupings permanent. Again, I may make them of mutually distinct nature—for example, one a conductive grouping and the other a reactive grouping.

50 These, and other broad and more limited aspects of the invention, are illustrated and are hereinafter described, with attention to many of their advantages. Purely typically, the illustration and description is of an instrument having

individual generators in the form of individual sound tracks, with pick-ups therefor forming the output devices. According to broader aspects, the pick-ups may operate on any known principle, with thereto appropriate form of track and pick-up; but I have particularly illustrated herein, by way of example, a capacitative pick-up action, and track and pick-up electrode appropriate thereto. While the formation of the track to cause a required periodic capacity variation may be as designed, I have specifically shown a variable-area formation. The sensitization of a capacitative pick-up will be understood to involve the impression, across the periodically varying capacity, of a voltage of inaudible frequency—typically of zero frequency, or direct voltage, which I have specifically shown by way of example only.

Figure 1 fractionally illustrates two tracks, 1 and 2, carried by a cylinder 3; the cylinder is suitably journaled for rotation, as indicated as to its left-hand end by the thrust of its inwardly-coned shaft 4 against a conical bearing 5 in standard 6, and by the driven gear 32 secured on the shaft. Each track may encircle the cylinder 3, and may be in the form of a conductive strip of contour representing a desired wave form—for example, a sinusoidal one. The cylinder surface is arranged to have an electrostatic influence on the adjacent pick-up electrodes (hereinafter described) which is minor relative to that of the tracks, and accordingly the tracks may be appreciably raised above the surface of the cylinder, or at least the outer portion of the cylinder may be of insulating material, or both; if the cylinder is of insulating material, spring brushes schematically illustrated as 7 and 8, contacting the tracks, may for example be employed to effect the electrical connection of the tracks to the metallic standard 6 which would otherwise be effected through the cylinder and its shaft 4 and bearing 5. As hereinafter appears, a plurality of cylinders may be employed, each carrying a number of tracks harmonically related to each other in frequency; a useful arrangement is that of 12 cylinders each carrying tracks of corresponding notes in all octaves of the range of the instrument (and desirably in one or more still higher octaves for harmonic development, as hereinafter more fully appears). For the several tracks of each cylinder I have illustrated a plurality of respective pick-up electrodes held together in a unit 10 which may now be described, but some of whose particular advantages will be more apparent hereinafter; in connection with the unit 10 reference may also be had to the cross-sectional Figure 2, in which in cross-section appear a plurality of these units—for the above-mentioned provision of a plurality of output devices (e. g., electrodes) per generator (e. g., track).

Each unit 10 may be formed of two metal strips 11 and 12, roughly as long as the cylinder 3, and clamped together as by screws 9 opposite spaces between the tracks. Intermediate of the screws there may be clamped between the strips 11 and 12 pairs of thin mica or other dielectric sheets 13 and 14 (for example of only a few thousandths of an inch thick); these may extend slightly beyond the edges of the strips 11 and 12. In turn between each pair of dielectric sheets 13 and 14 may be clamped a thin metal sheet 15 having a main portion of slightly smaller area than the dielectric sheets, but having a small tab 16 extending therebeyond on one side for electrical connection purposes, and having a larger extension 17 beyond the dielectric sheets on the other side. To each tab 16

is shown connected a small respective resistor 18, which may typically be of several or many megohms resistance.

The several extensions 17 form pick-up electrodes for the several tracks; accordingly each unit 10 may be supported longitudinally of the cylinder, either in or with small angular deviation from a plane containing the cylinder axis. The strips 11 and 12, electrically connected together as by the screws 9, are to be maintained electrically insulated from other elements so far described, and accordingly at each end of the unit an insulating extension 19 may be secured to or between the strips; this extension in turn may be rigidly secured, as to standard 6, through a bracket 20. For adjustment of the ends of the unit, to bring the electrodes 17 into desired close spaced relationships with their respective tracks, I have shown the securing of the bracket 20 to standard 6 as effected through the medium of a threaded stud 21 projecting from the standard, and nut 22 and thumb screw 23 on the stud respectively above and below the base of the bracket.

It is convenient hereinafter to consider the potential of the standard 6, and therefore of the tracks, as a reference or "ground" potential, for which reason the standard 6 has been shown connected to ground in Figure 1.

In Figure 1 I have included a simplified schematic showing of circuit arrangements for the sensitization of the electrodes 17 and for the utilization of their outputs. The upper end of each resistor 18—and, through tab 16 and that resistor, the respective electrode 17—may be connected to the pole of a respective double-throw switching means 24; by this switching means (e. g., when this is upwardly thrown) it may normally be rendered at ground potential. But upon downward throwing of the respective pole, a pick-up electrode will be connected (of course, still through resistor 18) to the non-ground terminal of a source 25 of the inaudible-frequency voltage abovementioned. No limitation as to the nature of the switching means is intended in broader aspects, as it is only necessary that these means be of a form appropriate to the nature of the voltage from source 25.

Accordingly by the several switching means the sensitizing voltage is applied selectively across the periodically varying capacities from electrodes 17 to the respective tracks (it being assumed, of course, that the cylinder is being continuously rotated); and when that voltage is so applied across any of these capacities, the respective electrode 17 will develop a potential difference from ground which varies in accordance with the frequency and waveform of the respective track. The strips 11—12 may be connected to ground through a very high impedance load typified by the resistor 26; and by virtue of the capacities from each electrode to those strips—i. e., from the metal sheets 15 through the dielectric sheets 13—14—there will appear across the load a voltage representing a superposition of potentials developed on all the electrodes 17. The load 26 may for example be the input circuit of a repeater tube 27, shown in Figure 1 with by-passed self-bias resistor 28 and plate voltage source 29. It will be understood that in the particular case of a direct voltage from source 25, tube 27 would be operated as a simple amplifier; while in the case of other inaudible-frequency voltage from the source 25, tube 27 would be operated as a demodulator.

The electrodes, when taken as including the

integral sheets 15, will be observed to be at once portions of the periodically varying capacities, and plates of fixed condensers for transferring oscillations from those varying capacities—the other plates of those fixed condensers being the strips 11—12. In Figure 1 I have schematically indicated as 30 grounded electrostatic shielding surrounding the unit 10, excepting for its side disposed toward the cylinder and tracks and for the insulating mounting extension 19; and as 31 grounded electrostatic shielding disposed about the lead from the strips 11—12 and the load 26, etc. In Figure 2, wherein a plurality of units 10 appear, I have schematically shown the shielding 30 not only as surrounding each unit but also as isolating the several units from each other. Typically the connections from the top extremities of the several resistors may individually pass insulatedly through the shielding 30.

The unit 10 broadly represents a grouping together (e. g. capacitatively) of a plurality of output devices (e. g., electrodes) for combination of their outputs, yet with the devices otherwise (e. g., conductively) independent for selective control of their sensitizations—making possible the construction of a very simple and flexible instrument as next typically described. At the same time the unit more specifically is a very simple and economical arrangement for the provision of a plurality of capacitatively coupled electrodes.

In Figures 3 and 3a I show an arrangement of a plurality of the assemblies of Figures 1 and 2 in a musical instrument which, purely by way of convenient example, may be assumed to have four octaves—from C# to C', C#'' to C'', C#''' to C''', and C#'''' to C''''', consecutively in ascending direction. Four of the cylinders of the instrument (which may for example total the 12 abovementioned) appear as E, F, B and C. Cylinder E may carry tracks E₁, E₂, E₃ and E₄ for the production of the E's in the four respective octaves of the instrument; and two additional tracks E₅ and E₆ for the production of two consecutively still higher E's. Quite correspondingly cylinder F may carry, for the production of corresponding F's, six tracks F₁ through F₆; and, again correspondingly, cylinders B and C may carry six tracks each—B₁ through B₆, and C₁ through C₆, for production of B's and C's. The gears 32 of the several cylinders are shown engaging other gear means 33 by which they are jointly driven in suitable speed relationships—it being understood that no limitation to similarity of any of these gears or gear means or to singleness of each of the latter is intended, but rather that they will be suitably chosen and related to provide a substantially equally-tempered scale, in manner well understood in the art.

Above the cylinder E there will be seen five of the units 10, the shielding 30 therefor having been omitted from the drawing for the sake of simplification. The most forward (or bottom-shown) of these units may comprise four output means or electrodes, for providing the fundamental components for the respective four E's of the instrument; such four electrodes, each in combination with its respective resistor 18 have been indicated as E₁₁, E₂₁, E₃₁ and E₄₁ respectively, above tracks E₁ through E₄ consecutively. The next or second of these units may comprise four output means or electrodes, for providing the second partial components for the respective E's of the instrument; its four electrode-resistor combinations have been indicated as E₂₂, E₃₂, E₄₂

and E₅₂ respectively, above tracks E₂ through E₅ consecutively. The third of these units may comprise four output means or electrodes, for providing the third partial components for the respective A's of the instrument; its four electrode-resistor combinations have been indicated as E₃₄, E₄₄, E₅₄ and E₆₄ respectively, above tracks E₃ through E₆ consecutively. The fourth unit may comprise four output means or electrodes, for providing fourth partial components for the respective E's of the instrument; its four electrode-resistor combinations have been indicated as E₃₄, E₄₄, E₅₄ and E₆₄ respectively, above tracks E₃ through E₆ consecutively. The fifth or last-shown unit may comprise three output means or electrodes, for providing the sixth partial components for the respective A's of the instrument (excepting, by way of example, the top A); its three electrode-resistor combinations have been indicated as E₄₆, E₅₆ and E₆₆ respectively, above tracks E₄ through E₆ consecutively. It will be observed that in the designation the letter and first digit of the subscript has been chosen to indicate in each case the track over which the electrode lies, and the second subscript digit to indicate the order of the partial component for which it is employed.

Above cylinder F five corresponding units 10 may be employed. In the interest of simplicity they have been only fractionally illustrated; but all the electrode-resistor combinations have been shown. These have been shown arranged and designated entirely similarly to those for cylinder E, except for the change of letter to F; and it will be understood that their functions are quite correspondent with those stated above, excepting that "E" will be read as "F", and "A" as "A#". Above each of cylinders B and C five again corresponding units may be employed, and have been illustrated and their electrode-resistor combinations designated quite correspondingly to those for cylinder F—excepting, because of these notes lying among the top five of the basic octave C# to C', that the four electrode-resistor combinations for the third partial component (e. g., F₃₃, F₄₃, F₅₃, F₆₃) will be replaced by the four B₂₃, B₃₃, B₄₃, B₅₃ or C₂₃, C₃₃, C₄₃, C₅₃; and that the three electrode-resistor combinations for the sixth partial component (e. g., F₄₆, F₅₆, F₆₆) will be replaced by the four B₃₆, B₄₆, B₅₆, B₆₆ or C₃₆, C₄₆, C₅₆, C₆₆. And it will be understood that for each of the balance of the 12 cylinders of the instrument five units 10 will be employed, arranged as are those actually shown (in the case of those for other of the bottom seven notes of the basic octave, like those for cylinders E and F; and in the case of those for other of the top five notes of the octave, like those for cylinders B and C).

All the electrodes for producing fundamental components are permanently grouped together; it will be appreciated that this condition already exists capacitatively as to those associated with any one cylinder (e. g., as to E₁₁, E₂₁, E₃₁ and E₄₁) by reason of their joint presence in a single one of the units 10, and it is readily extended to the entire instrument by connection of all the fundamental units (i. e., of their strips 11—12) to a common conductor 41. Likewise all the electrodes for producing second partial components are permanently grouped together by connection of their respective units to conductor 42; all the electrodes for producing third partial components, by connection of their respective units to conductor 43; all for producing fourth partial components, by connection of their re-

spective units to conductor 44; and all for producing sixth partial components, by connection of their respective units to conductor 46.

The potentials on these conductors are combined—preferably following a selective control of each, and if desired following individual passages through respective repeater tubes. Accordingly in Figure 3a I have shown these conductors connected through the respective high resistances 61, 62, 63, 64 and 66 to ground, and respective repeater tubes 71, 72, 73, 74 and 76 of which these respective resistances form the input circuits; if desired, condensers 51, 52, 53, 54 and 56 may be interposed between the respective conductors and high resistances. In the output circuits of the repeater tubes have been shown respectively connected the primaries of transformers 81, 82, 83, 84 and 86, across the secondaries of which appear the respective potentiometers 91, 92, 93, 94 and 96. A variable portion of each potentiometer may be connected in a common—for example, a series—circuit, which may typically feed into a cascade of amplifier 97, potentiometer or volume control 98 (manipulated as by pedal 98a); further amplifier 99, and loudspeaker 100, for amplification, general amplitude control, and translation into output tones of the superposed potentials from the several output devices or electrodes.

It will be understood that by variation of the variable portions of the several potentiometers there may be exerted full control of the contributions of the fundamental, second partial, third partial, fourth partial and sixth partial output means or electrodes to the output tones. If the tracks are purely sinusoidal, an amplitude control only need be exerted by each potentiometer; but if, as I have fractionally illustrated by tracks 1a and 2a in the alternative Figure 1a, each track be made to represent not only its main or above described frequency but also one or more harmonics thereof, phase as well as amplitude may advantageously be varied by the potentiometers. Accordingly I have illustrated the variable portion of each as that portion which lies between a fixed center-tap (e. g., 91c, 92c, etc.) and a contact (e. g., 91a, 92a, etc.) preferably fully variable over the whole potentiometer resistance.

Shielding 31, for each of the conductors 41, 42 etc. and the associated condensers 51, 52, etc., the associated high resistances 61, 62, etc., and the associated repeater tubes 71, 72, etc., has been schematically indicated in Figures 3 and 3a.

The reactive grouping of the output devices and its usefulness for tone quality variation purposes having been so described, attention may be directed to the distinct grouping—for example, conductive—of those devices for appropriate simultaneous sensitizations. Among the output devices or electrodes which I have described there will be found an individual one for each of the first (fundamental), second, third, fourth and sixth partials of each note of the instrument (excepting only for the sixth partials of the top seven notes); and (subject to that unimportant exception) I group together, for each note, individual output devices for those five partials thereof so that the same may be simultaneously sensitized. This I may do permanently, and conductively; and I have indicated this in full for all the E's and all the F's of the instrument. Thus there may be grouped conductively by conductor e', and connected to the pole of a switching means 24 (as in Figure 1) responsive to the key E', the electrode-resistor combinations E₁₁, E₂₂, E₃₄, B₂₃ and B₃₆ (of course by connection to

the top extremities of the respective resistors)—these combinations being those for the first, second, fourth, third and sixth partials respectively of the note E'. There may be correspondingly grouped conductively by conductor f', and connected to the pole of like switching means responsive to the key F', the electrode-resistor combinations F₁₁, F₂₂, F₃₄, C₂₃ and C₃₆. Entirely corresponding groupings, displaced upwardly by an octave (e. g., by one track on each of the respective cylinders) have been illustrated for E'' and F'', with conductors e'' and f''; displaced upwardly by two octaves, for E''' and F''', with conductors e''' and f'''; and displaced upwardly by three octaves, for E'''' and F'''', with conductors e'''' and f''''.

Each switching means is of course arranged normally to ground the respective conductor; upon key depression to connect it with the ungrounded terminal of source 25, as in Figure 1; and upon key release to restore it to ground potential. It will accordingly be understood that upon depression of the key for any note, the electrodes or output means peculiar to the several mentioned partials of that note will be simultaneously sensitized; and all those partials will combinedly appear as an output tone, subject to the individual regulation of each (in common for all notes) by the respective one of the potentiometers 91, 92, etc. The effects produced upon simultaneous depression of a plurality of keys will of course be understood to be simply the superposition of the effects produced by those keys individually—or a simultaneous production of a respective plurality of output tones.

When a direct potential source with conductive switching means is employed it may be desirable to render finite the rates of potential change of the respective electrodes, and hence the tone "attack" and "release". This may readily be done by associating with each grouping means last mentioned—e. g., by insertion in each of the respective conductors e', f', etc.—a time-delay means such as the two-stage series-resistance, grounded-shunt-capacity network which I have illustrated as 101 in each of the illustrated conductors. The use of such means broadly is of course well known; but my invention provides the particularly simple arrangement of only one of these means per note, yet in an instrument wherein full individual control may be exerted over each discrete partial component of the output tones.

In Figure 3 the groupings for simultaneous sensitization of the output means for notes other than the E's and the F's have been only incompletely shown in the interest of simplicity of the drawing; but the details of these groupings, in analogy to those described, will be quite obvious to those skilled in the art. And it is distinctly to be understood that by the specific mention of a particular five partial components only I intend no limitation to those particular five, as the manner of extending my invention to embrace any and all partial components up to the tenth or higher will likewise be utterly obvious. Details such as the arrangement of the cylinders, the range of the instrument in octaves, the nature of the combining and control means for the several partial outputs, the use or omission of individual repeater tubes or amplifying means for each partial component before combination, and the like are of course matters of choice in any given case.

And even in broader aspects the particular in-

strument which I have illustrated and above detailedly described is typical only and by no means exhaustive of arrangements for carrying out my invention, and I intend thereby no limitation of the scope of the latter; rather in the appended claims I undertake to express that scope broadly, limited only by the state of the art.

I claim:

1. In a musical instrument having a plurality of generators of frequencies respectively representing a musical scale, means for continuously operating said generators, and an electro-acoustic translating device: signal-transmitting means permanently connecting said generators with said translating device; output devices included in said generators, said transmitting means being responsive to said generators in accordance with sensitization of said output devices; and means for selectively sensitizing said output devices, including a plurality of conductors each for the sensitization in common of output devices for a plurality of different generators.

2. In a musical instrument having a plurality of generators of frequencies respectively representing a musical scale, means for continuously operating said generators, and an electro-acoustic translating device: signal-transmitting means permanently connecting said generators with said translating device; output devices included in said generators, said transmitting means being responsive to said generators in accordance with sensitization of said output devices; and means for selectively sensitizing said output devices including a plurality of conductors, each conductor being connected with a plurality of different-generator output devices for the common sensitization thereof.

3. In a musical instrument having a plurality of generators of frequencies respectively representing a musical scale, means for continuously operating said generators, and an electro-acoustic translating device: signal-transmitting means permanently connecting said generators with said translating device; output devices included in said generators, said transmitting means being responsive to said generators in accordance with sensitization of said output devices; and means for selectively sensitizing said output devices including a plurality of single-pole switches, each switch being connected with a plurality of output devices for different generators for the common sensitization thereof.

4. In a musical instrument having a plurality of generators of frequencies respectively representing a musical scale, and means for continuously operating said generators: output devices for said generators, including a plurality of separate output devices for each of at least some of said generators; and means for selectively sensitizing said output devices, including a plurality of conductors each connected in common with a respective plurality substantially harmonically related, different generator output devices.

5. In a musical instrument having a plurality of generators of frequencies respectively representing a musical scale, and means for continuously operating said generators: output devices for said generators, including a plurality of separate output devices for each of at least some of said generators; and means for selectively sensitizing said output devices including a plurality of single-pole switching means, for different notes respectively, each connected in common with a respective plurality of substantially harmonically related, different generators.

6. In a musical instrument having a plurality of conductive tracks of frequencies respectively representing a musical scale, means for continuously moving said tracks, and an electro-acoustic translating device: electrodes associated and forming capacities with said tracks; a permanent signal-transmitting circuit connecting said tracks and electrodes with said translating device; and means for impressing potentials selectively across said capacities, including a plurality of conductors each for the simultaneous impression of potentials across capacities associated with a plurality of different tracks.

7. The combination according to claim 1, further including time-delay means individually associated with each of said conductors.

8. The combination according to claim 5, further including time-delay means connected with each of said switches.

9. In a musical instrument having a plurality of generators of frequencies respectively representing a musical scale, and means for continuously operating said generators: output devices for said generators, including a plurality of separate output devices for each of at least some of said generators; a plurality of means for grouping said output devices for combination of the outputs from devices associated with generators for consecutive notes; and a plurality of distinct means for grouping said devices for the simultaneous sensitization of devices associated with generators for harmonically related notes.

10. In a musical instrument having a plurality of generators of frequencies respectively representing a musical scale, and means for continuously operating said generators: output devices for said generators, including a plurality of separate output devices for each of at least some of said generators; a plurality of means for permanently grouping said devices for combination of the outputs from devices associated with generators for consecutive notes; and a plurality of means for permanently grouping said devices for the simultaneous sensitization of devices associated with generators for harmonically related notes.

11. The combination according to claim 9, wherein one of said two pluralities of grouping means is reactive and the other conductive.

12. The combination according to claim 9, wherein one of said two pluralities of grouping means is capacitive and the other conductive.

13. The combination according to claim 9, wherein the first of said two pluralities of grouping means is capacitive and the second conductive.

14. The combination according to claim 9, further including output control means associated with each of said first mentioned grouping means.

15. In a musical instrument including means providing an oscillatorily variable capacity, and an electro-acoustic translating device: a fixed condenser for transferring voltage from said variable capacity to said translating device, and an electrode forming simultaneously a plate of said condenser and a portion of said capacity-providing means.

16. In a musical instrument including a movable sound track, a pick-up therefor, and an electro-acoustic translating device: a fixed condenser for transferring oscillations from said pick-up to said translating device, and a member forming simultaneously a plate of said condenser and at least a portion of said pick-up.

17. In a musical instrument including a con-

ductive sound track, a pick-up electrode in spaced relation thereto, and an electro-acoustic translating device: a fixed condenser for transferring oscillations from said electrode to said translating device, said electrode forming one plate of
5 said condenser.

18. In a musical instrument including means providing a plurality of mutually adjacent, oscillatorily variable capacities: electrodes forming portions of said capacity-providing means,
10 conductive means both supporting and having

capacities to said electrodes, and load means responsively connected to said conductive means.

19. In a musical instrument including means providing a plurality of mutually adjacent, oscillatorily variable capacities: a pair of conductive strips, electrodes forming portions of said
5 capacity-providing means clamped between said strips at consecutive regions therealong, and dielectric means interposed between said strips and said electrodes.

CHARLES T. JACOBS. 10