(No Model.)

E. S. BENNETT & H. F. PARSHALL.

ELECTRO MAGNETIC CLUTCH.

No. 454,832. Patented June 23, 1891.

Fig. 1

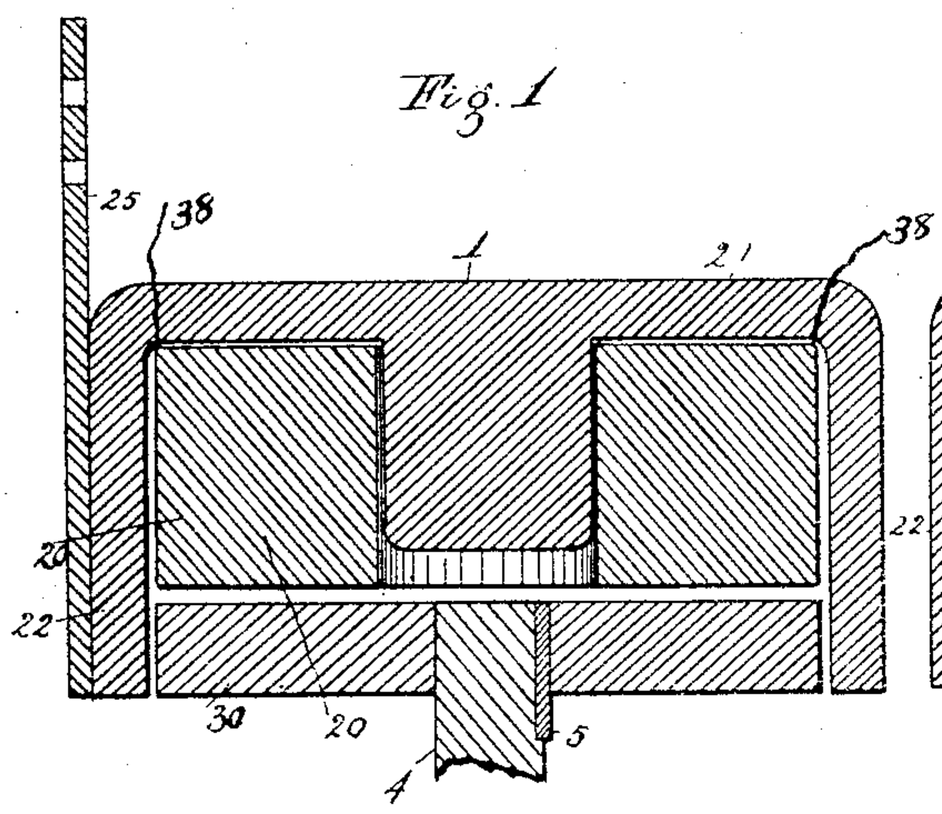


Fig. 3.

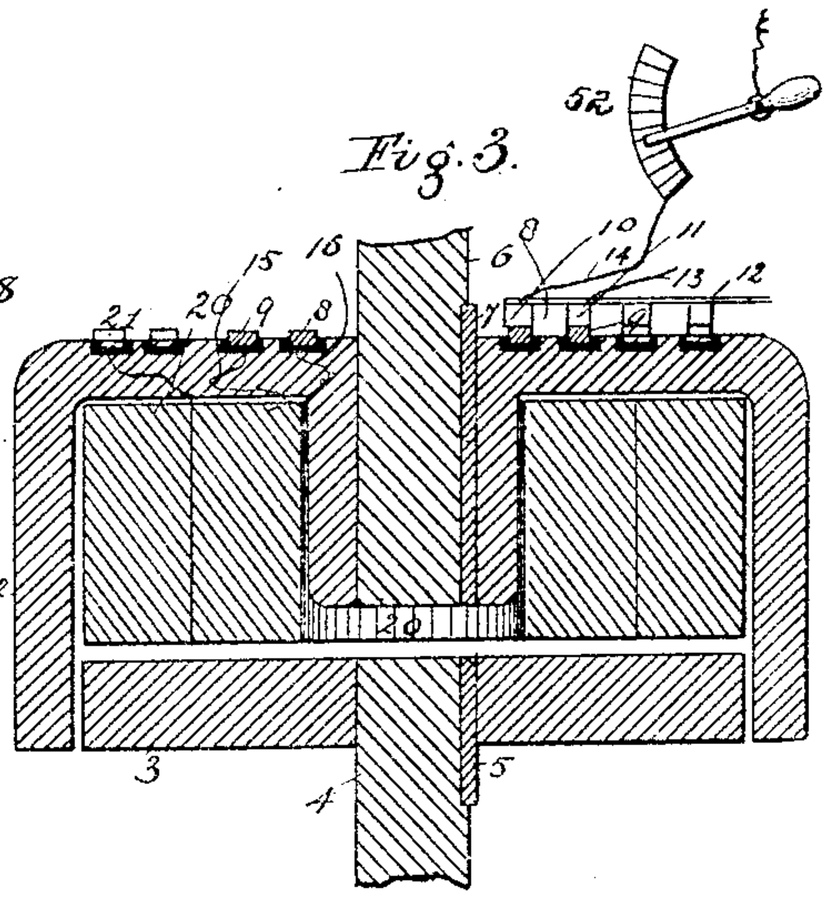


Fig. 2.

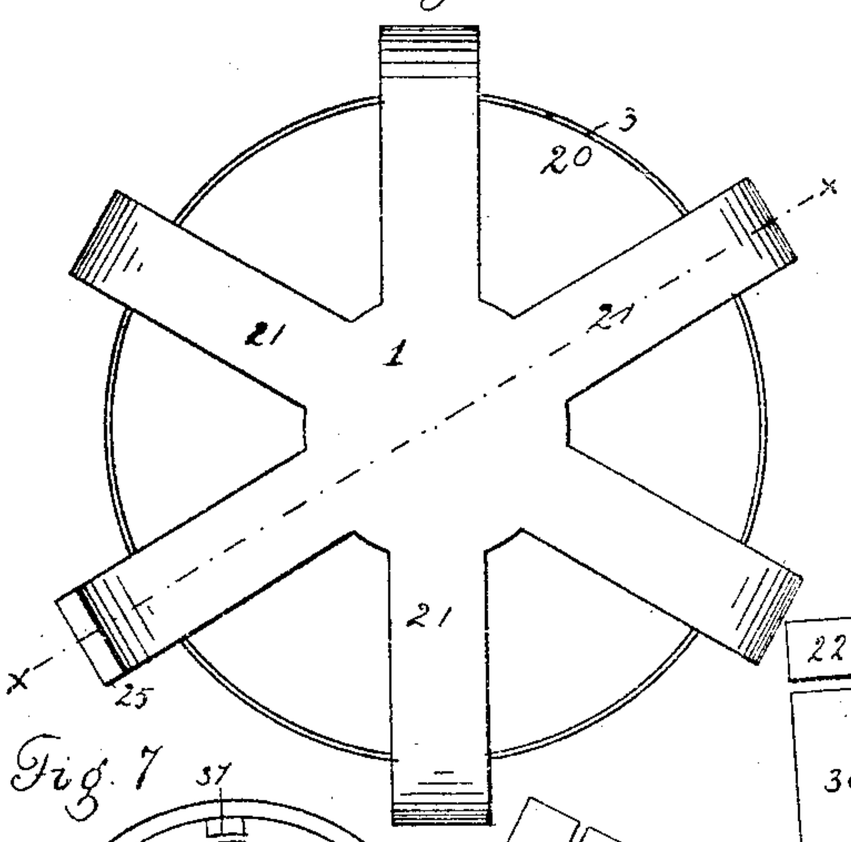


Fig. 4.

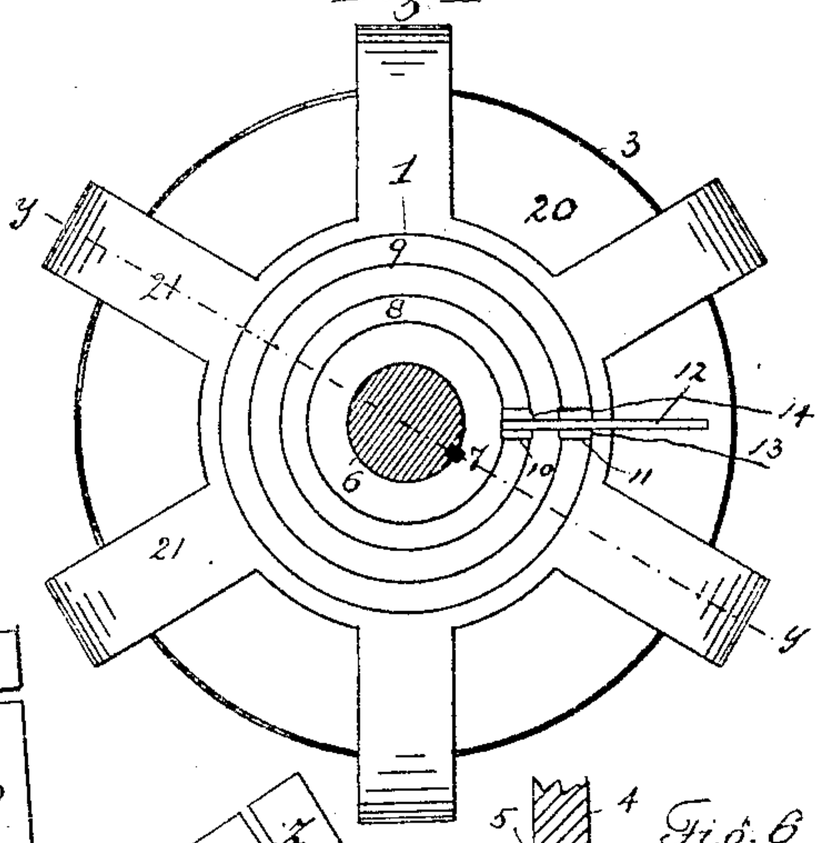
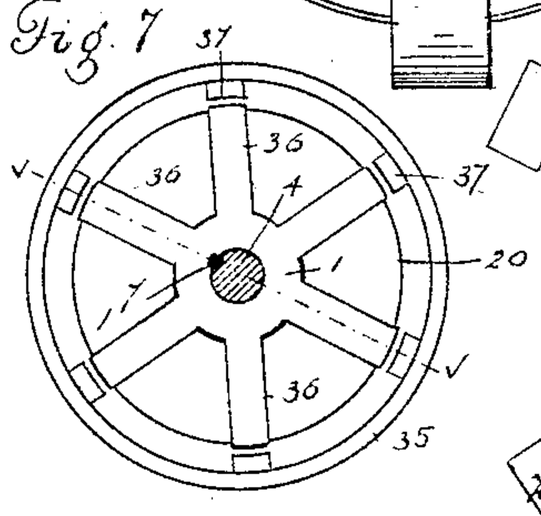


Fig. 7



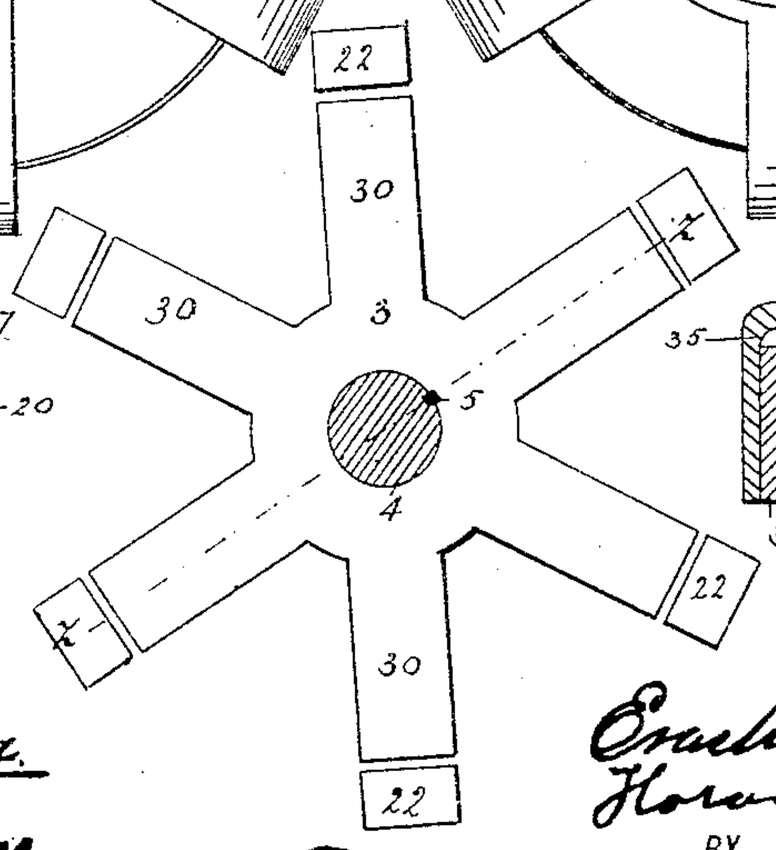


Fig. 6

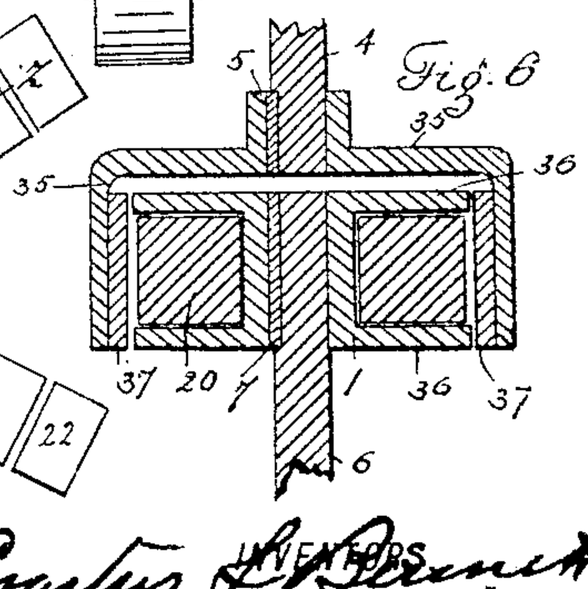


Fig. 5

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UNITED STATES PATENT OFFICE.

ERASTUS S. BENNETT, OF DENVER, COLORADO, AND HORACE F. PARSHALL, OF BALTIMORE, MARYLAND.

ELECTRO-MAGNETIC CLUTCH.

SPECIFICATION, forming part of Letters Patent No. 454,832, dated June 23, 1891.

Application filed July 29, 1890. Serial No. 360,328. (No model.)

To all whom it may concern:

Be it known that we, ERASTUS S. BENNETT, residing at Denver, in the county of Arapahoe and State of Colorado, and HORACE F. PARSHALL, residing at Baltimore, in the State of Maryland, both citizens of the United States of America, have invented an Improved Electro-Magnetic Clutch; and we do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

Our invention relates to a new form and construction of devices for applying electro-magnetism, whereby the electro-magnetic force or attraction is made to arrest motion, having the function of a brake, or to transmit motion, having an opposite function, the power acting in each case without the interposition of friction.

The object of our invention is to provide an efficient device for transmitting large forces, said device being simple in construction, consisting of few parts, the device being reliable and durable in use. It is to be noticed that, though our device may have any number of attracting-poles, but one magnetizing-coil is required, the invention being based on the following principles: It is well known that the force exerted between the two poles of an electro-magnet with a given magnetizing force increases as the poles are brought together, such increase of force being proportional to the increase of magnetic induction between the poles; further, that the force required to change their relative position depends on the change of induction between them brought about by the change of position. From this it follows that a device for transmitting force by magnetic attraction to be efficient must have its parts so arranged that in some positions they include the greatest possible number of lines of force and in adjacent positions they include the fewest possible number. It is further known that the greater the sectional area of any magnetic circuit the more magnetism will be generated in it with a given expenditure of heat in the magnetic coil. This becomes evident when we consider that the number of lines of force per unit of area is constant for a given number of ampère turns for a unit of length, and that while the area increases with the square of the diameter the energy dissipated in an ampère turn increases only with the diameter of the core. It follows that the greater the area of the poles or the greater the number of poles magnetized with a single coil, the greater will be the attraction and the greater will be the efficiency.

Our invention will be better understood by reference to the accompanying drawings, in which is illustrated an embodiment of the same, Figure 1 being a vertical section taken on line $x\ x$, Fig. 2, illustrating the invention as a brake. Fig. 2 is an end view of the mechanism shown in Fig. 1. Fig. 3 is a section taken on the line $y\ y$, Fig. 4, and showing the construction when used for transmitting motion. Fig. 4 is an end view of the mechanism shown in Fig. 3. Fig. 5 is an end view of Figs. 1 and 3, showing the shape of the armature used with the magnet. This shows the end of the mechanism opposite that from which views 2 and 4 are taken. Fig. 6 is a section taken on the line $v\ v$, Fig. 7. Fig. 7 is an end view or elevation, on a reduced scale, of a modified form of the device.

In the views let the reference-numeral 20 designate a coil of insulated wire forming the helix of an electro-magnet. The core 1 of the magnet is provided with arms 21, (see Figs. 1 to 5,) projecting radially from its outer extremity. These arms extend to the periphery of the coil, when they turn short and continue, as indicated by the numeral 22, in lines at right angles to radial parts 21. Parts 22 extend beyond the coil, so as to inclose the outer extremities of radial arms 30, projecting from the hub 3, secured to a shaft 4 by means of a spline 5.

The coil 20, together with the core 1 and arms 21 and 22, constitutes an electro-magnet which has the function of a series of magnets arranged annularly and electrically connected. The hub 3, together with the arms 30, forms the armature of this magnet; but the relative position of the parts is such that the arms are never in actual contact with the

poles of the magnet, a clear space lying therebetween sufficient to avoid at all times frictional engagement. Arms 22 of the magnet form in effect the poles of a series of electro-magnets, each of said poles acting independently upon corresponding radial arms 30, which form the armatures of these poles. The poles 22 and armatures 30 are correspondingly arranged, as shown in Fig. 5, so that all the poles acting shall act simultaneously upon corresponding armatures.

The number of armatures and poles need not necessarily be equal. The number of either may be a multiple of the other, the only other requirement being that all the poles acting shall act simultaneously.

The action of the device, generally, described is as follows: When a set of armatures is opposite a set of poles, the greatest number of lines of force is in the magnetic circuit, and when a force is applied to turn the armatures with respect to the poles the number of lines of force is changed, and the greatest force possible to transmit is measured by the greatest change it is possible to produce in the magnetic circuit. This change occurs just before an armature leaves its pole, for when this occurs a gap of high resistance is introduced in the magnetic circuit and the number of lines of force through the circuit is greatly lessened. In other words, there is a magnetic break, and the more complete this break the more force can be transmitted. Our construction is such that with a single magnetizing-coil we get first a magnetic circuit of very low magnetic resistance, and then by changing the relative position of the transmitting parts a magnetic circuit of very high magnetic resistance.

The device performs the office of a brake when either the armatures or magnets are made stationary. Figs. 1 and 2 show this application of it with the magnet stationary. This is effected by means of an arm 25, constructed of some suitable insulating material, the magnet being secured to this arm, which is provided with apertures through which the arm may be made fast to any suitable stationary object by the use of screws or bolts. The terminals 38 of the coil must of course be connected with some suitable current-supplying device, such as a battery or other generator.

In describing the operation of the brake, we will suppose the hub 3, together with its shaft 4, as shown in Fig. 1, to be in motion and propelled by some external power. Now when it is desired to arrest this motion by the use of our device the electric current is passed through the magnet, when the movement of the armature is stopped by the magnetic attraction thus induced between the poles of the magnet and the corresponding arms of the armature.

The use of our improved device in transmitting motion is illustrated in Figs. 3 and 4. In this case the electro-magnet is mounted upon a shaft 6, which passes through the core 1, the core being secured to the shaft by the use of a spline 7. The shaft 6, together with the magnet, is supposed to be in motion communicated from any suitable external source of power. The hub or armature, with its shaft 4, is now supposed to be stationary. Motion may, however, be imparted to these last-named elements at any time during the movement of the magnet by passing an electric current through the magnet which transmits motion to the armature by magnetic attraction.

In passing the current through the magnet, as just described, we make use of rings 8 and 9, surrounding shaft 6 and secured to radial arms 21, but suitably insulated therefrom. The rings are formed of some material which is a good conductor of the electric current, and are electrically connected with the positive and negative wires 15 and 16, respectively, leading from the coil 20 of the magnet.

12 is a brush-holder provided with copper or other suitable metallic rollers or brushes 10 and 11, which are adapted to engage rings 8 and 9, respectively, while the magnet is in motion and whenever it is desired to pass the current therethrough. These rollers, brushes, or other suitable devices are respectively connected with the positive and negative poles 13 and 14 of the battery or other suitable source of electrical energy. The object of using rollers to engage the rings is to reduce the friction between the switch and the moving magnet to a minimum. Yet, as before stated, a brush or any other suitable means of contact may be substituted for the rollers.

In the modified form of the device shown in Figs. 6 and 7 the armature 35, secured to shaft 4, projects outward from the shaft and incloses the magnet, which is provided with two sets of radial arms or poles 36 36, one set projecting from the core 1 on each side of the coil 20. The body of the armature is provided on its interior with lugs or projections 37, arranged to correspond in position with the arms 36 of the magnet. This is simply another form of carrying out the principle of our invention.

To vary the power exerted by the brake or clutch, it is only necessary to vary the power of the magnetic field, which may be done in an approved manner now in use with electro-motors, such as by varying the strength of the current passing through the coils, which may be done by means of the resistance 52, as shown in Fig. 3. The device performs the office of a clutch or gearing when both the armatures and magnets are free to rotate. It is not necessary that the armatures and magnets should have a common axis, since the one axis may form a slight angle with the other without departing from the principle or interfering with the operation of the device.

The ratio of the turns made by the armatures to the turns made by the magnets may be varied at will by varying the magnetizing force of the magnetizing-coil, said force being governed by the principles heretofore specified. When this ratio is one, or when the turns made by the armatures equal the turns made by the magnet, the device has the function of a clutch. When this ratio is made to vary by varying the power of the magnetizing-coil, as above described, the device has the function of a gearing where the engaging gear-wheels are of different diameters.

When both members (the magnet and the armature) rotate, we make contact with the coil, as before stated, by means of contact-rings 8 and 9, Fig. 3, one of these rings being connected with each terminal of the coil.

Having thus described our invention, what we claim is—

1. The combination, with the coil of an electro-magnet, of a core provided with a series of radially-disposed arms having their ends bent into a position substantially parallel with the sides of the coil, and an armature having radially-disposed arms adapted to rotate opposite the ends of said radial arms to be influenced thereby, as set forth.

2. The combination, with a magnetizing-coil, of a core having a series of radial arms, and an armature having a series of radial arms, said armature being mounted on a rotating shaft and having its ends disposed so as to move in front of the poles of the core, as specified.

3. The combination, with common magnetizing-coils, of a series of electro-magnets arranged radially around the axis thereof, and a number of arms arranged around a common center, so as to act when in certain positions as the armatures of said electro-magnets, as set forth.

4. The combination, with the magnetizing-coils, of a number of arms carried about an axis on a common center piece, so as to form with it series of electro-magnets, and arms carried upon a revoluble axis forming armatures for the said magnets, as described.

5. The combination, with a revoluble axis having magnetizing-coils thereon, of a core within the said coils and mounted upon the said axis, having arms radially projecting therefrom, forming magnetic poles and projections mounted upon a revoluble axis and serving as armatures for the said poles, as described.

6. The combination, with the common magnetizing-coils, of a series of magnets and armatures arranged about an axis, and means for varying the force of the said coils, as set forth.

7. The combination, with the common magnetizing-coils and with contact-rings connected therewith, of a series of magnets and armatures arranged around an axis, and a series of brushes bearing against said rings, and conductors connected with the said brushes, substantially as set forth.

In testimony whereof we affix our signatures in the presence of two witnesses.

ERASTUS S. BENNETT.
HORACE F. PARSHALL.

Witnesses to Erastus S. Bennett's signature:

JOHN WESTON,
WM. MCCONNELL.

Witnesses to Horace F. Parshall's signature:

W. E. LINDSAY,
D. B. BULLARD.