(No Model.) 3 Sheets—Sheet 1.

G. BREED.

APPARATUS FOR PRODUCING MUSICAL SOUNDS BY ELECTRICITY.

No. 560,679. Patented May 26, 1896.

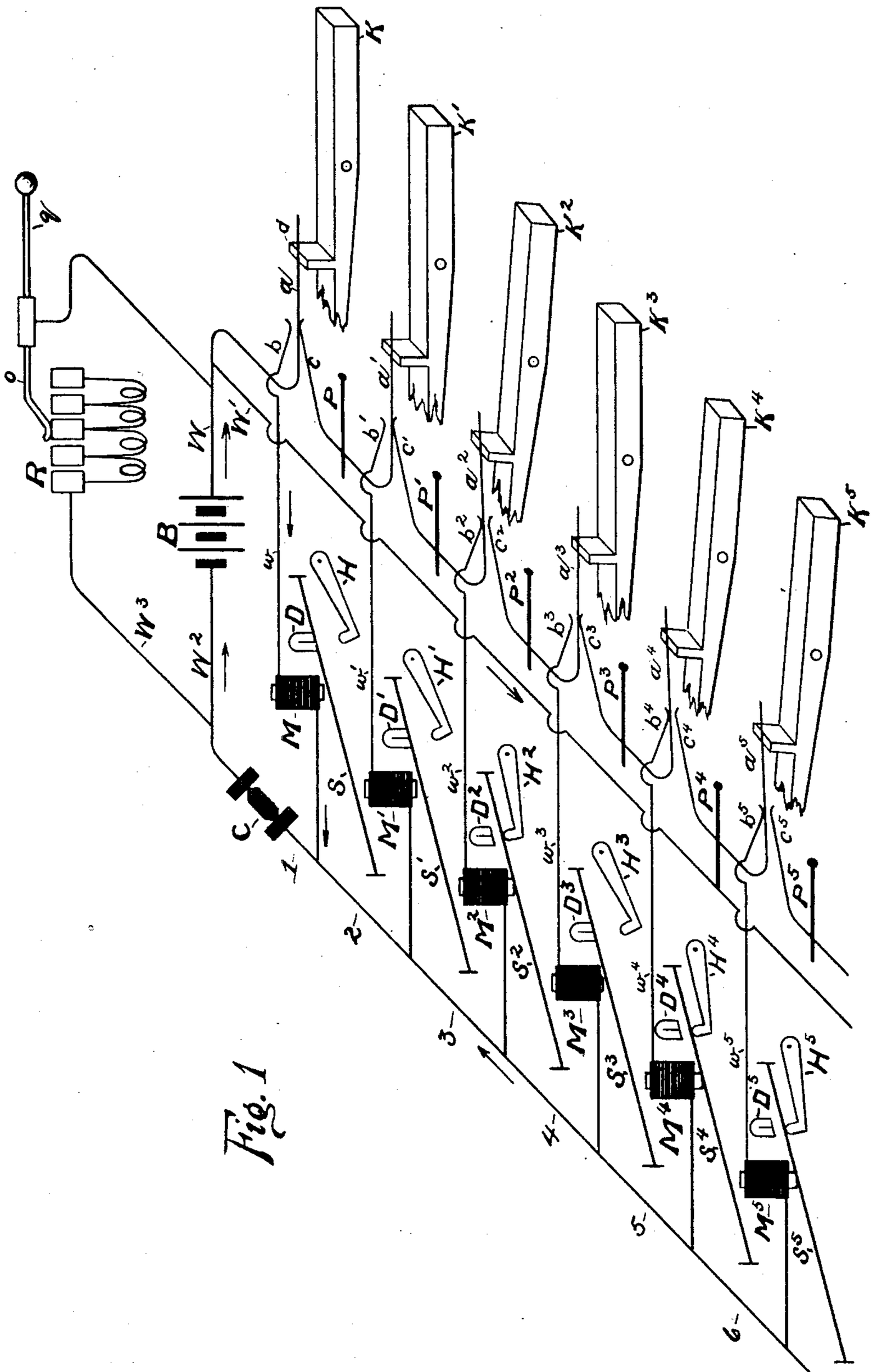

Fig. 1

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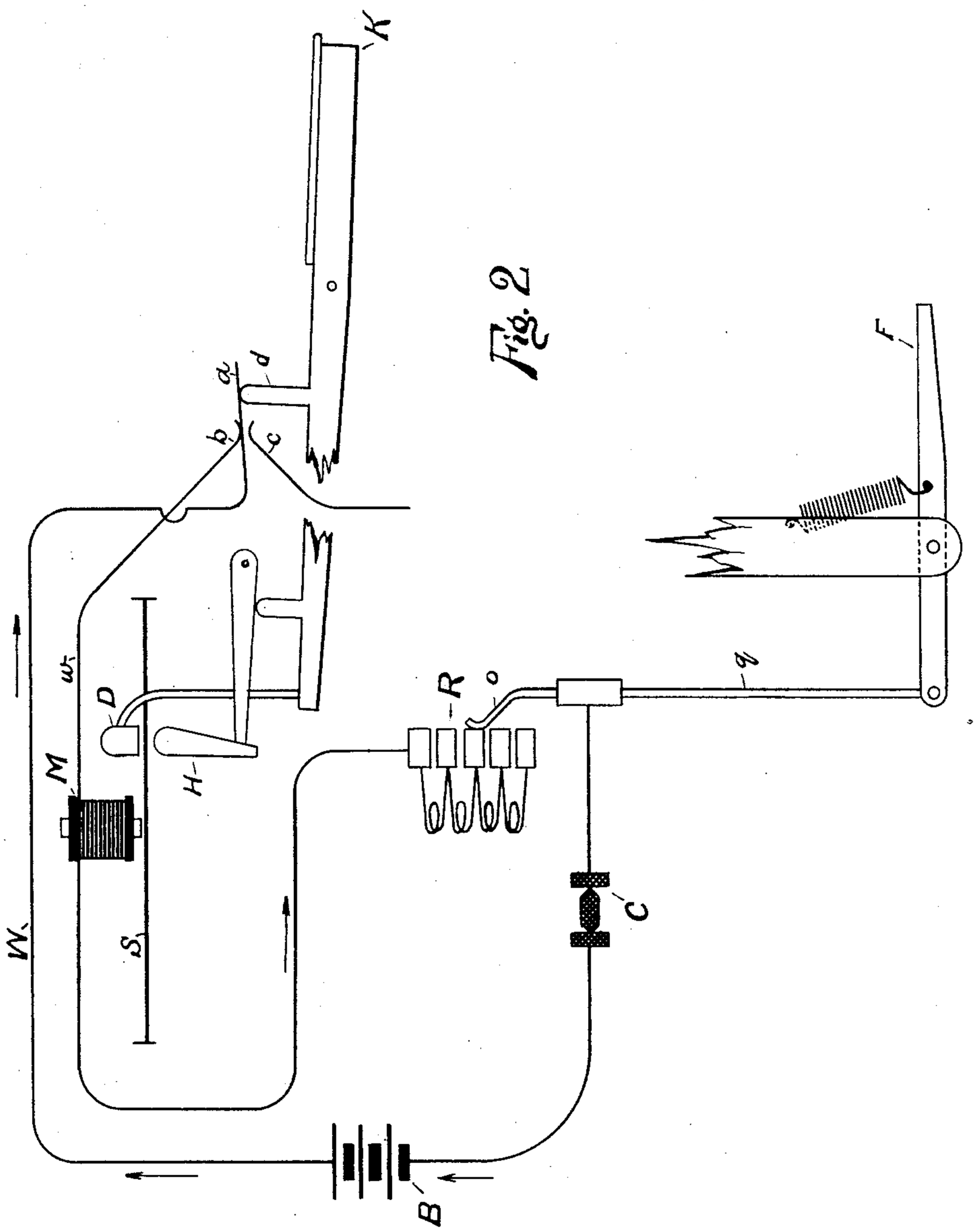

Fig. 2

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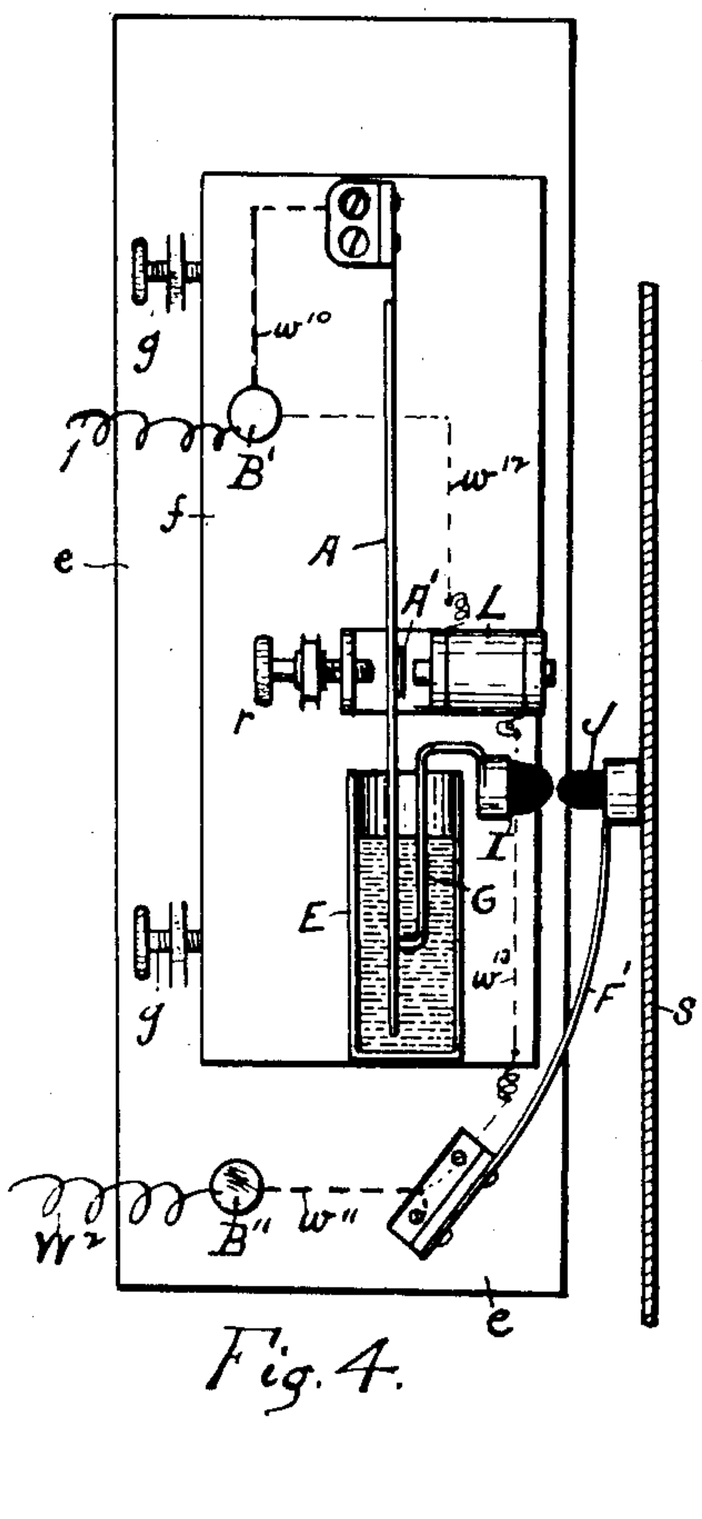

Fig. 4.

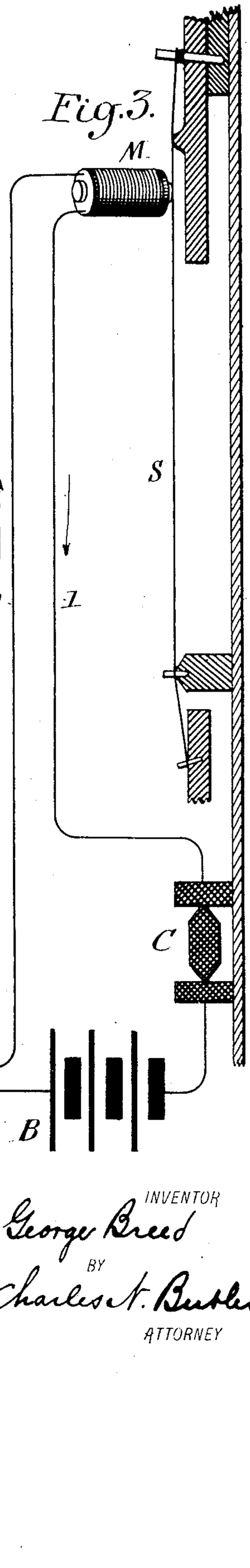

Fig. 3.

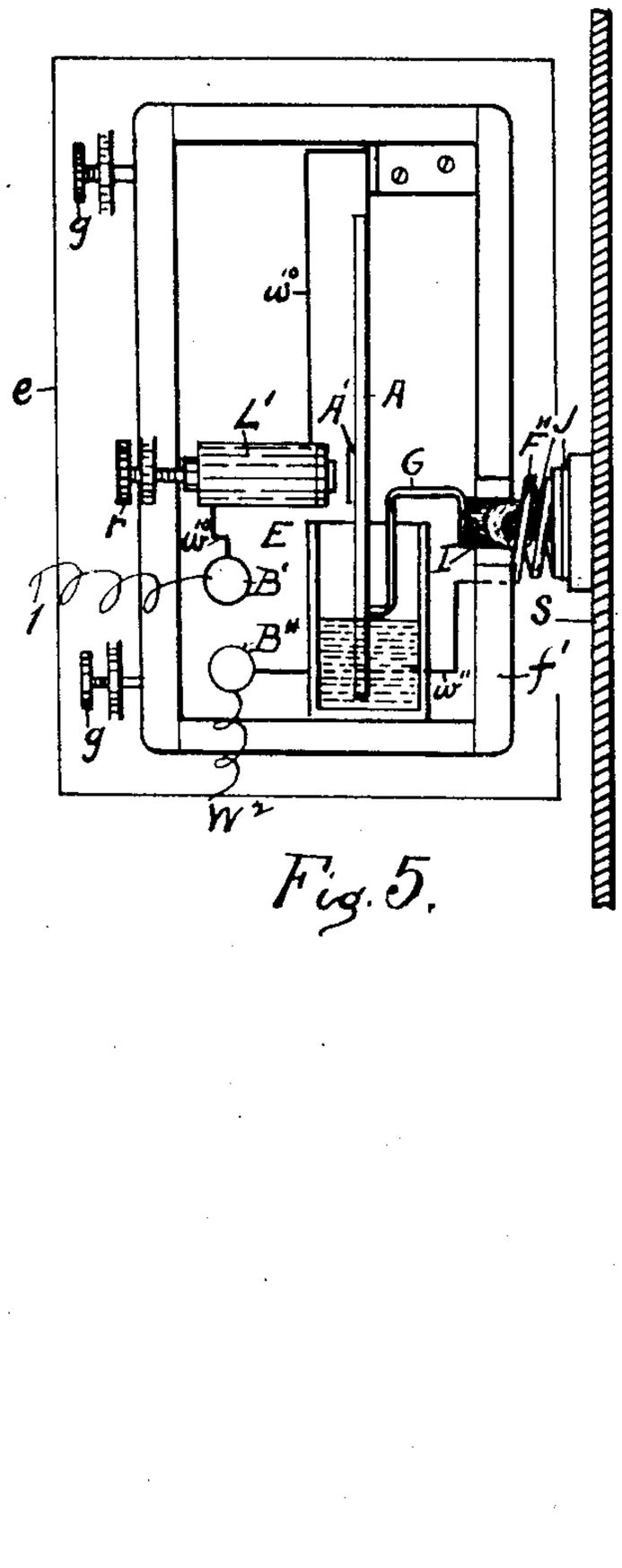

Fig. 5.

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UNITED STATES PATENT OFFICE.

GEORGE BREED, OF PHILADELPHIA, PENNSYLVANIA.

APPARATUS FOR PRODUCING MUSICAL SOUNDS BY ELECTRICITY.

SPECIFICATION forming part of Letters Patent No. 560,679, dated May 26, 1896.

Application filed November 20, 1894. Serial No. 529,350. (No model.)

To all whom it may concern:

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

My invention relates to the production of musical sounds by electrically vibrating a sonorous body and, by means of the sound-waves thus set in motion, vibrating a current-pulsating device which pulsates the exciting-current synchronously with the vibrations of the sonorous body. The microphone is an example of a device which may be vibrated or whose electrical resistance may be rapidly varied by sound-waves impinging upon it and, when placed in circuit with an electromagnet in position to attract a sonorous body and thus cause it to vibrate, the microphone will cause the exciting-current to pulsate in unison with the vibrating sonorous body. The advantage resulting from the isochronous action of the attracting force and the vibrating sonorous body is well known to those skilled in the art; and it is the object of my invention to embody this principle of action in a musical instrument in the most effective form. By my mechanism the intensity and distribution of the current in an electromusical instrument may be controlled and the adjustment of the current-pulsating device automatically effected. The performer is also enabled to determine at will the length of time any tone of the scale is to be sounded and to elect which tone shall be prolonged and which shall be affected by the usual mechanical influences only.

The accompanying drawings illustrate the principles of my invention and the mechanism I have invented for carrying them into effect.

Figure 1 is a diagrammatic view of my mechanism applied to a pianoforte. Fig. 2 illustrates the action of an element of the system. Fig. 3 is a diagrammatic view of my mechanism applied to an upright piano. Figs. 4 and 5 illustrate automatic adjusting contact devices.

Referring to Fig. 2, the part K illustrates the key of a piano, pivoted in the usual way and provided with a projection *d*. When the key is depressed, the part *d* rises and moves the spring-switch *a* from contact with the part *c* (where it is held by its own resiliency) into contact with the part *b*, thus closing an electric circuit. A current now passes from the battery B, in the direction of the arrow, through the wire W, contact *b*, wire *w*, electromagnet M, rheostat R, spring *o*, contact C, and thence back to the battery, the contact C being a conventional form. The depression of the key has produced the usual vibration of the wire S through the action of the hammer H and the damper D. The excited electromagnet M continues this vibration as long as the key is held down and the circuit closed. The sound-waves set in motion by the vibrating wire act upon the contact device C, thus varying the electrical resistance, whereby the current is made to pulsate isochronously with the vibrations of the wire. The rheostat R in the main circuit, as shown in Fig. 2, or arranged in shunt, as shown in Fig. 1, is operated from the pedal F, through the rod *q* and spring *o*, to vary the strength of the current, thereby varying the volume of the tone.

Referring now to Fig. 1, K K′ K^2 K^3 K^4 K^5 represent keys of a piano. *a* *a′* a^2 a^3 a^4 a^5 represent corresponding interlocking spring-switches normally held by their own resiliency against the contacts *c* *c′* c^2 c^3 c^4 c^5, respectively, and when the keys are depressed against the contacts *b* *b′* b^2 b^3 b^4 b^5, respectively. Hence it is seen each key controls an interlocking two-way switch. Wires *w* *w′* w^2 w^3 w^4 w^5 lead to electromagnets M M′ M^2 M^3 M^4 M^5, thence to the return-wires 1 2 3 4 5 6. A branch wire W′ leads from the main circuit, by means of which and the push-rods P P′ P^2 P^3 P^4 P^5 current may enter at points farther down the keyboard, as will appear later. The several keys have their corresponding wires or strings S S′ S^2 S^3 S^4 S^5, hammers H H′ H^2 H^3 H^4 H^5, and dampers D D′ D^2 D^3 D^4 D^5. If now the key K^2 be depressed, thereby bringing parts a^2 and b^2 into contact and thus closing the corresponding circuit, a current will pass from the battery through the circuit W *a* *c* *a′* *c′* a^2 b^2 w^2, electromagnet M^2, return-wires 3 2 1, contact C, and wire W^2 back to the battery. The vibra-

tions of the string S^2, produced by the hammer H^2, are continued by the action of the excited electromagnet so long as the key is held down. If while the key K^2 is depressed a key, as K^4, be depressed, the corresponding string S^4 is subject to the usual mechanical influences only, for the current which would excite the electromagnet M^4, were the higher keys dormant, has been switched through the electromagnet M^2, thereby cutting M^4 out of circuit. Thus it will be seen that the highest tone only of those being sounded is capable of being prolonged. If while the keys K^2 and K^4 are depressed it is desired to prolong the vibrations of any string, as S^5, which is beyond S^2 and S^4, the push-rod P^4 is thrust in, making contact with the wire W'. A current now passes through the circuit W' P^4 a^5 b^5 w^5, electromagnet M^5, back to the battery through the return-wires 6, 5, &c. By thrusting in all of the push-rods each string of the instrument may be made subject to electrical influence independently of the action of the rest of the system. I have devised means for pushing in all of these rods at once, which means I have not deemed it important to show here.

Referring now to Fig. 3, the string S is brought under magnetic influence and its vibrations prolonged by pressing down the key *k*, whereby the circuit is closed and the electromagnet excited. Here, as already explained, the sound-waves produced by the vibrating string act on the contact C to vary its resistance.

Fig. 4 shows a self-adjusting contact device. The carbon J is attached to the end of a spring F', secured to the block *e*, and normally rests against the sounding-board *s*. Set-screws *g* permit the adjustment of the block *f* in relation to the block *e*, and by consequence the adjustment of the carbon I with relation to the carbon J. The exciting-current reaches the binding-post B' through the wire 1, thence passing through the wire w^{10}, pendulum A, secured to the block *f*, arm G, carbon I, across the point of contact to J, thence through the spring F', wire w^{11}, binding-bost B'', and wire W^2 to the battery. The device is normally adjusted with the contact-points I and J slightly separated. The current from the battery, therefore, excites the shunt-magnet L, which draws them together and holds them in more or less intimate contact as long as the current flows. The wires w^{12} and w^{13} connect this shunt-magnet with the battery, and when excited this magnet attracts the armature A' of the pendulum A, thus moving the pendulum, and with it the part I, into closer relation with the part J. The shunt-magnet may be adjusted to the proper position by means of the thumb-screw *r*, connected to the block *f*. By thus adjusting the parts the desired pressure may be obtained, so that the vibrations of the sounding-board *s* may most readily affect the resistance of the circuit at that point. The end of the pendulum is submerged in a liquid contained in a cistern E, the liquid acting to check or dampen the oscillations of the pendulum.

Fig. 5 shows a device analogous to that shown in Fig. 4. In this instance, however, the main current passes from the binding-post B' through the electromagnet L', wire w^{10}, pendulum A, arm G, contacts I and J, through the coiled spring F^{11} and the wire w^{11}, to the binding-post B''. In this instance the part J, resting against the sounding-board *s*, is supported on a coiled spring secured to the block *f'*. By a simple reversal of the wiring of the electric system I am enabled to sound the lowest tone at will, while the higher tones are subject to the usual mechanical influences only.

I do not wish to be understood as limiting myself to the use of spring-contacts in the system of switches which control the distribution from the keyboard, as I may use equivalent circuit making and breaking devices, such as conductors dipping into mercury-cups.

Having thus described my invention, I claim and desire to secure by Letters Patent—

1. A series of musical strings, in combination with a series of electromagnets arranged in parallel and connected with a source of electric energy, and a system of two-way switches controlling the current to the electromagnets, substantially as shown and described.

2. In a piano, in combination, a system of keys, a system of interlocking two-way switches, a system of electric circuits and electromagnets, a current-pulsating device and a series of musical strings or wires, substantially as shown and described.

3. In combination with the key of a musical instrument, an electric circuit, an electromagnet, a second electric circuit, a two-way switch which diverts current from the first to the second circuit, a sonorous body, and a vibrating contact, substantially as shown and described.

4. In combination with the key of a musical instrument, an electric circuit, an electromagnet, a second electric circuit, a two-way switch which diverts current from the first to the second circuit, a vibrating body producing sound-waves, and means for synchronizing the vibrations of the sound-producing body and the pulsations of the electric current substantially as shown and described.

5. In a contact device, in combination with an electric circuit, a pendulum having a contact-point I, a spring having a contact-point J, and a cistern containing a liquid, substantially as shown and described.

6. In a contact device, in combination with an electric circuit, a pendulum having a contact-point I, a spring having a contact-point J, and an electromagnet, substantially as shown and described.

7. In a contact device, in combination, an

adjustable block, a pendulum having a contact I, a spring having a contact J, a cistern containing a liquid, an electric circuit, and an electromagnet, substantially as shown and described.

8. In a contact device, in combination with an electric circuit, an oscillating body having a contact-point, means for damping or checking the action of the oscillating body, and a spring provided with a contact-point, substantially as shown and described.

9. In combination with a sonorous body, an electric circuit having a wire W′, a push-rod P^4, a switch a^5, a contact b^5, an electromagnet and a vibrating contact, substantially as shown and described.

10. In a system of electric circuits, a series of two-way switches, a series of push-rods, and a branch conductor W′, substantially as shown and described.

11. In a musical instrument, in combination with a series of sound-producing bodies, a system of interlocking two-way switches, and a system of electric circuits and electromagnets, substantially as shown and described.

12. In a contact device, in combination with a musical instrument, an electric circuit, an oscillating body having a contact-point, and means for damping or checking the action of the oscillating body, substantially as shown and described.

13. In a contact device, in combination with a musical instrument, an electric circuit, an oscillating body having a contact-point, means for damping or checking the action of the oscillating body, and an electromagnet, substantially as shown and described.

14. In a two-way switch, in combination, the resilient spring a, the contact c, and the contact b, substantially as shown and described.

15. A two-way switch, comprising a pair of contacts, and a resilient member which is normally held by its own resiliency in engagement with one of the said contacts and adapted to be moved into engagement with the other of the said contacts, combined in interlocking relation with a second similar two-way switch, substantially as shown and described.

16. In a contact device, in combination with an electric circuit, an oscillating body having a contact-point, means for damping or checking the motion of the oscillating body, and a second contact-point mounted on the sound-board of a piano, as shown and described.

17. In a musical instrument a contact device comprising an oscillating body having a contact-point, means for damping or checking the motion of the oscillating body, a second contact-point, and an electromagnet placed in shunt relation with the said contact-points, substantially as shown and described.

18. In a contact device, in combination with a musical instrument, an electric circuit, an oscillating body having a contact-point, and electrical means for automatically effecting the desired mean pressure, substantially as shown and described.

GEORGE BREED.

Witnesses:
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