Sept. 14, 1937. S. YAMASHITA 2,093,223

ELECTRIC ORGAN

Filed July 10, 1935 2 Sheets-Sheet 1

Fig. 1

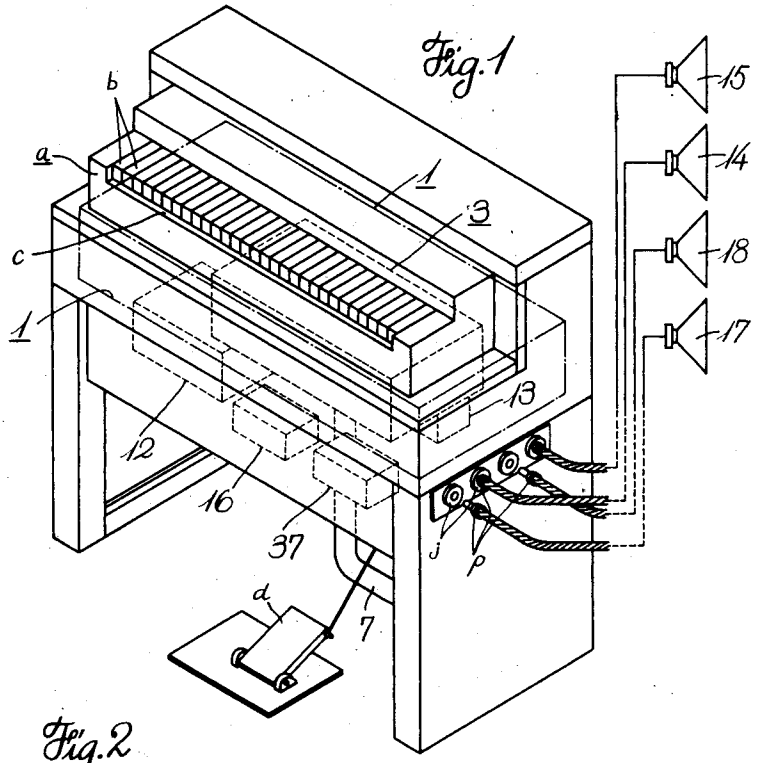
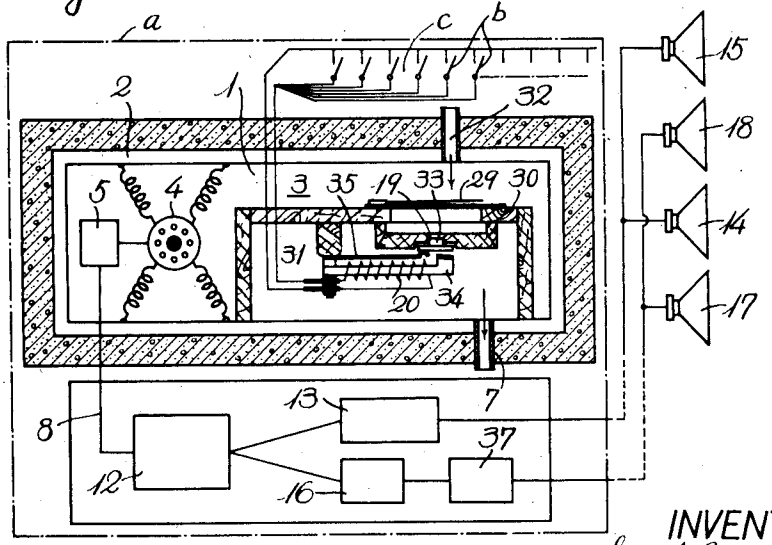


Fig. 2



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Fig. 3

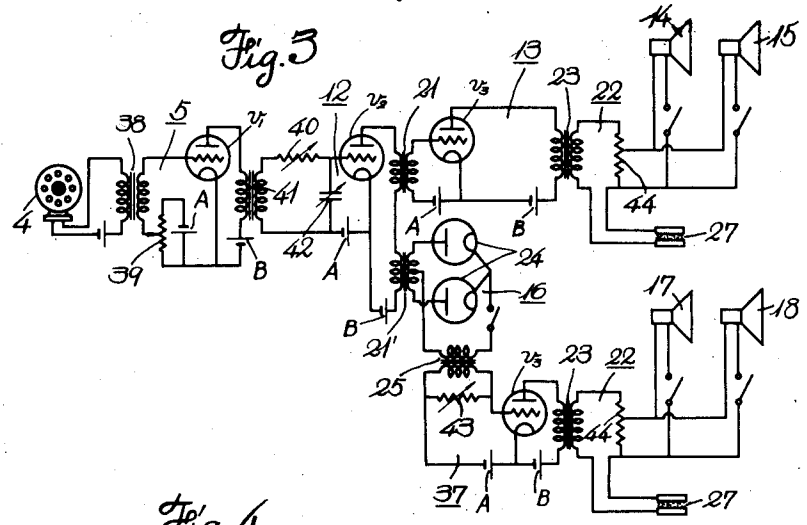


Fig. 4

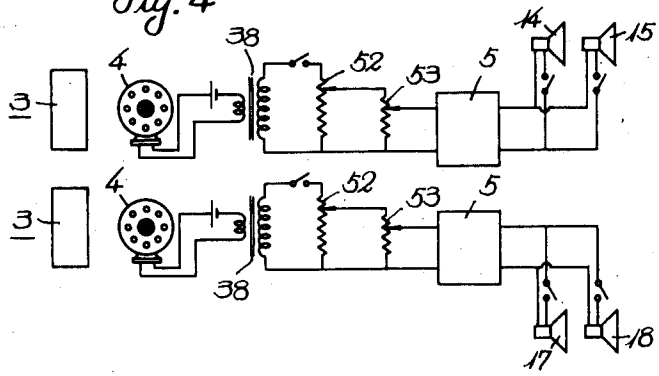
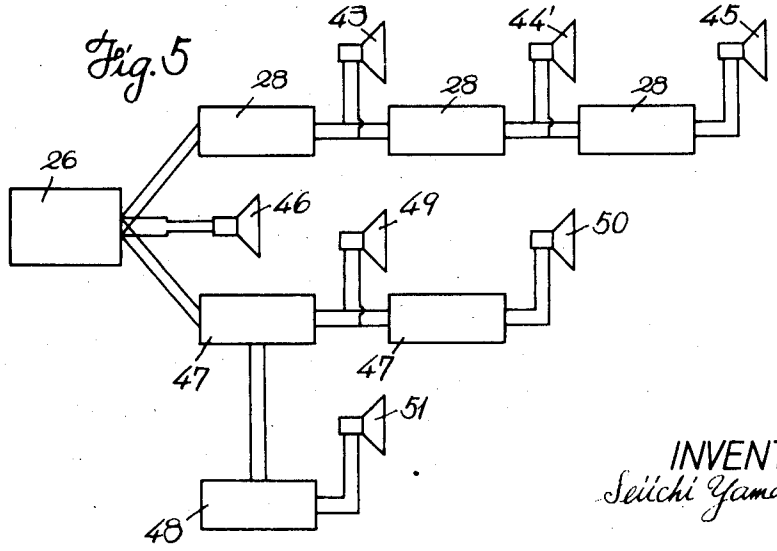


Fig. 5



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ELECTRIC ORGAN

Seiichi Yamashita, Hamamatsu, Japan

Application July 10, 1935, Serial No. 30,693

2 Claims. (Cl. 84—1)

This invention relates to improvements in electric musical instruments and more particularly to an electric organ which comprises vibrators and microphones totally enclosed in a sound proof casing, tone and frequency changing electric circuits with volume controllers, and loud speakers.

One of the principal objects of this invention is to provide a simple and compact electric organ without pipe arrangements whereby musical tones of any musical instrument, such as an ordinary pipe organ, a flute, a clarionet and the like, can be easily produced with a desired volume without disturbance from external noises.

It has heretofore been known that a small electric organ provided with a microphone and an amplifier for magnifying the microphone current enables the reproduction of sound as loud as in a large pipe organ. However, when the amplification is comparatively effective, the howling phenomena due to the acoustic feed back between the microphone and the outer sound sources may occur through the organ body with the result that the satisfactory operation of the organ becomes impossible.

According to this invention the howling phenomena caused by the incoming sound from the loud speaker, the other orchestra and chorus in the same concert room can be avoided and the volume of the musical sound can be easily controlled gradually to any desired amount and tremolo is played.

In the accompanying drawings, Fig. 1 is a perspective view of an electric organ embodying this invention; Fig. 2 is a diagrammatic view for illustrating the arrangement of the electric organ shown in Fig. 1, a sound proof casing being shown in a longitudinal section; Figs. 3 and 4 show electric connection diagrams embodying this invention and Fig. 5 is a schematic diagram showing an electric connection of a frequency changer to be used in this invention.

Referring to Figs. 1 and 2, *a* indicates an organ body, *b* designates its keys or electric switches arranged on a key-board *c*. According to this invention, the organ is provided with a sound proof casing 1 lined with sound absorbing material 2, such as felt. Arranged in the sound proof casing 1 are a sound producing element 3 and a microphone 4 which is led to a tone changing device 12 through an amplifier 5 and lead wire 8. The sound producing element 3 consists of a sound board 30, vibrator or a reed 29 attached thereon, a magnetically operated valve 33 which closes an opening 19 of the air chamber 31 formed by the sound-board 30, a spring 35 holding the valve 33 in its closed position, and an electromagnet 34 for controlling the valve 33, the operating coil 20 of which being led to the corresponding switch *b*.

The electromagnet 34, the spring 35 and the valve 33 are so arranged that these parts may establish a magnetic circuit when the electromagnet 34 is energized, thereby attracting the valve 33 to open the port 19. 32 is an inlet opening and 7 is an exhaust pipe which is connected to a suitable exhaust fan or blower (not shown).

Assuming that one of the keys 6 is operated and the corresponding electromagnet 34 is energized to open the valve 33, then the reed 29 is vibrated by the air current passing therethrough as indicated by the arrows. The sound energy caused by the sound producing member 3 is converted into electrical energy by the microphone 4 and the energy is led out of the casing 1 through the lead wire 8 after being amplified by the amplifier 5. The output side of the tone changing device 12 is led to a plurality of loud speakers 14, 15 through an amplifier 13 and also to loud speakers 17, 18 through a frequency changer 16 and an amplifier 37. These electric parts may preferably be arranged beneath the sound proof casing 1 in the organ body *a* as shown by the dotted lines and the speakers are selectively connected to the output circuit of the amplifiers 13 and 37 by inserting plugs *p* into jacks *j* respectively. If desired, only one common speaker may be connected to the output side of the amplifiers.

Fig. 3 shows the connection of the above described electric circuit more exactly. The output circuit of the microphone 4 is coupled through a transformer 38 to the input circuit of the amplifier vacuum valve V_1. This vacuum valve is provided with a potentiometer 39 by means of which the grid bias voltage thereof is adjusted to change the wave form of the input voltage. A vaccum valve V_2 of the tone changing device 12 is connected to the output circuit of the vacuum valve V_1 through a transformer 41. The input circuit of the vacuum valve V_2 includes the secondary winding of the transformer 41, a variable resistance 40, and a variable condenser 42 which may be so adjusted that oscillation current including desired higher harmonics can be produced in the output circuit of the vacuum valve V_2 having transformers 21 and 21′ in series. The secondary winding of the transformer 21 is connected to the loud speakers 14 and 15 through the amplifier 13 having a vacuum valve V_3 and a volume controller 22 including the secondary winding of a transformer 23 and volume control-

ling resistances 44 and 27 in series. The resistance 44 may be arranged to be adjusted by a pedal *d* (Fig. 1) which is connected to an operating lever of varying resistance, while the resistance 27 is constructed to be changed by the key *b* corresponding to the pressure of an operator's finger. Thus the gradual volume control ranging from a certain amount to zero and the tremolo play can be easily attained. The secondary winding of the transformer 21' is connected to a frequency doubler 16 consisting of two rectifier vacuum valves 24, the output circuit of which is led to the loud speakers 17 and 18 through a transformer 25, with a variable resistance 43, an amplifier 37 and a volume controller 22 as above described. A and B represent bias batteries and plate sources of the vacuum valves respectively.

In the arrangement shown in Fig. 3, it is clear that the sound which has the same frequency but different tone compared with the standard sound of the reed 29 can be produced by the speakers 14 and 15, and at the same time sound having the frequency of twice the standard frequency but different tone character can be reproduced by the speakers 17 and 18.

Fig. 5 shows another system of a frequency changer which consists of several numbers of frequency doublers and frequency triplers. The electric source 26 having the standard frequency *f* is led to three ways: The first way is a series connection of three frequency doublers 28, output circuits of which are connected respectively to speakers 43, 44' and 45 to produce 2*f*, 4*f* and 8*f* respectively. The second way is a direct connection of a speaker 46 which reproduces the standard frequency *f* itself. The third way is a series connection of two frequency triplers 47, the first stage of which is provided with a branch circuit having a frequency doubler 48. These frequency triplers and frequency doublers are also connected respectively to speakers 49, 50 and 51 which produce 3*f*, 9*f* and 6*f* respectively.

In the arrangement illustrated in Fig. 3 or 5, when the speakers are operated simultaneously or selectively, the current of the speakers includes higher harmonics and multiple frequencies of the microphone current so that the tone composition and octave performance can be easily attained without so many reeds in a multiple key-board and complicated stop mechanisms used in an ordinary pipe organ.

Moreover, if reeds of reed organs, microphones of electromagnetic, electrostatic and Reisz types, and speakers of horn and cone types, that is, microphones, sound producing and sound reproducing mechanisms having different characteristic frequency regions may be combined to the above circuits, then the desired tones of any musical instrument can be produced. Inventor's experiments show that the solemn sound of a pipe organ can be composed by using reeds of a reed organ as vibrators, of the Reisz types with flat characteristics as microphones and of the dynamic cone types which are sensitive to the lower frequencies as speakers; the tones of a clarionet may be also produced if reeds of an organ, condenser type microphones having very tensible diaphragms and speakers which are sensitive to the intermediate frequencies of sound wave are used; and tones of a group of flutes are composed by changing the above reeds of the reed organ to reeds of harmoniums, the other parts maintaining unchanged. By suitably combining a number of vibrators, microphones and speakers of different characteristics as above described to a plurality of electric circuits including tone changing devices and frequency changers, tones of musical instruments with pipes and those of violin groups may be reproduced from the natural tones of an organ with only one row of organ reeds.

Fig. 4 shows an arrangement of such a case. A plurality of sound producing elements 3 having different characteristic frequency regions are arranged respectively opposite to corresponding microphones 4 having different characteristics in the sound proof casing. The output side of the microphones 4 are respectively connected to amplifiers 5 through transformers 28, potentiometers 52 for volume control and potentiometers 53 for tremolo play at the outside of the sound proof casing. The tremolo play can, in practice, be attained by sliding the intermediate taps of the potentiometers 53 by an operator's hand. Connected respectively to the output circuits of the amplifiers 5 are loud speakers 14, 15 and 17, 18, which have different characteristic frequency regions. Though only two systems including the sound producing element, microphone, electric circuits and loud speakers are illustrated in the drawings, yet in practice a plurality of these systems may preferably be used. In the above arrangement, any desired musical tones can be reproduced by either or both of the sound producing elements 3 and selectively connecting the loud speakers to the amplifiers 5.

On the performance of the above electric organ, the howling phenomena between the microphone 4 and the outer sound sources such as many speakers and other orchestras may be effectively obviated since the microphone 4 is completely insulated from external sound in the sound proof casing 1.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. An electrically operated reed organ comprising a series of reeds arranged on a sound-board, a plurality of magnetically operated valves which normally close each of the inlet openings of the enclosed air chamber formed by said sound-board for controlling the operation of said organ reeds respectively, a plurality of electromagnets for controlling said valves respectively, said valves and electromagnets being disposed inside of said sound-board, a microphone for receiving the sound energy from said organ reeds, a sound-proof casing for totally enclosing said sound-board and microphone, said sound-proof casing having an inlet pipe for taking air therein and an exhaust pipe for connecting said air chamber to a blower, a key board arranged outside of said sound-proof casing for controlling said electromagnets, an amplifier connected to said microphone, a tone changing device for producing higher harmonics of microphone current, means for changing the frequency of said microphone current to its multiple frequencies, a volume controller for adjusting the output current gradually from a certain amount to zero, and a plurality of speakers having peak resonance characteristics at different frequency regions connected to the output side of said frequency changing means.

2. An electrically operated reed organ comprising a series of reeds arranged on a sound-board, a plurality of magnetically operated valves which normally close each of the inlet openings of the enclosed air chamber formed by said sound-board for controlling the operation of said organ reeds respectively, a plurality of electro-

magnets for controlling said valves respectively, said valves and electromagnets being disposed inside of said sound-board, a microphone for receiving the sound energy from said organ reeds, a sound-proof casing for totally enclosing said sound-board and microphone, said sound-proof casing having an inlet pipe for taking air therein and an exhaust pipe for connecting said air chamber to a blower, a key board arranged outside of said sound-proof casing for controlling said electromagnets, an amplifier connected to said microphone, a tone changing device for producing higher harmonics of microphone current, a frequency changer which is associated with said amplifier and which consists of a plurality of frequency doublers connected in series and a plurality of frequency triplers connected in series, the input circuit of said frequency changer being connected to the output side of said tone changing device, and a plurality of speakers having peak resonance characteristics at different frequency regions connected to the output circuit of said frequency doublers and frequency triplers respectively.

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