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SOUND PRODUCING APPARATUS

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FIG. 1

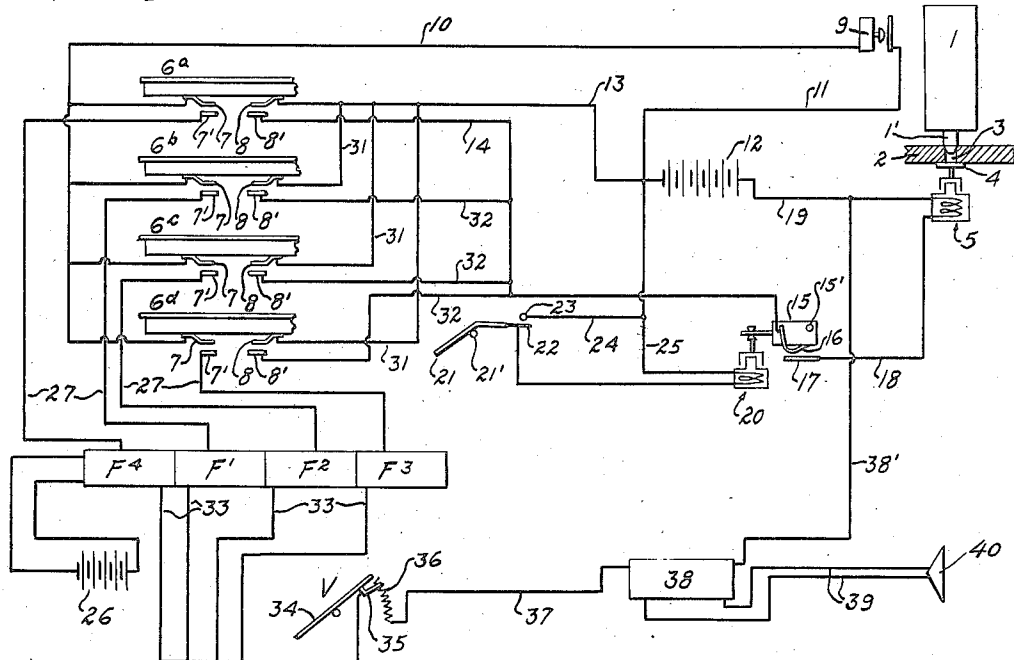
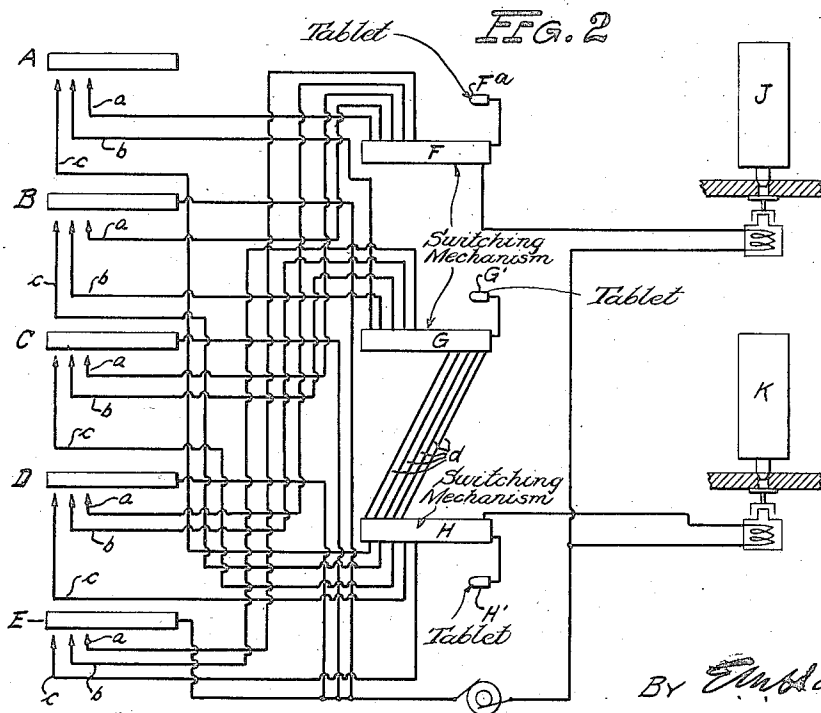


FIG. 2



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SOUND-PRODUCING APPARATUS

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13 Claims. (Cl. 84—1)

This invention relates generally to sound producing apparatus and more specifically to an improved sound producing apparatus of the general type of a pipe organ, the predominant object of the invention being to provide an improved sound producing apparatus of this general type which includes the use of frequency changers adapted to change the frequencies of the oscillations or vibrations of sound producing elements of the apparatus in a manner to produce with the aid of each individual sound producing element, sounds of different pitches.

So that the present invention may be more clearly understood it perhaps would be advisable to refer rather briefly to the operation of ordinary pipe organs. In the operation of straight and unified organs each individual sound producing element produces a certain sound which may not be varied at the will of the organist. It is true that in the operation of modern organs sounds may be produced which are different from the sound produced by any individual sound producing element of the organ, but these latter sounds are the result of combining the sounds of a plurality of the sound producing elements to produce a different or synthetic tone. It is clear however that each pipe organ is provided with a plurality of sound producing elements each of which produces a tone which is fixed insofar as the organist is concerned.

The present invention has as its basis the object of producing a sound producing apparatus which is provided with a limited number of sound producing elements, each of which when activated is vibrated or oscillated at a fixed frequency to produce a given sound. These sound producing elements have associated therewith frequency changers which are adapted to change the frequencies of the vibrations or oscillations of the sound producing elements at the will of the person operating the apparatus so that electrical impulses at frequencies different from the frequencies of the vibrations or oscillations of the sound producing elements are imparted to an amplifying device. Thus vibrations or oscillations are set up when a sound producing element of the improved apparatus is activated and these vibrations or oscillations are converted into electrical impulses at a frequency which is in exact consonance with the frequency of the vibrations or oscillations of the sound producing element, which electrical impulses are imparted to an amplifying device so as to produce a musical note at a given pitch, or at the will of the operator of the apparatus the frequency of the vibrations or oscilla-

tions of the sound producing element may be changed by a frequency changer so that electrical impulses at frequencies which differ from the frequency of the vibrations or oscillations of the sound producing element are imparted to the associated amplifying device so as to produce sounds which although they originate at the sound producing element are pitched higher or lower than the sound which the vibrations or oscillations of the sound producing element would normally produce.

In addition to the foregoing, an extremely important feature of the invention resides in the fact that my improved sound producing apparatus is unified in the manner in which a pipe organ is unified. In other words the improved apparatus is provided with a system of electrical wiring which is so arranged and capable of such operation that a plurality of tones may be sounded on actuation of a single controlling element such as a key.

Fig. 1 is a diagrammatical view of the invention.

Fig. 2 is a diagrammatical view illustrating the manner in which the improved apparatus may be unified.

In the drawing wherein I have shown for the purpose of illustration, merely, a diagrammatical view of the invention, 1 designates a sound producing element. This sound producing element may be of any suitable nature; that is to say, it may be any element which is capable of tuned vibration, or it may be a film, disk or other element which is characterized by the ability when associated with apparatus which usually includes a photo-electric cell to produce electrical impulses. For the sake of simplicity of description I have illustrated in the drawing a pipe organ pipe as the sound producing element, but, of course, I do not wish to be limited to the use of sound producing elements of the precise nature. The pipe organ pipe 1 of the drawing is mounted in the usual manner on an air chamber 2, or wind box as it is called, so that air under pressure may pass from said air chamber 2 into the pipe 1, the top wall of said air chamber being apertured as indicated at 3 so as to receive the extension 1' of the pipe 1 through which air passes from the air chamber to the interior of the pipe. Disposed at the aperture 3 in the top wall of the air chamber 2 is a valve 4 which controls passage of air from the air chamber to the pipe, said valve 4 being moved to open and closed positions by suitable means 5 which may include an electromagnet.

A plurality of keys 6^a, 6^b, 6^c, and 6^d are adapted

to activate the sound producing element 1, each of said keys having associated therewith a pair of electrical contact elements 7 and 7' which are caused to contact one with the other when the associated key is depressed. In like manner each of the keys referred to is provided with a second pair of electrical contact elements 8 and 8' which are brought into contact when the key is depressed.

Arranged immediately adjacent to the sound producing element 1 is a suitable pick-up device such as a microphone 9 and extended from said microphone to the contact element 7 of each of the keys 6^a, 6^b, 6^c and 6^d is an electrical conductor 10. Also an electrical conductor 11, which constitutes a part of the electrical circuits in which the microphone 9 is arranged, leads from a suitable source of energy 12 to the microphone. The electrical conductor 11 is connected, by means of an electrical conductor 13 to the electrical contact element 3 associated with the key 6^a, and the electrical contact element 8' associated with said key 6^a has connected thereto an electrical conductor 14 which leads to a stop switch 15. The stop switch 15 is of ordinary construction, being pivoted at 15' and having an electrical contact element 16 which is movable into electrical contact with a fixed contact element 17. The electrical contact element 17 is electrically connected by a conductor 18 to the electro-magnet of the valve operating means 5 and said electro-magnet in like manner is electrically connected to the source of energy 12 by an electrical conductor 19.

The stop switch 15 referred to above has associated with it an operating mechanism 20 which includes an electro-magnet, and this operating mechanism is controlled by a stop tablet 21 of ordinary construction and arrangement, said stop tablet being pivoted at 21' and being provided with an electrical contact member 22 which is movable on actuation of the stop tablet into and out of electrical contact with a fixed electrical contact element 23. The electrical contact element 23 is electrically connected to the source of energy 12 by an electrical conductor 24, and the electrical contact element 22 associated with the stop tablet 21 is electrically connected to the electro-magnet forming a part of the mechanism 20 which actuates the stop switch 15. Also an electrical conductor 25 connects the electro-magnet of the stop switch operating mechanism 20 to the source of electrical energy 12.

F designates a frequency changer which is of ordinary and well known construction and arrangement, said frequency changer having a source of electrical energy 26 associated therewith. The frequency changer F is characterized by the ability to change the frequencies of electrical impulses passing therethrough by increasing or decreasing the frequencies of such impulses, and in order to perform this function said frequency changer is provided with portions as suggested diagrammatically in the drawing. In other words the frequency changer F is provided with a portion F' through which electrical impulses pass without subjecting the frequencies thereof to change. Also said frequency changer is provided with a portion F² which is characterized by the ability to increase the frequency of electrical impulses passing therethrough to double the frequency of the impulses which pass through the portion F' of the frequency changer. In like manner the frequency changer is provided with a portion F³ which is characterized by the ability to increase the frequency of electrical im-

pulses which pass therethrough to double the frequency of electrical impulses which pass through the portion F² of the frequency changer. Finally the frequency changer is provided with a portion F⁴ which is characterized by the ability to decrease the frequency of electrical impulses passing therethrough to one-half the frequency of impulses passing through the portion F'.

By referring to the drawing it will be noted that the electrical contact member 7' associated with the key 6^a is connected to the portion F⁴ of the frequency changer F by an electrical conductor 27. It will also be noted that the electrical contact elements 7' of the keys 6^b, 6^c, and 6^d are connected respectively to the portions F', F², and F³ of the frequency changer by electrical conductors which are also designated by the reference character 27. In like manner the electrical contact element 3 associated with each of the keys 6^b, 6^c, and 6^d is electrically connected to the source of energy 12 by an electrical conductor 31, while the electrical contact element 3' of each of said keys is electrically connected by an electrical conductor 32 to the stop switch 15.

Leading from each of the portions F', F², F³, and F⁴ of the frequency changer F is an electrical conductor 33 which leads to a suitable volume control V. The volume control V comprises a pedal or other suitable means 34 which is provided with an electrical contact element 35. The contact element 35 is movable on actuation of the pedal in contact with, and with respect to a resistance element 36 which is connected by an electrical conductor 37 to an amplifying unit 38, said amplifying unit being connected by a conductor 38' to the source of energy 12. The amplifying unit is in turn electrically connected by conductors 39 to a loud speaker 40 and it is plain that by actuating the pedal and thus moving the contact element 35 with respect to the resistance element 36 the volume of the loud speaker may be controlled by the person operating the apparatus.

In the operation of the improved apparatus disclosed herein the sound producing element 1 is activated whenever the stop tablet 21 is operated to complete the electrical circuit leading to the electro-magnet associated with the stop switch 15 and when one of the keys 6^a, 6^b, 6^c, and 6^d is depressed. The result of depression of the key referred to is that the contact elements 8 and 8' associated with said key are caused to contact and thus complete the electrical circuit leading to the electro-magnet associated with the valve operating mechanism 5 whereby the valve 4 is moved to an open position so as to permit passage of air into the sound producing element 1. Such passage of air into the sound producing element 1 results in said sound producing element being vibrated at a fixed frequency so that it produces sound of a certain pitch. When the key is depressed as described the contact elements 7 and 7' associated therewith are likewise brought into contact so as to complete the electrical circuit which includes the conductors 10 and 27 and the source of energy 12 and which leads from the microphone 9 to the frequency changer F. The electrical conductors 27 lead to the various portions of the frequency changer F, hence, the vibrations of the sound producing element 1 will be picked up by the microphone and will be transformed thereby into electrical impulses which are conducted to the portion of the frequency changer F to which the electrical conductor 27 associated with the particular key de-

pressed leads. Thus if the key 6^b is depressed the electrical impulses produced by vibrations of the sound producing element 1 are conducted to the portion F', through which said electrical impulses pass unchanged, hence, the tone produced at the loud speaker 40 of the apparatus will be exactly the same as the tone produced by the sound producing element 1. However if the key 6^c is depressed the electrical impulses produced are conducted through the portion F² of the frequency changer with the result that the frequency of the impulses will be doubled and as a result a tone of a different pitch will be produced at the loud speaker. In like manner if the key 6^d is depressed the electrical impulses produced will be conducted through the portion F³ of the frequency changer with the result that the frequency of said electrical impulses will be increased to double the frequency of impulses passing through the portion F² a tone of still another and higher pitch will be produced at the loud speaker. Finally if it is the key 6^a that is depressed the frequency of the electrical impulses will be reduced by one-half with the result that a tone of a lower pitch will be produced at the loud speaker 40.

It is apparent, therefore, that by employing frequency changers I cause each sound producing element of the apparatus to perform the functions which heretofore were performed by a plurality of sound producing elements, hence, I very greatly reduce the number of the required sound producing elements of musical instrument of this general type.

An important feature of the invention is that the improved sound producing apparatus may be unified in the manner in which modern pipe organs are unified, and while the unification of pipe organs is very well known a diagrammatical view (Fig. 2) is included in the drawing so that the principle of unification may be readily understood. Briefly, unification is provided so that more than one sound producing element may be actuated on operation of a single sound controlling device, and reduced to its simplest form this system involves providing a system of electrical wiring which makes possible such sounding of a plurality of sound producing elements on operation of a single sound controlling device.

In Fig. 2 of the drawing A, B, C, D, and E designate suitable sound controlling elements, such as keys of the type employed in the production of pipe organs, and G^a, G, and H designate switching mechanisms also of the type employed in pipe organs. J and K designate suitable sound producing elements. Associated with each of the keys A, B, C, D, and E is an electric conductor *a* and all of these electric conductors lead to and are electrically connected to the switching mechanism G^a. In like manner each key A, B, C, D, and E has associated therewith an electric conductor *b* which leads to the switching mechanism G, and also each key has associated with it an electric conductor *c* which leads therefrom to the switching mechanism H. In the wiring scheme diagrammatically illustrated in the drawing the switching mechanisms G and H are cross-wired together by the wires *d* as is frequently done in pipe organ practice. Operation of the switching mechanisms G^a, G, and H is controlled by suitable controlling elements such as the tablets F^a, G', and H'.

From an inspection of Fig. 2 of the drawing it is plain that as each key is depressed electrical contact is made with each of the electric con-

ductors *a*, *b*, and *c*, so that electric current may pass from a suitable source of supply to the associated switching mechanisms. The switching mechanisms are controlled in their operation by the tablets F^a, G', and H', so that by subjecting the tablets to the proper manipulation a plurality of sound producing elements may be caused to function on depression of each individual key. As already stated the illustration of the unifying system has been reduced to the simplest possible form so that the broad principle of the invention may be readily understood. The arrangements and operation of these unifying systems are very well understood by persons familiar with the pipe organ industry, hence, it is not at all necessary to illustrate and describe in detail the very complicated wiring systems involved therein. Instead for a complete understanding of this invention it is necessary to know that unification of a musical instrument means, merely, that the keys of the instrument and the sound producing elements thereof are so connected by an electrical wiring system that different sound producing elements are operable through depression of a single key, that a certain sound producing element may be operated by depression of different keys, that certain predetermined combinations of sound producing elements may be simultaneously operated to produce synthetic musical notes, and that many other operations may be performed with the aid of the unifying system which provide for a better and more complete operation of the musical instrument.

As already stated herein I may employ different types of frequency changers as parts of my improved apparatus. For instance, one type of frequency changer which might be employed carries through the original quality of the tone and only changes the pitch thereof, while another type changes the quality of the tone as the pitch is changed. I wish it to be distinctly understood that frequency changers of either of these types may be used.

I claim:

1. A sound producing apparatus including a sound producing element, means for converting the resultant produced when said sound producing element is actuated into electrical impulses of fixed frequency, means for converting said electrical impulses into sound, and means for changing the frequency of said electrical impulses before the sound producing means is subjected to the effect thereof whereby sounds of different pitches may be produced by said sound producing means.

2. A sound producing apparatus including a sound producing element, means comprising a microphone for converting the resultant produced when said sound producing element is actuated into electrical impulses of fixed frequency, means for converting said electrical impulses into sound, and means for changing the frequency of said electrical impulses before the sound producing means is subjected to the effect thereof whereby sounds of different pitches may be produced by said sound producing means.

3. A sound producing apparatus including a sound producing element, means for converting the resultant produced when said sound producing element is actuated into electrical impulses of fixed frequency, means for converting said electrical impulses into sound, means for changing the frequency of said electrical impulses before the sound producing means is subjected to the effect thereof whereby sounds of different

pitches may be produced by said sound producing means, and controlling means whereby the electrical impulses are subjected to the desired frequency changes.

5 4. A sound producing apparatus including a sound producing element, means for converting the resultant produced when said sound producing element is actuated into electrical impulses of fixed frequency, means for converting said electrical impulses into sound, means for changing the frequency of said electrical impulses before the sound producing means is subjected to the effect thereof whereby sounds of different pitches may be produced by said sound producing means, and controlling means whereby the electrical impulses are subjected to the desired frequency changes, the last mentioned means comprising a plurality of keys arranged to direct the course of said electrical impulses so as to subject same to predetermined frequency changes.

20 5. A sound producing apparatus including a sound producing element, means for converting the resultant produced when said sound producing element is actuated into electrical impulses of fixed frequency, means for converting said electrical impulses into sound, means for changing the frequency of said electrical impulses before the sound producing means is subjected to the effect thereof whereby sounds of different pitches may be produced by said sound producing means, and controlling means whereby the electrical impulses are subjected to the desired frequency changes, the last mentioned means comprising a plurality of keys electrically arranged to direct the course of said electrical impulses so as to subject same to predetermined frequency changes.

40 6. A sound producing apparatus including a plurality of sound producing elements, means for converting the resultant produced when each of said sound producing elements is actuated into electrical impulses of fixed frequency, means for converting said electrical impulses into sound, means for changing the frequency of said electrical impulses before the sound producing means is subjected to the effect thereof whereby sounds of different pitches are produced by said sound producing means, controlling means whereby the electrical impulses are subjected to the desired frequency changes, and means for unifying the sound producing apparatus.

50 7. A sound producing apparatus including a plurality of sound producing elements, means for converting the resultant produced when each of said sound producing elements is actuated into electrical impulses of fixed frequency, means for converting said electrical impulses into sound, means for changing the frequency of said electrical impulses before the sound producing means is subjected to the effect thereof whereby sounds

of different pitches are produced by said sound producing means, controlling means whereby the electrical impulses are subjected to the desired frequency changes, and means for unifying the apparatus comprising an electrical wiring system.

8. The herein described method of producing sound which comprises producing with the aid of sound producing elements resultants which are converted into electrical impulses of fixed frequencies, changing the frequencies of said electrical impulses, and then converting said electrical impulses into sounds of different pitches.

9. The herein described method of producing sound which comprises producing with the aid of sound producing elements tuned vibrations, converting said vibrations into electrical impulses of fixed frequencies, changing the frequencies of said electrical impulses, and then converting said electrical impulses into sounds of different pitches.

10. The method of producing composition tones, consisting in providing at audio frequency a note with its overtones, then changing said audio frequency to radio frequency and varying this radio frequency in accordance with the frequency of another note which is desired, and finally obtaining the audio frequency of this latter note for audible reproduction.

11. The method of producing composition tones, consisting in separately providing at audio frequency the component overtones of a note, then changing said audio frequency to radio frequency and varying this radio frequency in accordance with the frequency of another note which is desired, and finally obtaining the audio frequency of this latter note for audible reproduction.

12. The method of producing composition tones, consisting in separately creating at audio frequency the component overtones of a note and combining these frequencies, then changing these combined frequencies to radio frequency and varying this radio frequency in accordance with the frequency of another note which is desired, and finally obtaining the audio frequency of this latter note for audible reproduction.

13. Apparatus for artificially producing composition tones comprising, in combination, means for producing at audio frequency a note of an instrument with its overtones, means for changing said audio frequency to radio frequency, a filter system through which the radio frequency is passed, a variable oscillator that beats with the output of the filter system to give a desired note, a detector for receiving the combined output of the filter and variable oscillator at audio frequency, and audio amplifying means for receiving the audio frequency from said detector.

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