(No Model.) 5 Sheets—Sheet 1.

G. BREED.

METHOD OF AND APPARATUS FOR PRODUCING MUSICAL SOUNDS BY ELECTRICITY.

No. 435,679. Patented Sept. 2, 1890.

FIG 1.

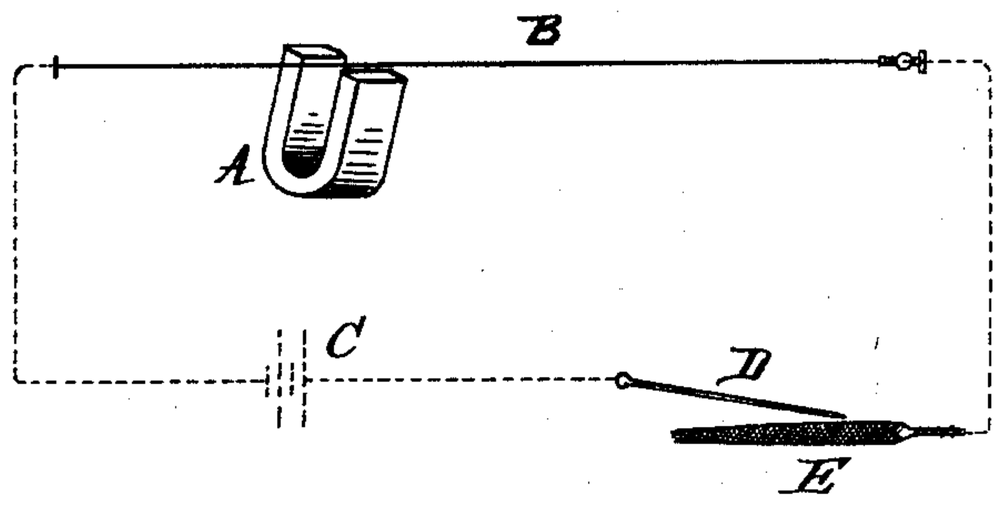
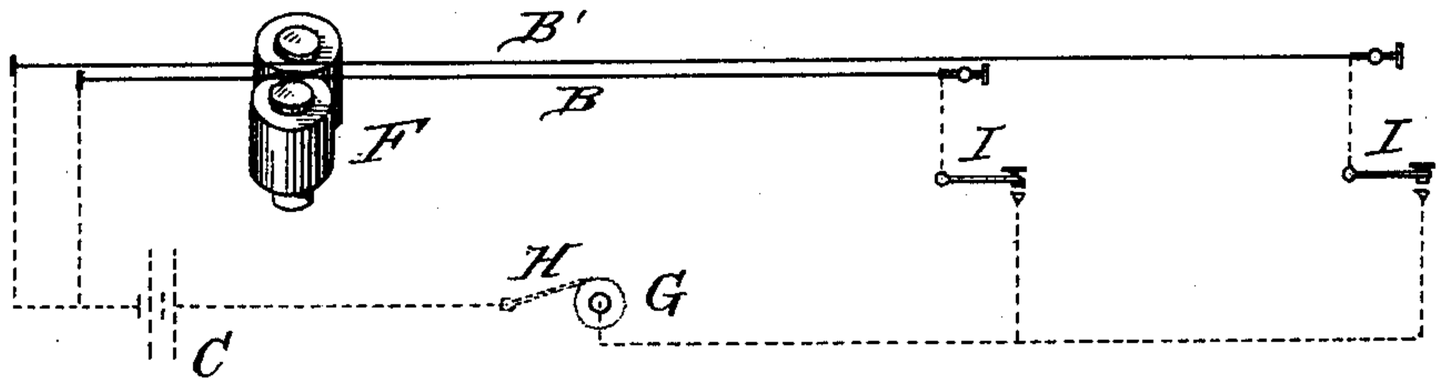


FIG. 2.



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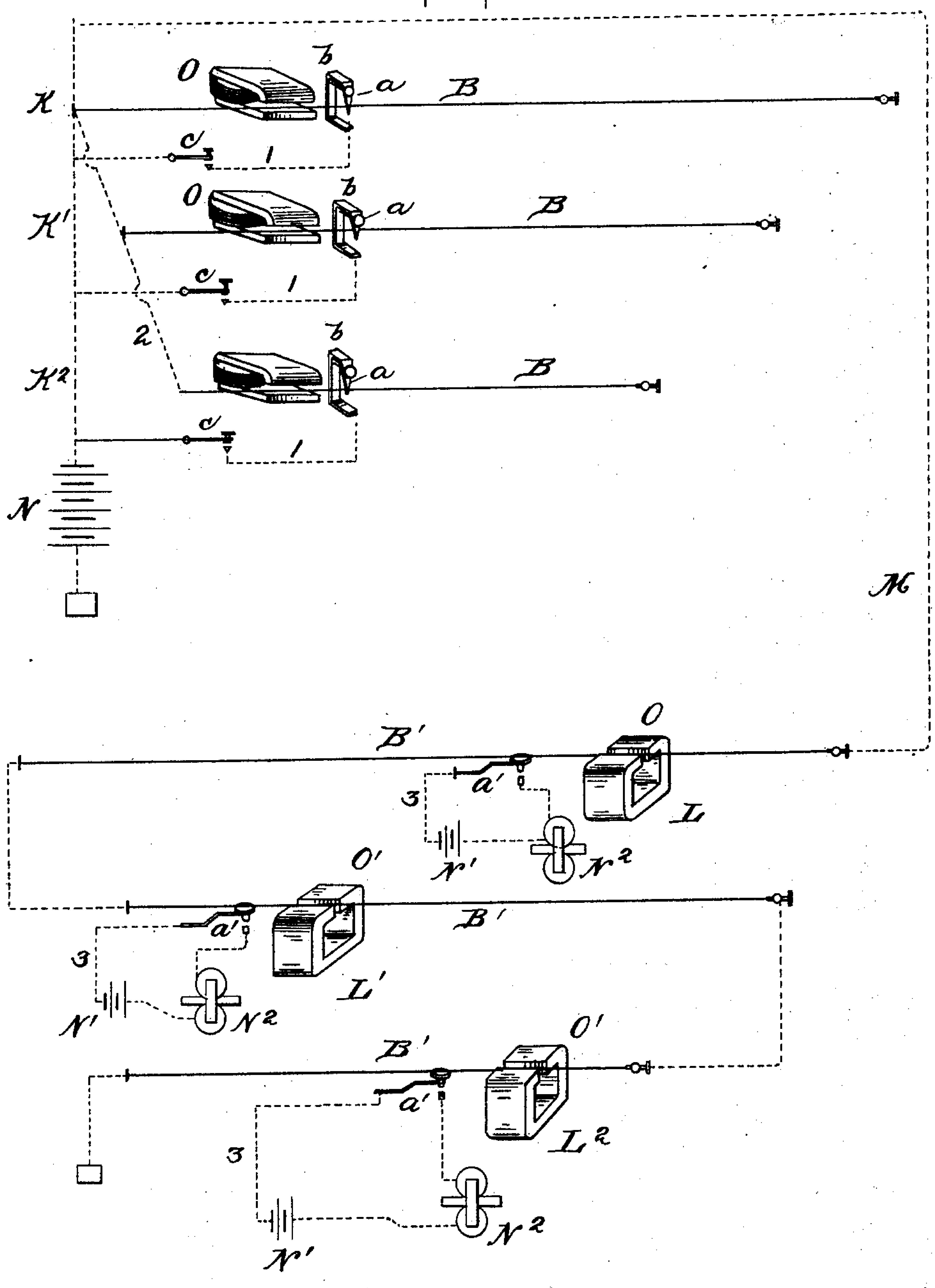
METHOD OF AND APPARATUS FOR PRODUCING MUSICAL SOUNDS BY ELECTRICITY.

No. 435,679.

Patented Sept. 2, 1890.

FIG. 3



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(No Model.) 5 Sheets—Sheet 3.

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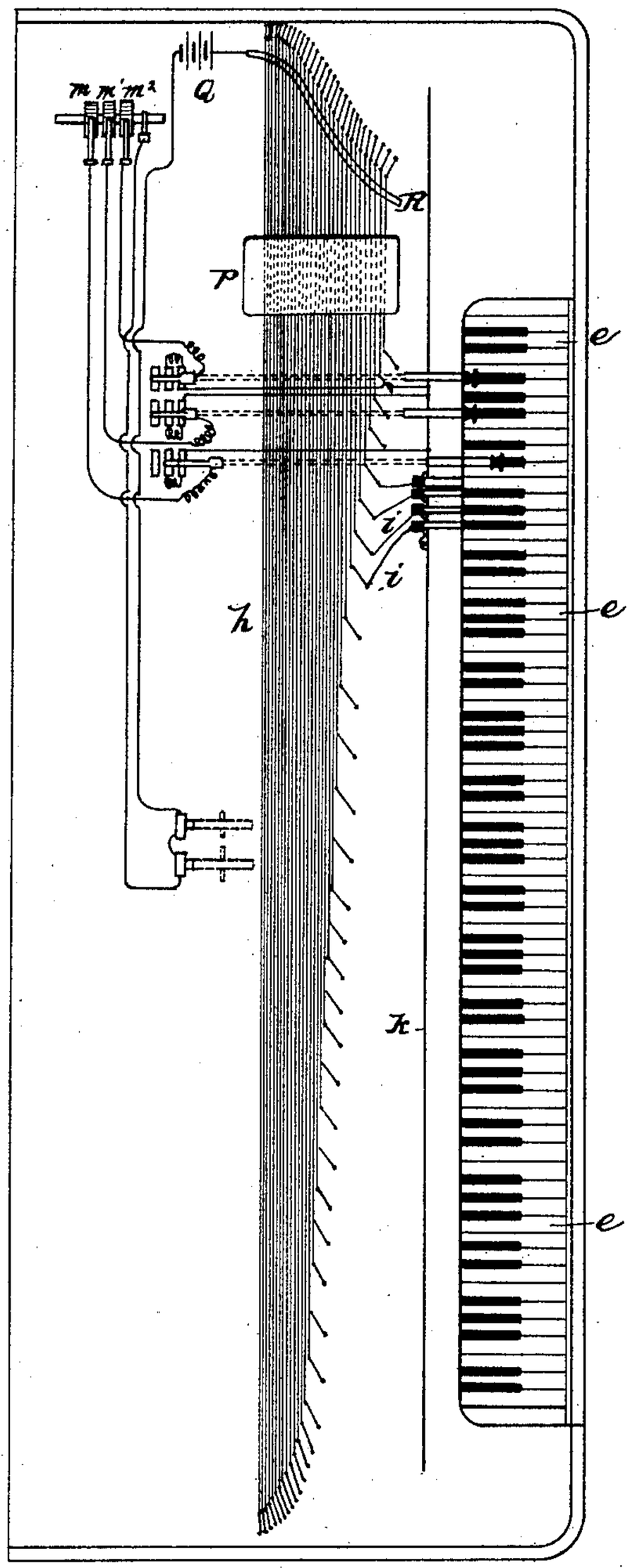
METHOD OF AND APPARATUS FOR PRODUCING MUSICAL SOUNDS BY ELECTRICITY.

No. 435,679. Patented Sept. 2, 1890.

FIG. 4



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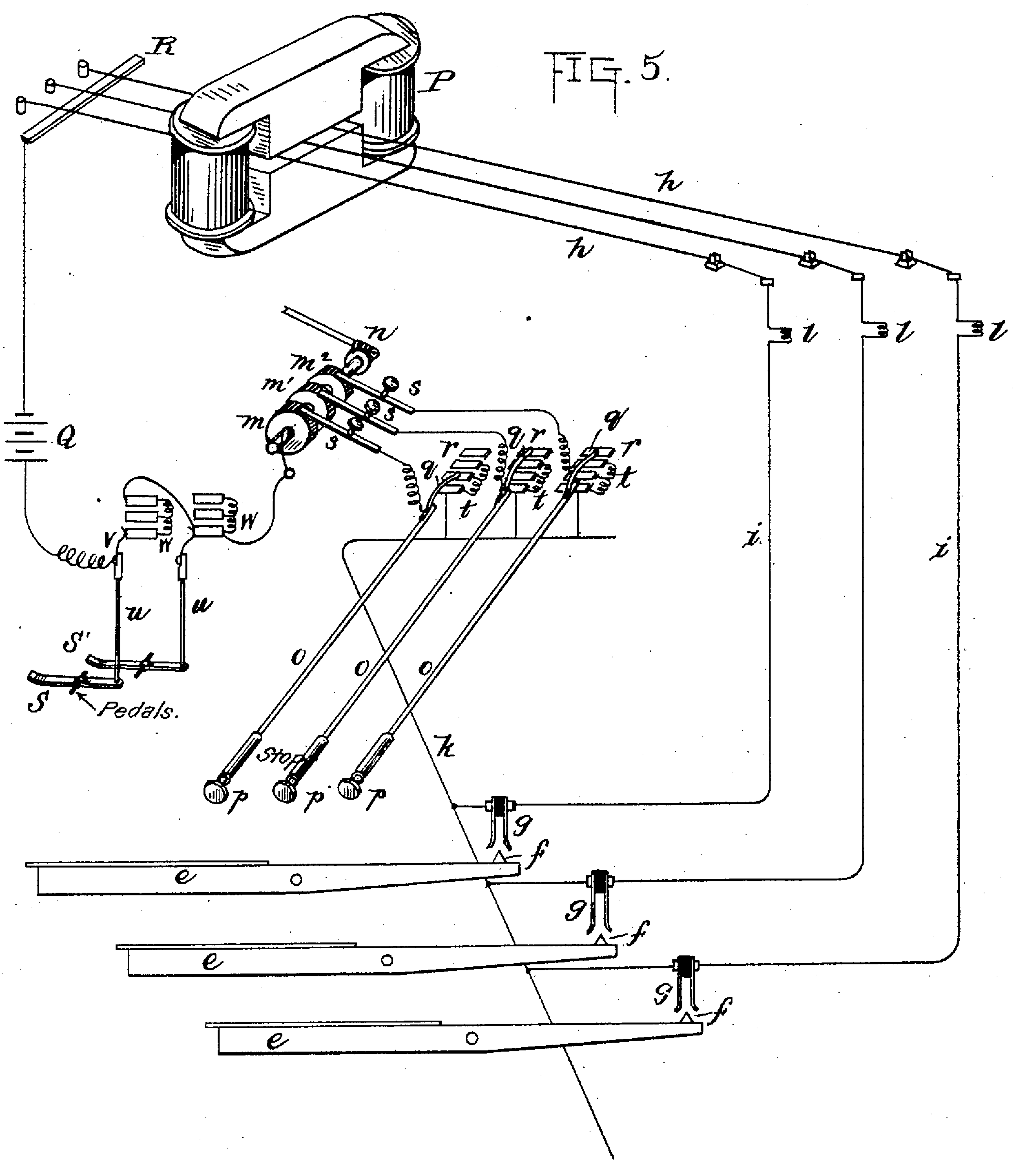
METHOD OF AND APPARATUS FOR PRODUCING MUSICAL SOUNDS BY ELECTRICITY.

No. 435,679. Patented Sept. 2, 1890.

FIG. 5.



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G. BREED.

METHOD OF AND APPARATUS FOR PRODUCING MUSICAL SOUNDS BY ELECTRICITY

No. 435,679. Patented Sept. 2, 1890.

FIG. 6.

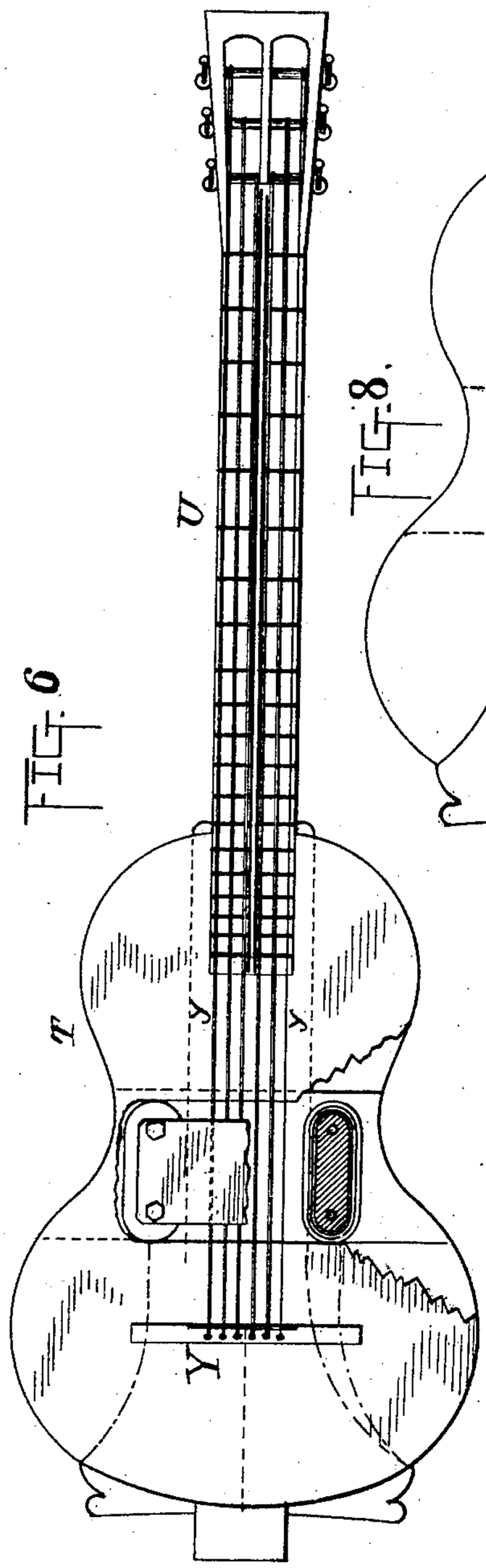


FIG. 8.

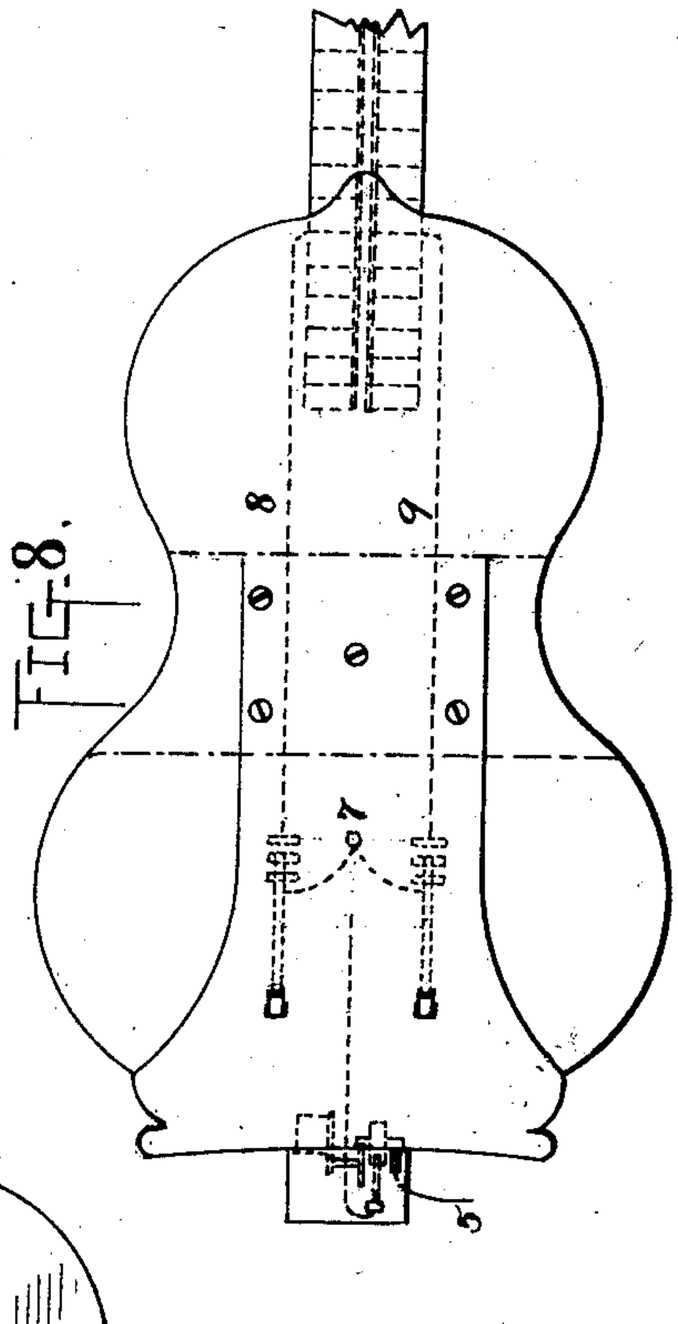


FIG. 7.

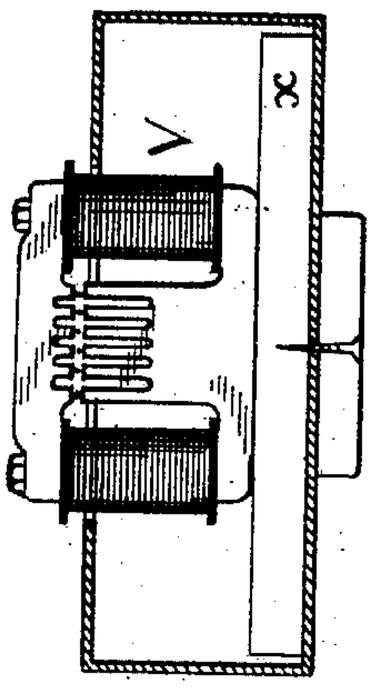
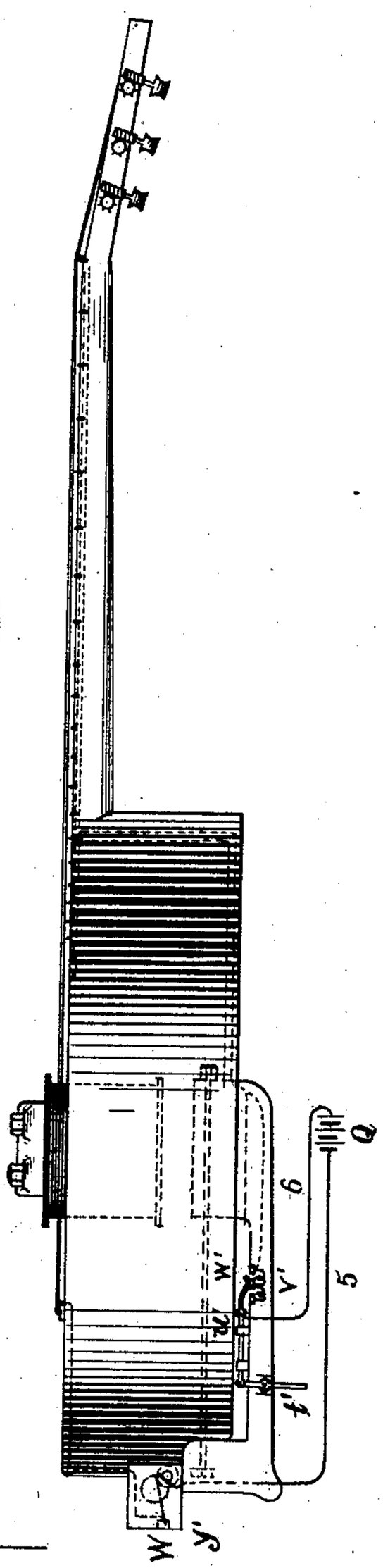


FIG. 9.



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UNITED STATES PATENT OFFICE.

GEORGE BREED, OF THE UNITED STATES NAVY.

METHOD OF AND APPARATUS FOR PRODUCING MUSICAL SOUNDS BY ELECTRICITY.

SPECIFICATION forming part of Letters Patent No. 435,679, dated September 2, 1890.

Application filed January 31, 1890. Serial No. 338,760. (No model.)

To all whom it may concern:

Be it known that I, GEORGE BREED, of the United States Navy, have invented a new and useful Improvement in the Method of and Apparatus for Producing Musical Sounds by Electricity, of which the following is a specification.

My invention relates to a novel method of producing sound by the vibrations of a stretched wire in a magnetic field, and to the application of such method to various purposes, such as telegraphic or signaling purposes and for musical instruments.

My invention is based on the discovery, which I believe to be original with me, that if a wire is stretched in a magnetic field and an irregular or non-continuous current—such as a current rapidly made and broken or an alternating current—is passed through such wire and maintained therein, vibrations will be set up in the wire so long as such non-continuous current is maintained in said wire, the pitch of which will be dependent of course upon the nature of the wire and the degree of tension upon it. I find the best results to be obtained by the use of a current which is made and broken rapidly and unevenly, so that the current-pulsations are uneven, whereby vibrations will be produced which will be synchronous with those of any wire which may be used. For example, such current as would be produced by drawing a metal point included in the circuit over a coarse file or other rough conducting-surface also in circuit I find to produce good results, and continuing this illustration I find that the tone of the vibrations is dependent on the nature of the file-surface—that is, with a finely-cut file a softer tone is produced than with one of coarser cut.

The principle of my invention and various applications thereof are illustrated in the accompanying drawings.

Figure 1 is a simple diagram illustrating the principle of the invention. Fig. 2 is a more extended illustration showing its application to two wires. Fig. 3 is a diagram illustrating the manner in which my invention may be employed for multiple telegraphy. Fig. 4 is a top view and partial diagram of an electrical piano embodying my invention; Fig. 5, a diagram and partial perspective view showing the arrangements and connections of the different parts of the piano. Figs. 6 to 9 illustrate the application of my invention to a guitar, Fig. 6 being a top view with a portion of the case removed, Fig. 7 a cross-section through the head of the guitar, Fig. 8 a bottom view, and Fig. 9 a side elevation.

Referring first to Fig. 1, A represents a permanent magnet, and B a wire stretched between the poles thereof and connected in a circuit from a battery C. In the circuit is a metal pin D and a file E. If the pin D is drawn over the surface of the file E, so that a broken current is produced in the circuit, a musical tone is produced by the vibrations of the wire B, the pitch of such tone being dependent of course on the well-known principles attending the production of sound by stretched wires.

In Fig. 2 I show two wires of different lengths B and B′, passing between the poles or through the magnetic field of an electro-magnet F, which may be energized in any suitable way. The current from the battery C passes through the stretched wires, and in the circuit common to both of them is included a rough-surfaced conducting-wheel G, on which bears a spring or brush H. Each circuit being provided with a key I or other circuit-closer and the break-wheel G being in rotation, if either key I is closed the corresponding stretched wire is set into vibration, and it will be seen that as each key is closed a sound of different pitch will be produced.

Referring now to Fig. 3, K K′ K² indicate transmitters, and L L′ L² corresponding receivers connected therewith by a line-circuit M, supplied by a battery N. Each transmitter consists of a magnet O, between the poles of which passes a stretched wire B, against which rests a flexible platinum point *a* on a metal standard *b*, from which standard a wire 1, containing a key *c*, extends to the line. The stretched wires B are all connected with the line through the wire 2. Each receiver consists of a magnet O′, between the poles of which is a stretched wire B′, resting against which is a circuit-controlling key *a*′, which controls a local circuit 3, including a battery N′ and sounder N². The wires B are of different lengths or otherwise adapted to produce sounds of different pitch, and so are the wires B′; but each wire B′ corresponds in pitch with one of the wires B. Now it will

be seen that if any key *c* is closed the circuit will be closed through the corresponding wire B at *a*, and the first vibration of such wire will break the circuit at *a*, and so long as the key remains closed the wire will vibrate against the point and cause pulsations of current on the line corresponding to the vibrations of the wire B. Such vibrations will be transmitted over the line to the receiver-station, and the corresponding wire B′ at that station will be thrown into vibration, the other wires not being affected. The vibrations of the wire B′ due to the vibrations of the current passing through it, it being in the magnetic field, as explained, will move the key *a′* and close the local circuit and operate the sounder. It will be seen that if a number of transmitters such as described and also a number of receivers are in connection with the line any transmitter may be made to communicate with any receiver without affecting the other receivers by using a wire which vibrates in synchronism with the receiver-wire, whereby several messages may be sent simultaneously over the line without interfering with each other.

With reference to the use of my invention for musical instruments, it may be said that it is applicable to most of the instruments now in use. I have shown it as applied to a piano and to a guitar, these being simple illustrations of use to which it may be put.

Referring to Figs. 4 and 5, each of the keys *e* of the piano, which keys are arranged in the ordinary way, is provided at its inner end with a metal contact-piece *f*, which, when the outer end of the key is depressed, enters between contact-springs *g*, so as to close circuit between said springs. The piano is provided with the usual stretched wires or strings *h*, and all these wires pass between the poles of the electro-magnet P, placed within the piano-case at a suitable point. Each of the piano wires or strings *h* is connected by a wire *i* with one of the pairs of springs *g*, the opposite spring *g* of all the pairs being connected to a common wire *k*, which extends through the break-wheels and regulating devices, which will be hereinafter described, to the battery Q, the other pole of the battery being connected to the metal bridge R, over which all the stretched wires *h* pass, whereby such wires are included in the circuit from the battery. In each wire *i*, connecting a piano-string with the key-board, I prefer to place a small resistance-coil *l*, these coils being for the purpose of so proportioning the resistance of the different circuits as to equalize the volume of sound, they being proportioned in the manufacture of the instrument so as to effect this result.

In the circuit common to all the keys I place break-wheels *m m′ m²*. The purpose of using several break-wheels will be presently explained; but apart from this it will be seen that when the break-wheels are revolved—which may be done by an electric motor or other motor connected by the worm *n* with the break-wheels, as shown—if any key of the piano is depressed a vibrating current will pass through the piano-string controlled by that key, and such wire will, as before explained, vibrate with a musical note as long as the key remains depressed. There is in this a great advantage over mechanical pianos, in which a continuous prolonged note cannot be obtained, whereas in my instrument the same note will be maintained so long as the key remains depressed.

The break-wheels *m m′ m²* are made of suitable conducting material and formed or provided with rough or corrugated surfaces. Each wheel has its surface of a different degree of roughness, the object being to enable the note or sound to be changed from a smooth sound to a rougher one. As already stated, by using a rough or uneven contact making and breaking surface I am enabled to make a single break-wheel act for a number of wires of different rates of vibration, since I find that with such a circuit-breaker there will always be some vibrations of current to correspond with the vibrations of the particular wire which may be in circuit at any time.

To connect the different break-wheels in circuit, respectively, and at the same time to enable the loudness of the sound from any break-wheel to be altered, I provide rheostats or choking-coils controlled by rods *o*, which extend outside of the case and have knobs *p* at their outer ends, so that the rods may be pushed in or pulled out after the manner of the stops of an organ. At the end of each rod *o* is a spring *q*, which rests on one of the plates *r*, according to the position of the rod. Springs or brushes *s*, resting on the break-wheels, are each connected with one of the rods *o* by a flexible or other connection. An end contact-plate of each series of plates *r* is connected with the wire *k*. The contact-plate at the other end of each series is disconnected from the circuit and the intermediate contact-plates are joined together through resistance-coils *t*. When any spring *q* is on the outermost plate *r*, the circuit of the corresponding break-wheel is closed through no resistance, and if the rod *o* is pushed in, a resistance-coil *t* is placed in circuit, and the resistance of the circuit may be varied by the extent to which the rod is drawn out, which varies the amount of resistance *t* in the circuit. When the spring is on the innermost plate, the circuit is broken.

As illustrated in the drawings, the break-wheel *m* is in circuit and the break-wheels *m′* and *m²* are out of circuit. It is evident that any one of the break-wheels or any two of them, or all of them, if desired, may be placed in circuit at any time, according to the different sound effects which it may be desired to produce. I also provide the usual pedals for modifying the volume of sound, these pedals controlling resistances in a common circuit of the break-wheels.

S is the loud pedal, the depression of which cuts resistance out of circuit and increases the volume of sound, and S′ is the soft pedal, by means of which resistance is placed in circuit to decrease the sound. The pedals are pivoted, as usual, and rods *u* extend up from them, carrying at their ends contact-springs *v*, which travel over the contacts of adjustable resistance *w*. It will be seen that the depression of the outer end of the pedal S reduces the amount of resistance *w* in circuit, while the depression of the pedal S′ increases the resistance, whereby the volume of sound is altered.

Referring now to Figs. 6 to 9, T is the head of the guitar, and U the stem. Within the hollow head T, on the bottom thereof, I place a brace *x*, which forms a support for the magnet V. This magnet extends through the top of the case, its poles being arranged one above the other, as shown, the lowermost pole projecting slightly above the case, so that the guitar-strings, which are all made of metal, or if of insulating material are wrapped with metal, may pass between the poles of the magnet.

In order to decrease the weight of the magnet and at the same time to concentrate the magnetic lines of force upon the wires, I make the poles, as shown, with projections separated by grooves, the wires being placed between the opposed projections. The strings *y* extend along the stem of the guitar, as usual, and are connected with the screws for adjusting their tension in the ordinary manner. The frets of the guitar-stem are strips of metal *z*, and each is preferably divided, as shown, at the middle of the stem.

I provide at the end of the head the small compartment W, in which is placed the break-wheel *z′*, on which bears the contact-spring *y′*, the break-wheel being revolved, preferably, by suitable clock-work, or it may be turned by a small electric motor run from the battery which supplies current for the instrument.

Fixed upon the lower side of the guitar is the shoe X, within which are placed the devices for regulating the current for altering the sound, these devices consisting of springs *w′*, sliding on the contact-plates of rheostats *v′* and carried at the ends of the rods *u′*, controlled by pivoted arms *t′*, extending outside of the shoe X.

The circuits of the instrument are preferably as follows: The battery Q or other source of current may be situated at any convenient point, and is preferably connected by flexible wires 5 and 6 with the instrument. Wire 6 extends into the middle of the shoe X, where it is connected with a cross-wire 7, joined to the rods *u′*, which carry the springs *w′*. From the end plates of the rheostats *v′* wires 8 and 9 extend, respectively, these wires being connected to any one of the metal frets *z*, preferably to one near the inner end of the stem. The sounding-wires *y* are all connected with a metal bridge Y, from which wire 10 extends to the axle of the break-wheel *z′*. From the spring *y′*, which rests on the break-wheel, wire 5 extends to the battery. All the frets on each side are electrically connected together by a metal strip 11. I prefer to thus divide the frets between two circuits separately, regulable by arms *t′*, in order that one part may be made louder than another—that is to say, by increasing the resistance in the circuit of the lower strings the bass will be made softer than the treble, and vice versa. It will be seen that the metal frets being all in circuit, whenever a wire *y* is made to touch one of the said frets a current will pass through said wire, which will be broken into vibration by the break-wheel, and such wire will produce a musical note, depending, first, upon the nature of the wire, and, second, upon the position of the fret against which it is pressed, and which will be prolonged as long as the wire is kept in contact with the fret. It will be seen that, since the only motion necessary to produce a note is to press the wire against the fret, both hands may be used for this purpose, instead of, as in the ordinary guitar, using one hand to control the frets and the other to vibrate the strings, whereby the facility of operation is increased.

It is evident that my invention is applicable to many forms of instruments and to many modifications of the instruments shown, which are not shown and described herein. I have, however, shown apparatus which may be conveniently and effectively employed to carry my invention into effect.

What I claim is—

1. The herein-described method of producing sound electrically by passing a maintained non-continuous current through a wire stretched in a magnetic field.

2. The method herein described of producing sound electrically, which consists in passing an unevenly-pulsating current through a wire stretched in a magnetic field, substantially as set forth.

3. The method herein described of producing sound electrically, which consists in passing a maintained pulsating current through a wire stretched in a magnetic field.

4. The combination, in apparatus for producing sound electrically, of a magnet, a wire stretched in the field thereof, a circuit including said wire, a device in said circuit for producing non-continuous current therein, and an additional circuit-controller for said circuit, substantially as set forth.

5. The combination, in an apparatus for producing sound electrically, of a magnet, two or more wires stretched in the magnetic field thereof, means for producing non-continuous current in said wires, and an additional circuit-controller for each of said wires, substantially as set forth.

6. The combination, in an apparatus for producing sound electrically, of a magnet, two or more wires stretched in the magnetic

field thereof, a device in a circuit common to said wires for producing non-continuous current in said circuit, and separate circuit-controllers for said wires, substantially as set forth.

7. The combination, in an apparatus for producing sound electrically, of a magnet, a wire stretched in the field thereof and a break-wheel, and an additional circuit-controller in the circuit of said wire, substantially as set forth.

8. The combination, in an apparatus for producing sound electrically, of a magnet, a wire stretched in the field thereof, and a rough-surfaced conducting-wheel and current-collector resting thereon in the circuit of said wire, substantially as set forth.

9. The combination, in an apparatus for producing sound electrically, of a magnet, two or more wires adapted to produce sounds of different pitch and stretched in the field of said magnet, a break-wheel in a circuit common to said wires, and separate circuit-controlling devices for said wires, substantially as set forth.

10. The combination, in an apparatus for producing sound electrically, of a magnet, two or more wires stretched in the field thereof and adapted to produce sounds of different pitch, a device in a circuit common to said wires for producing a non-continuous current in said circuits, separate circuit-controllers for said wires, and resistances in the separate circuits of the wires for equalizing the sound therefrom, substantially as set forth.

11. The combination, in an apparatus for producing sound electrically, of a magnet, two or more wires stretched in the field thereof, a device in a circuit common to said wires for producing non-continuous current therein, separate circuit-controllers for said wires, and means for modifying the volume of sound in said wires, substantially as set forth.

12. The combination, in an apparatus for producing sound electrically, of a magnet, two or more wires stretched in the field thereof, a device in a circuit common to said wires for producing a non-continuous current therein, separate circuit-controllers for said wires, and means for varying the current in said circuit, substantially as set forth.

13. The combination, in an apparatus for producing sound electrically, of a magnet, a wire stretched in the field of said magnet, two or more break-wheels having surfaces of different characters, and means for placing either of said break-wheels in the circuit of said wires, substantially as set forth.

14. The combination, in an apparatus for producing sound electrically, of a magnet, a wire stretched in the field of said magnet, means for producing a non-continuous current in said wire, and means for varying said current, substantially as set forth.

15. The combination, in an apparatus for producing sound electrically, of a magnet, two or more wires stretched in the field thereof, a device for producing non-continuous currents in a circuit common to all said wires, and a key-board containing a key for each wire controlling the circuit thereof, substantially as set forth.

This specification signed and witnessed this 20th day of January, 1890.

GEO. BREED.

Witnesses:
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