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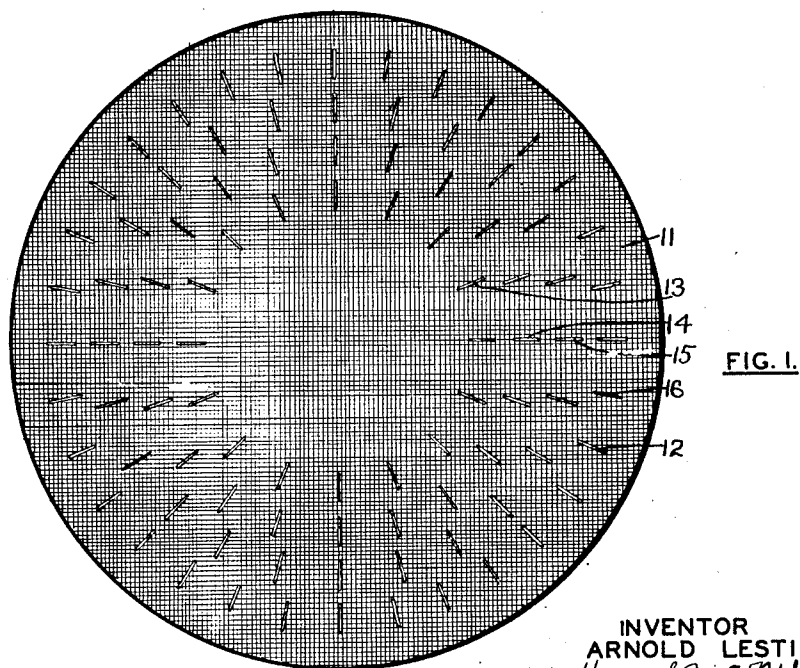
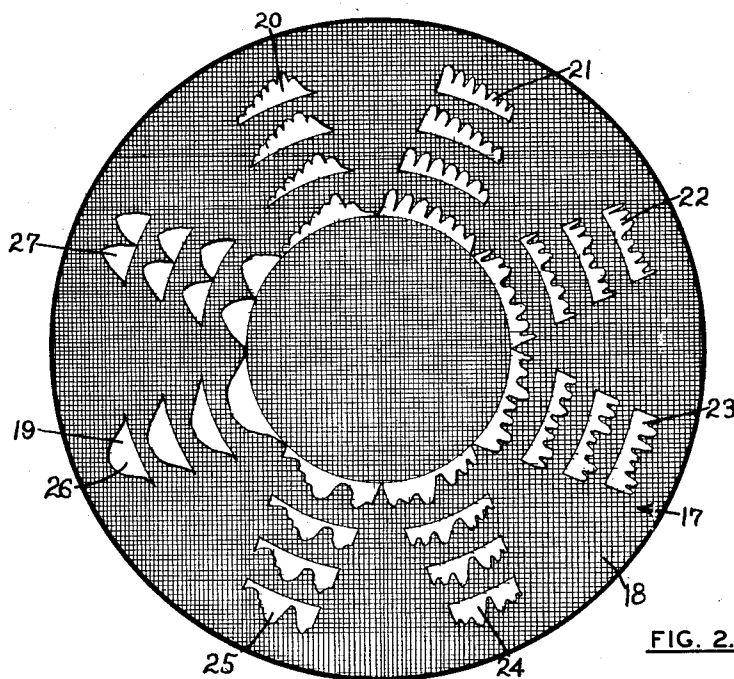
A. LESTI

2,014,741

VARIABLE TIMBRE OR QUALITY OF TONE MUSICAL INSTRUMENT

Filed Dec. 11, 1928

3 Sheets-Sheet 1



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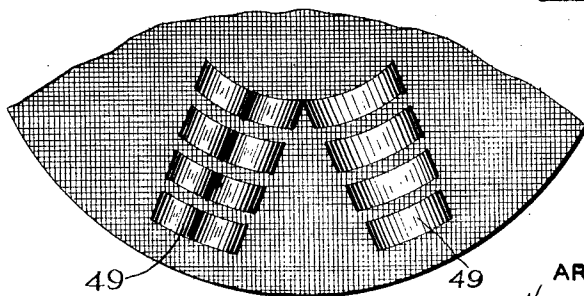
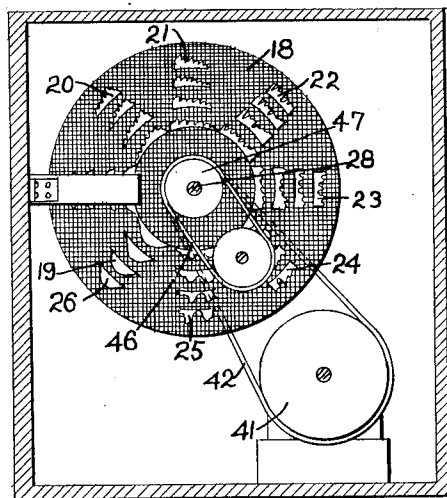
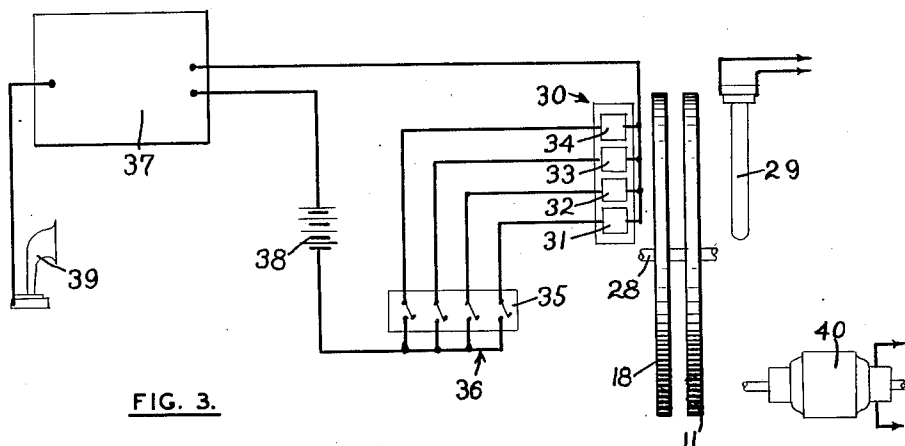
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3 Sheets-Sheet 2



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FIG. 4.

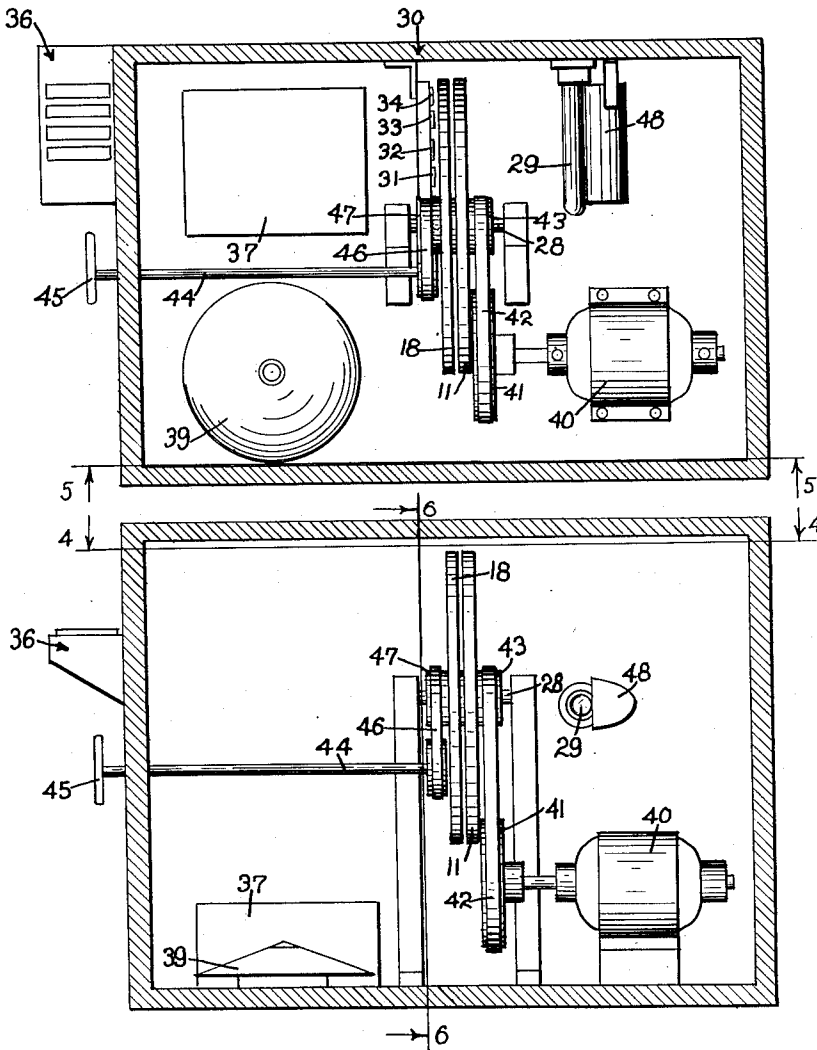


FIG. 5.

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VARIABLE TIMBRE OR QUALITY OF TONE
MUSICAL INSTRUMENT

Arnold Lesti, Los Angeles, Calif.

Application December 11, 1928, Serial No. 325,160

9 Claims. (Cl. 84—1)

My invention is in a variable timbre or quality of tone musical instrument and in the method of producing such variable timbre or variable quality of tone.

5 An object of my invention is the construction of a musical instrument in which sound wave forms are predetermined and these are used to reproduce characteristic sounds in accordance with the form of the wave.

10 A further object of my invention is the construction of a musical instrument or sound producer, in which predetermined sound wave forms may be utilized with an instrument producing a variable pitch so that the sounds having this timbre or quality of tone may be produced in a plurality of different pitches and thus used in musical compositions.

15 A further object of my invention is the construction of a plurality of predetermined sound wave forms which may be operated in connection with the variable pitch producing device so that changes can be made from wave forms representing one type of instrument to a wave form characteristic of another type or possibly to a wave form characteristic of the voice. In this connection a further detailed object of my invention is the construction of predetermined arbitrary sound wave forms which may not represent the sound waves of known instrument, but be purely imaginary.

20 Another detailed object of my invention in the construction of a plurality of predetermined sound wave forms, is the developing of these wave forms on an element of the instrument and have this element mounted so that it may be shifted to change the wave form. For instance, on this relatively stationary element of the instrument I may have wave forms characteristic of a violin, of a horn, a bass voice, an oboe, a clarinet, organ, a pure sine wave form or many other typical instruments or arbitrary imaginary sound wave forms.

25 A further object of my invention is an electrically operated and reproducing musical instrument or sound reproducer, in which the timbre or the quality of tone with a variable pitch may be developed utilizing a radio type or a loud address system of reproduction together with the use of projective light, and developed electric currents acting through the wave form element and the variable pitch forming element of the instrument. In this connection a detailed object of my invention is to utilize a relatively stationary part of the instrument having wave forms illustrated in 55 transparencies, the rest of the element being

opaque and non-transparent. These predetermined wave forms are placed so that light may shine through a rotating disc, this disc having a series of transparent openings; the openings being arranged to give a plurality of frequencies to light projected through the transparent openings of the rotary disc and the transparent wave forms of the relatively fixed element.

The light projected may shine on a bank of light sensitive elements such as a set of selenium cells or photoelectric cells and through the medium of a keyboard, any one or more of these cells corresponding to definite pitches may be operated, thereby producing musical sounds in a loud speaker type of radio reproducing instrument.

A more detailed object of my invention is the construction of the various predetermined wave forms on a disc, the similar wave forms radiate from the center towards the periphery of the disc. This disc while held stationary during the playing of any particular wave form, may be shifted to change the wave form. This stationary disc cooperates with a rotary disc which has a series of transparent openings through which the light from the common source of illumination may shine. These openings are arranged in the rotary disc to uncover or expose the transparencies representing the predetermined wave forms for each different pitch of musical sound desired. The light from the illuminating source shining through the rapidly rotating light openings in the rotary disc gives the different frequencies and the predetermined wave form gives the predetermined timbre or quality of tone.

35 The first action of the light on the bank of light sensitive elements such as the selenium cells or photoelectric cells, is to change the electrical resistance of any one or more of these which have a closed circuit through the medium of closing the key of the keyboard. Thus impulses are sent to an electric amplifying instrument and loud speaker such as used in radio work or in public address loud speaking units.

In constructing my invention I may have a keyboard similar to that of a piano and have a bank of light sensitive elements such as selenium cells or photoelectric cells, there being one corresponding to each key of the keyboard. The rotary disc is arranged so that the light from the illuminating lamp will shine through the different rings of clear openings corresponding to the pitch of an individual light sensitive cell. The predetermined wave forms made as transparencies on a shiftable disc, as above mentioned, are arranged

5 ranged close to the frequency producing disc and to the bank of light sensitive cells, there being a similar wave form for each of the annular rings representing the different pitches. Each light sensitive cell is thus connected through a key of the keyboard with the amplifying and loud speaking unit. Therefore when music is played on the keyboard and a particular wave form is positioned to act on the light, the music reproduced will represent the characteristic music of the instrument whose wave form is depicted. Thus the instrument may reproduce music typical of a violin, a horn, a bass voice, an oboe, clarinet, organ, flute and many other forms as well as arbitrary characteristic sound of no present known instrument.

10 Another object of my invention is the construction of the wave forms instead of in the manner of transparencies, in the form of variable densities on blocks on a disc, the variable densities or variable translucencies corresponding to particular predetermined wave forms.

15 My invention will be more readily understood from the following description and drawings, in which;

25 Figure 1 is a side elevation of the disc for giving the frequencies or light of vibration;

Figure 2 is a side elevation of the disc having the sound wave forms depicted thereon;

30 Figure 3 is a diagrammatic view showing the relation of the source of light, the pitch-forming disc, the sound wave form disc, the bank of light sensitive cells, the keyboard and the reproducing amplifying loud speaker unit;

35 Figure 4 is a plan view of my device in a suitable mounting, showing a box-like structure with the discs mounted therein and motor for driving the pitch forming disc, a manually operated control for the quality of tone producing disc and the keyboard. Such figure may be considered as taken on the line 4-4 of Fig. 5 in the direction of the arrows;

40 Figure 5 may be considered as a vertical section on the line 5-5 of Fig. 4 in the direction of the arrows; showing the mounting of the various units;

45 Figure 6 is a vertical transverse section on the line 6-6 of Fig. 5, in the direction of the arrows; showing the back of the stationary adjustable and the rotatable disc and the back of the light sensitive cells.

50 Figure 7 is a detail of another construction of predetermined sound wave form.

55 The pitch or frequency reproducing disc 11 is formed with a series of transparent openings 12; these being arranged in annular rings and there being a ring for each pitch. In the instance shown, this is arranged for four different pitches or sounds and the annular rings being designated 13, 14, 15 and 16. This disc is mounted on a suitable shaft and is designed to be rotated at a fixed definite speed of rotation so that when light is transmitted through the disc and shines on a bank of light sensitive cells, each of which is connected by a keyboard to a loud speaker, different sounds will be produced of different pitch. Therefore these transparent openings must be arranged in accordance with the pitches desired, so that for a certain definite pitch the openings will pass the light at the specified number of times per second to give the proper vibrations in accordance with the definite pitch. This may be worked out mathematically as the pitch or number of vibrations per second of different notes in music is known.

The wave form element of my invention designated generally by the numeral 17, utilizes a disc 18 which has a series of transparencies 19 arranged radially and there being a transparency corresponding to each of the rings of openings 13, 14, 15 and 16, that is, there is a transparency for each of the notes to be reproduced and arranged to coincide with the corresponding ring on the disc 11.

10 These several forms may be obtained from characteristic instruments by use of an oscillograph and it is only necessary to depict one complete wave form. For instance, the wave form designated as 20 is characteristic of a violin sound wave, 21 is a characteristic wave produced by a horn, 22 is a bass voice wave, 23 an oboe, 24 a clarinet, 25 an organ, 26 is a pure sine curved wave and will give a note corresponding to a clear pure flute-like tone. The wave form 27 is arbitrary and imaginary and may not correspond to any known musical instrument.

25 These and other wave forms may be readily made by using an oscillograph as above mentioned to secure the wave form and then drawing or copying these on drawing paper, subsequently photographing the drawing and reproducing on a sensitized disc whereby the transparencies may be formed corresponding to the drawing or diagram.

Referring to the drawing of Fig. 3, the disc 30 11 is rotatably mounted on a shaft 28 and is driven as hereunder mentioned. The disc 18 is also mounted on a shaft but arranged to be held stationary so that any one of the wave forms may be located between the source of light 29 and the bank of light sensitive cells 30. As above mentioned these cells may be selenium or photo-electric cells or any other suitable light sensitive element. In the instance shown there are four of these cells 31, 32, 33 and 34, corresponding to the lowest pitch note 13, the next note 14, the next 15 and the highest pitch note 16.

Each of these light sensitive cells is connected to a switch 35 of the keyboard designated generally by the numeral 36 so that on depression of anyone or more of the keys, a circuit is closed through the specific light sensitive cell. The electric circuits lead to an amplifying unit designated generally by the numeral 37, there being a source of power 38. This amplifier may be of any suitable character such as used in radio operations or in public address loud speaker units and the amplifier is connected to a loud speaker 39. A motor 40 for operating the disc 11 is illustrated diagrammatically in Fig. 3.

55 In the installation shown in Figs. 4, 5 and 6, the motor is indicated as having a pulley 41 with a belt drive 42 to the pulley 43 driving the disc 11. This drive will have a suitable regulating device so that the disc 11 may be rotated in the proper number of rotations per second to give the sounds of the designated pitch. The disc 13, while supported on the shaft 28, does not rotate therewith but there is a control shaft 44 having a hand dial 45. This shaft is connected by a belt 46 to a pulley 47 connected to the disc 18. Therefore the operator may shift the disc 18 so that anyone of the series of wave forms is located between the lamp 29 and the bank of light sensitive cells. The dial 45 is indicated as being positioned adjacent the keyboard 36. It is also preferable to have a reflector 48 concentrating the light from the lamp on the rows of transparencies and on the bank of light sensitive cells.

75 The transparencies on the disc 11 are prefer-

ably made by first making a large drawing on suitable material and photographing this, reducing the photograph to the proper size and printing on glass so that the transparent openings show through a dark ground and the glass disc may be mounted on the shaft. It is to be understood however, that the disc 11 may be made by punching holes corresponding to the transparencies and also in the disc 18 the wave forms may be depicted by having sections cut out of the disc of the desired wave form instead of having a disc with transparencies.

For the sake of simplicity of illustration I have illustrated my device as having four keys, four light sensitive cells, the disc 11 as having openings to produce notes of four different pitches and the disc 18 as having the transparency for each of the four different notes. It is to be understood however, that I may use a full scale keyboard such as of a piano and a light sensitive cell for each note and having the disc 11 with a variation of pitches corresponding to each note of the keyboard. The disc 18 will also have transparencies corresponding to each of the notes of a different pitch.

The manner of operation of my device is to position anyone of the desired wave forms between the source of light and the light sensitive cells and play any desired piece on the keyboard. This piece will be produced having the characteristic timbre or quality of tone of the particular wave form through which the light passes. The operator of the instrument may readily shift the disc 18 so that different wave forms are positioned in front of the light sensitive cells therefore quickly change from one characteristic sound to another characteristic sound and as above mentioned, these may correspond to known instruments or the sound forms may be developed mathematically such as a sine wave or they may be arbitrary and imaginary.

In Fig. 7 I illustrate the characteristic sound waves as being indicated by varying densities of the transparent sections 49. While in the drawings these are indicated as having the lines grouped close together to indicate dense or almost opaque sections and the lines spaced apart to indicate clearer sections, it is to be understood that the variations of density will be gradual. These variations of density for the wave form may be made by a photographic procedure somewhat as is done in connection with sound recording and reproducing films.

In using a disc similar to the disc 18 and having the wave forms represented by variations in density, the effect obtained is substantially the same as having wave forms depicted as shown in connection with Fig. 2, that is, there are different degrees of light transmitted as the rings of slots or perforations 12 pass over these sections graduated in density.

The characteristic wave form is obtained by the transparent sections of the rotating disc passing over the sections giving the characteristic wave forms. While each of these forms represents only one wave, nevertheless each of the slots or perforations 12 in the disc 11 give an impulse or vibration and hence the rapid succession of these impulses gives a series of vibrations corresponding to the notes of this wave and hence producing a musical note having the characteristic of the particular wave form depicted on the relatively stationary disc.

It is to be understood that to obtain an accurate

reproduction of the timbre or quality of a musical instrument the wave forms of each series of the type shown in Figs. 2 or 7 should be constructed to be similar to the wave forms of such instrument to correspond with different pitches. There is a slight variation in the timbre or quality of tone of an instrument for different pitch, that is, there is a slight change of the wave form of a certain instrument for, for instance, the low, high, or middle register notes.

Various changes may be made in the principles of my invention without departing from the spirit thereof as set forth in the description, drawings and claims.

I claim:

1. In an electrical instrument, a disk having a plurality of series of wave forms of specified timbre depicted thereon, each series extending in a path radially from the center of the disk and a different series being spaced around the disk.

2. In a musical instrument, a disk having a plurality of series of wave forms depicted thereon, each series depicting notes of a fixed quality of tone and all of the wave forms of each series being the same, the members of each series being arranged in a radial path considered from the center to the periphery of the disk and the wave forms from the center towards the periphery each corresponding to a note of a different pitch.

3. In a musical instrument as claimed in claim 2, the notes of the same pitch but in different series being located at the same radial distance from the axial center of the disk whereby the disk can be turned on its axis to transmit light varying in frequency in accordance with the pitches as represented by the different radial distances of each wave form from the center.

4. In an electrical instrument, a disk having a plurality of series of wave forms depicted thereon, the wave forms of each series corresponding to the same timbre, the wave forms of each series being arranged in similar paths considered from the center to the periphery of the disk, each wave form of a series corresponding to notes of different pitches, the lower pitches being closer to the center of the disk than the higher pitches.

5. In an electrical instrument as claimed in claim 4, the wave forms in the different series having the same pitch characteristic when at the same radial distance from the center of the disk, means to interrupt a light beam positioned to pass through the wave forms of any one series in accordance with the pitch characteristics of the wave forms in each series, the said disk being rotatable to bring another series of wave forms into alignment with the light beams.

6. In an electrical instrument, a disk having a plurality of series of wave forms depicting timbre or quality of tone thereon, the wave forms of each series being for the same timbre and each series for a different timbre, the wave forms of all the series being arranged in symmetrical paths from a central towards a peripheral portion of the disk, each wave form being proportional to a specific pitch, the lower pitches being closer to the center and the wave forms corresponding to the same pitch being at the same distance radially from the center of the disk.

7. In an electrical instrument as claimed in claim 6, the disk being mounted to turn on its axis, means to project beams of light to pass through the wave forms of any one series, means to turn the disk and to hold the disk stationary with the desired series of wave forms in alignment with the light beams, means to vary the

light passing through any desired wave forms at a frequency corresponding to the pitch of said wave forms, and means to translate the resultant varied light beam to sound.

- 5 8. In an electrical instrument as claimed in claim 6, the disk being mounted to turn on its axis, a second disk rotatable on the same axis as the first disk, said second disk having transparencies corresponding to the pitch characteristics of the wave forms of the first disk, and the
10 different pitch transparencies being at the same distance from the axis of the second disk as the corresponding wave forms from the axis of

the first disk, means to transmit light beams through the transparencies of the second rotating disk and through the desired wave forms of the first disk to vary the light beams, and means to translate the resultant varied light beams to sound. 5

9. In an electrical instrument, a disk having a plurality of series of wave forms of specified timbre depicted thereon, the various series extending in symmetrical paths from a central part toward a peripheral portion of the disk, and the
10 different series being spaced around the disk.

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