Nov. 13, 1934. R. K. POTTER 1,980,292

METHOD AND APPARATUS FOR PRODUCING MUSICAL SOUNDS

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Fig. 1.

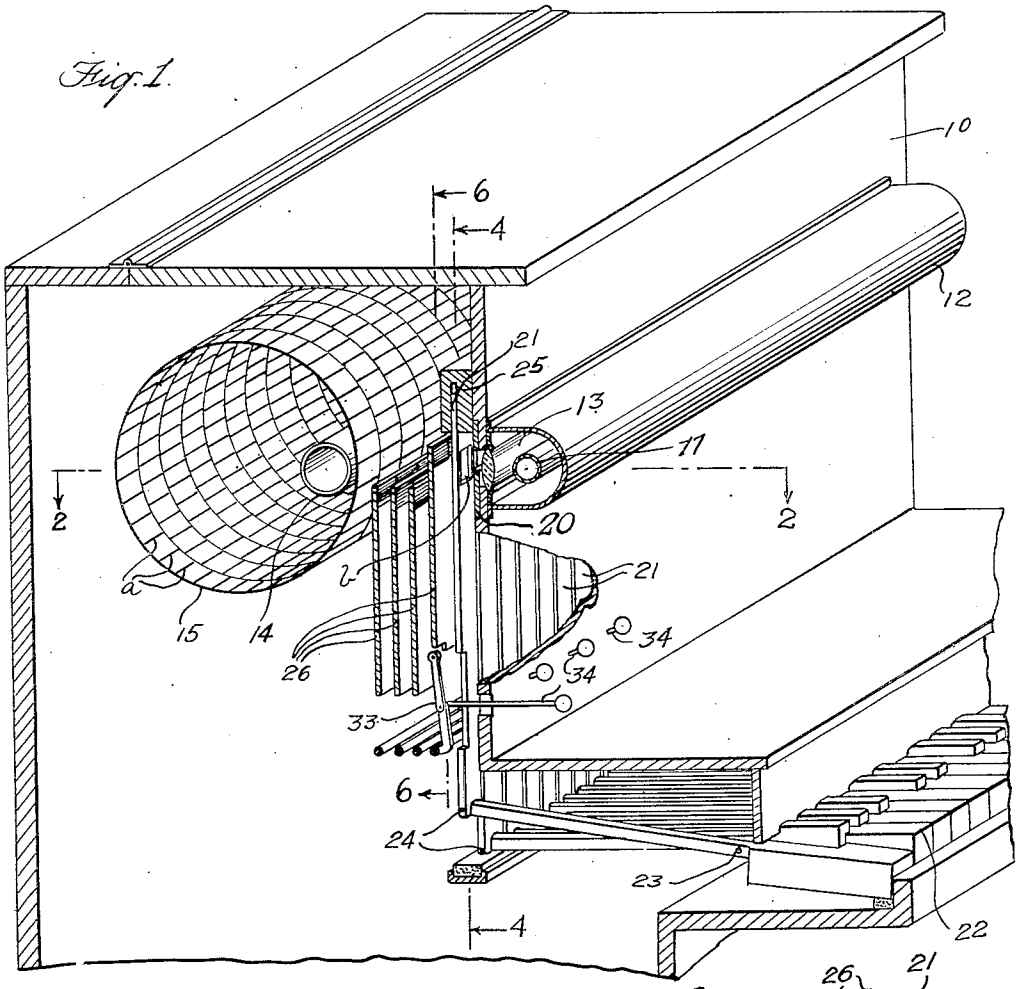
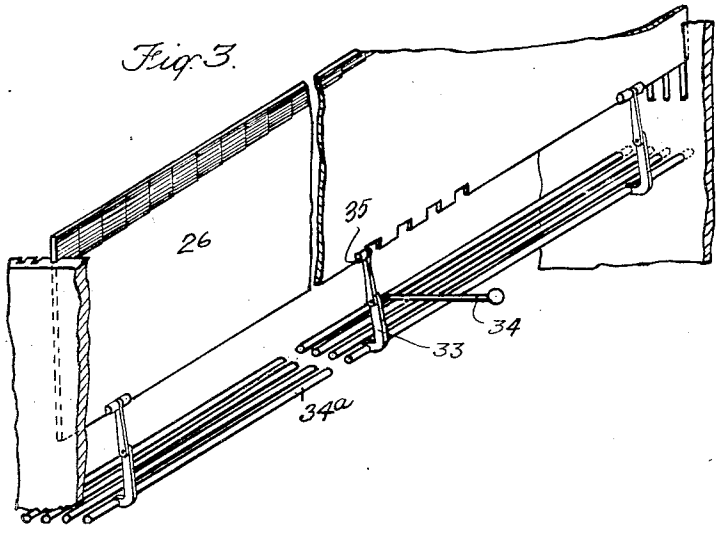


Fig. 3.



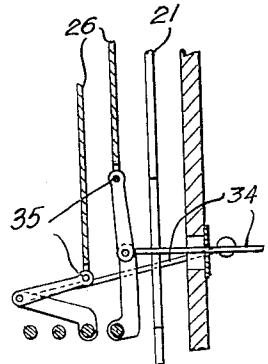


Fig. 3a

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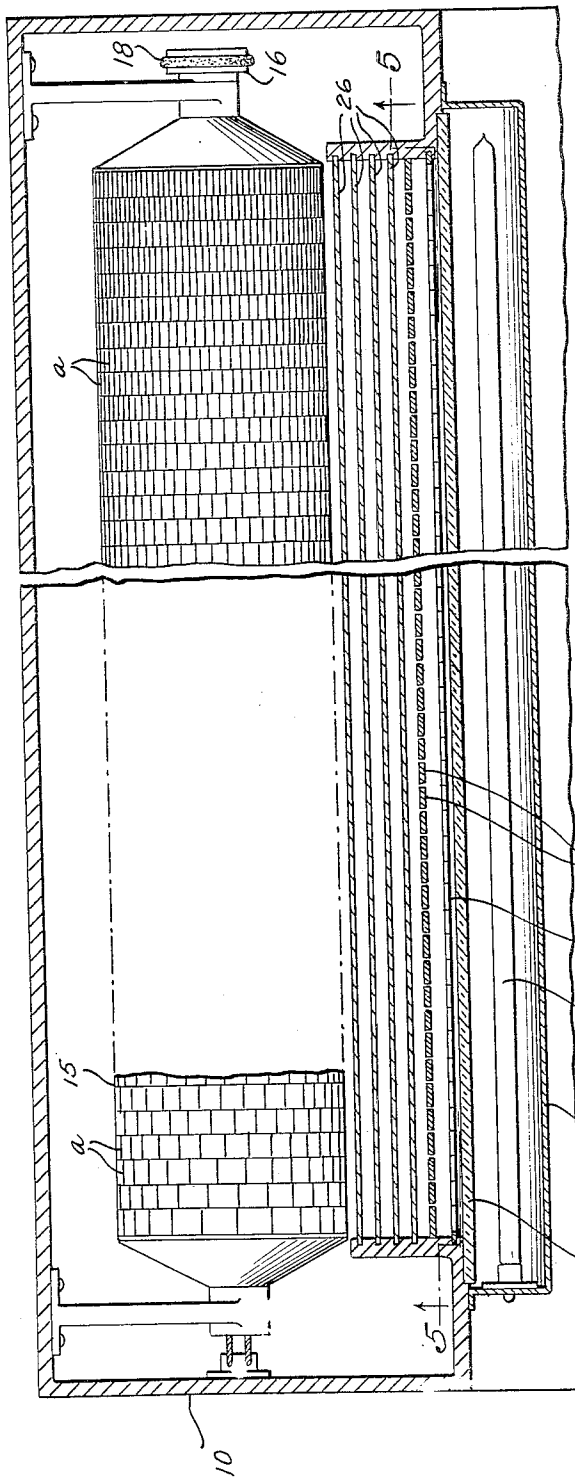


Fig. 2.

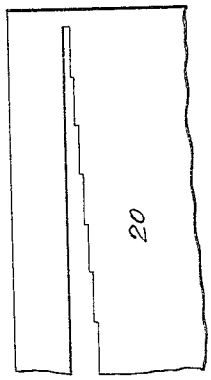


Fig. 9.

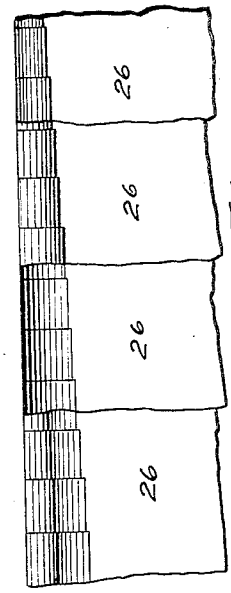


Fig. 8.

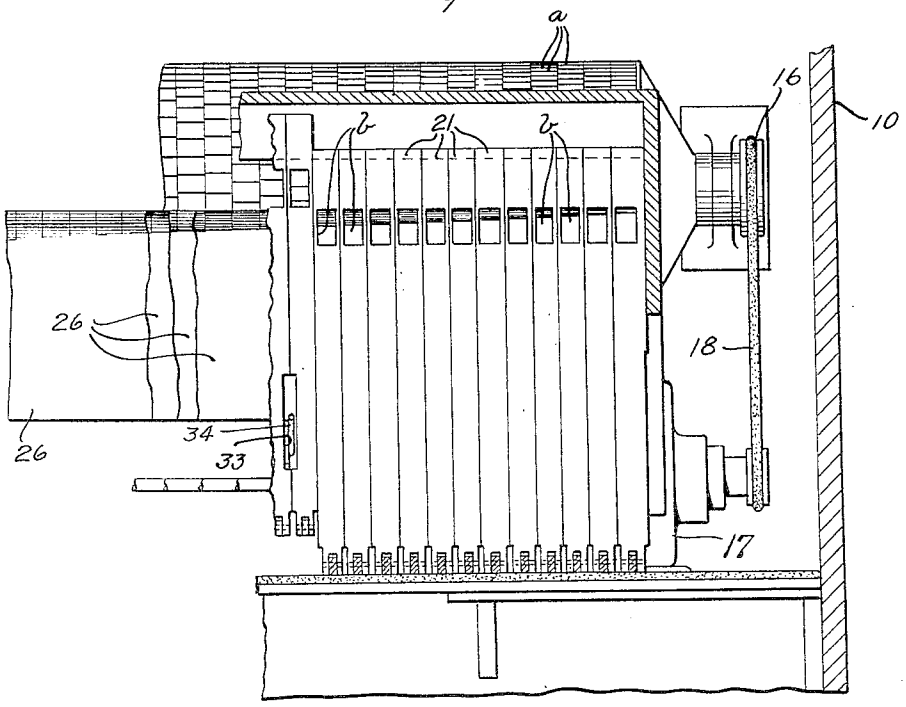
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METHOD AND APPARATUS FOR PRODUCING MUSICAL SOUNDS

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Fig. 4.



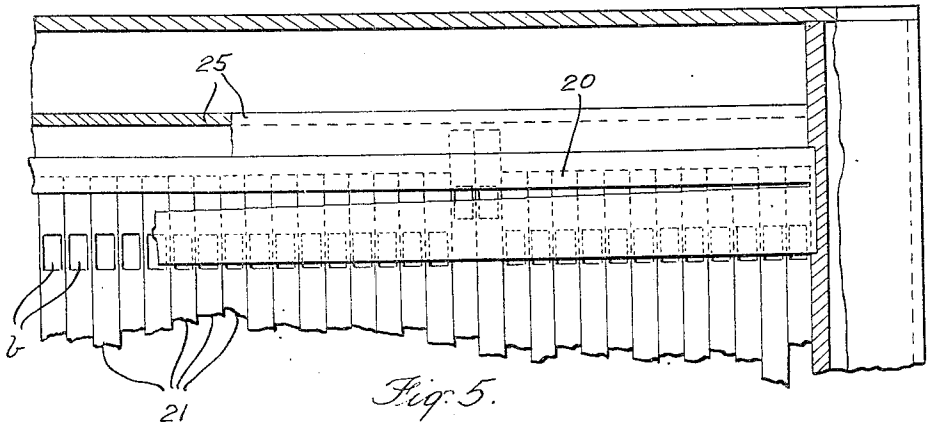


Fig. 5.

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METHOD AND APPARATUS FOR PRODUCING MUSICAL SOUNDS

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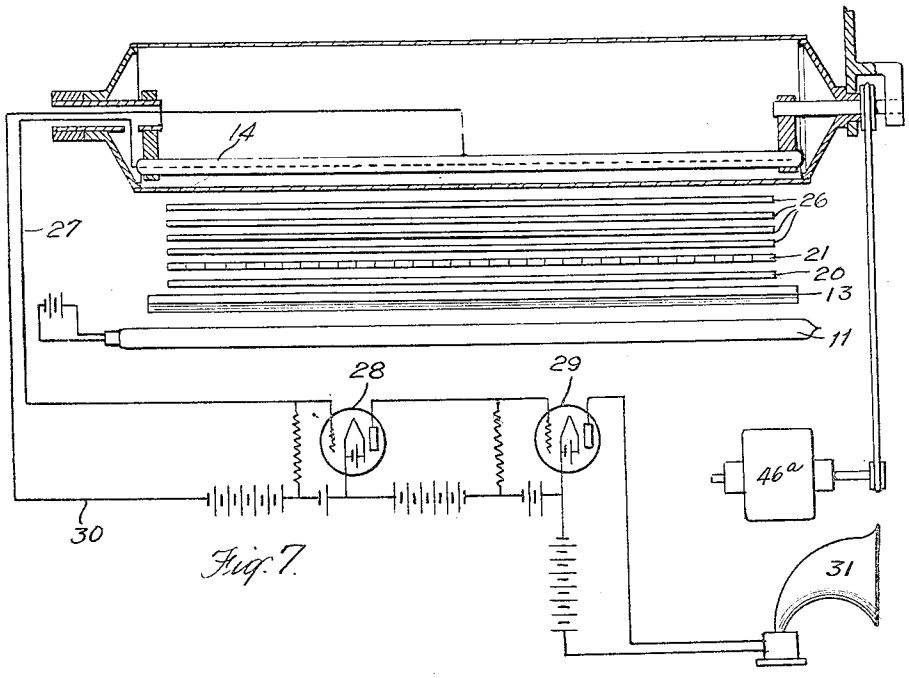


Fig. 7.

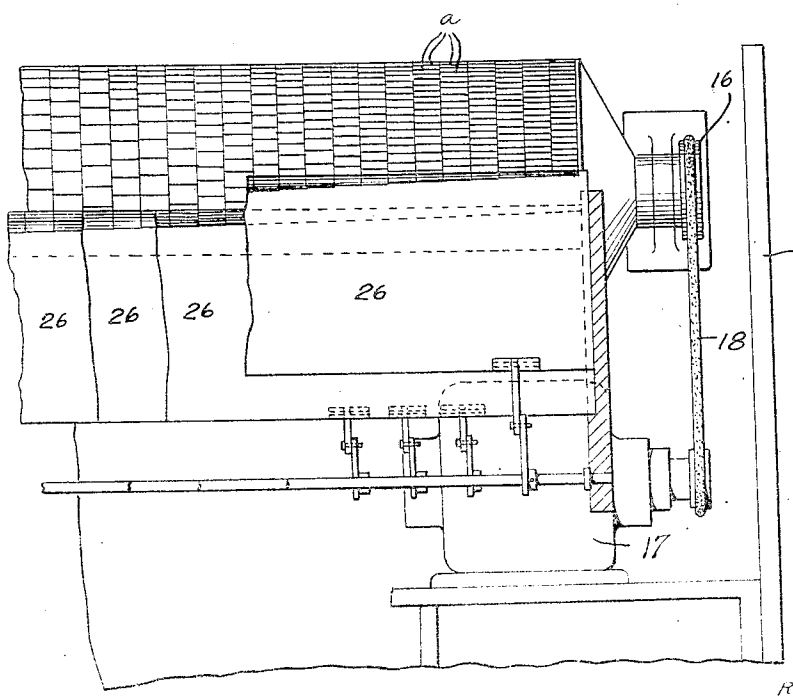


Fig. 6.

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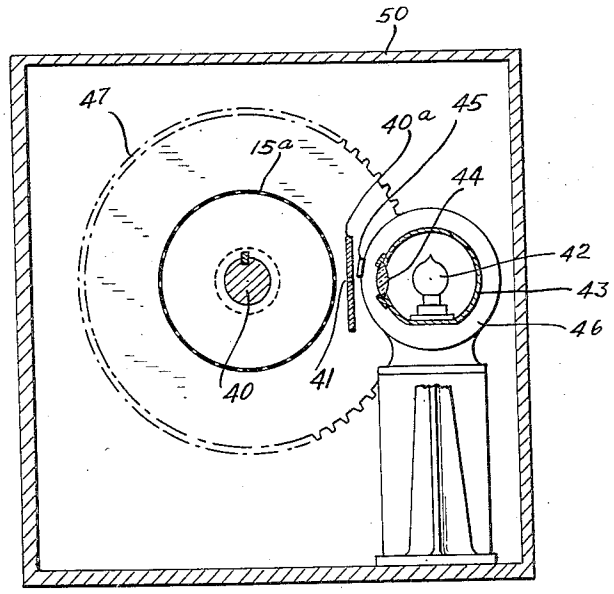
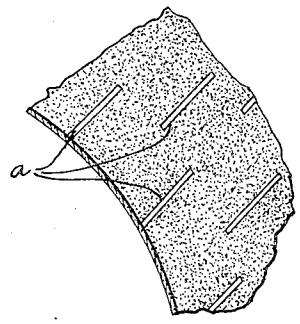


Fig. 11.

Fig. 10.



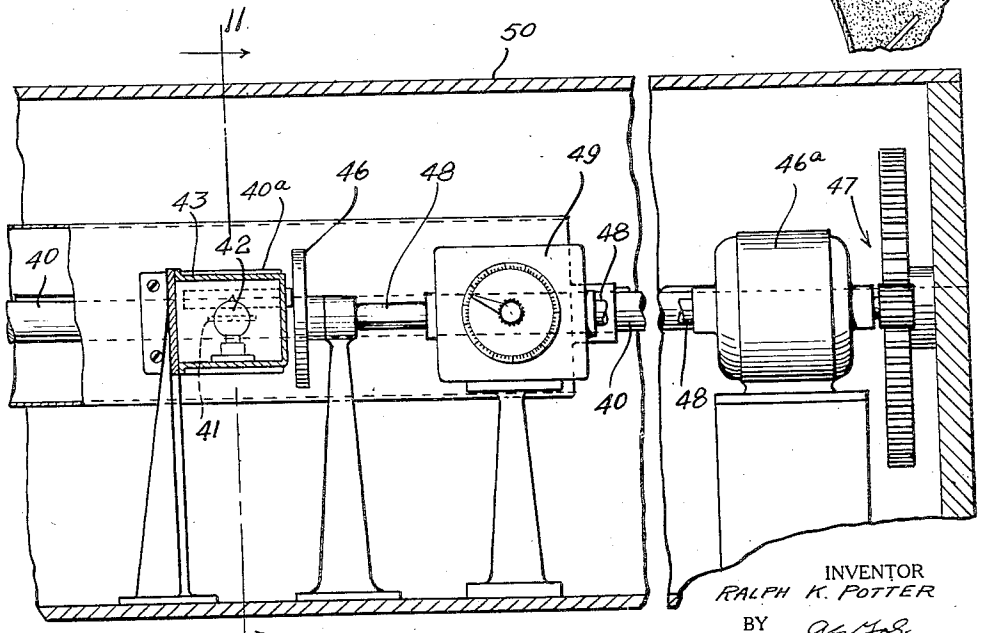


Fig. 12.

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UNITED STATES PATENT OFFICE

1,980,292

METHOD AND APPARATUS FOR PRODUCING MUSICAL SOUNDS

Ralph K. Potter, New York, N. Y., assignor to American Telephone and Telegraph Company, a corporation of New York

Application November 5, 1928, Serial No. 317,379

2 Claims. (Cl. 84—1)

The present invention relates in general to the production of musical notes of either simple or complex quality by the action of light upon a light sensitive electric cell. More particularly it relates to an instrument which may be played upon to furnish in any desired sequence notes of desired pitch and quality. For its understanding the invention may be considered with reference to that disclosed in my previous application, Serial No. 78,733, filed January 2, 1926, issued July 31, 1928 as Patent No. 1,678,872, of which the present invention is a further development. In said application I disclosed an instrument of the type mentioned, in which a light transmitting screen in the form of an endless band was moved between a light source and a light sensitive cell, the screen being arranged so as to contain note patterns which were repeated a large number of times for a given note, the arrangement being such that the same note pattern was moved across the light beam as many times as there were vibrations in the note produced.

The present invention has for an object the simplification of the foregoing to the end that the note pattern will be repeated but a few times or even occur only once, such simplification being brought about by providing a stationary screen and in effect a movable light beam. Such an arrangement in its preferred embodiment contemplates the provision of a movable lattice disposed between the note screen and the light sensitive cell, which lattice functions to direct a succession of moving light beams from the note pattern upon said cell in such a manner that a beam determined by a slit of the lattice commences to traverse the note pattern just as the beam determined by the preceding slit leaves the pattern. Since the pattern includes at least one note cycle and the beams are separated from one another by exactly one note cycle, there will be no break in the continuity of the sound current produced. In this manner the beam reaching the cell is varied in intensity strictly in accordance with the variation in light transmitting power of the pattern. It will be obvious that the same effect will be produced by having the lattice disposed between the light source and the note screen. It will also be understood that it is not necessary that the beam move with respect to the cell; for example, the cell surface may be disposed at the center of the lattice cylinder whereupon the light beam reaching such surface would not move at all. In the case illustrated where a note screen is stationary, the number of slits in the lattice moved per second across the light from the note screen will thus be seen to equal the number of vibrations per second of the note produced.

The contemplated arrangement, while simplifying that of my earlier application, also has the advantage that it enables a plurality of note patterns to be provided for a given note, such patterns being contained each on a stationary screen whereby any given pattern may quickly be substituted for any other pattern and a relatively simple and practical means thus provided for changing the tonal quality. The present invention makes use of a lattice for producing the moving light beams and also contemplates novel means for making same.

Other objects of the invention and advantages flowing therefrom will be apparent from the following detailed description taken with the annexed drawings in which:

Figure 1 is a view partly in section of an illustrative embodiment simulating a piano;

Fig. 2 is a view in section taken on line 2—2 of Fig. 1;

Fig. 3 is a view showing in detail a note screen;

Fig. 3*a* is a detailed view of the mechanism effecting the raising and lowering of the note screens;

Fig. 4 is a view taken on the line 4—4 of Fig. 1;

Fig. 5 is a view taken along line 5—5 of Fig. 2;

Fig. 6 is a view taken along the line 6—6 of Fig. 1;

Fig. 7 is a view similar to Fig. 2 but additionally showing the sound current circuit;

Fig. 8 is a view showing portions of the light screen used;

Fig. 9 is a view of a fragment of the beam limiting screen employed;

Fig. 10 shows a fragment of the lattice employed;

Fig. 11 is a view taken on the line 11—11 of Fig. 12 and shows an apparatus for making said lattice.

Fig. 12 is a view of said apparatus in elevation.

Referring to the drawings by characters of reference, 10, Fig. 1, denotes a frame to which is attached a light source consisting of an elongated bulb 11, a reflector 12, therefor, extending the length of the instrument, a cylindrical lens 13 mounted in an aperture in said frame, and a light sensitive cell 14, the supports connecting the bulb and those connecting the cell to the frame not being shown. Surrounding the cell 14 is a cylindrical lattice member 15 which is opaque except for slits *a* arranged in circumferential bands of slight width, the slits of each band having a progressively closer spacing as will be evident from

Fig. 2. The cylinder is preferably composed of transparent material, as for example glass or celluloid which is covered with a photographic emulsion in which the light transmitting slits have been formed by the proper exposure and development as will be explained in greater detail hereinafter. As shown in Figs. 4 and 6, means are provided for rotating the cylinder comprising a pulley 16 attached thereto, an electric motor 17 and a belt 18, connecting said motor with the pulley 16.

In order that the distribution of the light may be properly controlled, I have provided what may be termed a beam limiting screen 20 in front of lens 13 and next to said screen a series of shutters 21, each of which is controlled by one of a plurality of keys 22 constituting a keyboard, each shutter having an aperture *b* which in raised position admits light from the source 11 to the sensitive cell 14. In the embodiment shown, the return of the shutter is brought about by gravity. Further details of each shutter operating mechanism include a pivot 23 constituting the fulcrum for key 22, a pivot 24 connecting the key with the bottom of the shutter, and a guideway 25 toward the top of the instrument for maintaining the shutters in place. Cell 14 which is standard in the art need not be described in detail.

It will be evident that by the interposition of a screen carrying a note pattern of one or more cycles, a current corresponding to such note would be generated in the cell 14 by the action of a moving beam formed by passing a considerably larger beam (determined by the lens 13 and beam limiting screen 20) through a given shutter, thence through the note screen and then through a moving slit in the lattice 15. Thus for each note there will be provided a separate shutter 21, a note pattern comprised in a screen 26, a lattice band in cylinder 15 and a key 22 controlling said shutter 21.

The diagram for the sound current circuit involved is shown in Fig. 7. In this figure, current induced in cell 14 leaves same through conductor 27, through which it passes to an amplifying, thermionic tube 28, the output of said tube being passed preferably through a second thermionic tube 29 in which it is further amplified. The original cell current conducted to tube 28 leaves same through conductor 30 and returns therethrough to cell 14. The output of tube 29 is connected to a loud speaking unit 31, it being understood that the number of amplifier tubes will depend upon the nature of the light sensitive cell and in the manner in which it is operated.

The pattern of each note screen is such as to constitute the cycle of a note of given frequency and quality and is indicated best in Fig. 6, and is similar to any of the forms shown in my co-pending application referred to except that it is constituted preferably of a single cycle instead of a multiplicity of cycles as shown in said case. In other words, each note screen pattern is such that as a beam of light determined by a lattice slit moves through it, such beam will be varied in a manner exactly similar to that of said previous invention, in which the beam is stationary and the screen moves. As above stated, the spacing of the slits of the lattice are such that the beams of light determined by them traverse the note screen exactly a cycle apart whereby one beam will commence at exactly the same point in the cycle as the preceding beam left off.

As will be seen from Figs. 3, 10, and 11, the note screens are of diminishing height as the pitch increases and corresponding with this, the beam limiting screen 20 is arranged so as to pass beams of substantially the same size as patterns of the note screen, this arrangement being responsible for the stepwise formation of the aperture of the screen 20.

An advantage of the invention as has been pointed out resides in the fact that several note patterns may be provided, each producing a different quality of note and if desired corresponding to different instruments or different combinations of them. I have shown a number of such screens and mechanism comprising a toggle 33, a rod 34 upon which the toggle members are pivoted, the upper member of the toggle connecting such screen at 35. As shown in Fig. 3, a plurality of toggles 33 are provided at spaced intervals all of which are under the control of a single rod 34 due to a rod 34*a* connecting said plurality of toggles. The operative mechanism except for rods 34 and 34*a* are shown for the first screen only. Thus by pulling out a rod 34 any given note screen may be elevated in place and may be returned to its inoperative position by pushing in such rod.

In this manner, notes in any sequence may be played by depressing the keys corresponding thereto and by the interposition of the note screen the quality of such note determined in a manner analogous to the stops of an organ. In lieu of having the note screens as separate independently movable elements each containing the band or bands corresponding to one note only as shown, the several bands constituting said separate screens may, if desired, be arranged so as to constitute a single screen, and means provided for moving the latter so as to place in operative position any desired band of such screen.

Means for producing the frequency determining screens or lattice are illustrated in Figs. 11 and 12.

Thus in Fig. 11 the cylinder 15*a* covered with a light sensitive emulsion is mounted for rotation about a shaft 40. Close to the periphery of the cylinder 15*a* is mounted a beam directing element 40*a* having an aperture 41 through which light from a bulb 42 is to be passed at predetermined times. For accomplishing this, lamp 42 is mounted within an inclosure 43 having a concentrating lens 44 opposite slit 41. Mounted for rotation so as to pass between the lens 44 and slit 41 is a shutter member 45 secured to a disk 46. In operation, cylinder 15*a* is driven at a predetermined speed by means of a motor 46*a* through gearing 47, while disk 46 carrying shutter 45 is driven by a shaft 48 connecting same with said motor 46*a* through a speed change device 49. It can accordingly be seen that the exposure of cylinder 15*a* to the light from source 42 will be determined by the ratio of the number of revolutions of the shutter member, to one of the cylnders 15*a* for the reason that each time a shutter 45 moves past slit 41 an unexposed area in the shape of a slit is produced on cylinder 15*a*. When a given band has been produced as by the complete rotation of the cylinder 15*a*, the latter will be moved relatively to aperture 41 preferably along shaft 40 an amount equal to the width of the band and the gear ratio for driving shutter member 45 changed the required amount for the altered spacing of the slits in the next band. In a similar manner the process is repeated until the entire cylinder has been exposed.

It will be noted that the cylinder 15*a* and light source 42 are enclosed in a light proof casing 50, it being possible to change the relative position

of cylinder 15a along shaft 40, as well as the necessary gear ratio from without the casing and without opening same. After the cylinder has been fully exposed, the same is developed photographically whereupon a lattice is produced in accordance with Fig. 2 for example.

It will be understood that the shutter mechanism shown is capable of further refinement for producing various musical effects and various other means for modulating or otherwise varying the tone produced may be provided in a similar manner to what is shown in my earlier application. Since the applicability of such further refinements will be clear to those skilled in the art, I have not considered it necessary to repeat them here. Accordingly, I wish it understood that various changes may be made in the device disclosed herein without departing from the spirit of my invention or the scope of the appended claims, and that furthermore certain parts may be used without others.

I claim:

1. Mechanism for making a lattice of the character described comprising a light source, means for rotatably mounting a lattice cylinder having thereon a light sensitive emulsion, an element directing a light beam from said source upon said cylinder of substantially the width of the lattice band and means for interrupting said beam at a predetermined frequency.

2. Mechanism for making a lattice of the character described comprising a light source, means for rotatably mounting a lattice cylinder having thereon a light sensitive emulsion, an element directing a light beam from said source upon said cylinder of substantially the width of the lattice band and means for interrupting said beam at a predetermined frequency, and means for moving said cylinder relative to the beam directing element whereby when one lattice band has been exposed the operation may be repeated for other bands.

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