July 23, 1929. W. JOHNSON ET AL 1,721,865

MUSICAL INSTRUMENT

Filed June 21, 1928 2 Sheets-Sheet 1

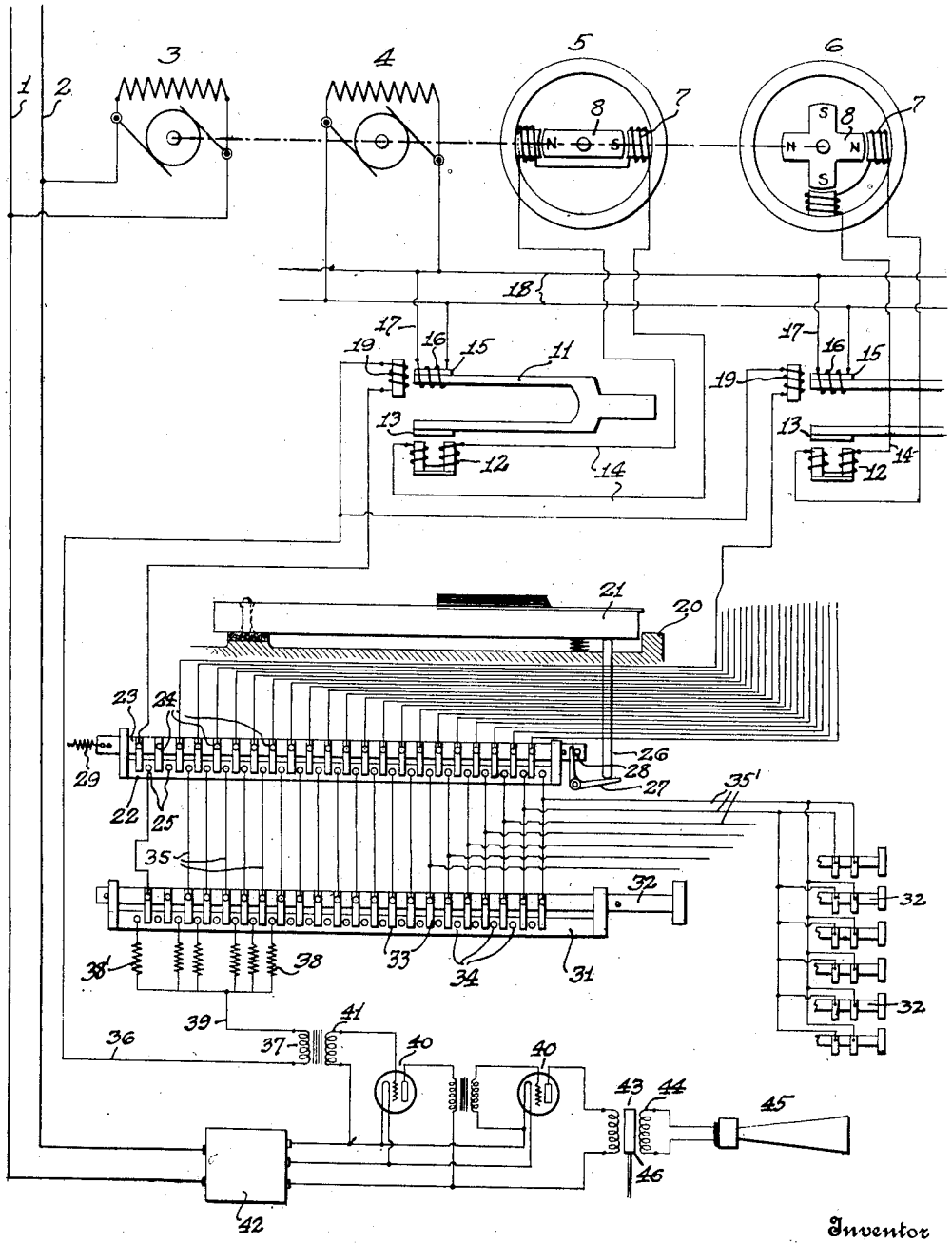

Fig. 1.

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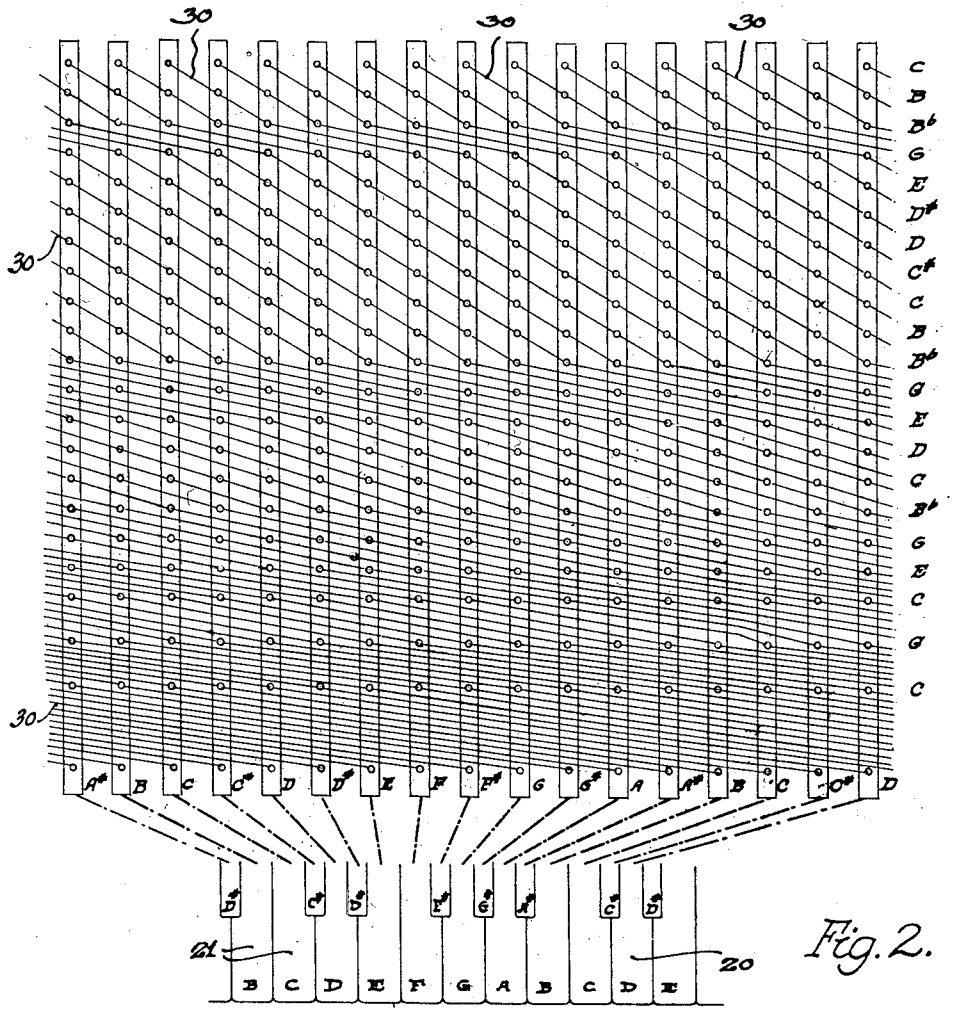

Fig. 2.

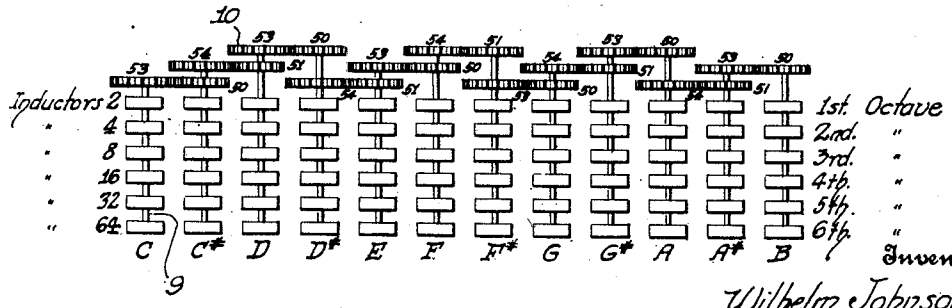

Fig. 3.

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UNITED STATES PATENT OFFICE.

WILHELM JOHNSON, OF DETROIT, MICHIGAN, AND FREDERIC H. CESANDER, OF STRANDBURG, SOUTH DAKOTA.

MUSICAL INSTRUMENT.

Application filed June 21, 1928. Serial No. 287,174.

The present invention pertains to a novel musical instrument in the nature of an organ to the extent that it is operated from an organ console.

The principal object of the invention is to provide an instrument of this character having the tone combinations and many of the other qualities of an organ and yet constructed of simpler and less numerous parts. The outstanding characteristic of the invention, as compared with an organ, is that the pipes are replaced by a loud speaker or more than one if desired. The speaker is included in a circuit to which are imparted various oscillations capable of producing sound when amplified and admitted to the speaker. These oscillations are produced by a series of units equal in number to the number of frequencies which the instrument is to render. Each such unit includes a tuning fork having one prong mounted as the armature of an electromagnet through which an oscillating current is driven by means of a frequency generator. The remaining prong obviously vibrates in sympathy with the first and carries a field coil positioned at right angles to an adjacent secondary coil in the speaker circuit. When the second prong vibrates, the field of the field coil intersects the secondary coil and produces in the speaker circuit an oscillation having the frequency of the fork.

The transmission of the oscillations to the speaker is controlled initially by keyboard switches operable by keys similar to the usual organ keys, and secondly by a series of stops which permit only selected fundamental notes and overtones to reach the speaker.

The invention is fully disclosed by way of example in the following description and in the accompanying drawings, in which—

Figure 1 is a sectional view through the console, showing in elevation, one of the keys, one of the keyboard switches, and one of the stop switches, and in diagram the remaining parts of the apparatus;

Fig. 2 is a diagrammatic plan view of the console, showing the wiring of the keyboard switches; and

Fig. 3 is a diagrammatic plan view showing the gearing of the frequency generators.

Reference to these views will now be made by use of like characters which are employed to designate corresponding parts throughout.

The line from which the power is derived is designated by the numerals 1 and 2, and across this line is connected a motor 3 which drives a direct current generator 4. Geared to the generator is a series of commutators or induction alternating current generators 5 and 6 constructed to produce either an interrupted direct current or alternating current of frequencies corresponding to the vibrational frequencies of the musical notes. In the present instance frequency generators have been illustrated, each comprising a plurality of field coils 7 and a multi-pole rotor 8. It will be obvious that any desired frequency may be obtained by selecting the proper combination and number of coils and poles.

The rotors are arranged on a plurality of shafts 9 interconnected by gearing 10 in ratios to produce the proper speeds. Each such shaft carries a series of rotors 8 and it is preferred that all the generators for a given note in the several octaves be operated by one shaft as shown diagrammatically in Figure 3.

For each frequency generator there is provided a tuning fork 11 and an electromagnet 12 which is positioned adjacent the free end of one of its prongs. This end carries an armature 13 adapted for attraction by the magnet, and the terminals of the magnet are wired as at 14 to the field coils 7 of the corresponding frequency generator. To the free end of the remaining prong is attached a core 15 around which is wound a field coil 16, and the several field coils are wired as at 17 to a line 18 supplied by the generator 4. Adjacent the field coil and preferably at right angles thereto is supported a secondary coil 19 adapted to be intersected by the field of the coil 16.

From the description already given, it will be apparent that the apparatus includes a series of units each comprising a generator corresponding in frequency to one of the notes which the instrument is capable of producing. There is one unit for each note of the instrument, and each unit further includes a tuning fork, a device for vibrating one prong of the fork, and a device at the other prong for producing oscillations in an electric circuit.

The keyboard 20 of the console is of usual construction and comprises a plurality of keys 21 pivoted to the board in the usual manner. Beneath each key is a keyboard switch comprising a fixed bar 22 and a slidable bar 23. It is to be noted that there is one

such keyboard switch for each key, and in turn one of the above described units for each key. The sliding bar carries a series of contact fingers 24 each connected to one end of one of the coils 19. The fixed bar 22 has a like number of contact points 25 engageable or disengageable by the fingers 24. The key 21 has a depending finger 26 resting against one end of a bell crank lever 27, the other end of which engages between a pair of pins 28 on the bar 23. The other end of the bar is joined by a spring 29 to some fixed point of the apparatus, and this spring normally tends to draw the sliding bar to a position which disconnects the fingers 24 from the contact points 25. Depression of the key 21 brings the fingers 24 into contact with the points 25.

Although there are as many keyboard switches as keys 21, each individual sliding bar 23 has its fingers 24 connected to those coils 19 which may be useful as overtones and the fundamental note associated with the key 21 corresponding to such bar. Instead of providing a frequency generating unit for every finger on all the sliding bars, there are provided only as many such units as there are notes in the keyboard range, and all points on the fixed bars 22 intended to produce a given note are interconnected by conductors 30 as illustrated in Figure 2. Thus, if a given note occurs several times in the fundamentals or overtones of a chord, it is derived from only one frequency generating unit.

The instrument is provided with stops corresponding to the stops of a pipe organ, and each such stop consists of a stopboard switch including a fixed bar 31 and a slidable bar 32. The bar 32 has fingers 33 adapted to contact with points 34 on the bar 31. The conductors 30 which join like points on the several fixed bars 22 are connected by wires 35 to the fingers 33 of the several sliding stop bars 32. This is shown diagrammatically in Figure 1 by a set of straight conductors joining the points 25 of one of the bars 22 to the fingers 33 of one of the bars 32, these conductors being branched as at 35′ to corresponding fingers on the remaining slidable stop bars.

Although all the contacts of the stops are joined to the intersecting conductors 30, only certain of the circuits are completed, for it is well known that the several stops are intended to produce varying numbers of overtones. It has already been stated that the coils 19 each have one end joined to certain of the fingers 24 carried by the slidable keyboard switch members 23. The remaining end of each coil is merged into a line 36 comprising one side of an amplifying circuit. This line is joined to one end of a transformer coil 37. The selected points 34 of each fixed stopboard switch member 31 are connected to resistances 38 which are joined by a line 39 to the other end of the transformer coil 37. Thus, the amplifying circuit is completed with respect to the points 34 corresponding only to those notes which are to constitute the overtones associated with a given stop. The value of the resistances 38 in each case is predetermined by the amount of current which is to pass into the amplifying circuit for producing the desired volume of any fundamental or overtone. The contact at the left-hand end of the keyboard switch or stopboard switch in Figure 1 preferably completes the circuit for the fundamental note, and the resistance 38′ connected to the fundamental note contact on the stopboard switch is merged into the line 39 in the same manner as the overtone resistances 38. Although only certain of the points 34 of any stopboard switch are used, it is preferable as a matter of construction to connect all of these points to the conductors 30, inasmuch as such an arrangement facilitates the changing of the resistances connected to any of the bars 31.

The amplifying circuit further includes two or more tubes 40 joined in the usual manner to the remaining coil 41 of the transformer and to a power pack 42 connected to the line 1, 2. Inasmuch as this hook-up is conventional, it is not deemed necessary to describe the same in detail. It is desired however to refer specifically to the volume control which comprises a transformer coil 43 in series with the amplifying circuit and another coil 44 in series with the loud speaker 45. Between these coils is a loose or movable core 46 by means of which the volume is regulated.

If it is desired to produce the effect of sound issuing from various parts of an auditorium, it is only necessary to provide loud speakers at such points and connect them into the amplifying circuit. These speakers may be connected to switches on the console so that any number of them may be simultaneously and selectively sounded.

The operation or playing of the console is the same as that of the ordinary pipe organ console. The completion of the oscillating circuits depends entirely on the setting of the stops, apart from the depression of the corresponding keys 21. Notwithstanding the fact that only one frequency generating unit is provided for each note on the keyboard, the plural occurrence of a given note in the fundamentals and overtones of a chord is reproduced by the passage of the oscillating current through the several resistances 38 and 38′ corresponding to said note. In the operation of the instrument the forks 11 may be regarded as vibrating constantly and are therefore housed in a sound-proof chamber to prevent the emission of sound thereof into the auditorium. It is to be noted that the frequency and not the sound of the tuning forks is used.

Some of the more apparent advantages of this instrument over a pipe organ will now be mentioned. The first is simplicity and cheapness of construction, due to the fact that the thousands of pipes of a pipe organ are replaced by a series of frequency generators equal in number to the useful tones in the audible range. No blowers are required, and hence the space occupied by blowers as well as the expense thereof is saved. The matter of moving parts of the instrument after installation is comparatively simple, for it is obviously easier to move electrical conductors than wind tubes. The flexibility of the stops, and the ease of changing them, will be apparent by reference to the manner of changing the stops which has already been described. The tone color is extremely flexible due to the fact that each overtone, in so far as the sound thereof is concerned, is derived from a distinct unit, while in a pipe organ many of the overtones are inherent in the pipes along with other tones and cannot easily be segregated or removed. To remove an overtone in the present construction requires only the disconnection of the resistance corresponding to the tone to be eliminated. Due to the fact that the apparatus operates electrically throughout, there is no lag corresponding to the interval required for the wind in a pipe organ to reach the reed. In other words, the attack is instantaneous. Finally, the instrument does not get out of tune in the manner that a pipe organ loses its tune. This property of the present instrument results from the fact that the sound is derived from tuning forks which are practically constant in frequency. In addition to these distinctions, other advantages of this device over the usual pipe organ will readily occur to those skilled in the art.

Although a specific embodiment of the invention has been illustrated and described, it will be understood that various alterations in the details of construction may be made without departing from the scope of the invention as indicated by the appended claims.

What we claim is:—

1. In a musical instrument, a tuning fork, means for positively vibrating one prong thereof, a field coil carried by the other prong, a secondary coil adjacent said field coil and positioned for intersection by the field of the field coil to produce oscillations in the secondary coil, a speaker connected to said secondary coil to form a circuit therewith, and amplifying means inserted between the secondary coil and the speaker.

2. In a musical instrument, a tuning fork, an armature carried by one prong of said fork, an electro-magnet adapted to attract said armature, a frequency generator connected to said magnet, a field coil carried by the other prong, a secondary coil adjacent said field coil and positioned for intersection by the field of the field coil to produce oscillations in the secondary coil, a speaker connected to said secondary coil to form a circuit therewith, and amplifying means inserted between the secondary coil and the speaker.

3. In a musical instrument, a tuning fork, means for positively vibrating one prong thereof, a field coil carried by the other prong, a secondary coil adjacent said field coil and positioned for intersection by the field of the field coil to produce oscillations in the secondary coil, a speaker connected to said secondary coil to form a circuit therewith, amplifying means inserted between the secondary coil and the speaker, a keyboard switch inserted between said secondary coil and speaker, and a key for operating said switch.

4. In a musical instrument, a series of coils, means for producing oscillations in said coils, a keyboard switch having a plurality of contacts connected to said coils, a stopboard switch having a plurality of contacts connected to the contacts of the keyboard switch, a speaker connected to certain of said stopboard switch contacts and wired to said coils to form circuits therewith.

5. In a musical instrument, a series of coils, a tuning fork adjacent each coil, a field coil carried by one prong of each fork and positioned to have its field intersect the adjacent coil, means for vibrating said field coils, a keyboard switch having a plurality of contacts connected to said coils, a stopboard switch having a plurality of contacts connected to the contacts of the keyboard switch, a speaker connected to certain of said stopboard switch contacts and wired to said coils to form circuits therewith.

6. In a musical instrument, a series of coils, means for producing oscillations in said coils, a keyboard switch having a plurality of contacts connected to said coils, a stopboard switch having a plurality of contacts connected to the contacts of the keyboard switch, a speaker connected to certain of said stopboard switch contacts and wired to said coils to form circuits therewith, and amplifying means inserted in the circuit of said speaker

7. In a musical instrument, a series of coils, means for producing oscillations in said coils, a series of keyboard switches having each a plurality of contacts connected to said coils, a stopboard switch having contacts conectned to the keyboard switch contacts, a speaker connected to certain of said stopboard switch contacts and wired to said coils to form complete circuits therewith.

8. In a musical instrument, a series of coils, means for producing oscillations in said coils, a series of keyboard switches having each a plurality of contacts connected to said coils, a plurality of stopboard switches having each a plurality of contacts connected to corresponding contacts of said keyboard switches, a speaker connected to selected con-

tacts of said stopboard switches and wired to said coils to form complete circuits therewith.

9. In a musical instrument, a series of coils, means for producing oscillations in said coils, a keyboard switch having a plurality of contacts connected to said coils, a stopboard switch having a plurality of contacts connected to the contacts of the keyboard switch, a speaker connected to certain of said stopboard switch contacts and wired to said coils to form circuits therewith, and resistance inserted in the connections from said speaker to said stopboard switch contacts.

10. In a musical instrument, a series of coils, means for producing oscillations in said coils, a series of keyboard switches having each a plurality of contacts connected to said coils, a plurality of stopboard switches having each a plurality of contacts connected to corresponding contacts of said keyboard switches, a speaker connected to selected contacts of said stopboard switches and wired to said coils to form compete circuits therewith, and resistance inserted in the connections from said speaker to said stopboard switch contacts.

11. In a musical instrument, a tuning fork, means for positively vibrating one prong thereof, a primary coil carried by the other prong, a secondary coil adjacent said primary coil and positioned to intersect with the field of said primary coil to produce oscillations in one of said coils, a speaker connected to the oscillating coil to form a circuit therewith, and amplifying means connected to said speaker.

In testimony whereof I affix my signature.

WILHELM JOHNSON.

In testimony whereof I affix my signature.

FREDERIC H. CESANDER.