(No Model.)

# S. E. NUTTING.

## ELECTRO MECHANICAL MOVEMENT.

No. 420,954. Patented Feb. 11, 1890.

Fig. 1.

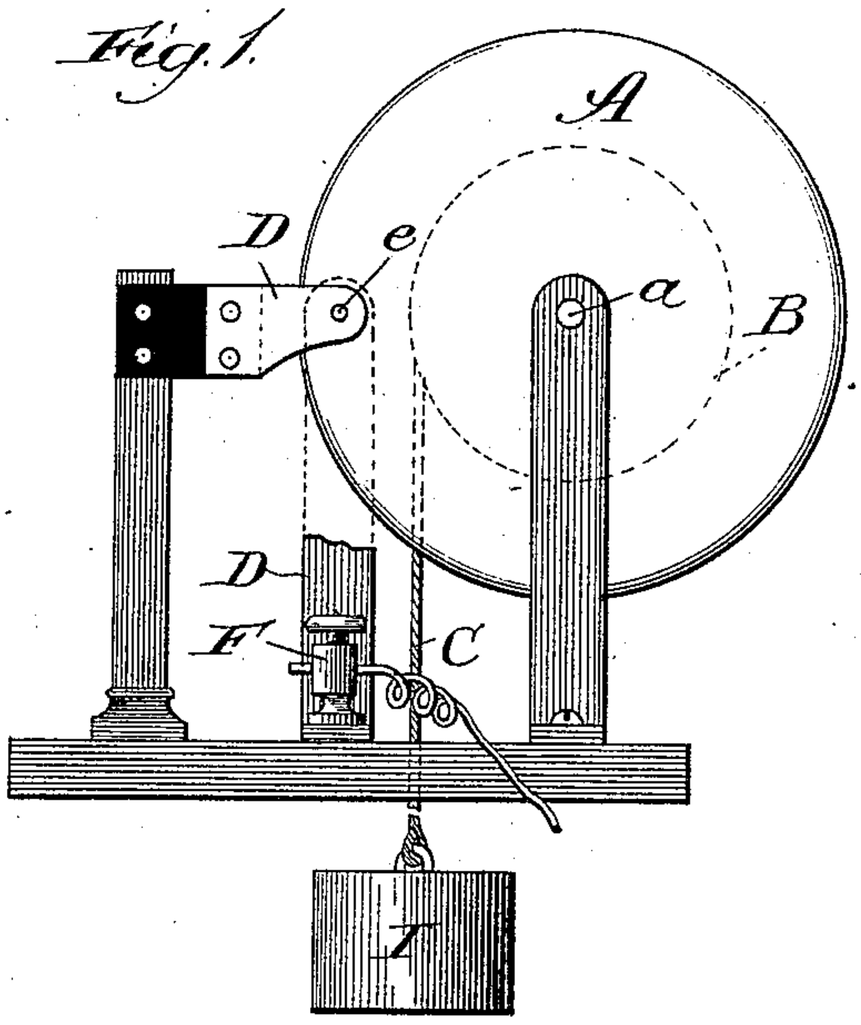



Fig. 2.

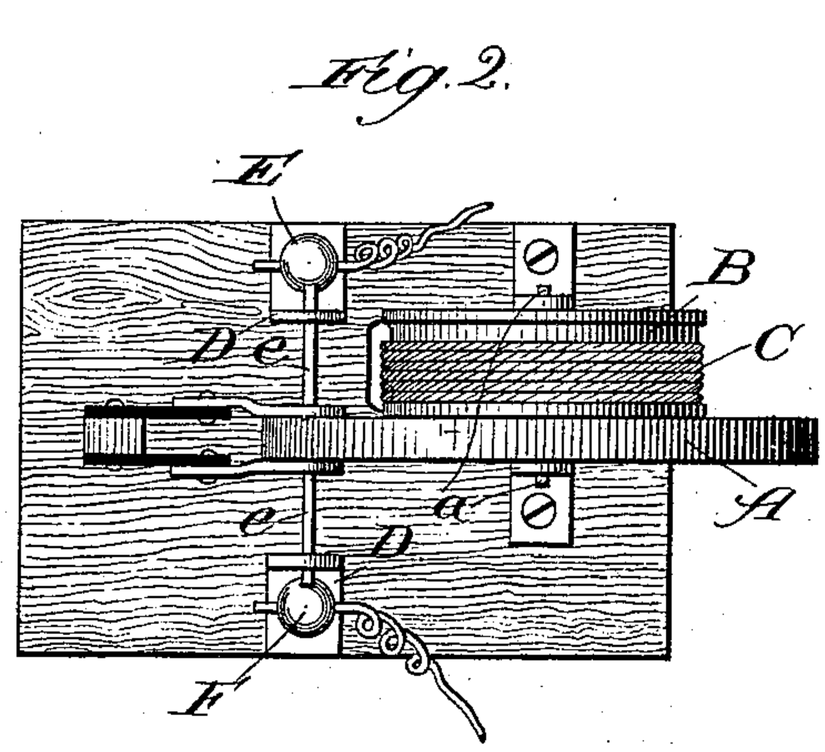



Fig. 3.

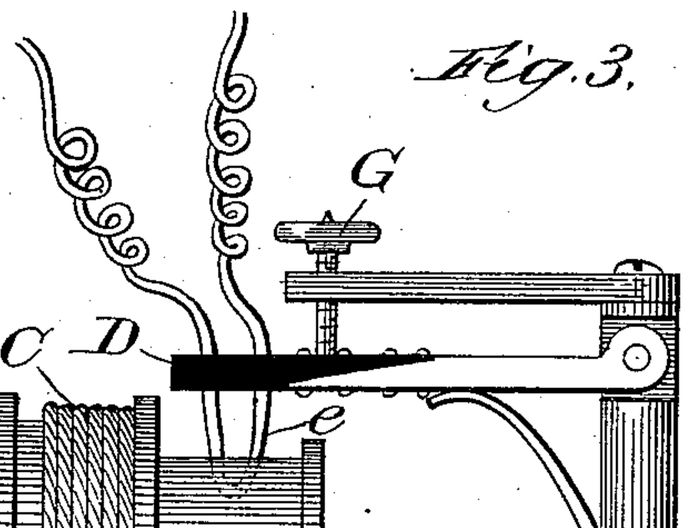



Fig. 4.

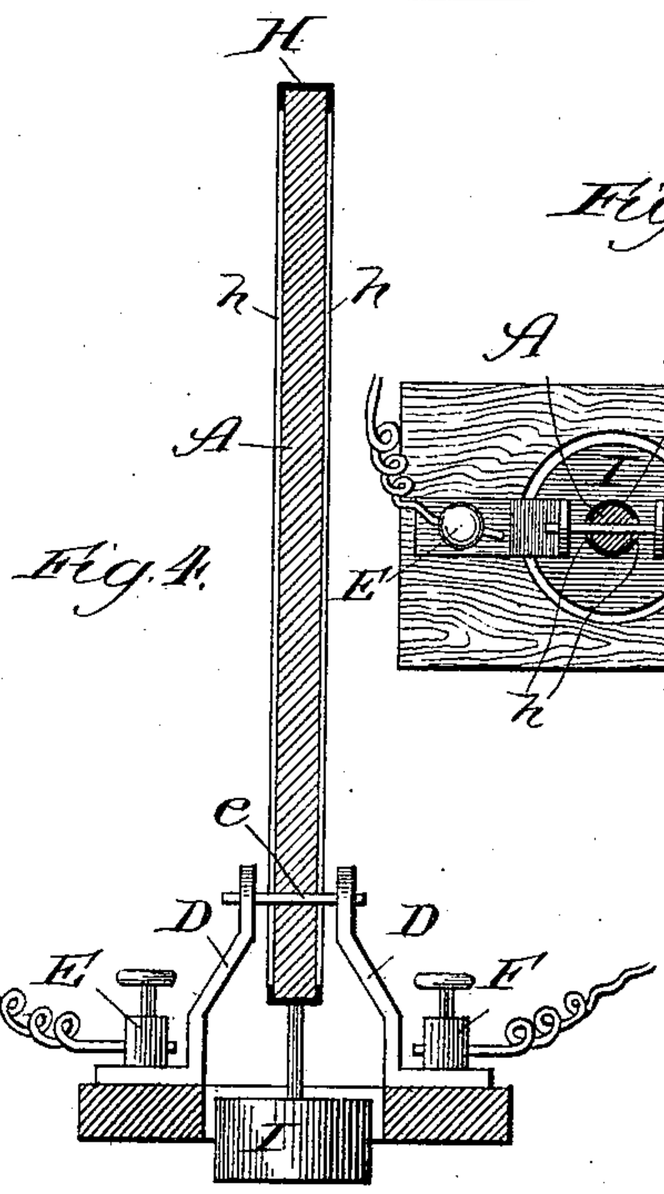
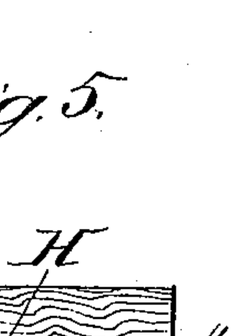



Fig. 5.




Fig. 6.

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# UNITED STATES PATENT OFFICE.

SAMUEL E. NUTTING, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE NUTTING ELECTRIC MANUFACTURING COMPANY, OF SAME PLACE.

## ELECTRO-MECHANICAL MOVEMENT.

SPECIFICATION forming part of Letters Patent No. 420,954, dated February 11, 1890.

Application filed March 12, 1889. Serial No. 303,000. (No model.)

*To all whom it may concern:*

Be it known that I, SAMUEL E. NUTTING, a citizen of the United States, residing at Chicago, Illinois, have invented certain new and useful Improvements in Electro-Mechanical Movements, of which the following is a specification.

The object of my invention is to make an electro-mechanical movement that will be proportioned at all times and under all circumstances to the quantity of the electric current, varying with every variation in the quantity of such current; and my invention consists in the features and details of construction hereinafter described and claimed.

In the drawings, Figure 1 is a side elevation of one form of mechanism embodying my invention. Fig. 2 is a plan view of the same. Fig. 3 is a side elevation of another form of mechanism embodying my invention; Fig. 4, a vertical section of still another form of mechanism. Fig. 5 is a plan view of the same, and Fig. 6 is a side elevation of a modification of one of the parts.

In embodying my invention I take a substance which softens or liquefies at a low temperature—such as beeswax, tallow, stearine, paraffine, and similar substances. As shown in the first three figures of the drawings, I make a cylinder or disk A out of such substance and mount it on a shaft *a*, supported in suitable bearings. I mount a pulley or sheave B on this same shaft, adapted to receive a cord C, which is wound around the same and provided with a weight. This arrangement or sheave, cord, and weight will constantly tend to rotate the cylinder or disk A in the direction of the unwinding of the cord. Other means for rotating the disk or cylinder may be employed, however, if preferred. In proper relation to this disk or cylinder I arrange a bracket D, which is either formed of non-conducting material or insulated from its support, as shown in the first three figures of the drawings. I lead a wire adapted to carry a current of electricity from any source or generator into or through the disk or cylinder A, composed, as above said, of substances that will soften or liquefy at a low temperature. As shown in Figs. 1 and 2, the wire conveying the current of electricity is attached to a binding-post E, from which a rod *e* of conducting material leads through the bracket and through the disk or cylinder to another binding-post F, from whence the wire passes on its way in the circuit. As shown in Fig. 3, this rod *e* is dispensed with, and the electric wire is carried through the bracket D and sunk into the top of the wheel or cylinder; either partially or wholly. As shown in Fig. 3, the wire is wholly submerged or sunk in the surface of the cylinder at the end of its loop, although it may be sunk to a less depth if desired, and to that end I have provided means, as a set-screw G, for adjusting its depth in or out of the cylinder; but whether the piece which passes through the wheel or cylinder of liquefiable material be a separate one, as shown in Figs. 1 and 2, or a portion of the electric wire, as shown in Fig. 3, it should be formed of material furnishing a greater resistance to the passage of the current than the rest of the circuit. As it thus possesses greater resisting power, it will cause a portion of the current of electricity passing through it in contact with the liquefiable material to be converted into heat, and thus melt the material in contact with it. The portion passing through or into the disk or cylinder will melt a way for itself therein, so that any force tending to rotate the disk or cylinder will cause it to revolve constantly in proportion to the rapidity with which the material of which it is composed softens, melts, or liquefies. If, therefore, the quantity of the electric current be great, the softening or melting will be rapid, and if it be small it will be slow, so that at all times the movement of the disk or cylinder will be dependent upon the quantity of the electric current.

In Figs. 4 and 5 I have applied the same principle in a somewhat modified way. Instead of using a disk or cylinder composed of material capable of softening, melting, or liquefying, I have placed such material in a tube H, provided with slots *h* on its opposite sides, forming a channel or way from near one end of the tube to the other. This tube is intended to be made of non-conducting material, and the brackets D are intended to be arranged at the sides with the rods *e*, pass-

ing through the slots in the tube, as shown in Figs. 4 and 5. If this tube now be filled with a substance that will soften, melt, or liquefy at a low temperature, and a weight I preferably but not necessarily be suspended from its bottom, the current of electricity passing through the piece *e* which, as above explained, affords a greater resistance than the wire of the circuit, a way will be cut through the material and the tube caused to gradually descend in proportion to the rapidity with which the melting or softening occurs. This will at all times be in proportion to the quantity of the electric current, producing a greater or lesser amount of heat in the piece *e*. In those cases where a very small quantity of electric current is intended to be passed through the circuit and through the piece in contact with the liquefiable substance, and at the same time it is desired to make the piece *e* of sufficient strength and stability to answer the purpose and afford the necessary resistance to the passage of the current, the piece *e* may be wrapped and inclosed in a very fine wire of high resistance, as shown in Fig. 6, which affords a view greatly enlarged. When made as shown in Fig. 6, the part shown takes the place of the piece *e* shown in Fig. 3. If, now, a very small quantity of electricity be passed through the fine resistance-wire shown in Fig. 6, sufficient heat will be developed to answer the purpose, and, if desired, the current may at the same time be passed through the frame or support around which the fine wire is wrapped. When the current is thus passed through both the fine wire and its frame or support, it should be passed through in series—that is, through the frame or support and then through the fine enwrapping wire. In this way the frame or support will be first heated and the heat developed in the fine resistance-wire utilized for the purpose of melting or liquefying the disk or cylinder A, rather than in heating its frame or support, while greater sensitiveness will thus be secured. As the material composing the disk or cylinder is softened or melted for the passage of the resistance portion of the circuit, it will immediately return to its former place and cool behind such portion, thus restoring it to its original shape and condition and fitting it for a repetition of the operation. In this way the condition of the wheel or cylinder is constantly maintained, so that the operation may be repeated without interruption and indefinitely. This is particularly true where the arrangement is such as that shown in Fig. 3, although I have found it also to be true where the arrangement was that shown in the other figures. Of course it will be understood, in reference to the arrangement shown in Figs. 4 and 5, that when the piece *e* has reached the top of the tube, it must be slipped out and inserted through the material again at the bottom of the slot.

In all these cases the same principle of operation is observed and applied. In all there is an electric circuit, a portion or section of the circuit which becomes heated by the passage of a current of electricity, a non-conducting material composed of a softenable substance—that is, a substance that will soften, melt, or liquefy at a low temperature—arranged in contact with the portion or section of the circuit, which becomes heated by the passage of the electricity, the section and substance being held in fixed relative positions to each other until the section is heated, when it softens or melts a way for itself through the substance in contact with it, and means for automatically changing the relative positions of the section and substance as the substance becomes softened by the heating of the section. In all of these cases the rapidity with which the way for the heated portion or section of the circuit to pass through the softenable substance will be cut or made is in proportion to the quantity of the electric current passing through the circuit by which greater or less heat will be developed in the portion or section in contact with the substance, and the weight or force employed to change the relative positions of the section and substance softened or melted by it. I have thus been able to secure an electro-mechanical movement that is at all times regular, uniform, and invariably proportioned to the quantity of the electric current passing through the circuit, and the force tending to change the relative positions of the heated section of the circuit and the softenable substance in contact with it. This movement may be applied to a variety of useful purposes—such as controlling and regulating the movement of the carbons in electric-arc lamps or by connecting it with the proper parts form an electrometer for measuring the quantity of electricity that passes through the circuit. I mention these merely as illustrations of the useful purposes to which my invention may be applied. In a word, I may say that it is applicable to all cases where a movement is required proportioned to the quantity of electricity employed in the circuit.

What I regard as new, and desire to secure by Letters Patent, is—

1. In an electro-mechanical movement, the combination of an electric circuit, a section of such circuit heated by the passage of a current of electricity, a softenable substance adapted to harden in an operative position in contact with such section, such substance and section being held in fixed relative positions to each other until the section is heated, and means for changing their relative positions as the substance is softened by the heating of the section, substantially as described.

2. In an electro-mechanical movement, the combination of an electric circuit, a section of such circuit heated by the passage of a current of electricity, a softenable substance adapted to harden in an operative position

in contact with such section, such substance and section being held in fixed relative positions to each other until the section is heated, and means, set into operation only by the heating of the section, for changing their relative positions as the substance is softened by the heating of the section, substantially as described.

3. In an electro-mechanical movement, the combination of an electric circuit, a section of such circuit heated by the passage of a current of electricity, a disk or cylinder of softenable substance adapted to harden in an operative position in contact with such section, such disk or cylinder and section being held in fixed relative positions to each other until the section is heated and changing their relative positions as the substance of the disk or cylinder is softened by the heating of the section, substantially as described.

4. In an electro-mechanical movement, the combination of an electric circuit, a section of such circuit heated by the passage of a current of electricity, and a disk or cylinder of softenable substance into or through which the section projects or passes, such disk or cylinder and section being held in fixed relative positions to each other until the section is heated and changing their relative positions as the substance of the disk or cylinder is softened by the heating of the section projecting into or passing through the same, substantially as described.

5. In an electro-mechanical movement, the combination of an electric circuit, a section of such circuit heated by the passage of a current of electricity, a disk or cylinder of softenable substance in contact with such section, such disk or cylinder and section being held in fixed relative positions to each other until the section is heated, and means for rotating the disk or cylinder as the substance of the disk or cylinder is softened by the heating of the section, substantially as described.

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