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MULTIPLE CHANNEL SPEAKER SYSTEM

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Fig. 2.

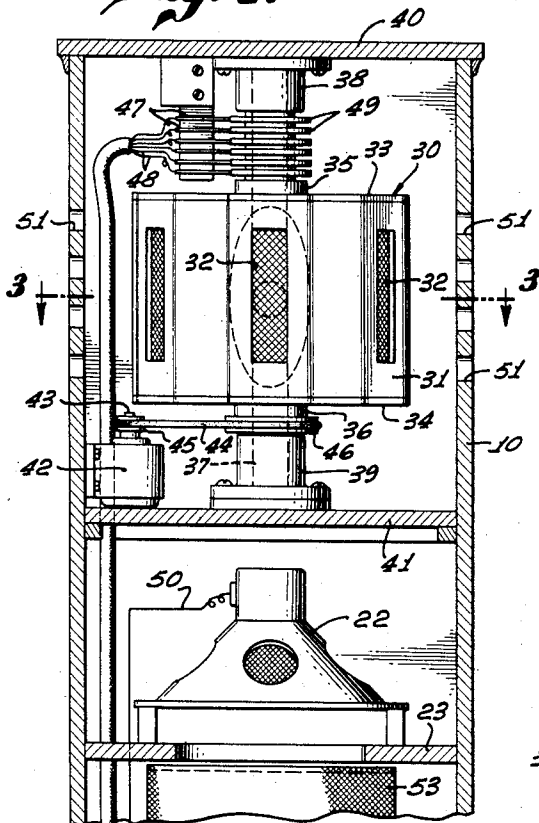


Fig. 1.

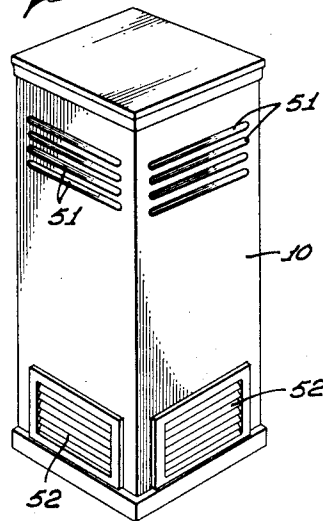
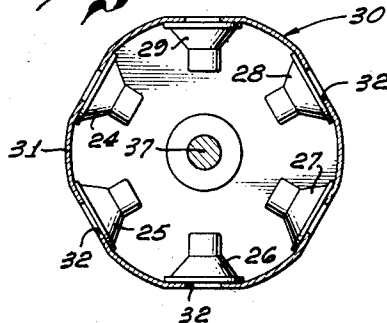
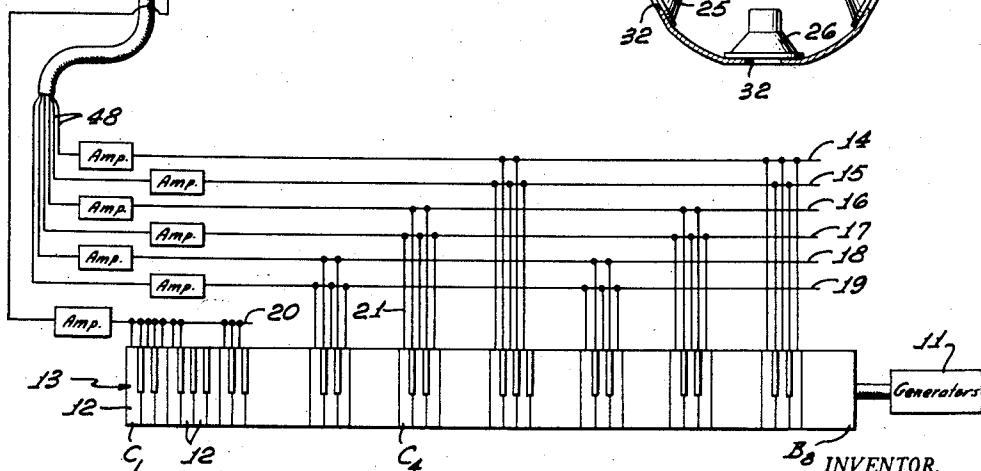


Fig. 3.



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## MULTIPLE CHANNEL SPEAKER SYSTEM

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4 Claims. (Cl. 84—1.25)

This invention relates to an electric organ speaker system in which tremolo effects are added by rotation of speakers at a rate of the order of seven cycles per second. Apparatus of this general character is shown, for example, in my prior United States Letters Patent No. 2,489,653, issued November 29, 1949, and entitled Rotatable Tremulant Sound Producer.

In my prior United States Letters Patent No. 2,596,258, issued May 13, 1952, and entitled Electric Organ Speaker System, and in my copending application Serial No. 500,568, filed April 11, 1955, and entitled Electric Organ Speaker System, there are shown systems intended to eliminate certain objectionable "beat effects" that otherwise would be produced by electrically mixing two impulses, the components of which have frequencies differing by about one or two cycles per second. The "beat effect" resulting from such electrical mixing may be described as a dull whining or unmusical cyclic swell.

The "beat effect" may be caused simply by virtue of the characteristics of the tempered scale. Thus, for instance, the third harmonic of A<sub>4</sub> (449 c.p.s.) has a frequency of 1320 c.p.s. The second harmonic of E<sub>4</sub> (659.26) has a frequency of 1318.52 c.p.s. Simultaneously transmitting impulses corresponding to these notes produces a "beat effect" at 1.48 c.p.s.

The "beat effect" may also be caused by mistuning of tone generators intended to be in octave relationship with each other.

To overcome the "beat effect," a plurality of electrical channels and speakers are provided, the connections being so distributed between the channels that electrical mixture of potentially interfering impulses is eliminated. To implement such a system, a larger number of speakers must be provided. Other systems, for various reasons, may require several channels and cooperating speakers. This seemingly requires a large space, since it has been known that a plurality of speakers intended to produce tremolo cannot be angularly spaced about a common rotary drum or support. Such arrangement is known to impair the tremolo effect by producing multiple vibrato or a fast fluttering sound. Furthermore, several rotary structures would result in different acoustical environment for speakers handling impulses in the same musical range, with a consequent undesirable effect, especially upon the faithfulness of reproduction of the music.

It is an object of this invention to provide a multiple speaker system for producing tremolo which does not require any significant increase in space requirements.

It is another object of this invention to provide a system of this character in which the several speakers have the same acoustical environment.

These objects are made possible by the discovery that placing a series of speakers in angularly spaced relationship about a common rotary support does not impair the tremolo effect or create multiple vibrato, provided each impulse is channeled to only one of the speakers.

This invention possesses many other advantages, and

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has other objects which may be made more clearly apparent from a consideration of one embodiment of the invention. For this purpose, there is shown a form in the drawings accompanying and forming part of the present specification. This form will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of this invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a pictorial view of a cabinet in which apparatus incorporating the present invention is housed;

Fig. 2 is a fragmentary enlarged longitudinal sectional view of the cabinet, including a diagrammatic representation of an organ producing electrical impulses corresponding to musical tones; and

Fig. 3 is a sectional view, taken along the plane indicated by line 3—3 of Fig. 2.

In Fig. 1 there is disclosed a cabinet 10 in which a speaker system incorporating the present invention is accommodated.

The speakers in the cabinet 10 cooperate with an electric organ that is diagrammatically illustrated in the lower portion of Fig. 2. The organ includes a series of electrical tone generators indicated at 11. These tone generators may in practice be oscillators or electromagnetic pick-ups associated with vibrating tone bars.

Connection between each generator and an electrical channel associated with a speaker is established by circuit controllers operated by depression of the keys 12 of the keyboard 13. The keyboard 13 in this instance spans a frequency range from C<sub>1</sub> (32.70 c.p.s.) to B<sub>8</sub> (7902.13 c.p.s.) in a tempered scale corresponding to eight octaves.

In a well-understood manner, each key may cooperate with a series of contacts for simultaneously operating more than one tone generator in order to add desired harmonic content or timbre to the tone.

Several distinct electrical channels 14, 15, 16, 17, 18, 19 and 20 are provided in this instance, among which the generator connections are segregated. Lines extending from the keys 12 to the channels 14 through 20 designate the connections for the generators, the fundamental tones of which correspond to the respective keys. The connection 21, for instance, illustrates that the generator having a fundamental corresponding to C<sub>4</sub> is connected to the electrical channel 17. It will furthermore be understood that a connection other than that indicated by 21 may be operated by depression of the key C<sub>4</sub> by virtue of interconnections operable by the stops of the electric organ.

The connections between the generators 11 and the channels 14 through 19 are so arranged as to prevent the simultaneous occurrence in a single channel of impulses, the harmonics or fundamentals of which might interfere to produce the undesirable "beat effect." This is described in detail in my copending application filed April 11, 1955, above identified. The arrangement is such that a single tone generator may be connected to only one of the several channels.

The channel 20 cooperates with impulses corresponding to tones in the first two octaves, and is connected to a low frequency speaker 22 secured upon a lower wall 23 in the cabinet 10. The generators for this group of impulses cooperate with the single channel 20 in that no appreciable "beat effect" arises in this range of frequency. A rotary sound channel 53 registering with the opening of the speaker 22 adds desirable tremolo effects.

In order to maintain the electrical segregation of impulses, each of the channels 14, 15, 16, 17, 18 and 19 cooperates with separate speaker units. Speakers 24, 25, 26, 27, 28 and 29 are provided for this purpose. These

speakers are accommodated in the upper portion of the cabinet 10.

In order to add suitable tremolo effects to the sound produced by the several speakers 24 through 29, the speakers desirably are rotated at tremolo frequencies of the order of seven c.p.s. to impart orbital movement to their openings. Instead of providing a series of separate rotary supports for the respective speakers to achieve the tremolo effects, the speakers 24 through 29 are mounted upon a common support. The support comprises a hollow drum 30, and the speakers are supported within the peripheral wall 31 of the drum at angularly spaced locations thereabout. The speakers each register with correspondingly angularly spaced openings or ports 32 formed in the peripheral wall 31 of the drum.

To facilitate mounting of the speakers 24 through 29 to the inner surface of the peripheral wall 31 of the drum, those areas of the wall 31 adjacent the openings or ports 32 are flattened to extend in a plane perpendicular to the axis of the opening. The flat surface facilitates attachment of the flange of the cone of each of the corresponding speakers.

The flattened areas may be formed in any convenient manner. In the present instance, they are shown as integrally formed with generally cylindrical sections of the wall joining adjacent flattened areas. Optionally the flattened areas may be formed by inserting flat elements in openings of the wall 31.

The drum is mounted for rotation about its axis to impart orbital movement to the speaker openings. For this purpose, the upper and lower walls 33 and 34 at the opposite ends of the peripheral wall 31 have hubs 35 and 36 secured to a shaft 37 that passes through the drum. Also, the ends of the shaft 37 are journaled in upper and lower bearing brackets 38 and 39 secured respectively to the top wall 40 of the cabinet 10 and an intermediate partition wall 41 located above the low frequency speaker 22.

To impart rotation to the drum, a motor 42 is provided. A motor shaft 43 is coupled to the drum by the aid of a flexible endless belt 44 engaging pulley elements 45 and 46 respectively carried by the motor shaft 43 and the hub 36 in the lower wall 34 of the drum.

It has been found that mounting the speakers 24 through 29 in a common enclosure does not impair tremolo effect or create multiple vibrato. This is due to the fact that a single impulse is translated into sound by only one of the speakers. This arrangement not only conserves space and obviates undue duplication of structure, but results in definite advantages from the standpoint of quality sound output. Thus, the use of a common enclosure for the several speakers provides the same orbital movement for all of the speakers; also, the speakers share the identical acoustical environment in the drum 30. These factors assure a uniformity of output obviously not obtained by using separate supports for each of the speakers.

A series of brushes 47, connected to the respective channels 14 through 19 through leads 48, engage rings 49 located on the upper part of the drum shaft 37 for maintaining electrical connection between the channels 14 through 19 with the respective speakers 24 through 29 during rotation of the drum. A connection 50 is provided between the low frequency electrical channel 20 and the low frequency speaker 22.

Each of the vertical walls of the cabinet 10 has a series of vertically spaced slits or openings 51 located generally at the level of the ports 32 for permitting passage of sound exteriorly of the cabinet. Louvers or grills 52 covering ports at the lower end of the speaker permit outward passage of sound from the rotary sound channel 53 cooperating with the low frequency speaker 22.

In the present instance, the ports 32 registering with the respective speakers 24 through 29 are elongated in an axial direction and are quite narrow. This relationship

ensures a clear tremolo effect. Other forms of speakers and openings could be provided.

In the present example, six separate electrical channels 14 through 19 are shown, and accordingly six speakers are provided for the channels. The specific segregation arrangement shown is merely representative of a system in which electrical impulses corresponding to notes or tones may be segregated.

The invention is not limited to any specific number of channels and speakers. For example, in my prior Patent No. 2,596,258, issued May 13, 1952, entitled Electrical Organ Speaker System, there is shown and described an arrangement in which only two separate electrical channels are provided. A speaker system in accordance with the present invention, useful in connection with the system described in that said patent, would mount only two speakers. Optionally the arrangement shown could be used with any two of the speakers of the group 24 through 29 operative.

The angular spacing between the speakers has no effect upon the appropriate production of tremolo since a single impulse is produced by only one speaker in any event. Equi-angular spacing only serves to provide a compact and simple structure.

The inventor claims:

1. In an electrical musical instrument having means for producing impulses corresponding to notes in a musical range, means forming a plurality of separate electrical channels and connected to preselected impulse producing means so that an impulse corresponding to any one note exists only in one of the channels, the musical range of tones corresponding to the impulses in each channel overlapping the musical ranges of the tones corresponding to the impulses in other channels, the combination therewith of: a support rotatable about an axis; means forming a plurality of electrically actuated sound channels mounted on the support at angularly spaced locations thereabout; means separately connecting the electrically actuated sound channels respectively to the electrical impulse channels; and means for continuously rotating the support at a frequency of the order of seven cycles per second.

2. In an electrical musical instrument having means for producing impulses corresponding to notes in a musical range, means forming a plurality of separate electrical channels and connected to preselected impulse producing means so that an impulse corresponding to any one note exists only in one of the channels, the musical range of tones corresponding to the impulses in each channel overlapping the musical ranges of the tones corresponding to the impulses in other channels, the combination therewith of: a generally cylindrical support; means mounting the support for rotation about its axis; said support having a plurality of openings located in angularly spaced relationship thereabout; a plurality of similar speakers within the support and registering with the respective openings; the support providing a common enclosure for the speakers; means separately connecting the speakers to the electrical channels; and means for continuously rotating the support at a frequency of the order of seven cycles per second.

3. In an electrical musical instrument having means for producing impulses corresponding to notes in a musical range, means forming a plurality of separate electrical channels and connected to preselected impulse producing means so that an impulse corresponding to any one note exists only in one of the channels, the musical range of tones corresponding to the impulses in each channel overlapping the musical ranges of the tones corresponding to the impulses in other channels, the combination therewith of: a support rotatable about an axis; means forming a plurality of electrically actuated sound channels mounted on the support at angularly spaced locations thereabout; means separately connecting the electrically actuated sound channels respectively to

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the electrical impulse channels; each of said sound channel means including a corresponding number of speaker means; and means for continuously rotating the support at a frequency corresponding approximately to seven cycles per second divided by said number.

4. In electrical musical apparatus providing a series of separate electrical channels in which impulses corresponding to musical tones are segregated among the channels, the combination therewith of: a rotary drum having a substantially cylindrical outer wall provided

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with a series of angularly spaced openings; speakers supported in the drum and registering with the openings; means connecting the channels respectively to the speakers; and means for rotating the drum at a tremolo frequency.

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