Sept. 26, 1961 C. W. ANDERSEN 3,001,431

MUSICAL INSTRUMENT SYSTEM

Filed Sept. 22, 1954 4 Sheets-Sheet 1

Fig. 1.

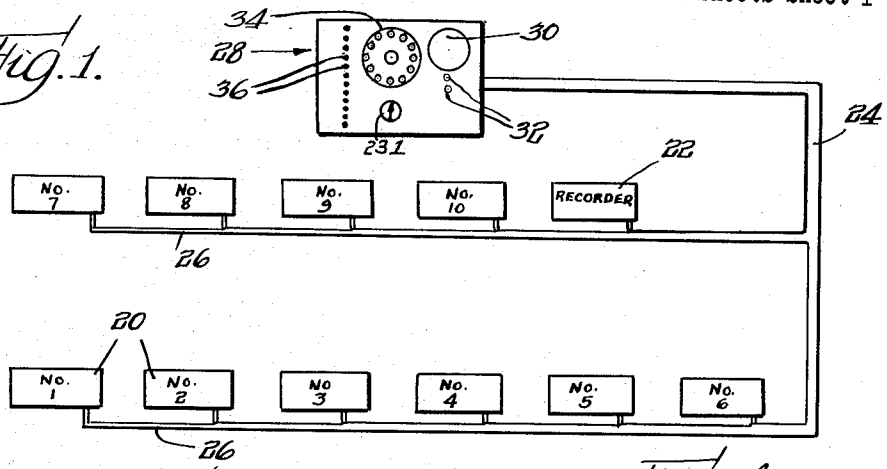


Fig. 2.

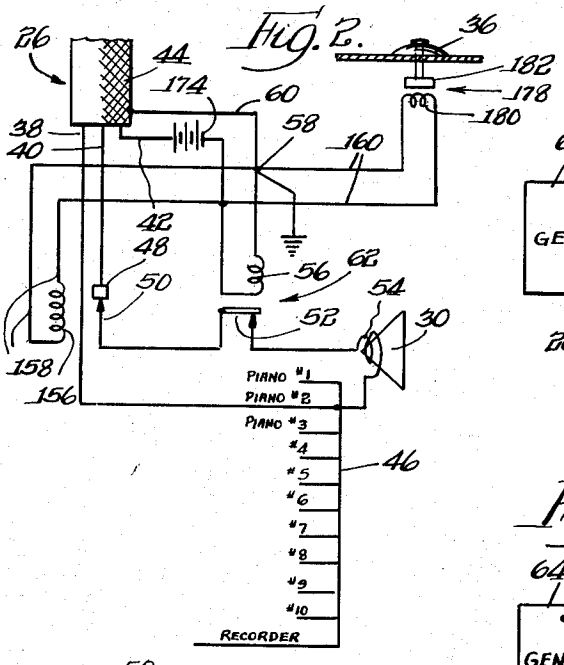


Fig. 4.

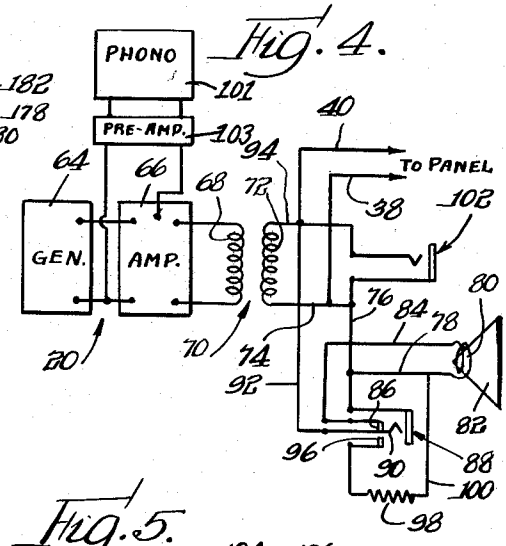


Fig. 5.

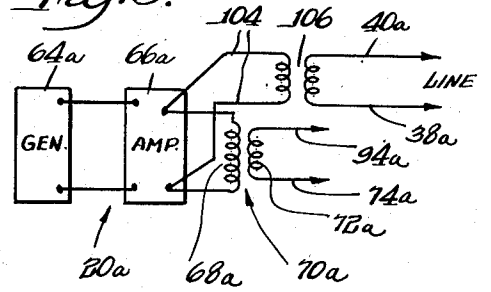
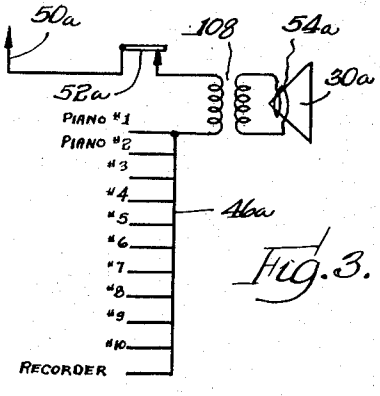


Fig. 3.



INVENTOR.
Clifford W. Andersen
BY:
Olson & Trexler
Attys

Sept. 26, 1961 C. W. ANDERSEN 3,001,431

MUSICAL INSTRUMENT SYSTEM

Filed Sept. 22, 1954 4 Sheets-Sheet 2

Fig. 6.

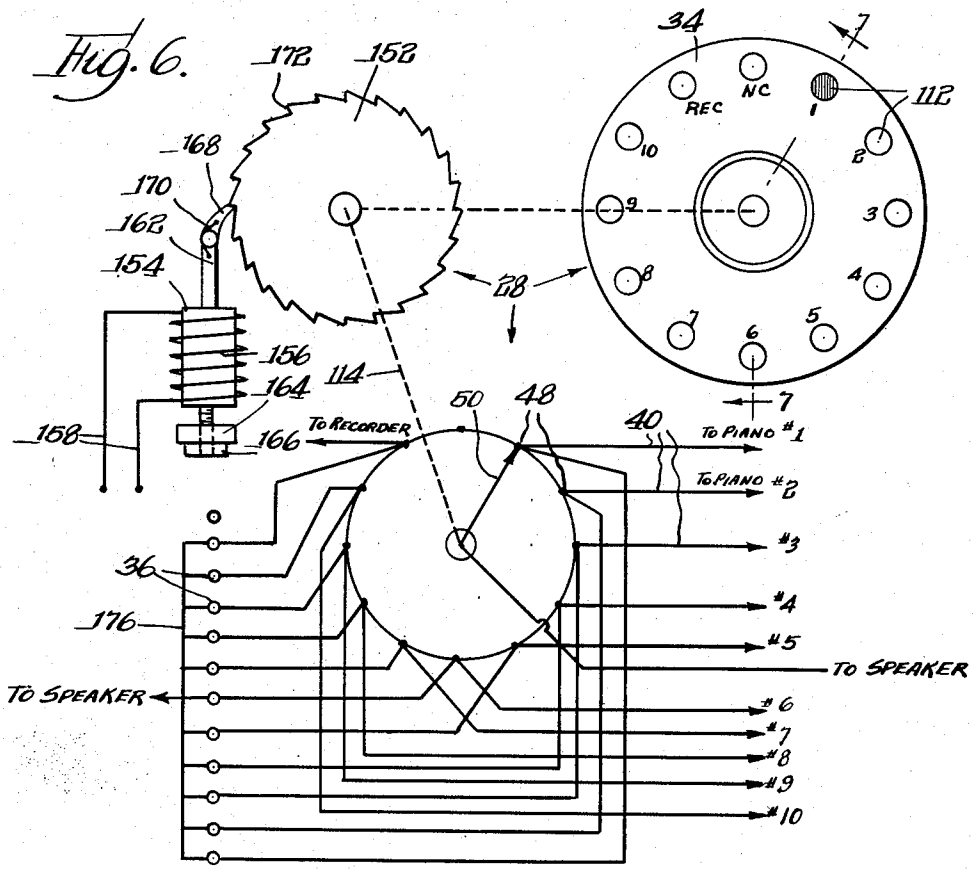


Fig. 7.

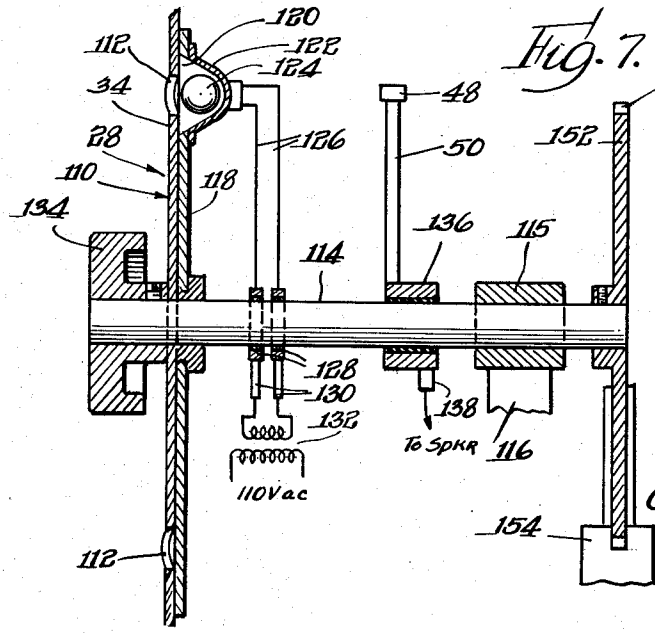
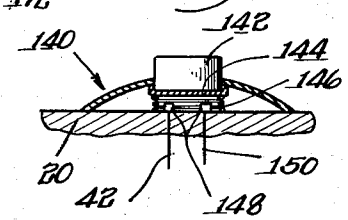


Fig. 8.



INVENTOR.
Clifford W. Andersen
BY: Olson & Trevor
Attys.

Sept. 26, 1961 C. W. ANDERSEN 3,001,431

MUSICAL INSTRUMENT SYSTEM

Filed Sept. 22, 1954 4 Sheets-Sheet 3

Fig. 9.

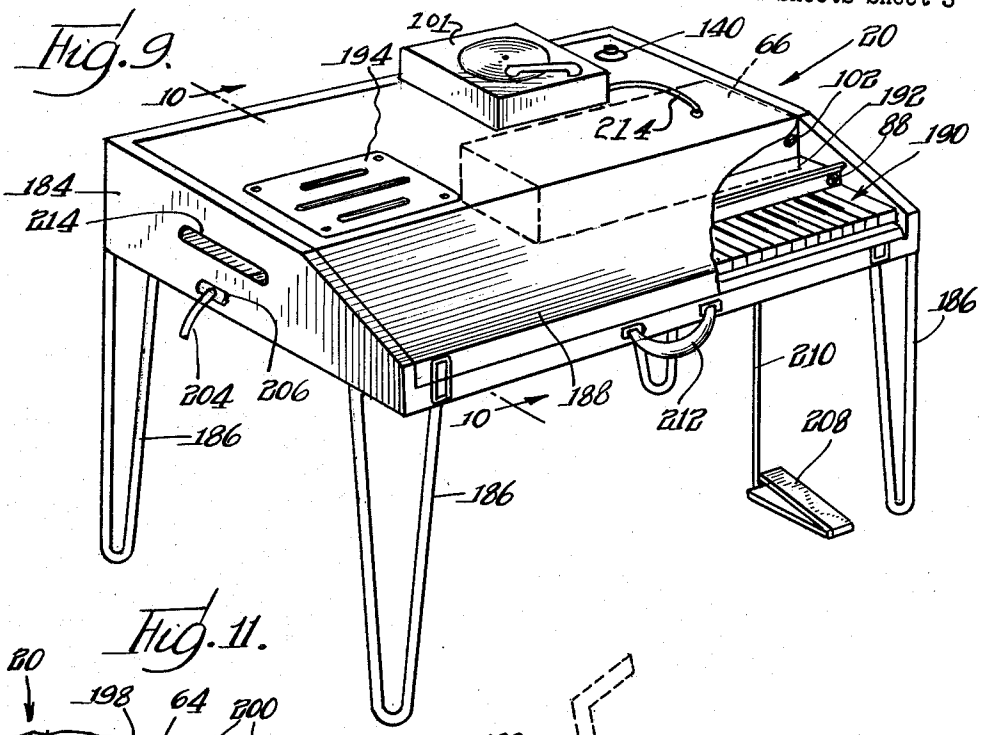


Fig. 11.

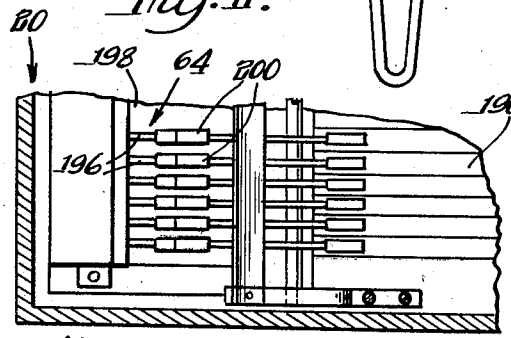
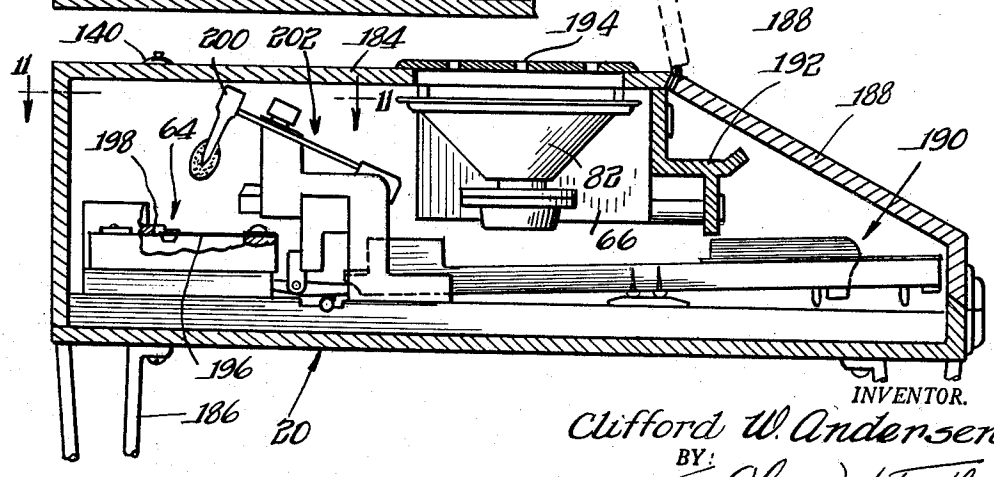


Fig. 10.



INVENTOR.

Clifford W. Andersen

BY: Olson & Trefflich

Attys.

Sept. 26, 1961 C. W. ANDERSEN 3,001,431

MUSICAL INSTRUMENT SYSTEM

Filed Sept. 22, 1954 4 Sheets-Sheet 4

Fig. 12.

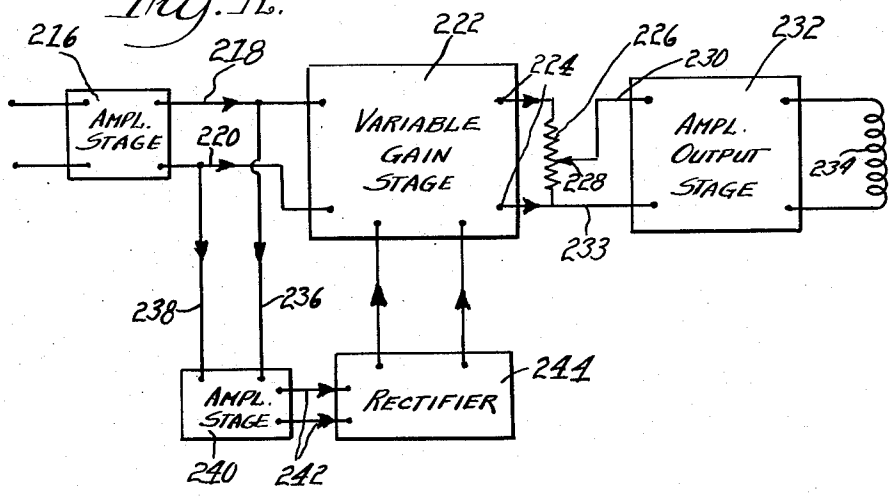
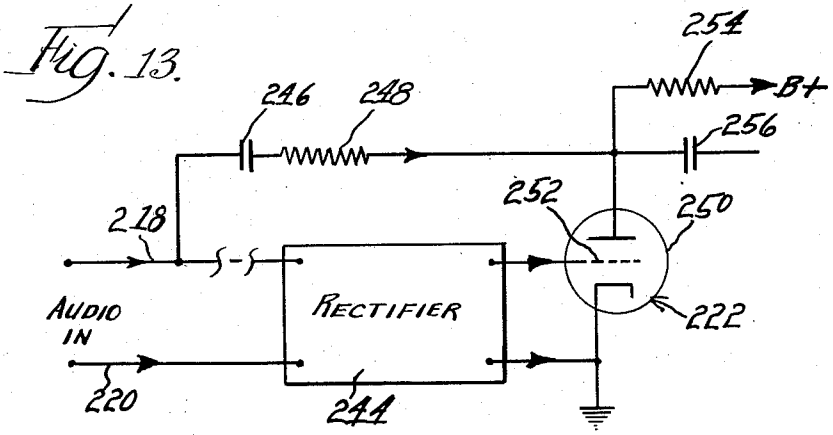


Fig. 13.



INVENTOR.
Clifford W. Andersen
BY
Olson & Trexler
attys.

United States Patent Office 3,001,431 Patented Sept. 26, 1961

3,001,431

MUSICAL INSTRUMENT SYSTEM

Clifford W. Andersen, De Kalb, Ill., assignor to The Rudolph Wurlitzer Company, North Tonawanda, N.Y., a corporation of Ohio

Filed Sept. 22, 1954, Ser. No. 457,728
8 Claims. (Cl. 84—1.01)

This invention is concerned generally with the electronic production of music, and more particularly with a system for selectively rendering musical tones generated audible from any one or more of a group of instruments.

Heretofore, teaching the art of piano playing has generally required individual supervision of each student. Space limitations have militated against a large number of pianos being played in one room, and the sound coming from other pianos is likely to distract a student. As a result, it has been common practice for students to have a minimum of individual lessons with long hours of unsupervised practice. Generally, such practice has been in small student practice rooms which are scarcely large enough to hold an upright piano and the student. The small rooms have precluded proper resonance and have rendered it extremely difficult for a student to ascertain whether or not he is playing the proper tones. During unsupervised practice, it is impossible for anyone to ascertain whether or not the student is fingering properly.

Heretofore, I have solved the space requirements for pianos by inventing an electronic piano occupying no more space than a small desk. The piano is portable, and may be supported on a desk, table, or detachable legs. The electronic piano which I have invented utilizes vibratory reeds as variable capacitors to develop electrical oscillations corresponding to piano tones. These oscillations are amplified electronically and are transduced either by means of a loudspeaker or by means of earphones. A student may utilize earphones to listen to his own playing without anyone else in the room being conscious of such playing.

It is an object of this invention to provide a system of piano instruction utilizing such electronic pianos, or other electronic musical instruments, whereby each student may listen to his own playing, and whereby a teacher can observe the fingering or other manipulation of each student and can listen selectively to any given student.

More particularly, it is an object of this invention to provide a piano teaching or playing system in accordance with the foregoing object wherein the teacher can move about the room and connect earphones to any of the pianos or other instruments for listening thereto.

More specifically, it is an object of this invention to provide a piano teaching or playing system wherein a large number of electronic pianos or the like can be played in the same room without audible sound, the players or students individually listening to themselves by means of earphones, and wherein there is provided a central station wherein the teacher or monitor can selectively connect one or more of the pianos to a loudspeaker or earphones for listening to such piano or pianos without moving from the central station.

Furthermore, it is an object of this invention to provide a piano or other instrument teaching or playing system wherein a plurality of pianos or the like is played in a single room without audible tones emanating from the pianos, each student or player listening to his own piano with earphones, and wherein a teacher or monitor can move about the room individually to observe the fingering or manipulation, and wherein the teacher or monitor can connect any given piano to a central station for audible reproduction of the tones of that piano by means of a loudspeaker or the like.

It further is an object of this invention to provide a system for teaching the piano or the like wherein student pianos individually or in groups may be compared with a recording made by one of the recognized master pianists of the day with such control available to the teacher from a central station or from any one of a number of pianos located in the same room.

Another object of this invention is to produce a system in accordance with all of the foregoing objects which does not require complicated wiring and which is simple and economical to set up.

A further object of this invention is to produce a system in accordance with the preceding objects wherein all tones will be reproduced at the central or master station at a predetermined adjustable intensity regardless of the volume level set at each instrument.

The invention hereinafter will be explained in detail with regard to electronic pianos, all played in the same room. However, it will be understood that electronic organs, electric guitars, or any other instruments which produce or can be adapted to produce electrical oscillations rather than audible tones are equally subject to the principles of the invention. It further will be apparent that many of the objects of the invention could be attained with the students or players in one or several rooms and with the teacher in a room isolated from any or all of the pianos or other instruments.

Other and further objects and advantages of the present invention will be apparent from the following description when taken in connection with the accompanying drawings wherein:

FIG. 1 is a schematic view illustrating a piano teaching or playing system set up in accordance with the principles of my invention;

FIG. 2 is a schematic wiring diagram of the master panel or station;

FIG. 3 is a view similar to a portion of FIG. 2 showing a modification thereof;

FIG. 4 is a schematic wiring diagram of the electronic piano or other instrument including the output connections therefrom;

FIG. 5 is a view similar to FIG. 4 showing a modified connection;

FIG. 6 is a somewhat schematic diagram illustrating the selector at the master station or panel;

FIG. 7 is a cross sectional view through the selector;

FIG. 8 is a cross sectional view of a control member located at each piano or other instrument;

FIG. 9 is a perspective view of an electronic piano such as preferably is used in my playing system;

FIG. 10 is a vertical cross sectional view through the piano and taken along the line 10—10 in FIG. 9;

FIG. 11 is a fragmentary horizontal view partially in section taken substantially along the line 11—11 in FIG. 10;

FIG. 12 is a schematic wiring diagram of an amplifier preferably provided at the central or master station for maintaining a constant, pre-set volume; and

FIG. 13 shows some details of a portion of FIG. 12.

Referring first to FIG. 1 there will be seen a plurality of pianos illustrated somewhat diagrammatically and identified by the numeral 20, the various pianos being indicated as number 1, 2, etc. There are ten pianos in the illustrative embodiment of FIG. 2, and there is also provided a recorder 22. This recorder may be of any suitable type, such as for playing commercially available disc records in order to reproduce the artistry of a master pianist, or the recorder may be a tape recorder whereby the progress of a student readily may be observed. The pianos and the recorder are connected by means of a cable 24 and a plurality of branch cables 26 to a main station or panel indicated somewhat schematically at 28.

This main station or panel **28** is provided with a loudspeaker **30** and with jacks for accommodating earphones, the jacks being indicated at **32** and preferably being two in number. The main station **28** also is provided with an indicator **34**, which in the present illustrative invention is provided with twelve indicating stations. A row of pushbuttons **36** is provided adjacent the indicator **34**, and the pushbuttons correspond in number with the stations of the indicator **34**, there being twelve pushbuttons in the illustrative embodiment.

Each of the branch cables **26** as readily may be seen in FIG. 2 comprises three insulated wires **38**, **40** and **42** carried within a conductive sheath **44** which may conveniently be of the braided variety. The wires **38**, **40** and **42** preferably are limited to three in number inasmuch as cables having conductive sheaths or shielding and three internal wires are readily available in commerce at a reasonable price and are not unduly bulky.

The wire **38** of each sub-cable **26** is connected to a common connector or bus line **46**, the connection for piano No. **2** being illustrated in FIG. 2, and the connections for the other pianos to the bus line merely being indicated. The wires **40** of each of the sub-cables **26** are connected individually to fixed contacts **48** associated with the indicator **34**, and a rotary arm or contact **50** is selectively engageable with any one of the contacts **48**. The switch arm **50** is connected through a normally closed relay switch **52** to the voice coil **54** of loudspeaker **30**. The relay switch **52** is openable by means of a relay coil or a solenoid **56**, the wire **42** of each sub-cable **26** being connected to this coil, and the other side of the coil being grounded as indicated at **58**. The conductive sheath or shielding **44** of the individual sub-cables also is connected to ground by a wire as indicated at **60**. The operation of the relay **62** comprising the switch **52** and coil **56** will be described shortly. Each piano **20** is shown in FIG. 4 schematically as comprising a tone generator or generators **64** connected to the input connections of an amplifier **66**. The output connections of this amplifier are connected to the primary **68** of an output transformer **70**. The secondary coil **72** of the output transformer **70** is connected by means of wires **74**, **76** and **78** to the voice coil **80** of a loudspeaker **82** located at each piano. The voice coil also is connected by means of a wire **84** to a switch contact **86** in an earphone jack **88**, one of the contacts **90** of the jack normally engaging the contact **86**. The contact **90** is connected by means of a wire **92** to a wire **94** at the opposite end of the output coil **72** from the wire **74**.

When a plug is inserted into the jack **88**, the contact **90** is moved away from the contact **86** into engagement with a contact **96**, this latter contact being connected through a resistor **98** of low value and a wire **100** to the wire **78**. Accordingly, when an earphone plug is inserted in the jack **88** the resistor **98** is connected in parallel with the high impedance of the earphones so as to present a load to the output of the amplifier which is substantially the same as that presented by the voice coil **80** of the loudspeaker **82**. As a specific example, the resistor **98** may be a 7.5 ohm resistor rated at 10 watts.

A second earphone jack **102** is connected directly to the wires **74** and **94**, thereby being in parallel with the loudspeaker voice coil **80**. Thus, the output of the piano can be listened to by one person on earphones, and by others via the loudspeaker. This often is advantageous when the student wishes to hear his own playing without being distracted by external sounds.

The phone jacks **32** at the central station and shown in FIG. 1 preferably are interconnected with the voice coil **54** in the same manner as the jacks **88** and **102** are interconnected with the voice coil **80**. They have been omitted from FIG. 2 for clarity of illustration.

In many instances it will be found desirable for each student or pianist to listen to a record while he is playing. Such a record may provide local instructions for the student, or it may provide an orchestral background for the student, or it may provide a time or metronome signal, or it may suit any of a further variety of purposes. As is shown in FIG. 4 a phonograph **101** is connected through a preamplifier **103** to the amplifier **66**. The phonograph may comprise any suitable sort of record player known in the art, and may rest on top of the piano as hereinafter will be disclosed.

It will be appreciated by those skilled in the art that if the cables or sub-cables **26** are unduly long, there will be transmission losses which will adversely affect the tonal output from the speaker **30** or from the phone jacks **32**. Accordingly, if the pianos are to be located at a substantial distance from the main station or panel **28**, it is preferable to use transmission lines to eliminate or minimize losses. Connections for a transmission line are shown in FIGS. 3 and 5 as modifications of FIGS. 2 and 4 respectively. Most of the parts remain the same and description thereof is unnecessary inasmuch as the similar parts are identified by similar numerals with the addition of the suffix *a*. The modification resides, in FIG. 5, in adding a pair of wires **104** connected to the output of the amplifier **66***a* in parallel with the primary **68***a* of the output transformer **70***a*. These wires **104** could be connected to the wires **74** and **94** in the same manner as the cable wires **38** and **40** (FIG. 4) but are illustrated as connected in parallel with the transformer **70***a*. A line matching transformer **106** connects the wires **104** to the wires **38***a* and **40***a* as may be seen in FIG. 5.

The structure in FIG. 3 is substantially the same as that in FIG. 2, the only change comprising the insertion of a line matching transformer **108** between the voice coil **54***a* of the loudspeaker **30***a* and the bus **46***a* and switch **52***a*. With this modification the pianos may be located at a substantial distance from the main station or panel **28** without any substantial transmission losses.

Referring next to FIGS. 6 and 7, the main station **28** will be seen to comprise a face plate **110** having the indicator **34** formed thereon. The indicator **34** preferably comprises a circular area having windows **112** equally arcuately spaced thereabout and corresponding to the indicia previously mentioned with regard to the indicator. The windows **112** preferably are provided with transparent or translucent plastic or glass of eye catching color such as red so that when a light is positioned behind one of the windows, it will be easy to observe from across the room which window is illuminated.

A shaft **114** is journaled in the face plate **110** concentric with the windows **112**, and also is journaled in a bearing **115** spaced therefrom and supported by any suitable support **116**. A disc **118** is fixed on the shaft **114** immediately adjacent and behind the face plate **110**. This disc **118** is provided with a single aperture **120** selectively alignable with the windows **112** upon rotation of the shaft **114**. A small reflector **122** is carried by the disc behind the aperture **120**, and a small light bulb **124** is carried in this reflector and is connected by means of wires **126** to slip rings **128** insulatedly mounted on the shaft **114**. Brushes **130** slidingly engage the slip rings **128** and are energized preferably at a low voltage from the secondary of a power transformer **132** having the primary connected to the usual 110 volt alternating current supply. A knob **134** is preferably provided on the protruding front end of the shaft **114** for turning the shaft whereby to move the light bulb **124** from one window **112** to the next.

The switch arm **50** previously mentioned is insulatedly supported on the shaft **114** by means such as a slip ring **136**. The contacts **48** are arcuately spaced concentrically about the shaft **114** for selective engagement by the switch arm **50**. The contacts **48** as previously indicated with respect to FIG. 2 and as also shown in FIG. 6 are individually connected by means of the wires **40** to the various pianos. A brush **138** slidingly engages the slip

ring 136 and is connected via the relay switch 52 to the loudspeaker 30. The switch arm 50 is radially aligned with the light bulb 124, and accordingly the light bulb indicates the contact 48 that is engaged by the arm 50.

The knob 134 may be used to rotate the shaft 114 for connecting any of the pianos 20 to the loudspeaker or to earphones connected to the jacks 32. However, it is desirable that the teacher or monitor be able to walk about to observe the individual students or pianists and to connect any desired piano to the loudspeaker 30 without the necessity of walking over to the main or master station 28. Remote control is effected by means of a pushbutton 140 (FIG. 8) located at each piano. Each pushbutton includes a depressible element 142, preferably of insulating material, and bridged at the bottom by a conductive member 144. A spring 146 bears upwardly beneath the conductive member to hold the depressible element 142 in raised position, and simultaneously to hold the conductive member out of contact with a pair of contacts 148. The contacts 148 are respectively connected to the wire 42 of the sub-cable associated with the piano in which the pushbutton is located and to a wire 150 connected to the sheath or shield 44 of that cable.

A ratchet wheel 152 is fixed on the shaft 114, and a solenoid 154 is positioned adjacent the edge of this ratchet wheel. The solenoid as may be seen in FIG. 6 is provided with a coil 156, and this coil is connected by means of wires 158 to bus line 160 (FIG. 2) which are connected to the wires 52 of the sub-cables 26 and to the grounded wires 60 of the sheath or shield. The solenoid 154 is provided with a non-magnetic plunger 162 (FIG. 6) and a magnetic slug 164 is threaded onto the outer end of this plunger, a jam nut 166 also being provided to lock the slug in place. Each time the solenoid coil 156 is energized the slug 164 is drawn up against the solenoid 154, thus to move the plunger 162 and to determine the extent of throw of the plunger. A pawl 168 is pivoted on the opposite end of the plunger 162 from the slug 164 and is urged by a spring 170 into engagement with the teeth 172 of the ratchet wheel 152.

A source of electromotive force is arranged for connection into each wire 42 and is conveniently illustrated at 174 (FIG. 2) as a battery. However, it will be understood that this conveniently could be a rectified voltage taken from the amplifier of each piano, and thus would be located at the piano end of the wire 42 rather than at the master station end as illustrated in FIG. 2. In any event, each time one of the pushbutton elements 142 is depressed, the battery 174 or other source of electromotive force is connected to energize the solenoid coil 156, thereby attracting the slug 164 against the end of the solenoid and acting through the plunger 162 and pawl 168 to rotate the ratchet wheel 152 a predetermined distance. Such rotation effects movement of the rotary switch arm 50 from one of the contacts 48 to the next. A second depression of the element 142 will advance the arm 50 another step, and so on. Thus, the teacher or monitor may push any of the pushbutton elements 142 while observing the indicator 34 until the correct piano is connected to the speaker 30.

It would be undesirable to hear the clicks associated with such switching and to hear a portion of each piano being played until the desired piano was connected in circuit. Accordingly, the aforementioned relay coil 56 (FIG. 2) is connected in parallel with the solenoid 156 across the bus lines 160. The relay 62 is of the quick operating, slow release type readily available in commerce. More specifically, the switch 52 opens substantially instantaneously upon depression of the depressible element of one of the pushbuttons 140, and the switch does not reclose until a predetermined time thereafter, two seconds being a suitable illustrative time lag. If the selector must be moved through several steps, each succeeding impulse caused by depression of one of the pushbutton depressible elements will serve to delay the time

the switch 52 is held open. Accordingly, no clicks or spurious piano tones are audible, and the desired piano may be heard over the loudspeaker 30 a predetermined time after the last depression of the pushbutton depressible element.

At times it may be desirable to connect two or more pianos simultaneously to the speaker 30 for the playing of a duet, or a quartet, or the like. Similarly, it might be desired to connect the recorder 22 and one of the pianos simultaneously to the speaker 30 for the student or other player to compare his playing with that of a piano artist, or to play a duet with the piano artist. It is to be understood that the student also could play the piano accompaniment to a recorded solo on some other instrument such as a violin or a clarinet in this manner. Also, it might be desirable to have several of the student pianos played with the recorder. Such eventualities are provided for by means of the pushbuttons 36 and the switch contacts associated therewith. The various contacts 48 are individually connected to contacts beneath the pushbuttons 36 as may be seen in FIG. 6. Twelve pushbuttons are provided in the illustrative example, one for each of the ten pianos and for the recorder, and one which is not connected. A common bus line 176 is connected to the opposite contact associated with each pushbutton 36. The pushbuttons 36 are of the type which may individually or simultaneously be depressed, and which will remain in depressed, closed position until the non-connected pushbutton, i.e., the top one in FIG. 6, is depressed, thereby releasing all of the remaining pushbuttons for movement to raised or non-connected position. Such pushbutton arrangements are well known in the art and are available in commerce. Specific illustration thereof accordingly has been omitted. It thus will be apparent that any number of the pianos and the recorder can be connected simultaneously to the speaker 30 by means of the pushbuttons 36.

A relay 178 is associated with the uppermost or non-connected pushbutton 36 as may be seen in FIG. 2 and comprises a relay coil or solenoid 180 connected to the bus lines 160, and also a magnetic slug 182 affixed to the depressible element of the pushbutton and attractable toward the solenoid or relay coil 180. Thus, each time an impulse is imparted to the bus lines 160 by depression of the depressible element of one of the pushbuttons 140 the depressible element of the uppermost or non-connected pushbutton 36 is depressed. Accordingly, if the teacher or monitor has a certain playing combination set up at the master station, he may eliminate this combination remotely from any of the pianos simply by pushing the depressible element 142 of the pushbutton 140 at any of the pianos.

A suitable electronic piano 20 for use in the system of my invention is illustrated in FIGS. 9, 10 and 11. The piano 20 includes a case 184 of generally rectangular outline and relatively low in height. The case may rest on a desk, table or the like or may be provided with detachable metal legs 186 of the wrought iron or simulated wrought iron variety, or any other suitable or desirable type. The case is provided with a hingedly connected, downwardly inclined lid 188 which opens to expose the keyboard 190 comprising conventional piano keys. The lid 188 tilts back into position for cooperation with a tray 192 to form a music rack. The phone jacks 88 and 102 previously described are preferably located above and below the shelf respectively at the right end thereof. The speaker 82 is mounted within the case adjacent the opposite end thereof and opens upwardly through a grille 194.

The tone generators 64 comprise a series of vibratory reeds 196 capacitively related to a conductive pickup element 198, preferably having a slotted edge confronting the reeds with the reeds vibrating in the slots. The reeds 196 and pickup element 198 are respectively connected to the input of the amplifier 66, and impart oscillations

corresponding to piano tones to the amplifier when the reeds are vibrated. The reeds are vibrated by hammers 200 of piano actions 202 which may be of conventional or special manufacture, each piano action corresponding to one reed and including one of the keys of the keyboard 190.

Power is supplied to the piano 20 by means of a lead wire 204 detachably connected by means of a plug and socket 206 (FIG. 9) to the piano. The piano actions include the conventional dampers and provision is made for operating the dampers individually when the action is operated, or as a group when it is desired to play forte. A "loud" pedal 208 is detachably connected by means of a push-pull control such as a Bowden cable 210 to the piano.

It will be observed that a handle 212 is provided at the front of the piano case for carrying the same, and that slots 214 are provided at opposite ends of the case to facilitate handling thereof and also to control back loading of the loudspeaker 82.

The pushbutton 140 associated with each piano may be located at any convenient location thereon, such as on the top and near the rear as illustrated in FIGS. 9 and 10. The phonograph or record player 101 also may rest on top of the piano with the preamplifier in the record player housing (not shown) and suitably connected to the amplifier 66 by a cable 204 of any suitable design and preferably having a plug for detachable association with a jack in the piano case.

It will be apparent from the foregoing that each student or other player on one of the pianos 20 can play and listen with earphones plugged into the jack 88 to hear his own playing without any other playing being audible. A teacher or monitor can walk around the room, observing the fingering and other manipulation of each player, and can carry earphones to plug into each jack 102 to listen to the playing of each piano one by one. If the teacher wishes to hear the playing on the central station loudspeaker, all he needs to do is to push the depressible member 142 of the pushbutton 140 on which ever piano he is near and to watch the lights of the indicator 34 for alignment with the proper position number. The earphone plug of any given piano can be pulled out momentarily for the student to listen to his own playing compared with that of a piano artist from the recorder 22 if it is so desired, or he may slip one of the earphones aside so that he may listen to his own playing with a single earphone while listening to the recorder with the other ear.

The teacher or monitor may utilize earphones at the central station if he so desires by means of the jacks 32, and may utilize the knob 134 to move the selector . He may utilize the pushbuttons 36 to set up any given combination of the pianos for playing duets, quartettes, and the like.

It will be appreciated that various pupils or musicians will play their instruments at different volume levels. If the teacher or monitor were to walk around the room and connect any given piano to the master or central station, the intensity of some of the instruments would be too great, while the tones of some of the other instruments would scarcely be audible. Accordingly, provision preferably is made for maintaining the volume level emanating from the loudspeaker 30 at any predetermined level adjustably pre-set by the teacher or monitor. This is accomplished by the circuit shown in FIGS. 12 and 13. Instead of connecting the wires 38 and 40 directly through the switch contacts 48, 50 and the relay switch 62 to the speaker voice coil 54, the connections are made to an amplifier stage 216. The amplifier stage 216 is connected in exactly the same way as the speaker coil 54 previously was illustrated, and the wiring otherwise remains the same. The amplifier stage 216 is connected by means of wires 218 and 220 to a variable gain stage 222 designed to have a constant output at 224 across a volume control potentiometer 226. The sliding tap 228 on the volume control is controlled by a knob 231 (FIG. 1) or the like at the main station 28. The sliding tap is connected by means of a wire 230 to the input of amplifier output stage 232, and a wire 233 connects the lower end of the potentiometer resistor 226 to the amplifier output stage. The amplifier output stage preferably is provided with a matching transformer 234 for connection to the voice coil of the loudspeaker at the main station. It will be understood that the amplifier output stage preferably includes a pair of push-pull power output tubes.

A signal is tapped off the wires 218 and 220 by means of wires 236 and 238 respectively, these wires being connected to an input of an auxiliary amplifier 240. The amplifier stage 240 is connected by means of wires 242 to a rectifier 244, which may be of any suitable type such as a diode, and may comprise the diode plates of a dual purpose tube including also an amplifier section in the variable gain stage 222. The rectifier output is a direct current potential proportional to the output of the amplifier stage 216, and this of course is proportional to the volume of the instrument connected to the main station. The output of the rectifier is used to control the gain of the variable gain stage 222 so that the intensity of the output thereof appearing at 224 is substantially constant regardless of the intensity of the output of the amplifier stage 216, and hence of the input of the amplifier stage 222. Thus the volume of the tones reproduced by the loudspeaker at the main station is substantially entirely independent of the volume of the instrument connected to the main station, and the volume of these output tones can be pre-set at any desired level by the instructor or monitor by turning the knob 231 to adjust the potentiometer tap 228.

The manner in which the rectifier 244 is connected to the variable gain stage 222 is shown in FIG. 13, the audio input to the controlling stage as applied to the wires 218 and 220, being connected directly by means of a capacitor 246 and a series resistor 248 to the plate of a loading or shunt triode tube 250 included in the variable gain stage 222. The output of the rectifier 244 biases the control grid 252 of the triode 250. B+ voltage is supplied to the plate of the triode 250 through a load resistor 254, and the plate also is connected through a coupling capacitor 256 to the potentiometer resistor 226. It will be apparent from an inspection of the circuit shown in FIG. 13 that the output intensity of the variable gain stage 222 as applied through the capacitor 256 is substantially constant due to the biasing action of the rectifier 244.

Although the invention has been described with reference to electronic pianos, it will be apparent that other instruments could be used with suitable provision for an electrical output and for audio isolation. Indeed, several different instruments could be used to provide a band or orchestra, quartette, trio, duet or the like, and the teacher, monitor, or conductor could listen to each student or instrumentalist individually, or could combine the tones of the instruments by means of the pushbutton switches to obtain the full effect of the orchestra or other group. The loudspeakers at all of the instruments could be used to create a similar, but more dispersed effect.

The specific structure herein shown and described is for illustrative purposes only, and various modifications thereof occurring to those skilled in the art will be understood as forming a part of my invention insofar as such modifications fall within the spirit and scope of the appended claims.

I claim:

1. A musical instrument system comprising a plurality of individually operable musical instruments, each such instrument having means providing electrical oscillations corresponding to the tones of that instrument, means at each instrument operatively connected to the oscillation providing means for individually listening to the tones of

that instrument, a station located remotely of said instruments, means at said station for transducing said electrical oscillations into audible instrument tones, connecting switch means at said station for selecting which of the oscillations is to be tranduced at said station, means at said station for operating said selecting means, means remote relative to said station and respectively at said instruments and respectively operatively connected to said selecting means for operating the selecting means, and means connecting said electrical oscillation providing means to said selecting means.

2. A musical instrument system comprising a plurality of individually operable musical instruments, each such instrument having means providing electrical oscillations corresponding to the tones of that instrument and further including volume control means for determining the amplitude of said electrical oscillations for volume control purposes, means at each instrument operatively connected to said oscillation providing means for individually listening to the tones of that instrument, said tones varying in volume in accordance with the intensity of the oscillations as determined by said volume control means, a station located remotely of said instruments, means at said station for transducing electrical oscillations into audible instrument tones, means respectively operatively connecting said oscillation providing means to said station and means at said station connected to said last mentioned connecting means for selectively coupling the electrical oscillations from any of the musical instruments to said transducing means, said selectively coupling means including means for adjustably predetermining the amplitude of the oscillations applied to the transducing means regardless of the amplitude of the oscillations as determined by said volume control means.

3. A musical instrument system comprising a plurality of individually operable musical instruments, each such instrument having means providing electrical oscillations corresponding to the tones of that instrument, means at each instrument operatively connected to said oscillation providing means for individually listening to the tones of that instrument, a station located remotely of said instruments, means at said station for transducing said electrical oscillations into audible musical tones, means at said station for selectively individually connecting said instruments to said transducing means for transducing the electrical oscillations thereof into audible musical tones, separate means at said station for selectively connecting a group of said instruments to said transducing means for simultaneously transducing the electrical oscillations of said group of instruments into audible musical tones, and separate means for operating said individual connecting means and said group connecting means, the means for operating the individual connecting means comprising means at said station and a plurality of means respectively located at said instruments.

4. A musical instrument system as set forth in claim 3 and further including means interconnecting said individual connecting means and said group connecting means whereby operation of said individual connecting means effects disconnection of said group connecting means.

5. A musical instrument system as set forth in claim 1 and further including indicating means operable in conjunction with said selecting means for indicating the position of said selecting means, said selecting means including a light source movable with said selecting means.

6. A musical instrument system as set forth in claim 1 and further including a constant volume device at said station providing a substantially constant output amplitude of electrical oscillations substantially independent of the amplitude of input oscillations thereto, the output oscillations of said instruments being selectively connected by said selecting means to said transducing means for producing a substantially constant volume of musical tones substantially irrespective of the volume control setting of said instruments.

7. A musical instrument system as set forth in claim 1 and further including an intermittent operating device for intermittently moving said selecting means from one position to another whereby selectively to connect any one of said instruments to said transducing means.

8. A musical instrument system as set forth in claim 7 wherein the operating device comprises a stepping switch.

References Cited in the file of this patent

UNITED STATES PATENTS

1,296,617	Britten	Mar. 11, 1919
1,632,012	Toomey	June 14, 1927
1,685,835	Bascom et al.	Oct. 2, 1928
1,924,713	Eremeeff	Aug. 29, 1933
2,110,358	Dreisback	Mar. 8, 1938
2,162,369	Campbell	June 13, 1939
2,225,196	Miessner	Dec. 17, 1940
2,258,807	Pitkin	Oct. 14, 1941
2,427,078	Tucker et al.	Sept. 9, 1947
2,492,320	Riggen	Dec. 27, 1949
2,496,629	Lamberty et al.	Feb. 7, 1950
2,530,251	Luberoff	Nov. 14, 1950
2,606,976	Campbell	Aug. 12, 1952
2,695,338	Doriot et al.	Nov. 23, 1954