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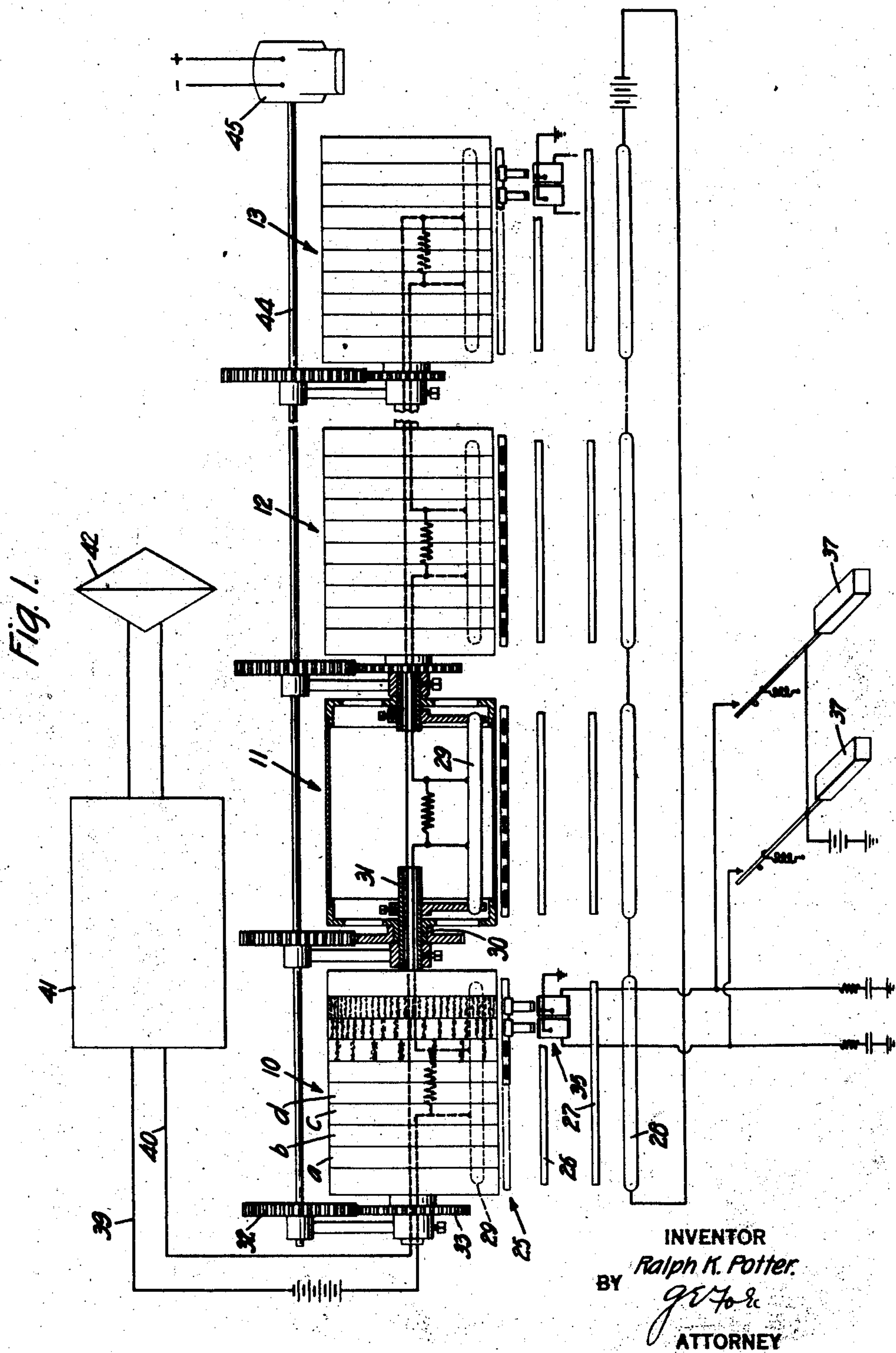
R. K. POTTER

1,848,222

PRODUCING MUSICAL SOUNDS

Filed May 29, 1929

6 Sheets-Sheet 1



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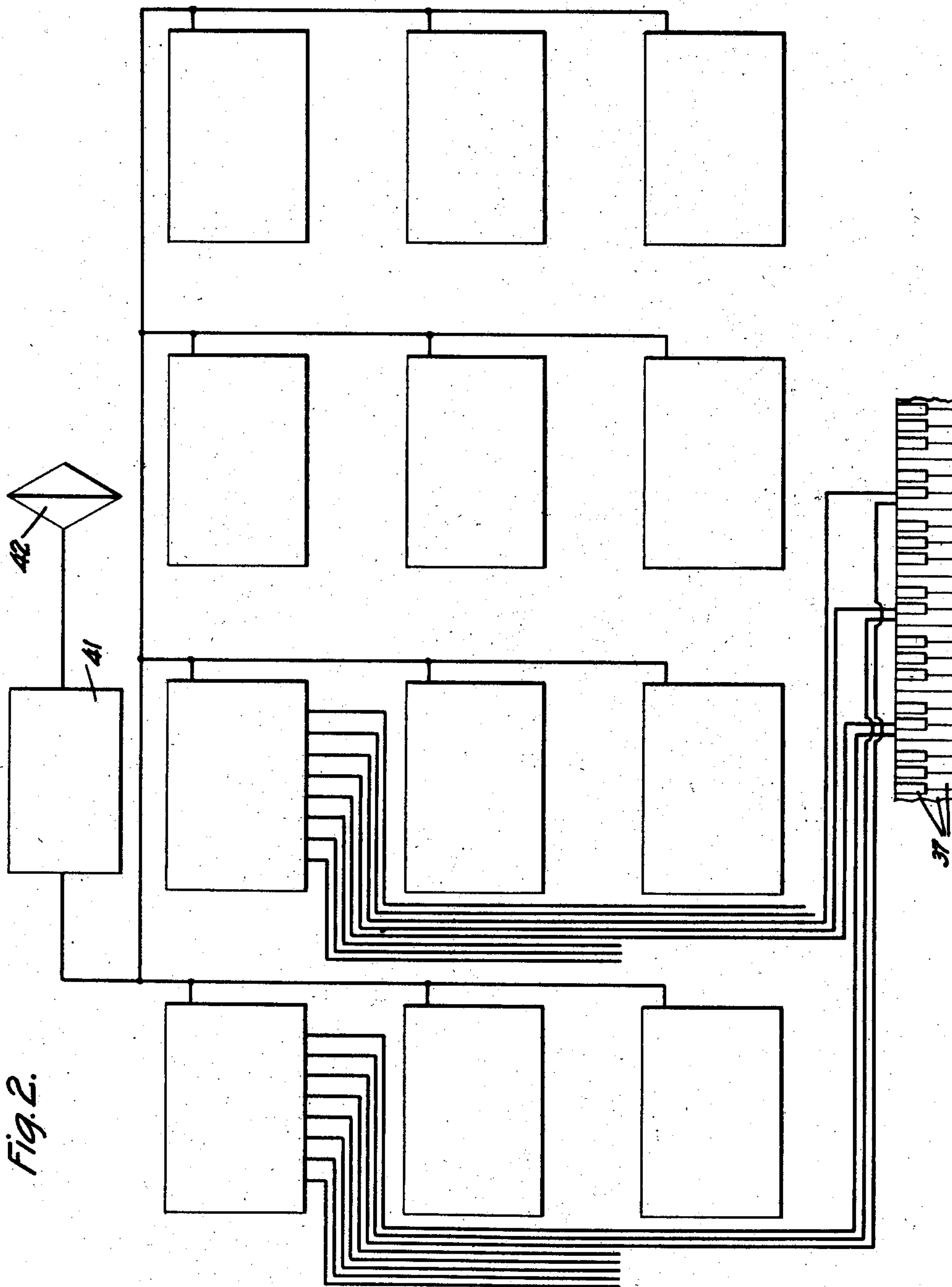
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PRODUCING MUSICAL SOUNDS

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6 Sheets-Sheet 2



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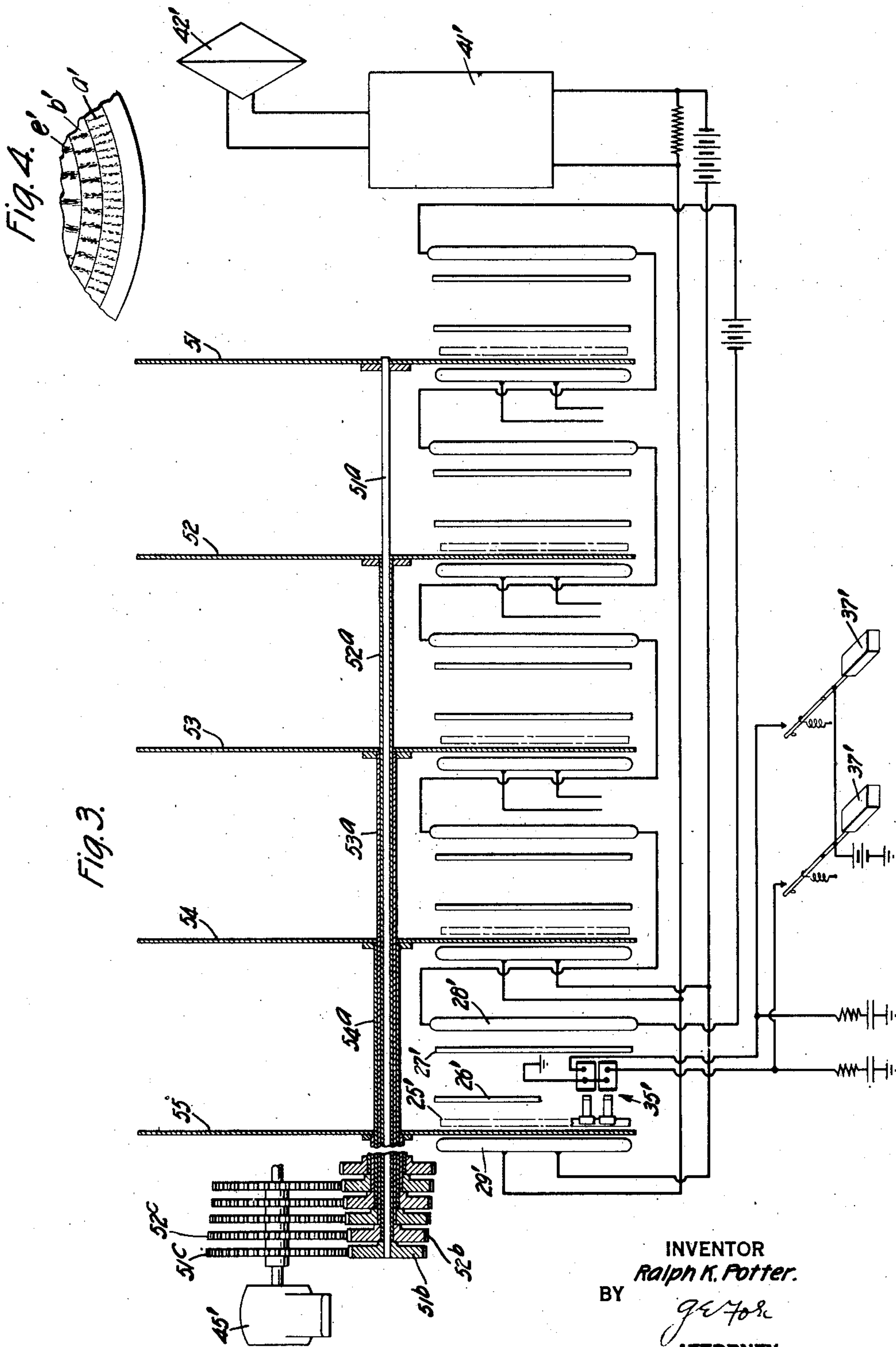
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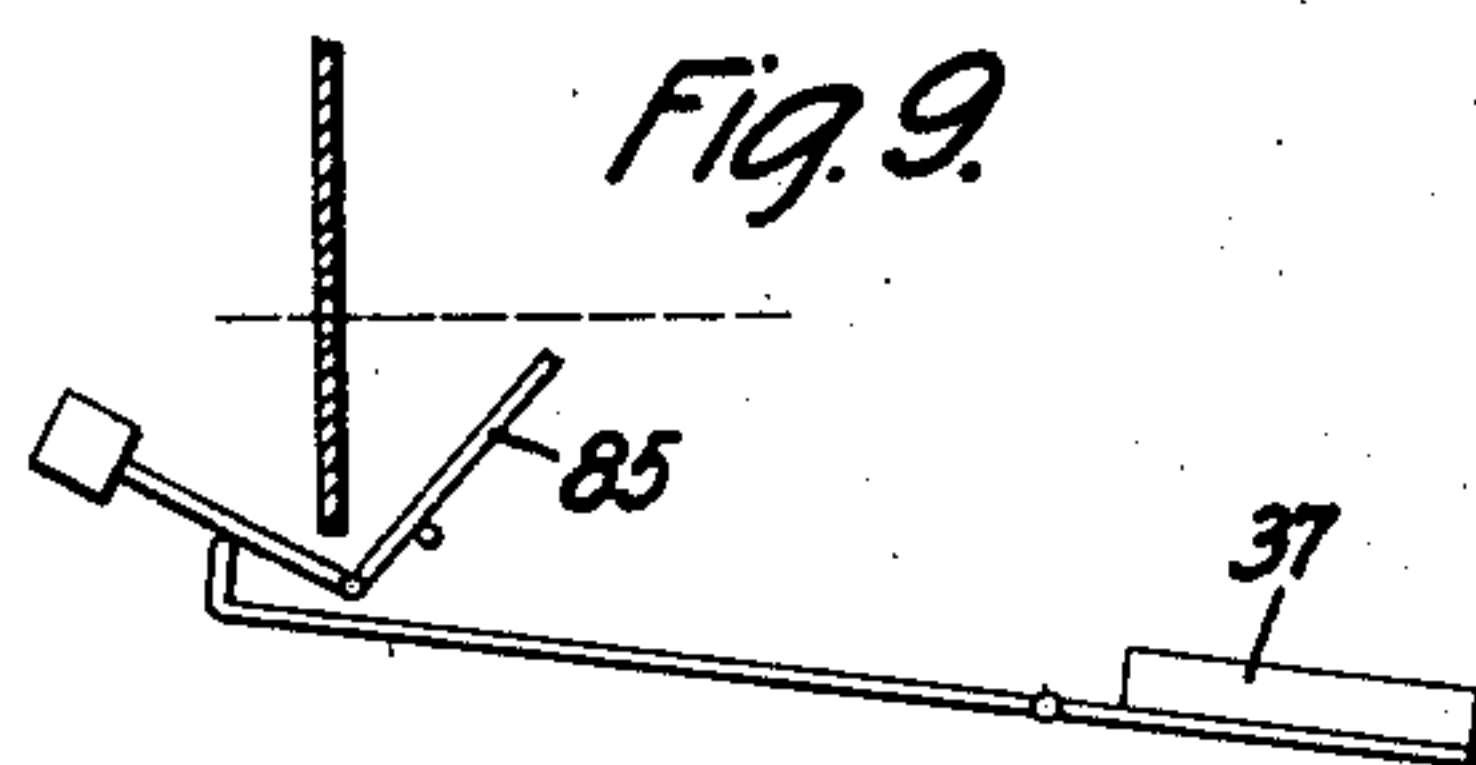
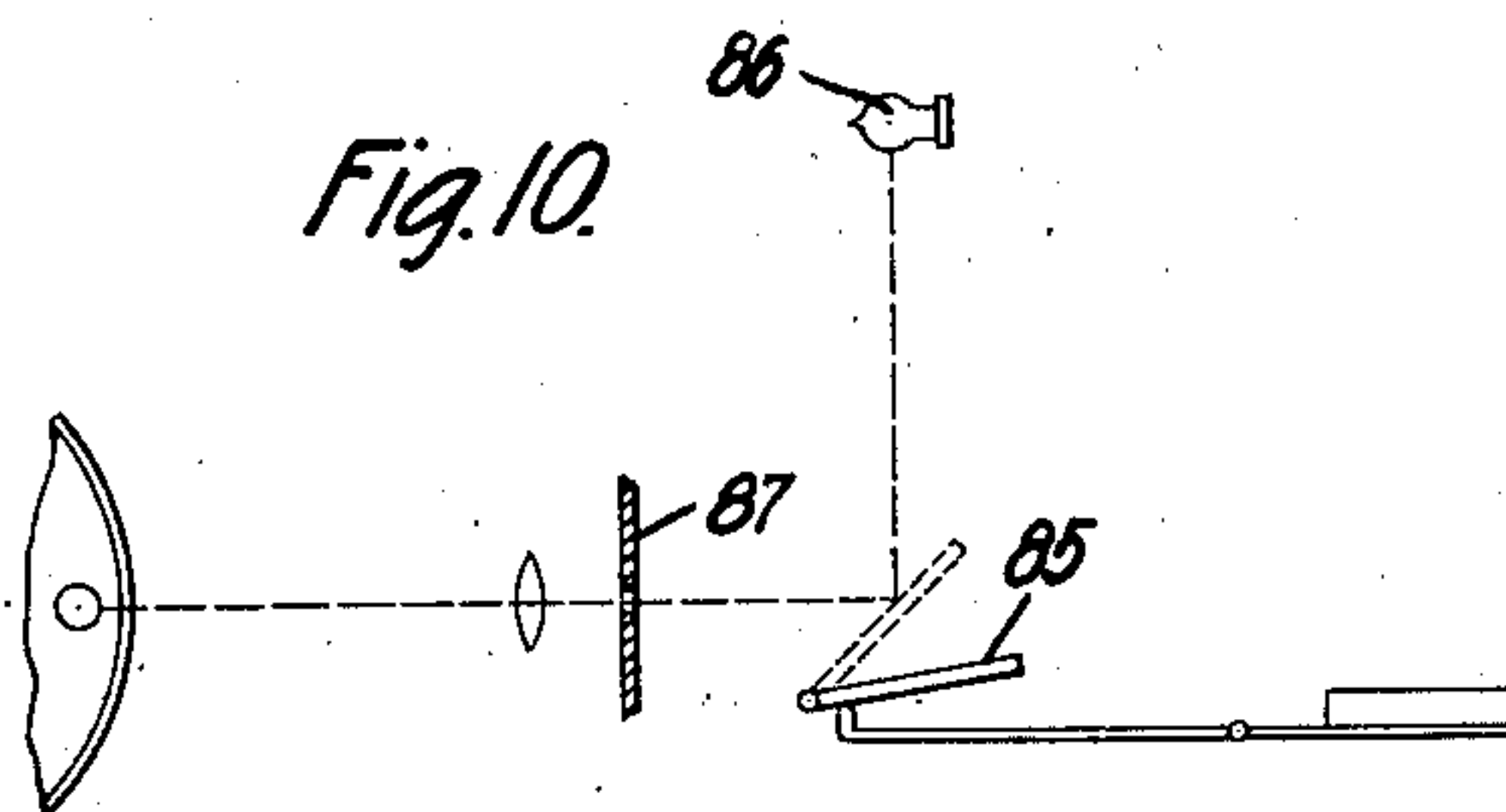
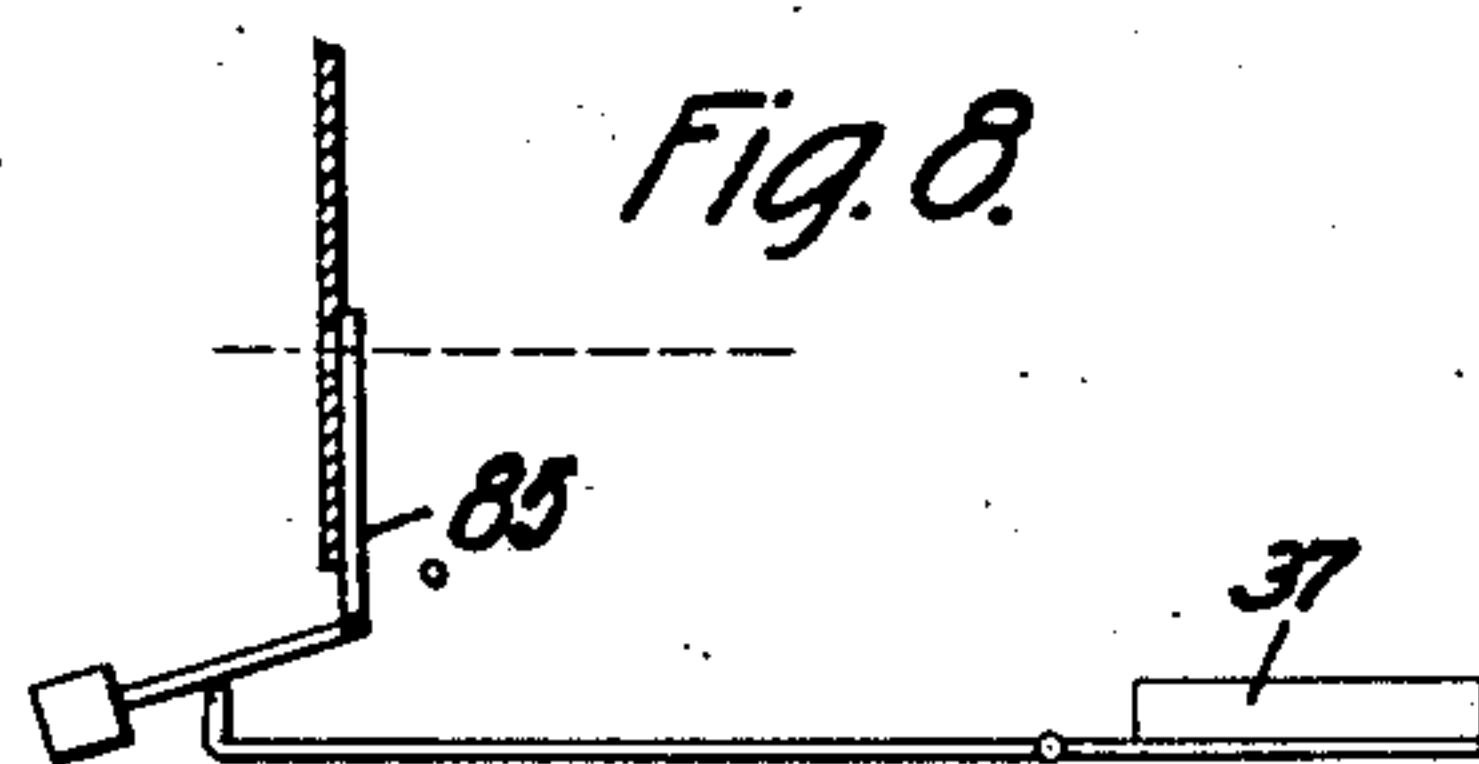
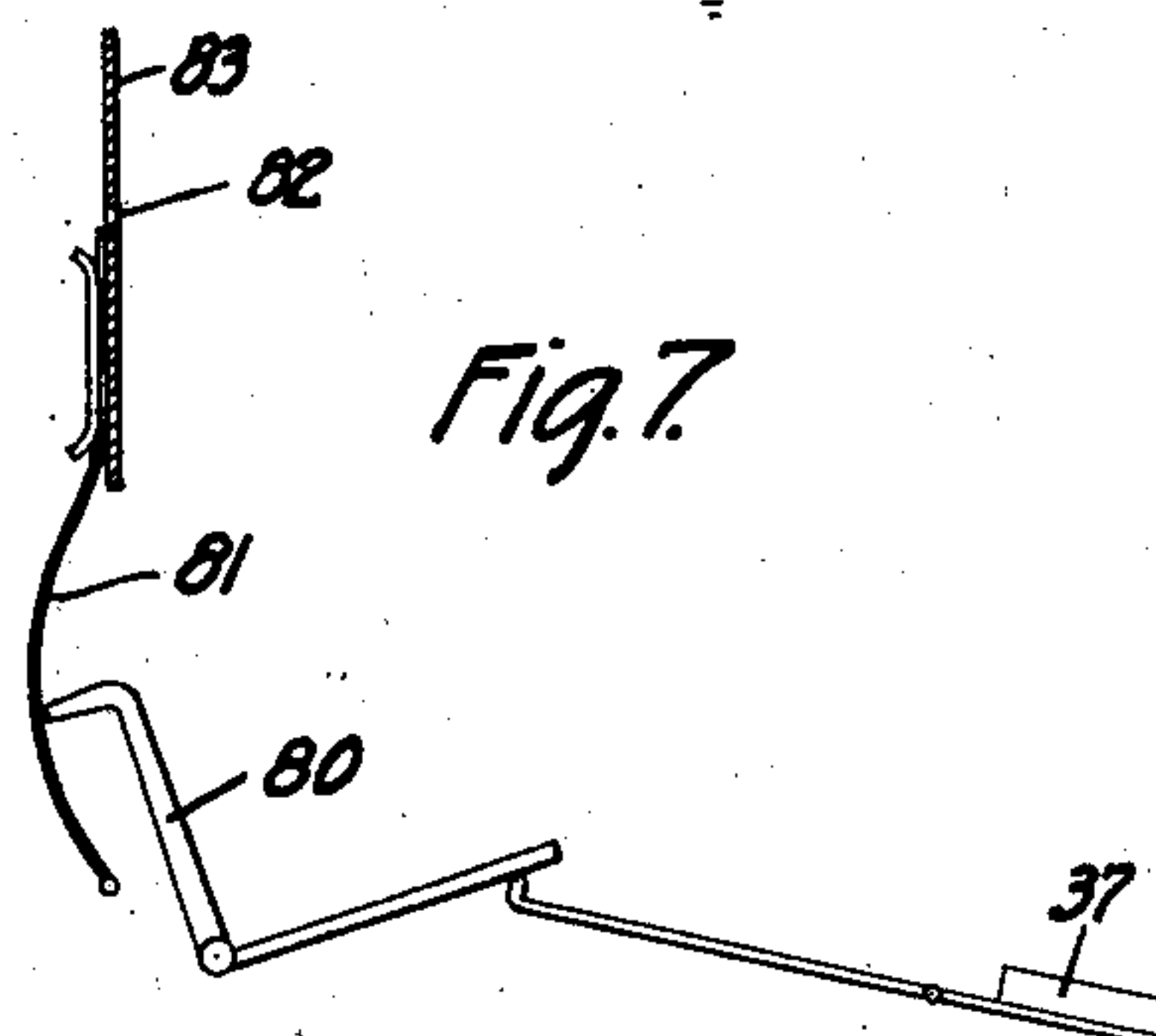
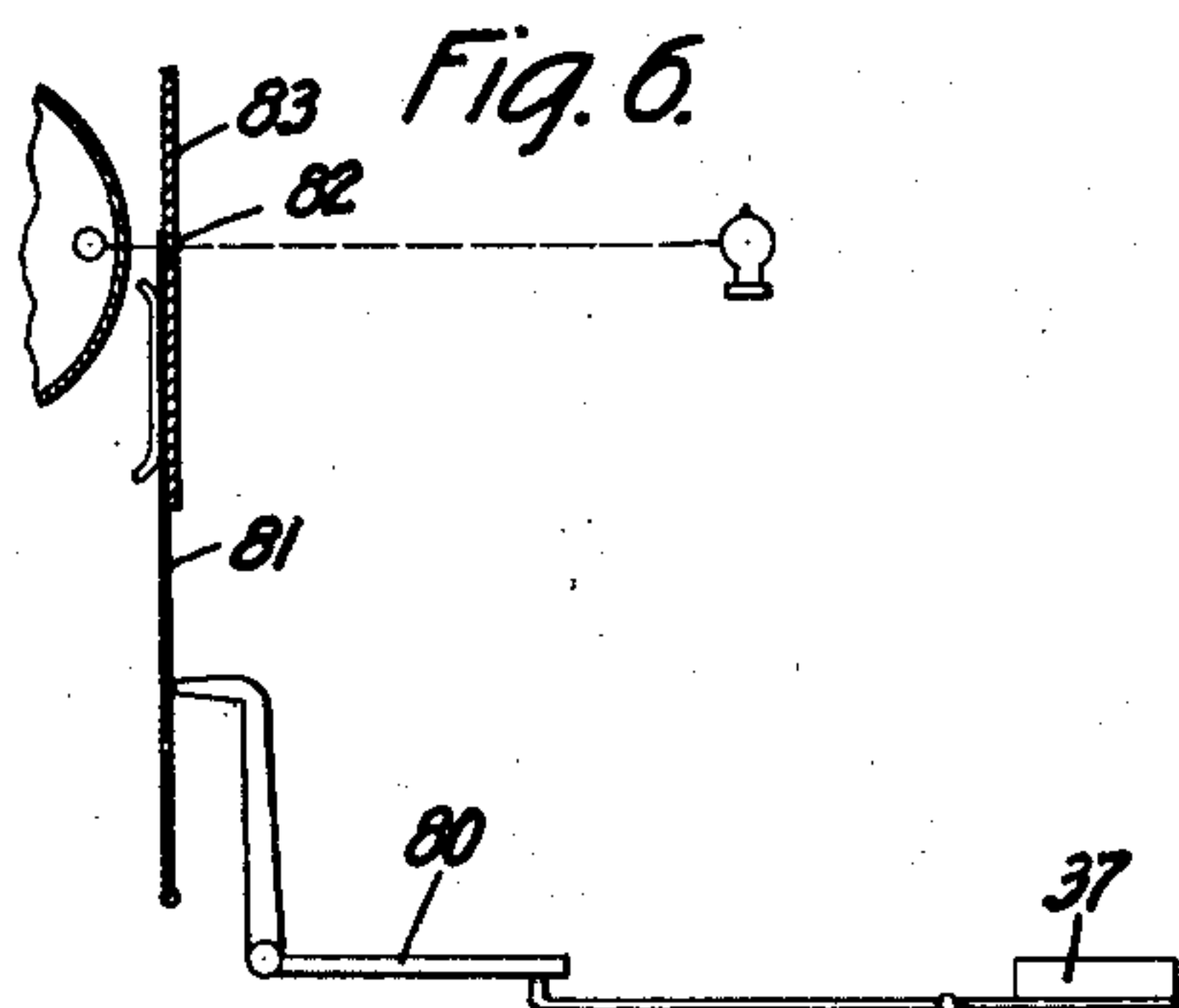
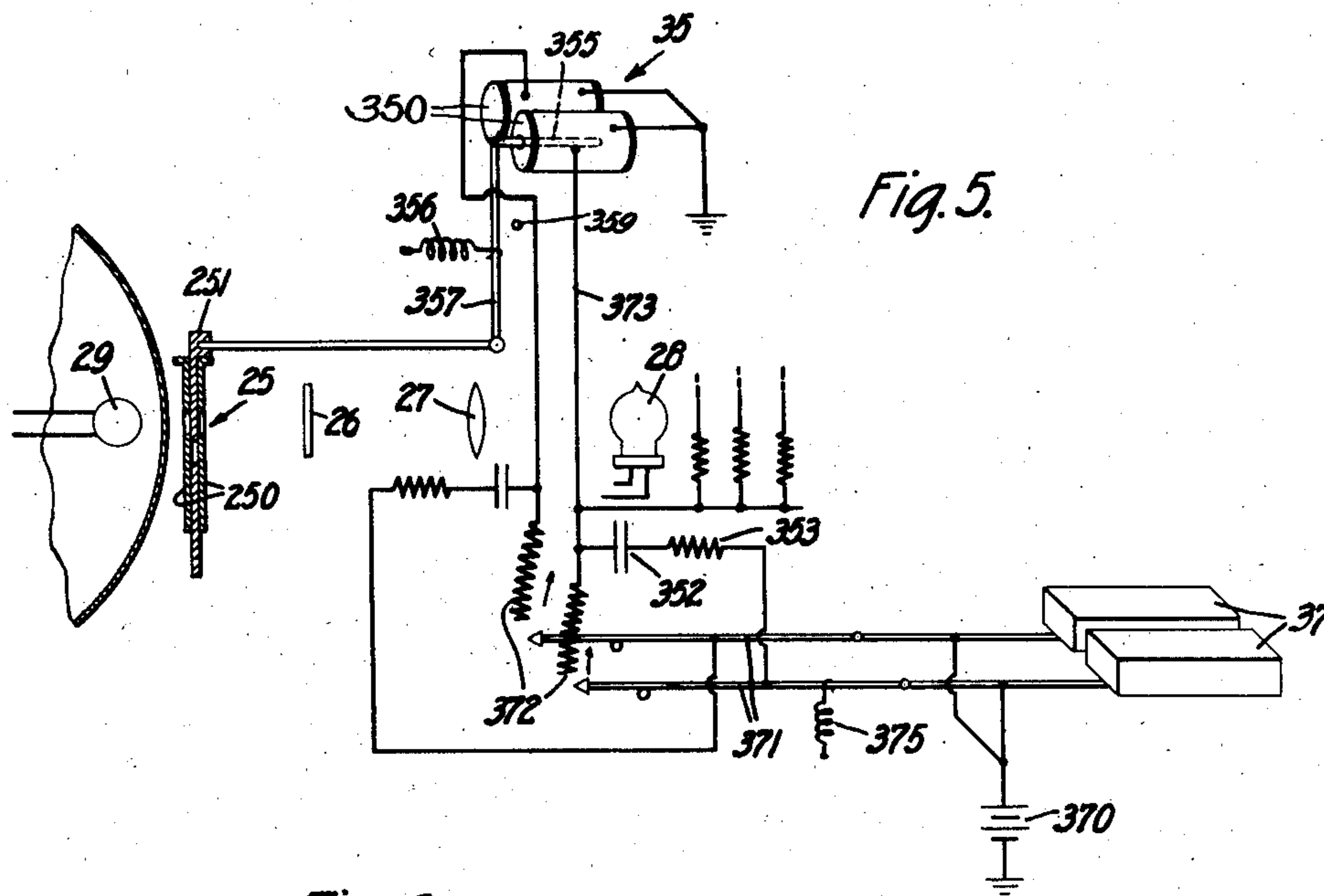
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PRODUCING MUSICAL SOUNDS

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PRODUCING MUSICAL SOUNDS

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Fig. 11.

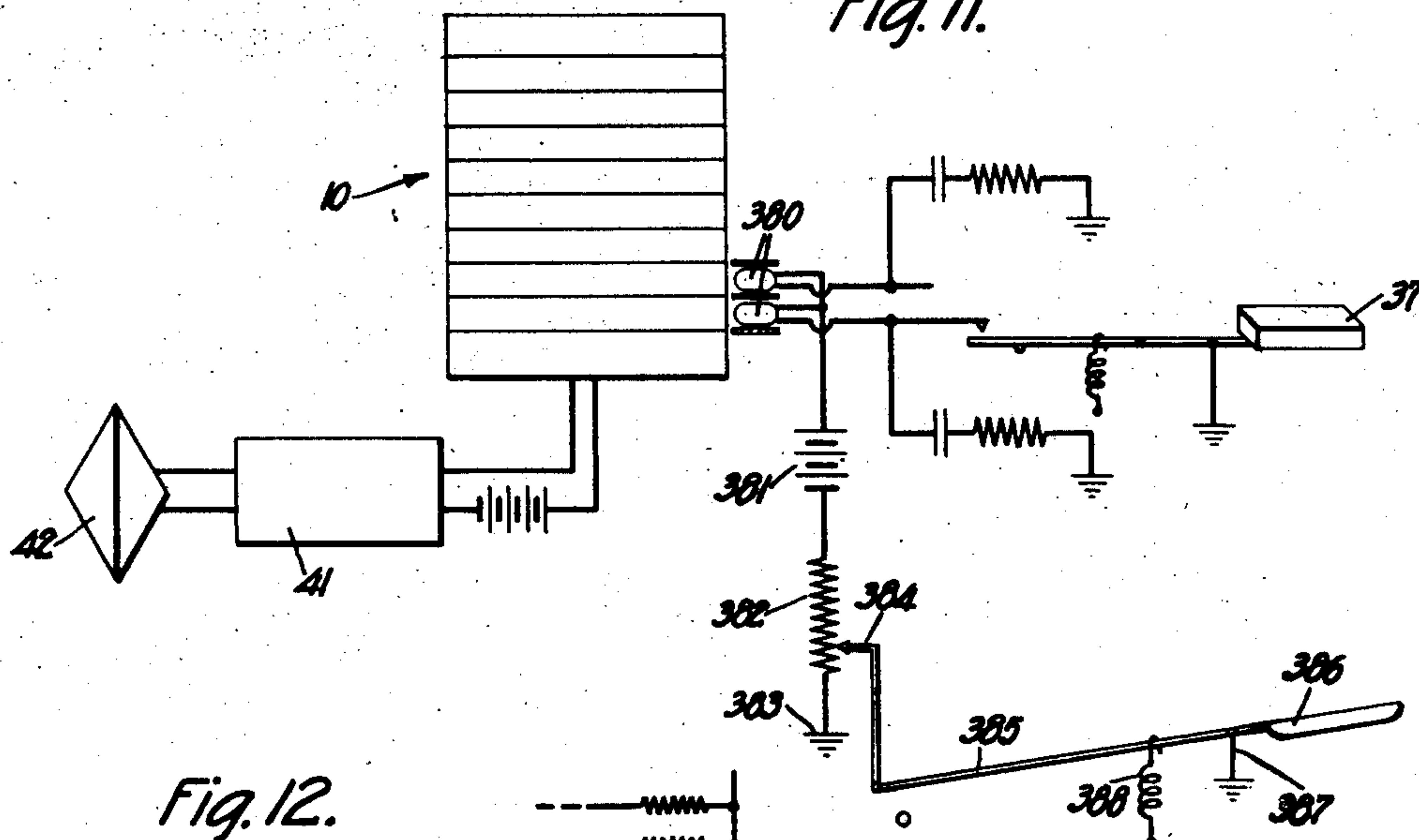
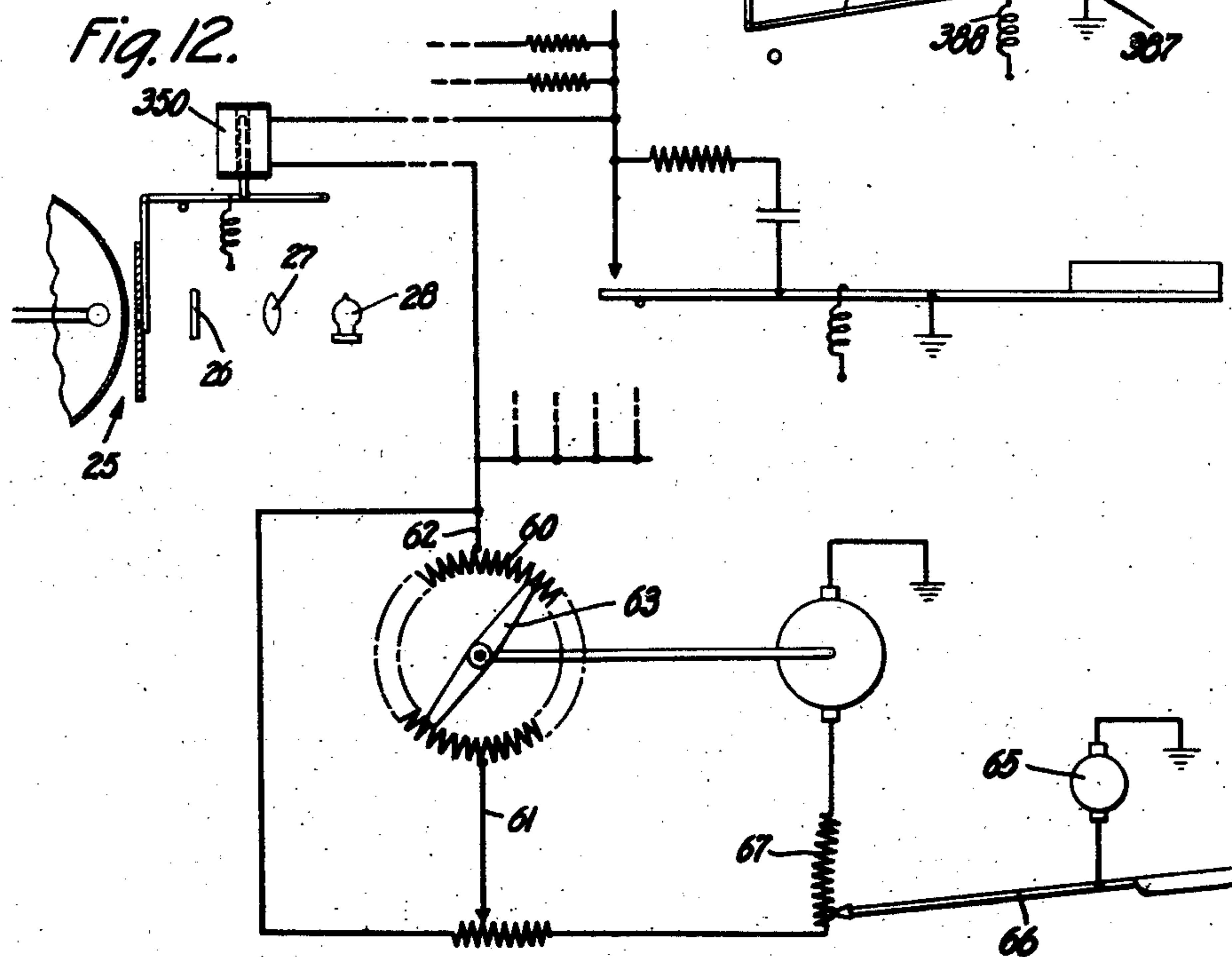


Fig. 12.



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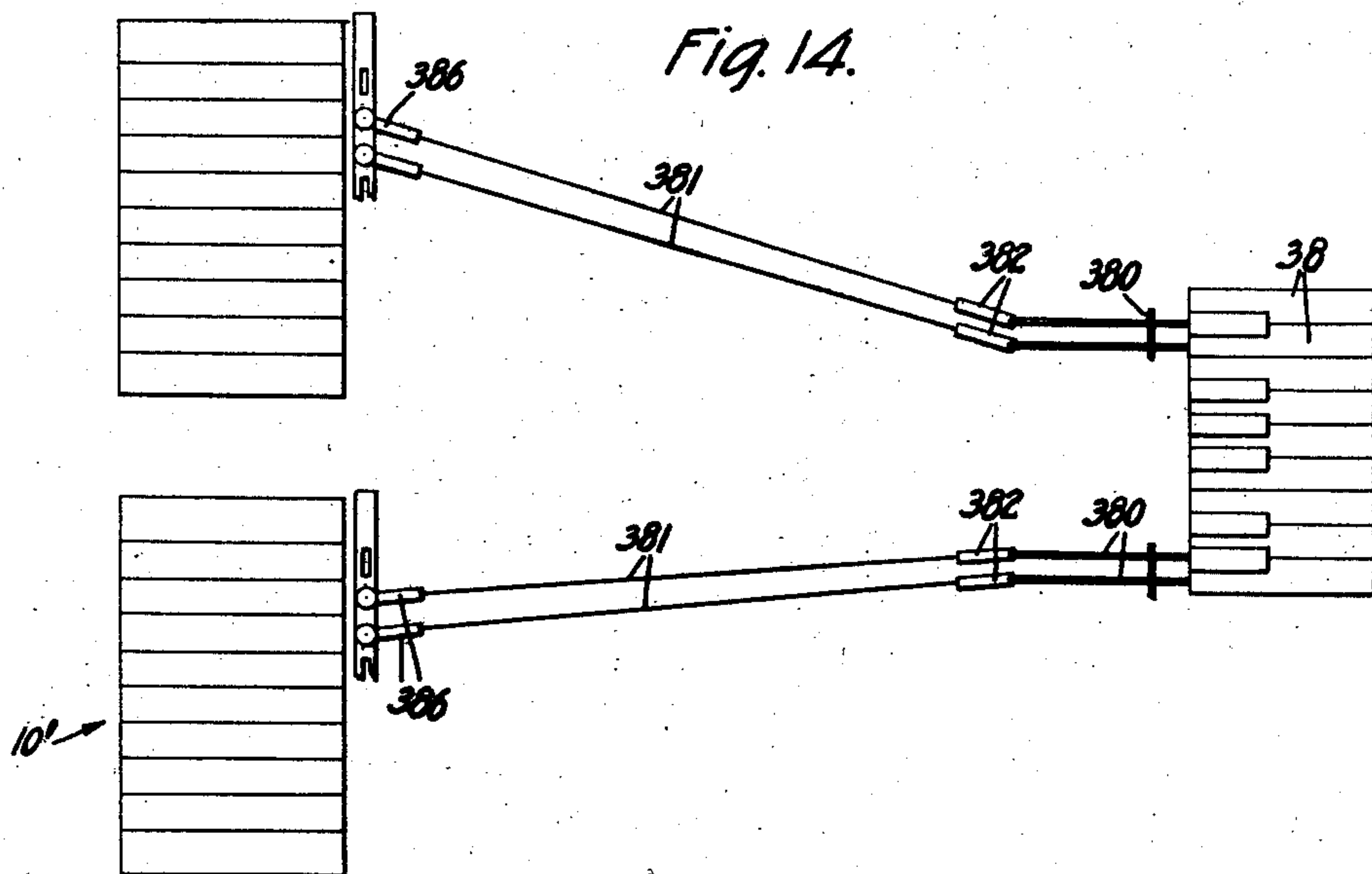
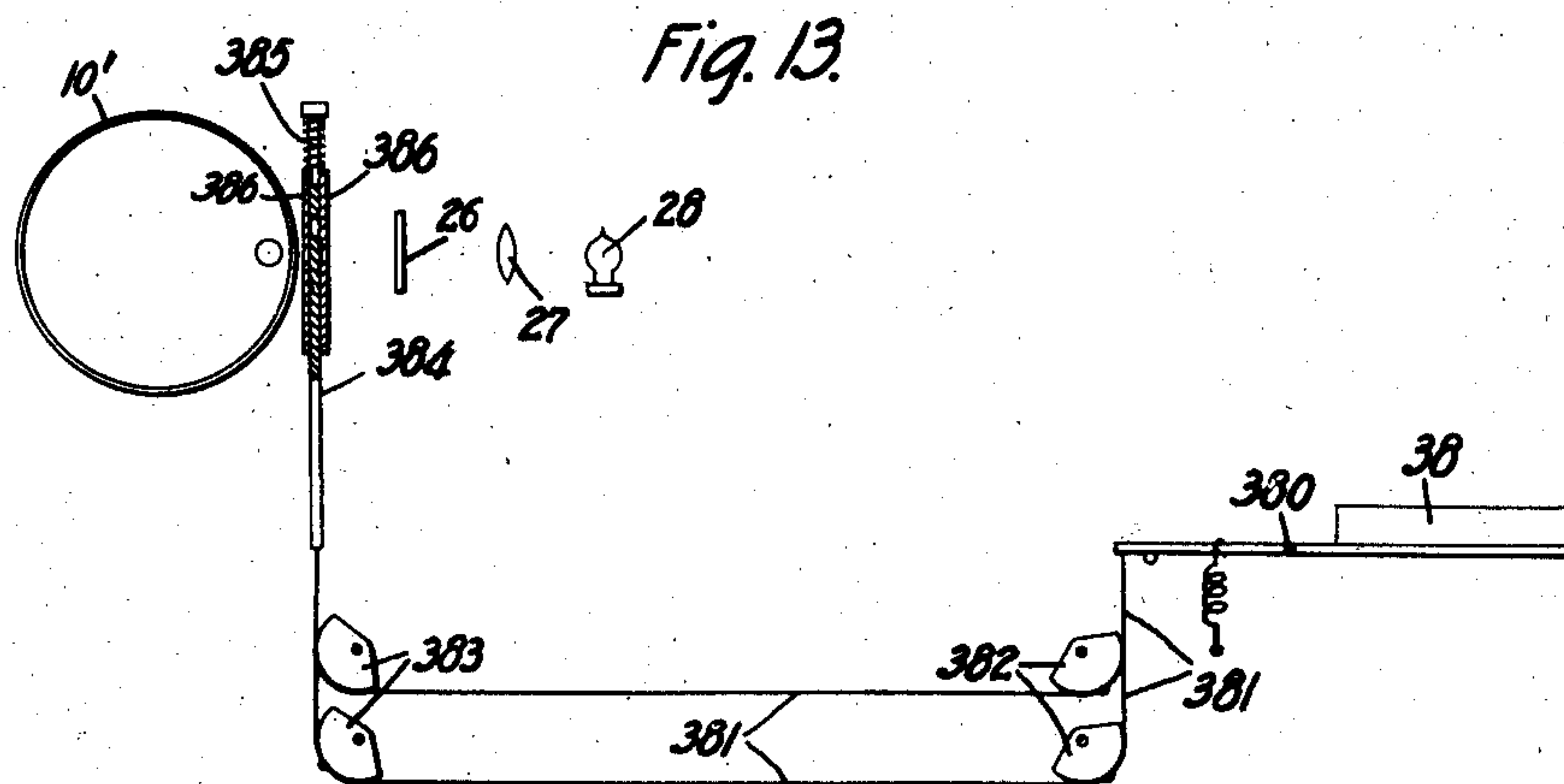
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6 Sheets-Sheet 6



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PRODUCING MUSICAL SOUNDS

Application filed May 29, 1929. Serial No. 366,866.

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 improvements in instruments 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, now Patent No. 1,678,872, issued January 31, 1928, 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 was moved between a light source and a light sensitive cell, the screen being arranged so as to contain a note pattern or note determinant, the arrangement being such that the note pattern was moved with reference to the light beam in the manner so as to produce variations in the cell current corresponding to the desired note.

The present invention has for an object an improvement over the invention disclosed in such earlier application to the end that the apparatus may be to some degree simplified, and furthermore capable of rendering more accurately the notes of a tempered musical scale. In the embodiment disclosed in said previous application, a single cylinder was provided which contained all of the note patterns or determinants whereby the pitch relationship of each note with reference to every other note was fixed for all times, the absolute pitch being determined by the speed with which such cylinder was rotated. Inasmuch as the number of vibrations per second of different notes of the tempered scale are incommensurate, this raised the difficulty in said prior construction that the cylinder had to be made fairly large to reduce the error incident upon the fact of such incommensurability. In the present invention, I propose to employ a plurality of units each containing a single note and the octaves of such note which it is desired to employ and to employ as many of such units as there are notes in the tempered scale, or twelve in all. This,

while preserving the true octave relationship, enables each unit to operate at such a speed as is theoretically required to produce the pitch demanded of each note in the tempered scale.

Further objects of the invention are to provide improved means for actuating the mechanism admitting light to the note patterns, as well as improved shutter mechanisms whereby the playing of the instrument may be facilitated, to provide improved means for regulating the action of the shutters and for modulating the note currents produced.

Other objects to be attained and advantages of my invention will be apparent as the description proceeds. My invention will be best understood by reference to the following detailed description taken with the annexed drawings in which:

Figure 1 is a more or less diagrammatic view, showing one illustrative embodiment thereof;

Fig. 2 is a view showing the arrangement of a keyboard and note units, this view showing the units for the twelve notes of the tempered scale;

Fig. 3 is a view similar to Fig. 1, but showing a modification;

Fig. 4 is a detail of a note disk employed in the arrangement according to Fig. 3;

Fig. 5 is a view showing the light valve or shutter and the actuating mechanism therefor;

Figs. 6 and 7 are diagrammatic views of a further form of shutter;

Figs. 8 and 9 are views of a still further modification;

Fig. 10 is a view of an arrangement involving a mirror for the purpose of valving the light;

Fig. 11 is a view of a modification in which a separate light source is provided for each note determining band;

Fig. 12 shows an improved means for producing a so-called tremolo effect; and

Figs. 13 and 14 are, respectively, elevation and plan views of a mechanical means for controlling the shutters from the keyboard.

Referring to Fig. 1, I have provided a plurality of note determining elements in the

form of cylinders 10, 11, 12 and 13, representing four of the twelve notes of the tempered scale, the elements for the other notes being similar and are omitted from the drawings for sake of simplification. Each cylinder contains thereon note patterns *a*, *b*, *c*, *d*, etc., of which *a* may be taken as the lowest note, and *b*, *c*, *d*, etc. higher octaves of such note. The character of the bands *a*, *b*, *c*, etc. is similar to that described in detail in my prior patent mentioned, and therefore need not be gone into in detail here, it sufficing for an understanding of the invention to state that each of said bands contains the determinant or pattern of the note such that when a band is moved across a beam of light a current will be set up in a light sensitive cell to be described. The other elements cooperating to produce the sound current in addition to the cylinder 10 are shutters, denoted generally by 25, a beam limiting screen 26, a light concentrating lens 27 of elongated shape, an elongated light source 28, and finally a light sensitive cell 29 contained within the cylinder 10. The latter, as will be seen, has trunnions 30 which turn upon shaft 31 whereby the cylinder 10 is mounted for rotation and is driven by means of gears 32, 33. The shutters 25 in the embodiment under description are actuated by means of electromagnets 35 to be described in greater detail, such magnets in turn being operated by means of keys 37.

It will accordingly be apparent that assuming the light 27 to be on and the cylinder 10, for example, to be in rotation, upon depressing a key 37 connected to said cylinder, a beam of light from the bulb 28 will be allowed to pass through the light valve operated by said key through or across the moving beam opposite said valve and onto the light sensitive cell 29. Due to the variation produced in said light beam, a current will be set up in cell 29 which will be conducted through wires 39, 40, be amplified in amplifier 41 and actuate a loud speaker 42. As shown in Fig. 1, I may conveniently mount four of the note cylinders so as to be driven from a common shaft 44 which is connected to an electric motor 45. The manner of connecting the various keys with the various note elements is seen best from Fig. 2, it being noted that due to the fact a given note and the octaves thereof are grouped together, the sequence of the note bands does not, of course, correspond with the keys of the keyboard. Due, however, to the special connecting mechanism employed by me, no structural difficulty arises because of this fact.

In Figs. 3 and 4 I have shown an alternative arrangement of the note patterns, this form being characterized by the employment of a plurality of disks 51, 52, 53, 54, 55, etc., such disks being similar in principle to the cylinders 10, 11, etc., and containing circumferentially parallel bands *a'*, *b'*, *c'*, etc. (Fig. 4).

The shutters 25', beam limiting screen 26', lens 27', light source 28' and light sensitive cell 29' are all essentially similar to their counterparts in the embodiment first described. A feature of the disks is that they are mounted upon concentric shafts 51*a*, 52*a*, 53*a*, 54*a*, etc., and are separately and respectively driven by pairs of gears 51*b*, 51*c*; 52*b*, 52*c*; etc., gears having the exponent "*c*" being directly connected to a motor 45'. In addition, the amplifier 41' and loud speaker 42' are the same as in said previously described embodiment, as is the key mechanism (key 37' and magnets 35') illustrated.

The foregoing describes the general arrangement of the elements necessary for tone production by manual means such that any desired sequence of notes may be played similar to the piano.

A more detailed description of the means for valving the light to a given note screen may now be given. Referring to Fig. 5, circuit is made by depressing key 37 from a battery 370, key arm 371, resistance 372, conductor 373, solenoid 350, and thence to ground. When key 37 is not pressed the circuit is open as seen in Figure 5 since the end of arm 371 is no longer in contact with resistance 372. A condenser 352 and inductance 353 are shunted across the arm 371 and resistance 372 for the purpose of preventing sparking. When solenoid 350 for example is energized, an armature 355 is drawn thereinto against the action of a spring 356 attached to bell crank 357 and thereby actuating the shutter mechanism 25 consisting of stationary apertured guides 250 and an apertured shutter 251. Due to the action of the resistance 372 the armature 355 will be drawn into the solenoid a variable amount depending upon the force with which the key 37 was struck and thus varying the amount of light passed through the shutter mechanism 25. Spring 375 returns the key to its inoperative position. A stop 359 may also be provided to vary the limit of travel of the bell crank of 357 and thus the amount of light opening.

In Fig. 11, I have shown a slightly different arrangement of elements wherein, in lieu of a single light source for which a plurality of valves are provided, such valve mechanism is dispensed with and separate light sources are provided for each note band. In this arrangement a key 37 makes a circuit including a light valve 380, battery 381, resistance 382, and ground 383. Resistance 382 is common to a plurality of keys and has a contact 384 in wiping relation which contact is a contact forming part of a lever 385 which terminates in a pedal 386, said lever being joined to the ground at 387 and also being provided with a spring 388 for returning same to its initial position. By means of pedal 386 it is thus possible to vary the in-

tensity of a plurality of lights which may include the lights for all the notes on the keyboard.

In Fig. 12, I have shown means for varying the quality of the notes produced particularly for producing the so-called tremolo effect. This arrangement includes means for continuously varying the flux through a plurality of solenoids 350 controlling the shutter mechanisms 25. As shown, this is accomplished by means of a resistance 60 which is of annular shape and is connected at either side thereof by means of conductors 61, 62, such that by means of the double contact 63 the amount of resistance in the circuit of said solenoids is continuously varied by rotating such contact by means of a motor 64 which is set into operation when the contact carried by arm 66 engages resistance 67. At such time current from generator 65 also flows through the pedal arm 66, variable resistance 67 to solenoid 350 which thereby causes shutter 25 to have a vibratory movement and thus produce a tremolo effect in the tone produced.

In Fig. 13, I have shown a mechanical connection between the keys and the light valves which because of its flexibility may be used in lieu of the electrical connections in Fig. 2. As shown, the key 38 is pivoted at 380 and has joined to its end a thin steel wire 381 for which are provided guides 382, 383, the other end of the wire being connected to shutter 384. It will be evident from this figure that depressing key 38 will cause the shutter 381 to move against the action of a spring 385 so that the aperture in said shutter will coincide with the apertures in guides 386 and thereby admit light to the note screen 10'.

In Figs. 6 to 9, I have shown various forms of light valves and actuating means therefor. Thus, in Fig. 6 depressing key 37 tilts a bell-crank lever 80 and thus causes a shutter 81 of flexible spring material to assume the shape shown in Fig. 7 whereupon it is pulled down so as to uncover the opening 82 in a stationary member 83. In Figs. 8 and 9 a depressing key 37 causes the shutter 85, also in the form of a bell crank, to tilt in the position shown in Fig. 9, suitable means being provided for limiting the throw of said shutter and for returning the key to initial position. In Fig. 10, I have provided a shutter 85 in the form of a mirror which when in raised position, will cause light from a source 86 to be reflected through the aperture in member 87 and thence upon the note screen. It will be understood that the shutter arrangements above described, while in the form shown, are primarily adapted for a form of cylinder in which the note patterns follow in order, i. e., similar to the strings of a piano, that the showing of the keys is merely conventional and that so far as the inventive concept of these arrangements is concerned, they are equally adapted either to mechanical actua-

tion illustrated in Figs. 13 and 14, or to an appropriate form of magnetic actuating means.

In a co-pending application, Serial No. 317,379, filed November 5, 1928, I have shown a modification in which the note determinants instead of being mounted on a cylinder are stationary and in which a movable light beam is provided. The element bearing such note patterns is arranged so that it may be brought into operative position and removed therefrom and others of different tone quality substituted. Accordingly, I wish it understood that the device disclosed herein may be applied equally to such an arrangement.

I wish it understood that various devices constituting my improved system of producing musical notes are illustrative only and are susceptible to modification which will occur to those skilled in the art without, however, departing from the spirit of my invention nor the scope of the appended claims.

I claim:

1. In a device of the character described, in combination, a plurality of units, each corresponding to a given note of a musical scale, each unit comprising a source of light, a light sensitive cell, a screen interposed between said source and said cell, said screen having a determinant for said note together with those of octaves of said note and arranged so that when moved with reference to the light from said source, a current corresponding to said note or an octave thereof as the case may be will be set up in said cell, means for controlling the light admitted to each determinant and means for determining at will the sequence of notes to be played.

2. In a device of the character described, in combination, a plurality of units, each corresponding to a given note of a musical scale, each unit comprising a source of light, a light sensitive cell, a screen interposed between said source and said cell, said screen having a determinant for said note together with those of octaves of said note and arranged so that when moved with reference to the light from said source, a current corresponding to said note or an octave thereof as the case may be will set up in said cell, and means for controlling the light admitted to each determinant and means comprising a keyboard having the keys in pitch sequence for determining at will the sequence of notes to be played.

3. A device according to claim 1 in which each screen is in the form of a disk and the screens of the several units are arranged concentrically with respect to one another.

4. A device according to claim 1 in which each screen is in the form of a disk and the screens of the several units are arranged concentrically with respect to one another and spaced from each other longitudinally of the axis of rotation.

5. A device according to claim 2 having electrical means connecting the keyboard with said light controlled means.

6. In a device of the character described, a light source, a light sensitive cell, a light screen interposed between said source and said cell, and a light valve between said cell and said source and means for actuating same comprising electric magnetic means, a key for making the current therethrough and means for varying the strength of said magnetic means in accordance with the amount of depression of said key.

7. In a device of the character described, having a light source, a light sensitive cell, in combination therewith of a shutter of flexible material in the path of a light beam from said source, a key, and a connection between said key and said shutter such that when said key is depressed said shutter will be flexed so as to be held in an inoperative position and thus allow the light to pass to its required destination.

8. In a device of the character described having a light source and a light sensitive cell, in combination therewith of a shutter between said cell and said light source acting as a valve for such light, said shutter being tiltably mounted, and means for actuating same.

9. The device according to claim 8 in which the shutter has a reflecting surface which, when actuated, is operative either to reflect light onto said cell from said source or to reflect said light out of contact with said cell.

10. In a device of the character described having a light sensitive cell, a controlled source of light for actuating same, means for producing a tremolo effect comprising a shutter element for valving the light to said cell, magnetic means controlling same, and means for continuously varying the position of said shutter element by continuously varying the flux of said magnetic means.

In testimony whereof, I have signed my name to this specification this 27th day of May, 1929.

RALPH K. POTTER.