WILLIAM B. GUERNSEY.

# Improvement in Electro-Magnetic Alarms.

No. 126,287. Patented April 30, 1872.

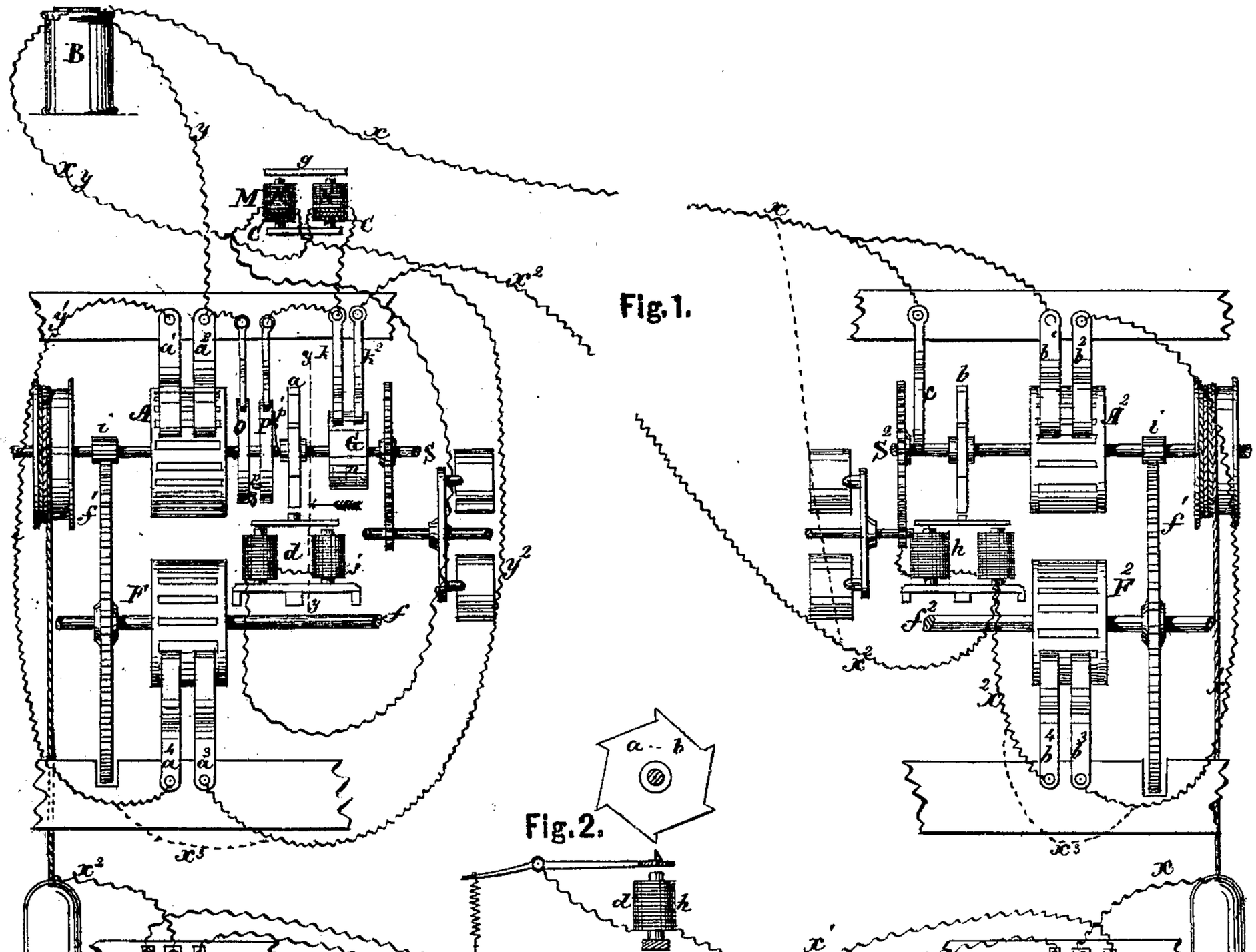

Fig. 1.



Fig. 2.

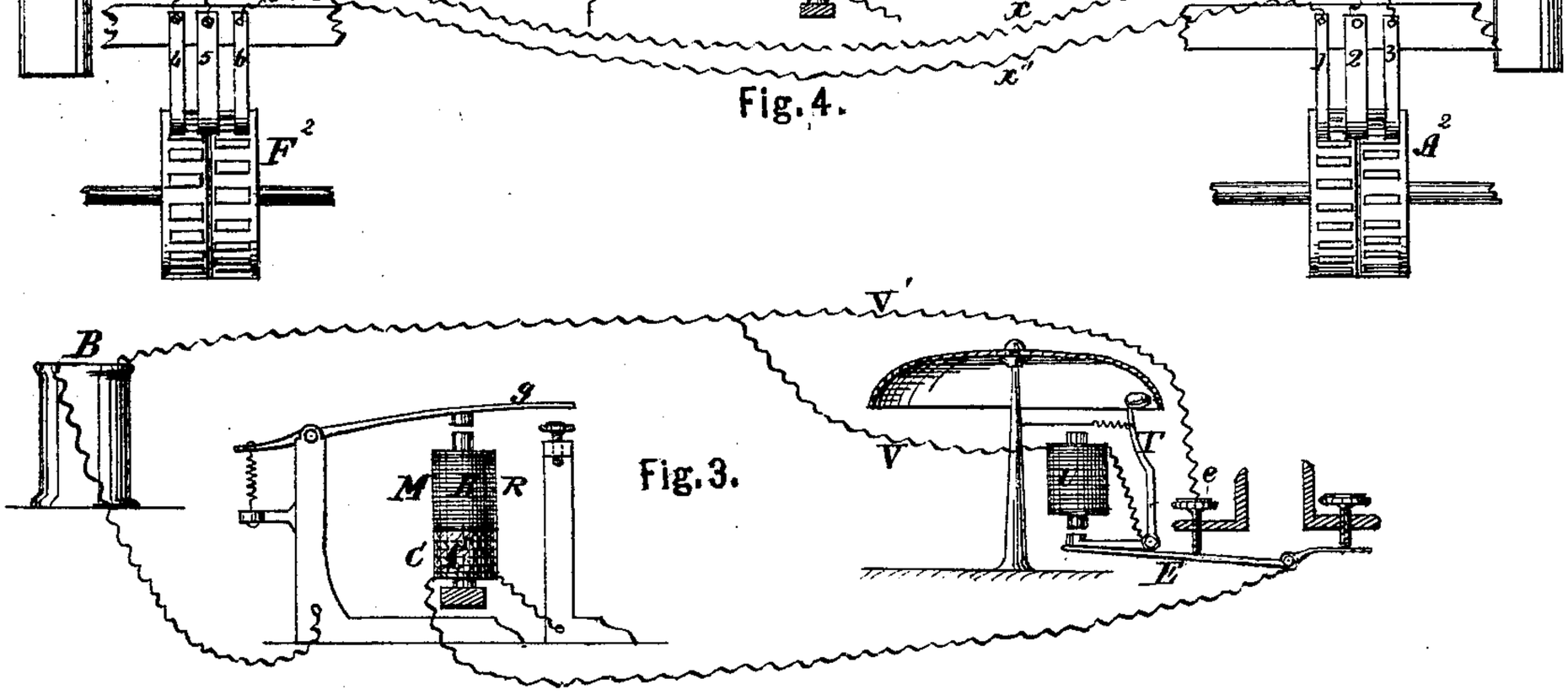

Fig. 4.



Fig. 3.

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# UNITED STATES PATENT OFFICE.

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## IMPROVEMENT IN ELECTRO-MAGNETIC ALARMS.

Specification forming part of Letters Patent No. 126,287, dated April 30, 1872.

Specification of an Improvement in Electro-Magnetic Alarms, invented by WILLIAM B. GUERNSEY, of Jersey City, in the county of Hudson, State of New Jersey.

This invention consists, first, in controlling the circuit of an electro-magnetic alarm by two or more mechanical circuit-breakers in such a way that electric pulsations or intermittent impulses will be caused and any variation in the proper pulsations or any interference therewith will cause an alarm by disturbing the synchronism of the circuit-breakers. The invention consists, second, in combining with each other and with other elements of an electro-magnetic alarm two or more circuits controlled by circuit-breaking devices in such a manner that they will act synchronously and will cause an alarm in the event of their correspondence or synchronous action being interfered with, or in event of the circuit which they control, or either of them, being relieved from or made independent of their actions. The invention consists, third, in connecting two such synchronous circuits separately with the respective helices of one magnet or its equivalent, so that the said magnet may be excited, to cause an alarm on the occurrence of any interruption of the synchronous action of the circuits. The invention consists, fourth, in combining with two or more synchronous circuits, arranged to operate as set forth, a permutation mechanism by which the intervals or duration of the impulses may be varied, as a further safeguard against "picking."

It will be manifest that various devices may be used in connection with trains of gearing to effect the synchronal opening and closing of the circuits.

One mode of carrying my invention into effect is illustrated in the accompanying drawing, in which—

Figure 1 is a diagram of an apparatus, including a permutation arrangement, which illustrates what is referred to above as the fourth part of the invention. Fig. 2 is a section at *y y*, Fig. 1. Fig. 3 is a sectional elevation of the relay-magnet, local circuit, and alarm. Fig. 4 is a plan of a modified form of permutation apparatus.

For simplicity and clearness of description, I will first explain the operation of the apparatus without the permutation device. The apparatus here represented consists, in its simple form, of two circuits, in each of which is introduced a circuit-breaker formed of a wheel or cylinder, A or $A^2$, of non-conducting material, in the periphery of which are inserted, parallel with the axis, metallic strips, serving, as the wheel rotates, to form, at intervals, electrical connection between the ends of a pair of springs, $a^1$ $a^2$ or $b^1$ $b^2$, which press upon the periphery of the rotating cylinder. The two wheels or cylinders being connected so as to move in unison, the two circuits will be broken simultaneously and reclosed simultaneously. The two contact breakers or makers A and $A^2$ are mounted upon shafts S and $S^2$. These shafts are supposed to be rotated each by clock-work regulated to run as nearly at like speeds as may be. Supposing the wires $x^1$ $x^2$ to be connected as indicated by the dotted line $x^3$, or by other means, and the wires $y^1$ $y^2$ also connected, it is evident that when either pair of the springs $a^1$ $a^2$ or $b^1$ $b^2$ rest or impinge upon one of the pieces of metal in the faces of said wheels such pair will be electrically connected, and that if said wheels revolve at precisely the same speed and are provided with contact strips corresponding in number, position, and width, two simultaneous circuits will be established, proceeding from battery B as many times during the rotation of said wheels as there are metallic strips or surfaces upon their faces; and if each of these circuits be of same length or resistance, the effect of each upon magnet M will be the same. It is, therefore, only necessary to conduct the said circuits, each through its respective helix, of magnet M in a contrary direction, to insure that they will entirely neutralize each other, producing no effect upon the magnet; but if either of said circuits be broken or interrupted, or if a cross-circuit be established, as, say, between $x$ $x^2$, then M would be likely to be affected by one or the other circuit solely, and so would become a magnet and attract its armature *g*, thereby setting in motion some devices, causing an alarm.

I do not desire to limit myself to any specific mechanism for sounding an alarm, but have represented in Fig. 3 an efficient device for this purpose. Some features of this device I have made the subject of a separate application for Letters Patent. It is adapted to sound a continuous alarm, which, when once started by any

disturbance in either of the main circuits, cannot be stopped by any subsequent act at the point where the disturbance originated. The drawing down of the armature *g* establishes a new local circuit, which, by means of the vibrator E, contact-stop *e*, and branch wires V V′, is caused to pass alternately through the bell-magnet U and around the same, so as to vibrate the hammer T in the usual manner. A mechanical alarm can be employed, if preferred.

One of the contact-breakers, with its clock-work and belongings, is to be located at the point to be protected, and the other, with battery-magnet and bell at some other place, as, say, a police-station or the residence of owner, and it is to protect the conductors $x$ $x^1$ $x^2$ connecting the two that this invention is designed.

The synchronism of the two movements may be insured by use of the toothed wheels *a b*, magnets *d h*, and arrangement of springs and circuits shown. The speed of shafts S and $S^2$ (driven by clock movements) being known and the limit of probable error of the driving-clocks ascertained, such number of teeth are put into *a b* as will insure one of them passing a certain point in the revolution often enough to keep the error in the going of the clocks less than the time required to saturate the magnet M and affect its armature. It is necessary, also, that at the points on the peripheries of the wheels A $A^2$ corresponding to said teeth there shall be a space of non-conducting material of sufficient width to make it certain that there shall be at that time no contact through the springs. The magnets *h d* are arranged as shown, so that their armatures, when open, will arrest the wheels *b a* as the successive teeth arrive over them. Then, if one of the teeth, in say *b*, is arrested by the armature of *h*, it will be there held until the corresponding tooth of *a* comes in contact with armature of *d*, or vice versa, at which moment a circuit will be closed through *x*, *c*, $S^2$, *b*, *h*, $x^2$, $k^2$, *s*, *a*, and *d*, to B, saturating both magnets *d* and *h*, causing them to attract their armatures and release *d* and *a*, thus taking up or condoning all the past error, and starting both movements exactly together for another stage, or until the arrival of the next tooth. It is also necessary to the correct working of this device that the contact-breakers *n* be wider than the probable error.

In order to insure the sounding of the alarm in the event of the exposed circuit-wire being severed at the instant while the springs $b^1$ $b^2$ may be insulated and the shaft S arrested by its check-wheel *a*, I apply to the shaft S two pulleys, O and P, both insulated from the shaft but rotated thereby. The pulley O is fast upon the shaft, but the pulley P has a limited motion thereon if the rotation of the shaft be suddenly arrested. This motion throws pins *o p* upon the faces of the pulleys into electrical contact, causing a current from *y*, through *o* and *p*, to the alarm-magnet. This effect will not be produced by the checking of the wheel *a* for an instant to await the arrival of *b*, but will be caused by the permanent stoppage of the shaft. Other expedients may be devised for this purpose. A spring, $p^1$, restores the pulley P to its original position.

Another and a better method of obtaining synchronism allows me to dispense with wheels O and P and their belongings, as also with the contact-breakers *n* on wheel G. I have only to arrange wheels A and F and $A^2$ and $F^2$, so that the two circuits shown shall be completed upon each approach of a tooth in wheels *a* and *b* to the respective stops on armatures of magnets *d* and *h*, and to make the resistance of each helix R of magnet M considerably greater than that of the circuits through the respective magnets *h* and *d*, to insure the same results as are obtained by method shown. And these devices can be varied almost infinitely.

In the foregoing description no allusion has been made to the permutation mechanism represented in the lower part of Fig. 1. This is not essential to the effective working of the principal part of my invention, but may be arranged to vary the intervals or duration of the successive synchronous pulsations to such a degree as to preclude the possibility of imitating the effect, for the purpose of tampering with the apparatus, without detection.

F $F^2$ are contact breakers and makers, consisting of non-conducting wheels with metallic strips similar to the wheels A $A^2$, but with the widths or distances of the contact-surfaces varied, if required. $a^3$ $a^4$ and $b^3$ $b^4$ are pairs of springs pressing upon the peripheries of the wheels and connected to the wires $y^1$ $y^2$ $x^1$ $x^2$ respectively, as shown, the connections $x^3$ being omitted. The wheels F $F^2$ are keyed upon shafts *f* $f^2$, driven by means of clock-work or by gearing $f^1$, connecting them with the shafts S and $S^2$, respectively, so that the least common multiple of rotation of the two shafts S *f* or $S^2$ $f^2$ would occupy a long period. If, now, the contact-surfaces on the two wheels A F or $A^2$ $F^2$ be numerous and irregular, and never alike on any two machines, it is evident that a principle of permutation is introduced into the arrangement which can be made to run through so many hours as to render it practically impossible, from that cause alone, for an evil-disposed person to ascertain what electrical impulses were likely to pass over the circuit $x$ $x^1$ $x^2$ in any given time. With such knowledge it would be scarcely possible that the arrangement could be picked; without it it is certain that it could not be.

Fig. 4 illustrates a modified form of permutation mechanism, and I intend, by showing these two forms, to indicate that the arrangements or appliances for this purpose admit of numerous variations without limiting myself to either form.

$A^2$ represents a contact maker and breaker, consisting of a wheel of non-conducting material, made in two parts or with divided or separate contact-strips arranged irregularly on the respective parts. On the periphery of this divided wheel press springs 1 2 3, the middle

one 2 resting on both parts of the wheel so as to form a connection with every successive contact-surface on either part. The spring 1 touches the contact-surfaces on one part of the wheel and the spring 3 those on the other part. It will, hence, appear that as each contact-strip of one part of the wheel reaches the springs it forms an electrical connection between 1 and 2, and that each strip on the other part forms a connection between 2 and 3; but these respective connections are not made simultaneously, but in an irregular manner. $F^2$ is a wheel, also made in two parts, and driven by clock-work or by gearing from the wheel $A^2$ in such a manner that $A^2$ may perform a number of revolutions for one revolution of $F^2$. The wheel $F^2$ is provided with divided contact-strips of varying widths. These strips are not arranged irregularly as those on the wheel $A^2$, but are set in alternate positions around the wheel, so that a contact-surface on one part will be opposite an insulating surface on the other part, or vice versa, around the entire periphery. Three springs, 4 5 6, bear on the periphery of the wheel $F^2$, the center one 5 receiving contact from every metallic strip, so that the said spring 5 will be placed in electrical connection with 4 and 6 alternately. The wire $x$ is attached to the spring 2; $x^1$ unites 3 and 4; $x^2$ is attached to 5; and a supplemental wire, $x''$, unites the supplemental springs 1 and 6. The office of the wheel $F^2$ is to place $x^2$ into connection with $x^1$ and $x''$ alternately. The effect of this arrangement is such that the sequence of breaks and contacts which wheel $A^2$ effects is being constantly varied by the action of wheel $F^2$, which makes alternately, but at varying intervals, either section of $A^2$ the medium for effecting said breaks and contacts.

I have described an arrangement by which a second electrical circuit may be made the means of detecting any variation in the normal pulsations of an exposed electrical circuit whether such variation be produced by cutting, short-circuiting, or other tampering with the conductors, or by the doing of any act which the apparatus is arranged to detect. This general result may be accomplished by other means of combining two or more synchronous mechanical circuit-breakers, a plurality of circuits not being essential.

Having thus described my invention, I wish it distinctly understood that I do not desire to limit myself to the details or mechanism herein specified; but

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

1. An electrical circuit, an alarm mechanism, and two or more synchronous mechanical circuit-breakers or changers, or two or more automatic circuit-breakers, the combined action of which are synchronous with another or others so combined that any interruptions or variation of the normal pulsations in the conductor will cause an alarm.

2. An electro-magnetic circuit and a mechanical device for causing the current to pass through it in pulsations, irregular in interval, duration, or intensity, in combination with an alarm which will be caused to sound in the event of the normal succession of pulsations being interfered with.

3. A single electro-magnetic circuit controlled by one or more mechanical circuit-breakers or changers, in combination with an alarm when arranged so that an alarm will be had if the said circuit be broken or short-circuited, or if the normal sequence of electrical impulses be interfered with.

4. An electro-magnetic circuit in combination with two or more mechanical circuit-breakers and other appliances for causing two sets of impulses in the same conductor, one of which will and the other will not affect the movements of the circuit-breakers, or one controlled by and the other controlling the movements of the circuit-breakers.

5. The combination, with one or more electro-magnetic circuits, of two or more mechanical circuit-breakers or changers which act independently on the circuit or circuits, but are themselves controlled synchronously by electricity.

6. The combination of two or more electro-magnetic circuits controlled by synchronous mechanical circuit-breakers and an alarm so arranged that the alarm will be actuated by any interruption of the synchronous pulsations of the circuits.

7. The two electro-magnetic circuits connected separately to the respective helices of a magnet, and caused to act in unison or opposition by the agency of synchronous mechanical circuit-breakers.

8. Secondary circuit-breakers or permutation appliances when combined with an electro-magnetic circuit, an alarm and mechanical devices to render the action of the circuit-breakers synchronous, substantially as set forth.

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Witnesses:
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