Sept. 17, 1940. F. ROPOHL 2,215,056

ELECTRICAL MUSICAL INSTRUMENT

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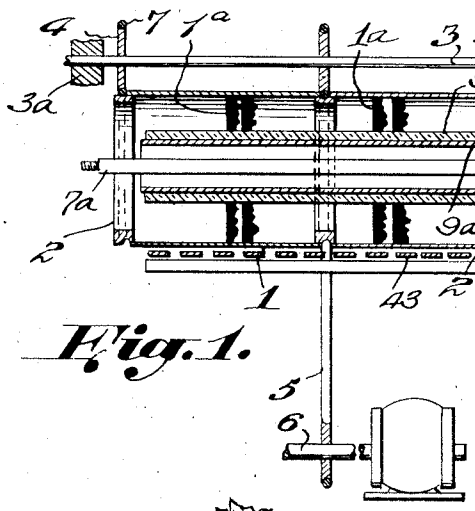


Fig. 1.

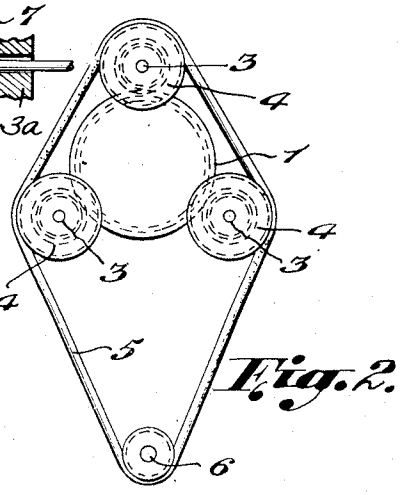


Fig. 2.

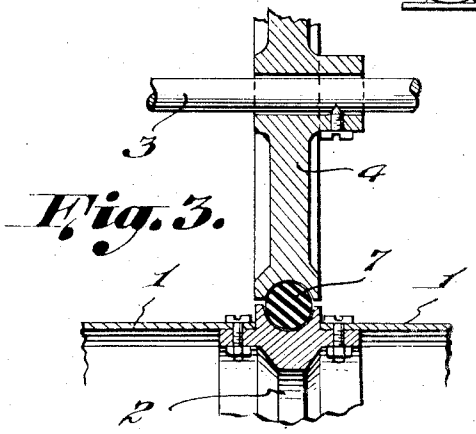


Fig. 3.

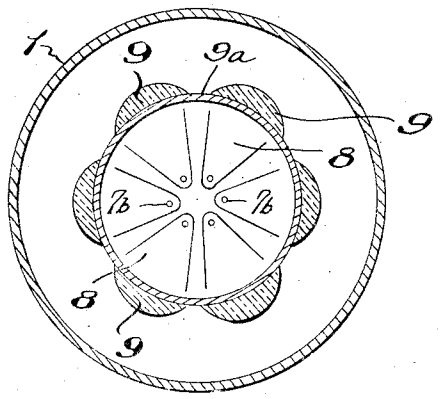


Fig. 4.

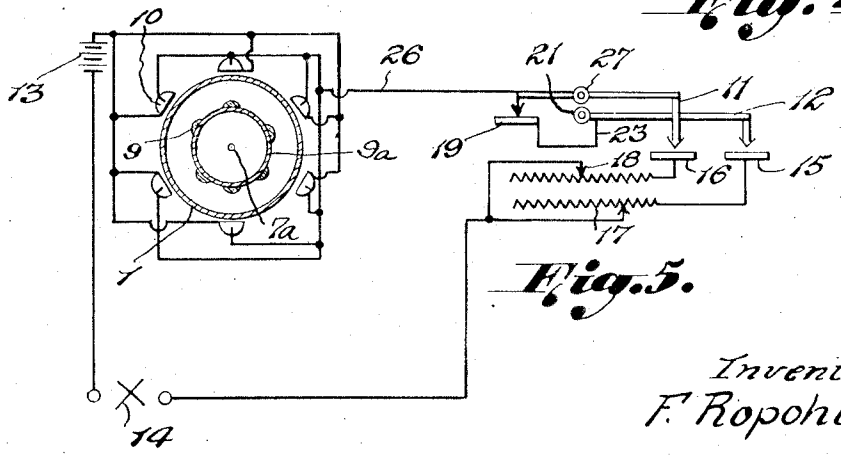


Fig. 5.

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Fig. 6.

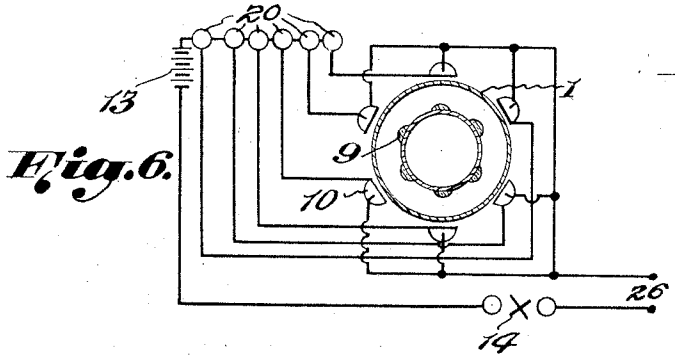


Fig. 8.

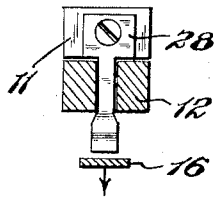


Fig. 9.

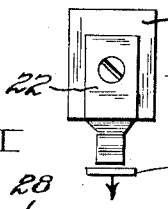


Fig. 7.

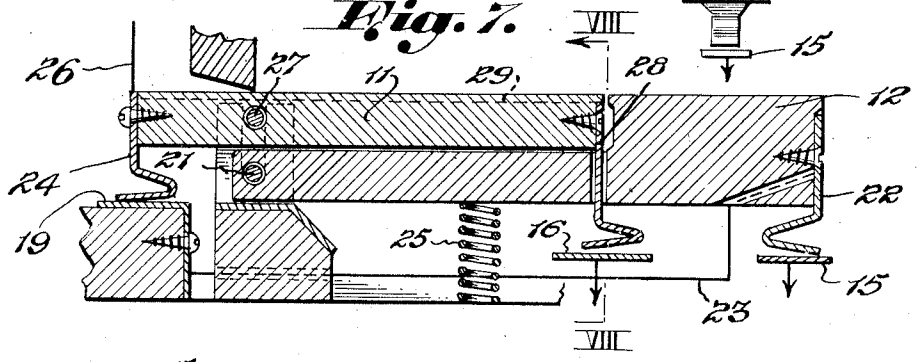
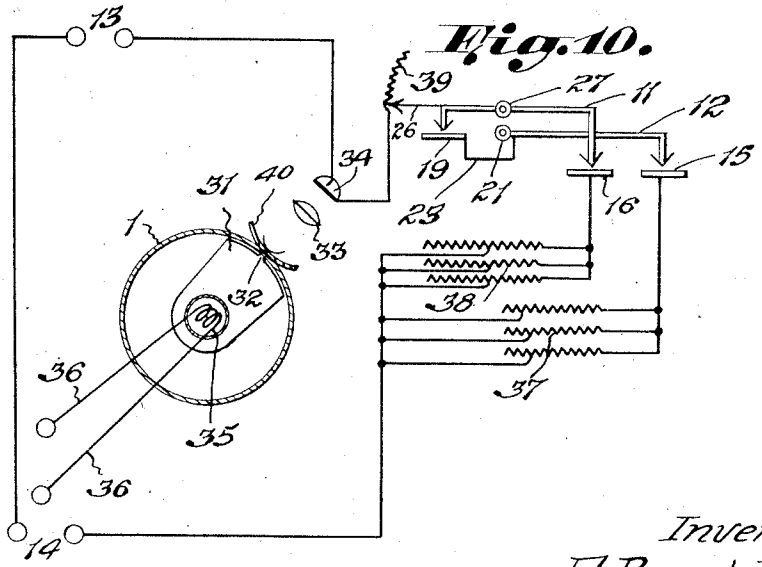


Fig. 10.



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Fig. 11.

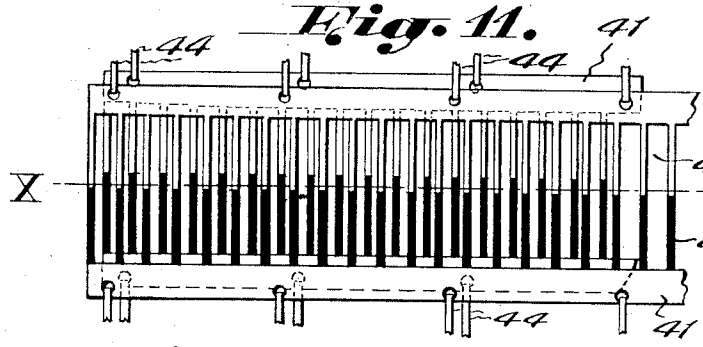


Fig. 13.

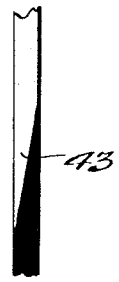


Fig. 12.

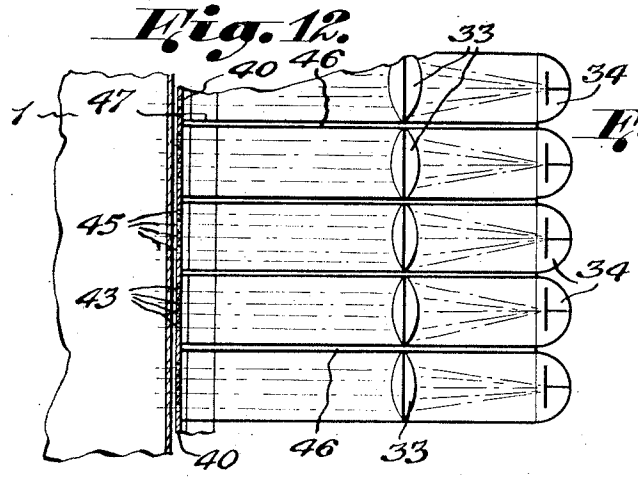


Fig. 14.

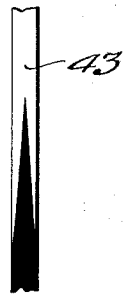


Fig. 15.

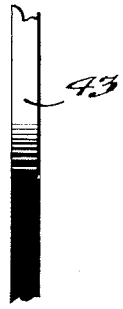
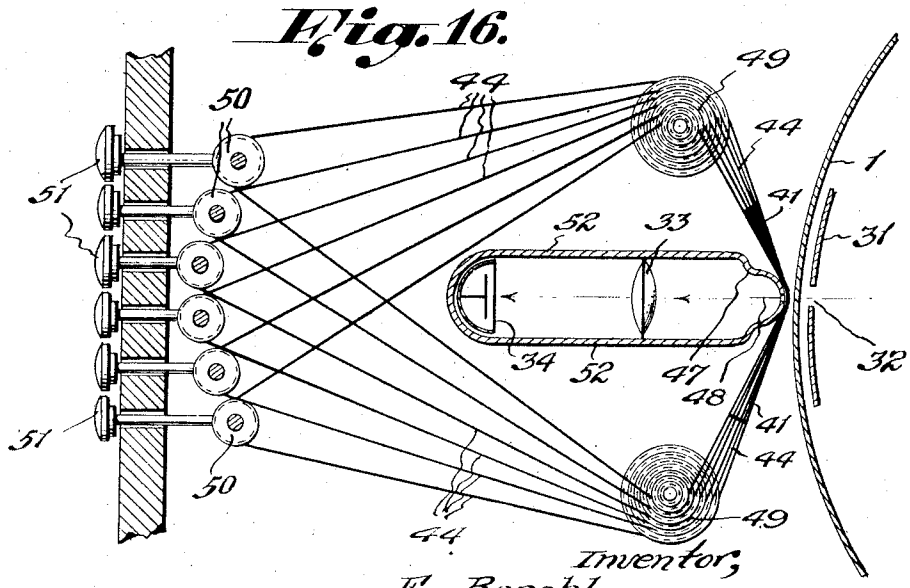


Fig. 16.



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UNITED STATES PATENT OFFICE

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ELECTRICAL MUSICAL INSTRUMENT

Franz Ropohl, Cologne-Ehrenfeld, Germany

Application August 6, 1937, Serial No. 157,757
In Germany May 27, 1935

7 Claims. (Cl. 84—1.18)

The present invention relates to musical instruments and more particularly pertains to apparatus for electrical reproducing sound.

According to the invention the sound lines are carried by a transparent rotating cylinder, on the surface of which known means are provided for the photographic recording of the sound lines, the essential advantage being in the fact that the series or group arrangement of endless adjacent sound lines tuned to different instruments is made directly possible in a mechanical manner. For the group arrangement of the tone lines there is an extensive possibility of the inclusion of numerous known instruments, as for example, violin, cello, clarinet, saxophone, etc. According to the invention precautions are also taken for the technically satisfactory reproduction of the most different sound variations by, for example, controlling of the light and current in combination with suitably constructed novel key-board, by means of which the selected strengthening or weakening of individual sound groups in chord is made possible. The sound reproduction is effected by means of the key-board by closing the feeble current circuit between the photo-cells and the low frequency amplifier. The power circuit for the illumination of the sound lines remains independent of the selection of the individual tones by means of the key-board. The disturbances due to interruption of the power circuit, for example, noises produced in the loud speaker by induction, can thus be avoided and disturbances due to the interruption of the feeble current circuit are not noticeable. For the choice of registers according to the invention there is provided in the intermediate space between the rotating cylinder and photo-cells, a light screen aggregate acting as a variable choke. This arrangement has the result that even when several registers are chosen for one sound group, only one photo-cell is necessary and consequently only the closing of one circuit is required for the reproduction of the sound. The illumination itself which is permanently switched on during the operation of the instrument, is provided in the rotating cylinder, the screening of which is effected in such a manner that only a single light slot parallel to the longitudinal axis of the cylinder remains. The switching on and off of the illumination can be effected in a known manner by means of a control lamp connected with the illumination of the music disc or by parallel connection with the driving motor for the cylinder and so forth.

The invention will be described more fully with reference to the accompanying drawings.

Fig. 1 is a longitudinal sectional view of the transparent cylinder carrying the sound lines.

Fig. 2 is an end view of the cylinder illustrating means for supporting and driving the same.

Fig. 3 is an enlarged detail view of the cylinder mounting.

Fig. 4 is a transverse sectional view of the cylinder.

Fig. 5 is a circuit diagram associated with the cylinder.

Fig. 6 is a schematic diagram illustrating a modified circuit arrangement.

Fig. 7 is a longitudinal sectional view of the double key.

Fig. 8 is a sectional view of the double key taken on the line VIII—VIII of Fig. 7.

Fig. 9 is a front end view of the double key.

Fig. 10 is a sectional view of a modified illuminating arrangement with the circuits therefor.

Fig. 11 is an elevational view of two sections of stop-combs.

Fig. 12 is a plan view illustrating the manner in which the photo-cells and the collecting lens are arranged along the cylinder.

Figs. 13, 14 and 15 illustrate various forms of opaque covering for the bars of the stop-combs.

Fig. 16 is a sectional view showing the screen unit associated with the cylinder.

In order to facilitate manufacture of the cylinder 1 carrying the sound lines 1*a* it is advisable to subdivide it. The connecting rings 2 for the individual cylinder sections serve also as running rings for the mounting of the cylinder. The rings 2 bear against the rollers 4 which are carried by driven shafts 3. The shafts 3 are rotatably supported in bearing 3*a*. In Fig. 2 the cylinder is supported by three groups of rollers which are coupled with the motor shaft 6 by means of a driving belt 5.

Fig. 3 shows in detail a part of the means for supporting the cylinder by means of the ring 2, the roller 4 and the roller shaft 3. To obtain noiseless running rubber rings 7 may be interposed between the rollers 4 and the rings 2.

The cylinder 1 serves as a sound record carrier in the center of which illuminating means 7*a* is arranged in the form of an elongated light source. A plurality of condenser lenses 8 are mounted on a cylinder 9*a* so as to be supported between the light source 7*a* and the cylinder 1. the illuminating means may include a plurality of light sources 7*b* as shown in Fig. 4. In this modification the light from each source 7*b* is di-

rected through one of the condenser lenses 9 by means of reflecting members 8.

It is to be noted that each tone group may embrace a large number of instruments. The photo-cells 10 are grouped around the cylindrical record carrier 1 opposite the condenser lenses 9. It is obviously also possible to provide the six photo-cells for each single sound line. In the exciting circuit of the photo-cells 10 the keys 11 and 12, are interposed. The illumination is permanently switched on and the sound lines provided on the rotating cylinder 1 move past the photo-cells and influence the beam of light. The current source is indicated at 13 and the low frequency device at 14. When the front key 12 is depressed, this strikes the bus bar 15 whereby the exciting circuit of the photo-cells is closed and the influencing of the photo-cells by the sound lines becomes effective in the loud speaker. The choice of register or register groups is effected in this case by switching on the individual light sources. The six photo-cells provided in this case each correspond to a different group of sound lines, so that when one key is depressed from one to six sound groups, that is the desired number of registers or the desired register group, become effective. A current limiting device such as a resistor 17 becomes effective when the front key 12 is depressed. If at the same time it is desired to obtain half tones or the like, this is done by depressing the rear key 11, which by making contact with the bus bar 16 closes the exciting circuit through another resistor 18 which is also variable, for example by means of a pedal. When the rear key 11, which may if necessary carry the front key 12 along with it, is operated the contact 19 is opened so that the key 12 is cut out of the circuit.

Fig. 6 shows another circuit arrangement in which, in contradistinction to Fig. 5, all six light sources are constantly illuminated. Choice of registers is effected in this case by switching out the individual photo-cells by means of six register switches 20 with which the exciting circuits of the separate photo-cells can be closed or opened.

The front key 12 mounted at the pivot 21 has at the front end a spring contact 22 which touches the bus bar 15 when the key is depressed. The spring contact 22 is connected with the exciting conductor 23. This is in turn connected to the contact plate 19 which is connected with the contact 24 on the back of the key 11. The conductor 26 leads from the contact 24 to the photo-cells. The back key 11 mounted on the pivot 27 has at the front end a contact 28 which, when the key is depressed, strikes against the bus bar 16 and thereby closes the exciting circuit of the photo-cells. The intermediate connection 29 leads from the contact 28 to the rear contact 24. When the back key 11 is depressed the front key is simultaneously forced downwards and the back contact 24 is lifted from the contact plate 19, whereby the front key 12 is cut out of the circuit. The return of the keys 11 and 12 into the original position can be effected by means of a spring 25.

For reproducing sound from a rotating cylinder according to the invention it is not necessary to use multiple reflectors for illumination, as shown in the previous examples. In some cases a single reflector is sufficient with a source of light.

Fig. 10 shows such an illuminating arrangement, together with the corresponding circuit diagram. In the rotating sound line cylinder 1 a single reflector 31 is arranged, the screen of which extends nearly up to the cylinder 1 and is covered to such an extent that only a light slit 32 remains. The beam passing through this slit is intersected by a collecting lens 33 after having passed through the moving sound record 1 and is directed to the photo-cell 34. The illuminating device is indicated at 35 and the current for which is supplied by the conductors 36.

The circuit arrangement of the double key is substantially the same as shown in Fig. 5. In the exciting circuit regulated from the front key 12 there is interposed a multiple resistor 37 which is actuated, for example, by a pedal. The same applies to the exciting circuit regulated by the back key 11, in which a multiple resistor 38 is interposed. A further possibility is to provide a variable resistor 39 which can be operated directly by striking the keys 11 or 12. From the circuit shown in Fig. 10 it will be seen that by extensive provision of resistors the reproduction of sound can be varied as required. The regulation of the light beam falling on the sound record carrier 1 from the slit 32 is effected by means of a light screen unit 40 which is moved close to the cylinder 1 opposite the light slit 32.

Fig. 11 shows two sections of the six stop-combs 41 placed one above the other, of which if necessary more can be used. The transparent stop-combs 41 have recesses 42 so that only thin bars 43 remain at such distances apart that five bars of the comb 41 are packed together in the opening 42 of the sixth stop comb. The bars 43 are, for example, covered so as to be opaque over part of their length, as shown in the drawing. In Fig. 11 the one comb 41 is already displaced with respect to the second comb by means of the strap 44. The line X—X shows the position of the light slit 32. It should be noted that the beam of light can pass through the transparent part of the bars 43 of the one comb while the covered part of the bars 43 of the second comb let no light pass through. With six combs 41 it becomes possible to regulate the incident light beam very extensively. The regulation of the passage of light to the photo-cells 34 can be made finer if the opaque parts of the bars 43 are covered in a suitable manner, for example by a gradual shading off of the covering, as shown for example in the constructional forms according to Figs. 13, 14 and 15.

Fig. 16 is a diagram showing the operation of the screen unit. This shows how the six screen combs 41 are interlocked close to the parts which move past the slit 32 close to the cylinder 1, so that only one thickness of the stop comb is operative. The combs 41 slide over a screen carrier 47 extending along the sound line cylinder 1, which has a slit 48. By means of the straps 44 the combs 41 can be pulled separately, the straps 44 being guided over stepped rollers 49 to the driving roller 50, which latter can be operated by turning or drawing the registration stops 51. It is clear that the light screen aggregate 41 extends either divided or not divided over the whole length of the sound line cylinder, and that by means of the six stops 51 all the sound groups are regulated simultaneously. The secure interlocking of the combs 41 is ensured by the stepped rollers 49, each comb being guided at a different angle. It will further be seen from Fig. 16 that the separation of the light groups can be effected in such a manner that the screen carrier 47, the collecting lenses 33 and

the photo cells **34** are arranged in a casing **52**, which is divided by means of partitions **46** into separate chambers containing the number of photo-cells and sound line groups.

It is obvious that the screen aggregate can also be used with the multiple photo cells and multiple reflectors as shown in Fig. 5, whereby the number of registers can be greatly increased.

The light screens can be duplicated photographically so that manufacture on a large scale is extremely simple. As regards the effectiveness of the light screen aggregate it must be mentioned that by suitable pulling of the combs **51** the sound lines of the instruments provided in the individual sound line groups can be cut out as desired so that solo playing of the separate instruments is possible.

By means of the invention the possibility of obtaining a keyed instrument for producing music by electrical means is offered, the effectiveness of which as regards sound reproduction is unlimited, while the means according to the invention ensure satisfactory operation of the instrument.

What I claim is:

1. A key controlled, photo-electrically operated musical instrument having a rotatable transparent cylinder having inscribed thereon groups of endless sound lines, the lines of any one group being of the same pitch but of different tone qualities, the number of groups being equal to the number of notes in the scale of the instrument, a source of light inside the cylinder, a plurality of photo-electric cells outside the cylinder, means for directing a narrow beam of light through the sound lines on to the photo-electric cells, a collecting lens for centralizing the light passing through said cylinder, and a screen unit consisting of flexible, partly opaque strips guided close to the cylinder so as to permit selection of sound lines corresponding to the different tone colours.

2. A musical instrument as claimed in claim 1, having a screen unit consisting of a number of combs equal to the number of sound lines in group, arranged between the cylinder and the photo-electric cells each comb being of transparent material with bars which are partly opaque and having means for drawing the combs so as to cover or uncover individual sound lines with the opaque parts.

3. A musical instrument as claimed in claim 1, having a screen unit consisting of a number of combs equal to the number of sound lines in group, arranged between the cylinder and the photo-electric cells, each comb being of transparent material with bars which are partly opaque, the spaces between the bars of each comb being wide enough for all the combs to interengage between the cylinder and the photo-cells and having means for drawing the combs so as to cover or uncover individual sound lines with the opaque parts and stepped rollers over which such means are guided.

4. A musical instrument as claimed in claim 1, having each group of sound lines divided into sub-groups, a photo-electric cell for each sub-group, the cells for each group of lines being arranged around the periphery of the cylinder and a separate illuminating device inside the cylinder for each sub-group, screened off from adjacent sub-groups.

5. A musical instrument as claimed in claim 1, having each group of sound lines divided into sub-groups, a photo-electric cell for each sub-group, the cells for each group of lines being arranged around the periphery of the cylinder, a plurality of light sources inside the cylinder, a reflector surrounding each light source and condenser lenses in front of each reflector for conducting the beam of light through the sound lines to the corresponding photo-electric cells.

6. A musical instrument as claimed in claim 1, having a key corresponding to each photo-electric cell for switching on the electrical circuit thereof, and an impedance in the circuit of each cell for varying the sound intensity.

7. A musical instrument as claimed in claim 1, having the cylinder divided into cylindrical sections, and having rings for supporting the section and driving the cylinder.

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