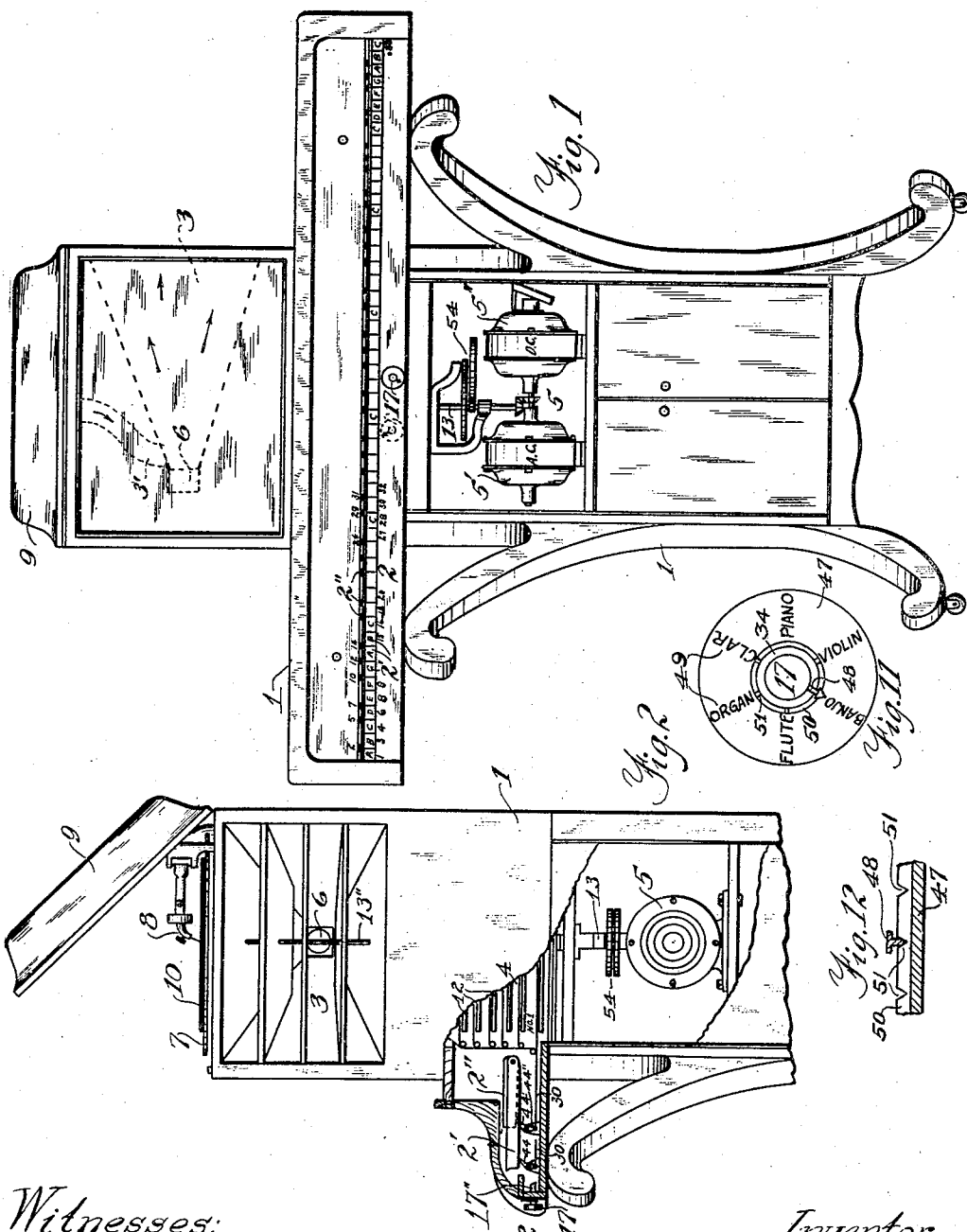


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MUSICAL INSTRUMENT.
APPLICATION FILED MAY 21, 1917.

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UNITED STATES PATENT OFFICE.

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MUSICAL INSTRUMENT.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, ELMER FREDRICK EDMOND MUELLER, a citizen of the United States of America, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Musical Instruments, of which the following is a specification.

This invention relates mainly to musical instruments of a kind adapted for automatic and manual playing features, and control means therefor, and especially to the comprehensive development and application of phonographic features in a single unitary instrument.

The main objects of the invention are to provide a method and suitable means adapted for phonographically recording and synthetically reproducing and combining consistently with the principles of musical composition the elementary phonographic notes or tones of an instrument, and also of a plurality of instruments; to combine the keyboard feature of a piano with the sound recording and reproducing features of a phonograph; to provide in an instrument of the character referred to both means for reproducing the sounds recorded on an ordinary phonographic record, as for instance a musical selection, and means for producing by manual operation an accompaniment derived from a suitable selection of phonographically recorded analytic instrumental tones; and to provide selective means for predetermining at will the set of elemental or scale tones corresponding with any of the particular instruments provided for which it may be preferred that the accompaniment shall simulate.

An illustrative embodiment of this invention is shown in the accompanying drawings, in which:

Figure 1 is a front elevation of a complete instrument, the keyboard lid being open.

Fig. 2 is a side view of said instrument, the phonograph lid being open.

Fig. 3 is an enlarged fragmentary side view (right of Fig. 1) of the part which contains the elemental tone records.

Fig. 4 is a rear view of the part shown in Figs. 3 and 5 but on the smaller scale.

Fig. 5 is a section at A-A of Figs. 3 and 4 and shows mainly a plan of one of the tone records and the mechanism immediately associated therewith.

Fig. 6 is a much enlarged plan of one of the microphones and its associated stylus.

Fig. 7 is a side view of said microphone and stylus with the near side plate of the former removed.

Fig. 8 is a diagram of electrical connections for the microphones and the common reproducer associated therewith.

Fig. 9 represents a fragment of one of the tone records representing on a much enlarged scale part of the length of one zone and showing the impression records of a number of corresponding pitch tones or sustained notes representing the several instruments.

Fig. 10 is a fragmentary axial section of one of the reproducer supporting bars showing the cam part and coacting lift member.

Fig. 11 is an enlarged front view of the manual control instrument selector and index dial.

Fig. 12 is an enlarged fragmentary cross section of the selector index finger and associated dial plate showing the positive stop notches for each setting respectively.

In the illustrative embodiment shown in the drawings and referring especially to Figs. 1 and 2, the instrument which I have denominated as a "pianophone" as a whole comprises mainly the inclosure or casing member 1 adapted to serve as a support and having a keyboard 2 disposed on its front side, a sound amplifying chamber 3 in its upper part, a phonographic record member or group of members 4 operatively connected to the keyboard, motive means 5 in the lower part adapted for driving the necessary mechanism, a phonographically responsive sound emitting member 6 operatively related to and disposed preferably at the rear end of the chamber 3, and at the top of the instrument a phonographic attachment which may be of the usual character including an ordinary record holder 7 and reproducer 8 communicating by passage 3' with chamber 3, a tiltable lid or cover 9 being provided therefor to facilitate changing the records or disks 10, as usual in phonographs.

The central part of the device to which the invention mainly relates embodies two principal features, namely, phonographic records respectively of the sustained scale-tones or pitch values, and multiplication of these pitch sounds respectively for each of

a plurality of sound sources, such as musical instruments, et cetera. This includes the provision of synchronously operable elemental pitch tone records corresponding with the several notes of any desired instrument, as for instance a flute, for which purpose the record member may be regarded as divided into a series of zones (see Fig. 5) corresponding with the several instrumental notes or pitch tones. Moreover each pitch zone may have, and is preferably provided with, not only one but a plurality or series of corresponding pitch tones respectively of a number of different instruments, as for instance the banjo, flute, organ, clarinet, piano, and violin, in which case each zone would have six parallel records or tone grooves all representing the same pitch, but each corresponding with its particular instrument (see Fig. 9). The number of pitch zones corresponds with any desired pitch range or number of notes contemplated, and preferably corresponds with the usual keyboard of a piano, illustrated in this instance by eighty-eight keys (black and white), as shown in Fig. 2.

In order to avoid crowding of the zones referred to, and to facilitate compactness, the phonographic record member 4 is multiple or sectional in form, and the pitch range is divided equally over the plurality of sections or disks. In this instance eleven zones 11 are provided on each of the record parts or disks 12, and eight disks are provided, being arranged coaxially one over the other for synchronous operation by the motor-driven shaft 13.

Each zone is provided with a separate reproducing member 14, comprising a stylus or needle 15 operatively connected to a microphone 16, which in turn is electrically connected to the common electromagnetic sounder 6 in the chamber 3. The casing or frame of each microphone is inclosed and contains suitable carbon as shown at 16'. Said casing also has a removable side or wall 16'', same being removed in Fig. 7. A similar side is disposed oppositely thereto. Said sides and the front and rear walls 16^a and 16^b are of insulating material so that the path for the current through the microphone is limited to the irregular column of carbon 16'. The front wall 16^a to which the stylus 15 is fixed is held loosely by the other wall members so as to be free to respond to the sound vibrations picked up by the stylus from the record 12. Wires 6' lead to the battery and to the reproducer 6.

Selective means 17 adapted for manual control are provided for changing the registry of the reproducers 14 each with respect to the several instrumental or other records in its corresponding zone.

The fundamental mechanical difference in the record grooves in the successive zones

11 is in primary wave length, each zone having fundamental wave lengths or vibration periods corresponding with its respective pitch, as understood in the art. The grooves in each zone are all alike in primary wave length and corresponding pitch, but differ in extent and character of the secondary waves on which depend the different intensities of the harmonics and corresponding timbre or color which accompany the primary tones of the several instruments. Hence the change from one instrument record groove to another in the same zone is in effect a change in timbre, color, or association of the various characteristic harmonics, with the fundamental note or pitch values remaining unchanged.

Each member 14 is operatively mounted for control of its coaction with the record by means of its certain corresponding key on the keyboard. Whenever a key is struck or depressed the corresponding reproducer is moved toward its corresponding disk 12, so that the stylus 15 descends upon its corresponding note zone and engages the sound record groove corresponding with the setting of the selector 17.

For the purpose stated the microphone and stylus of each member 14 are mounted on a lever 18 held pivotally at 19 on the horizontal shaft 20, and operating means are provided therefor comprising a key-operated lift member in the form of a cam plunger 21 and resilient restoring means 22 adapted to hold the plunger normally in its retracted or lifting position. In order to prevent lateral movement of the lever 18 on its pivot shaft 20, such as would interfere with the stylus following its record groove, coacting shoulder and guide means are provided, said means preferably being in the form of a peripheral slot or groove 23 in the shaft 20, and coacting therewith a shoulder or screw 24 set in the end of the lever 18. Positive guide means for the cam plungers are provided on the carriage member 25 hereinafter described, said guide means being in the form of a pair of horizontally disposed rods 26 positioned in the same horizontal plane and apertured as at 26', in alinement to receive said plungers transversely thereof. One end of the plunger, remote from the stylus, is shouldered as at 27, to hold in place the restoring spring 22, one end of which coacts with the plunger shoulder, and the other bears against the adjacent guide rod 26. The opposite end of said plunger is turned upward or shouldered at 28 to coact with a cam slot 29 formed in the under side of the lever 18. The cam slot 29 is formed at one end, toward pivot 20, as a shallow depression 29', wherein the coacting end 28 of the plunger normally stands, and adjacent thereto is an upwardly curved deeper part 29'' with which the tip 28 co-

acts when the plunger is drawn forward toward stylus 15. Thus the microphone is permitted to be moved downward by gravity when the lift member 21 is pulled forward by operation of its corresponding key 2' or 2'' and connection 30. When the key is released the plunger 21 is restored by the spring 22 and said plunger, by cam wedging action, operates to lift the microphone support 18 so as to raise the stylus 15 out of contact with the record 12.

In order that all of the reproducers 14 which are in one set and controlled by the same selector may be moved uniformly and positively by the manual operation of the selector 17, a suitable carriage or mounting 25, above mentioned, is provided adapted to reciprocate sufficiently to move the reproducers across the width of their respective zones 11. For this purpose the carriage or frame 25 on which the reproducer supporting levers 18 are mounted, is arranged to slide laterally in the direction of the rods 20 and 26 comprised by said carriage (as shown in Fig. 5).

In order to insure positive action of the carriage 25 with respect to the selector 17, the carriage is equipped with a rotary shaft 17' with which the carriage member 25' has threaded relation, said shaft being mounted on the stationary journal members 32, whereby the turning of the shaft advances the frame in one direction or the other according to the turning of said shaft, endwise movement of said shaft being prevented by suitable means, as for instance shoulders or pins 33 coacting with the journal lugs 32. The operation of said shaft is controlled positively by the hand wheel 34 of selector 17 through the intermediation of suitable connections including the bevel gears 35 and 36 mounted on the adjacent ends of the shafts 17' and 17''.

In order that accidental or inadvertent contact of one or more needles 15 with the record, as by depression of the corresponding keys, when the selector is operated may be positively guarded against, the threaded part 37 of shaft 17' is made eccentric or camlike and the threads are spaced in accordance with the spacing of the record grooves 38 on the plates 12. The shaft is also cam-shaped at 39 though not threaded at this end. When the shaft 17' is turned once around the carriage is lifted and carried forward one pitch unit or thread space, and the needles of the eleven reproducers on that carriage are all likewise lifted well away from their grooves 38 and advanced to the next groove respectively and there lowered into place ready for effective actuation by the keys. In Figs. 3 and 4 the carriage is shown in its lowered position, ready for playing the keys. The upper rail 40 of the carriage is guided between the shoulders 41

equipped with rollers 42. A vertical clearance space 43 is provided between the carriage top and the frame 1 so as to accommodate raising of the carriage by the cams 37 and 39.

The operating mechanism or action whereby the keys 2' and 2'' control the reproducer 14 includes a lever 44 associated with each of the keys 2' and 2'' respectively, said levers each being of bell-crank shape and so arranged that depression of the key moves the lever in one direction (clockwise in Fig. 2), and release of the key permits the lever to move in the opposite direction. The lever arm 44' normally is nearly horizontal and coacts with the key, and a connection preferably in the form of wire 30 extends from the other arm 44'' to the reproducer cam actuating member 21, suitable pulleys 45 being provided over which the wire may be properly guided. When the wire is pulled by depression of a key, a corresponding reproducer is lowered and its needle 15 brought into coaction with the corresponding groove 38 in the record member 12.

The manual selector 17 includes the hand-wheel 34 and a stationary dial 47 mounted concentrically behind the hand-wheel, an index arm 48 being attached coturnably to said hand-wheel for indicating the relative position of the hand-wheel with respect to the dial. The face of the dial is marked at intervals around its periphery as at 49 to indicate the several instruments for which records are provided, the consecutive arrangement of the instrument labels on the dial being in accordance with the corresponding record grooves 38 (Fig. 9) on the several zones 11, into which the record disks 12 are divided, as shown in Fig. 5. The gears 35 and 36 are proportioned so as to cause one revolution of shaft 17' for each movement of the index 48 from one label 49 to the next.

In order that the setting of the hand-wheel may be definite and positive for each instrument, the dial is provided with an up-standing rib 50, in which notches 51 are provided opposite each label respectively, and the index 48 which is somewhat yielding is formed on its under side to engage said notches. For this purpose the cross section of the notch engaging part is preferably T-shape, as shown in Fig. 12. The selector 17 may be positioned for fixing the hand-wheel directly on the forward end of shaft 17'' or intermediate connecting means may be provided, as will be understood. This selecting device is finely adjusted so that due setting of the selector by the operator results in a corresponding instrumental note when one of the keys is depressed, and hence since all of the reproducers are moved simultaneously in the same manner, and with like effect, the result is that any of the instruments pro-

vided for may be simulated by the operator using the notes substantially as in playing the piano.

In order that the several record plates 12 may be easily replaced when worn out, and to provide suitable support for same when in use, the upper end of shaft 13 is made sectional and each section 13' is provided with a plate-like shoulder or flange 52 whereon the records are mounted. The adjacent ends of abutting sections are formed to screw together, as shown at 53. Each record 12 has a central aperture 12' to receive the shaft part 13'. The uppermost section of said shaft is provided with an upward extension 13'' for driving the holder 7 for the ordinary record 10.

In order to better facilitate observing the relation of the corresponding groups of keys and record zones, the keys and zones are numbered (on the drawings) in their numerical order, as shown in Figs. 1 and 5. The lowermost record disk No. 1 contains zones 1 to 11, the next disk No. 2 has zones 12 to 22, and the top disk No. 8 has zones 78 to 88, corresponding with the keys 1 to 88 respectively. The instrument-records or grooves 38 in the several zones 1 to 88 are arranged in the same sequence, as illustrated in Fig. 9, wherein starting from the center the violin comes first and then the piano, and so on, and the banjo comes last.

The electrical connections for the reproducers are illustrated in a most elementary conventional way in Fig. 8, though in practice more elaborate details may be introduced to conserve the current and make for higher efficiency as understood for instance in the telephone art.

When two or more keyboards are used, a separate sounder 6 is provided for each.

Speed reducing gears 54 are provided to properly correlate the speed of the disks 12 and the driving means 5. Duplicate motors are provided one for alternating current, as indicated at 5', and the other for direct current as shown at 5''. If preferred the motors may be alike, one serving as a reserve.

When a double keyboard is provided, as will be understood though not shown, and a plurality of sets of reproducers are furnished, so as to provide for simultaneous playing of a plurality of different instrument sounds, the several sets of reproducers are mounted on corresponding independent carriages and separate selectors are provided therefor, two carriages and selectors being illustrated in Figs. 1 and 5, the second of each being shown by dotted lines. The full line equipment is shown set for playing the outermost record, namely the violin, while the dotted equipment is set for playing an intermediate record namely the organ, as may be seen by reference to Figs. 5 and 9.

As each individual record groove gives a

sustained note or tone when and so long as the corresponding key is depressed there is no need of synchronizing the reproducers for simultaneous playing, as would be the case if two ordinary records were to be played at once.

Although for the sake of simplicity, only phonographic apparatus is actually shown on the drawings it is to be understood that the features here shown may be used in conjunction with the strings and "action" of an ordinary piano, in which case the one set of keys serves in common to sound the strings and the corresponding phonographic notes. If desired the piano may be played independently of the phonographic attachment, for which purpose the selector index 48 may be turned to an intermediate point half way between two adjacent notches 51, whereby the reproducers 14 are held in their raised and inoperative position, owing to the cams 37 and 39 on shaft 17' (Figs. 3 and 4).

The operation is as follows: The motor is started as usual for motors of this size and the operator turns the selector handle 46 to register the index 48 with the instrument desired, as for instance the banjo (see Figs. 5 and 11). The keys are then played substantially as on a piano or organ. If desired a record may be placed on the holder 7 for the purpose of an accompaniment. If the instrument has two keyboards and duplicate reproducing equipment the operator may set the second selector for the same or some other instrument, as for example the organ.

Although but one specific embodiment of this invention has been herein shown and described, it will be understood that numerous details of the construction shown may be altered or omitted without departing from the spirit of this invention as defined by the following claims.

I claim:

1. In a device of the character described, a carriage having phonographic reproducing means thereon, a shaft having threaded connection with said carriage for moving the latter, and a hand-wheel operably connected to said shaft for manual setting of said carriage.

2. In a device of the character described, a frame, a carriage mounted reciprocatably thereon, a rotary phonographic record member also mounted thereon and with respect to which said carriage has relative movement, said member having a plurality of parallel records, reproducing means on said carriage, and selector means for adjusting the position of said carriage with respect to the records on said record member.

3. In a device of the character described, a supporting frame, a rotary sound record of phonographic character mounted thereon, means for driving said record, sound

reproducing means movable radially for co-
action with different zones on said record
respectively, a carriage whereon said repro-
ducing means are mounted, threaded cam
5 means for moving said carriage whereby the
reproducers are moved across the zones re-
spectively and thrown out of operative en-
gagement with said record during the car-
riage movements, and guide means for said
10 carriage.

4. In a device of the character described,
a support, journal means on said support, a
shaft carried by said journal means, and a
carriage having a journal part with which
15 said shaft has threaded relation, and said
shaft having a cam part coacting with one
of said journal parts, whereby said shaft
and carriage have relative movement both
longitudinally and transversely of said
20 shaft.

5. A phonographic device having sound
reproducing means of electro-telephonic
character including a chamber provided
with irregular-shaped insulating walls,
25 spaced electrodes respectively in series with
the telephonic circuit, granular carbon occu-
pying the space between said electrodes and
connecting the same electrically, and one of
the walls of said chamber being held loosely
30 and provided with a rigidly connected
stylus adapted to coact with a sound record

and thereby to correspondingly agitate said
carbon.

6. In a device of the character described,
a frame member comprising a pivot rod, a 35
plurality of sound reproducers mounted
thereon, plungers for swinging said repro-
ducers respectively, guide means for sup-
porting said plungers, and means for oper-
ating said plungers manually, said plungers 40
and reproducers having cam relation to each
other whereby the latter is swung in accord-
ance with the reciprocatory movement of
the latter.

7. In a phonographic device of the char- 45
acter described, a record disk having a series
of concentric zones corresponding with the
pitch tones of a definite scale, each zone
having a series of concentric record grooves
corresponding with like pitch tones of dif- 50
ferent instruments, a pair of carriage mem-
bers, a plurality of sound reproducers on
each carriage, said carriages being adapted
and arranged for moving said reproducers
radially across their respective zones, and 55
manual selective means for adjusting the
position of each carriage in accordance with
the instrumental tones to be reproduced.

Signed at Chicago this 12th day of May,
1917.

ELMER FREDRICK EDMOND MUELLER.