

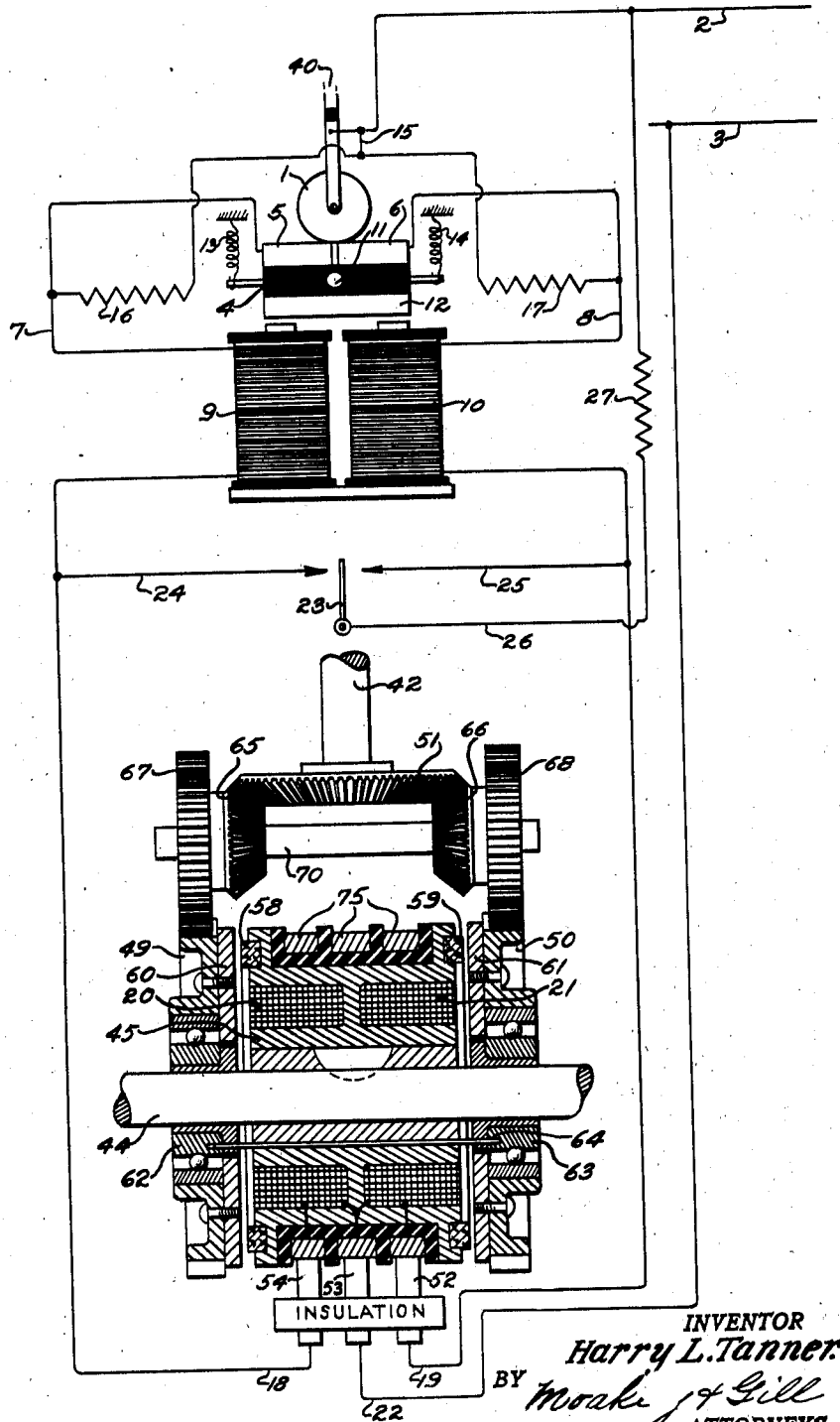
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CLUTCH

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## UNITED STATES PATENT OFFICE

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## CLUTCH

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This invention relates to clutches, and more particularly to clutches electrically controlled to drive the output elements in reversible directions at variable speeds. Such a clutch may be controlled in any desired manner, one suitable means being by a variable speed control mechanism of the type shown in the parent application, Serial No. 106,917, filed May 5, 1926, of which this application is a division.

The principal object of this invention is to provide a device for producing variable speed motion in reversible directions from a given source of power supply. A further object is to reduce inertia effects to a minimum so that changes in speed and complete reversals may be made quickly and accurately. Such a device has many applications, a typical one being in a follow-up system as disclosed in the parent application which provides a system having relatively movable primary (followed) and secondary (follower) elements, the latter being driven by a clutch of the type herein disclosed. A vibratory member may be used to control the clutch by rapidly varying the energization thereof proportionally to the movements of the primary element. Inasmuch as the members controlling both forward and reverse directions of movement are energized by the vibratory make and break action but for varying lengths of time depending upon the direction of movement of the primary, the secondary element is capable of instantaneous and minutely variable movement so that a smooth positive following motion of the secondary element results.

Other objects and advantages of this invention will become apparent from the following description of a preferred embodiment of the invention as illustrated by the accompanying drawing.

The single figure shows a reversing clutch mechanism which is the preferred form of this invention, the same being connected to a variable speed control device as disclosed and claimed in the parent application.

Referring to the drawing, numeral 1 designates a contact trolley or roller of conducting material and which is connected to one

side 2 of the electrical supply line, the other side of which is designated 3. Contact roller 1 represents the primary or followed element of the system, the movements of which are adapted to be followed by the secondary or following element, and which may be represented by commutator 4 consisting essentially of spaced contacts 5 and 6 mounted upon a block of insulating material. A pair of leads 7 and 8 are attached to contacts 5 and 6, respectively, and to magnetic vibrator coils 9 and 10, respectively, whereby a lateral reciprocatory or vibratory motion is imparted to member 4 as roller 1 engages either one of contacts 5 or 6 and thus alternately energizes magnet coils 9 and 10, respectively. The commutator 4 is pivotally mounted at 11 and carries an armature 12 which is attracted to either magnet coil 9 or 10 according to whether roller 1 engages either one of contacts 5 or 6, respectively. It will be seen that when coil 9, for example, is energized by engagement of roller 1 with contact 5, armature 12 will be drawn toward coil 9, thereby causing roller 1 to engage contact 6 to energize coil 10. This alternate energization of coils 9 and 10 is continuous whereby a vibratory motion is imparted to commutator 4, so that the resultant effect produced is a rapid relative movement between the respective contacts of the primary and secondary elements of the system. Centralizing springs 13 and 14 are attached to either side of commutator 4, in order to alter the period of vibration thereof.

Connected across leads 7 and 8 and to side 2 of the electrical supply line by lead 15 are a pair of resistances 16 and 17 which are adapted to balance conductors 5 and 6, respectively, so that there will be no sparking as roller 1 moves between contacts 5 and 6. Resistances 16 and 17 have an additional utility which will be explained hereinafter.

Connected to vibratory coils 9 and 10 by means of leads 18 and 19 are the opposite coils 20 and 21, respectively, of the electromagnetic clutch which is preferably of the type illustrated. The terminals of clutch coils 20 and 21 are connected by lead 22 to the other side 3 of the electrical supply line.

The clutch, being power driven, actuates the secondary element in accordance with the movements of the primary element, inasmuch as the clutch is intermittently energized so that it imparts a series of pressure impulses of a varying degree with extreme rapidity to the secondary element, which produce the effect of a constant and smooth following motion. Moreover, such rapid energization and variable pressure of the clutch imparts great sensitivity to the mechanism and a corresponding accuracy results.

If a hunting tendency between the primary and secondary elements of the system develops, contact lever 23, which moves with the primary element of the system to which roller 1 is connected, through the use and arrangement of means not shown, engages either one of contacts 24 or 25, which are mounted on the secondary element and are connected to leads 18 and 19, respectively. Inasmuch as contact lever 23 is connected to side 2 of the electrical supply line by lead 26 through resistance 27, which is equivalent to the resistance of the circuit above leads 18 and 19, a short circuit is established between line 2 through resistance 27, lead 26, lever 23 and either contact 24 or 25 to either clutch coil 20 or 21, respectively. Accordingly, if a secondary element carrying commutator 4, tends to hunt or overrun to either one side or the other, another circuit is established through the clutch coil on the same side to increase the clutching effect or pressure, whereupon the secondary member is actuated to decrease the time of return of roller 1 back to its central position. Accordingly mechanical damping is effected in the clutch and hunting is prevented as well as overrunning, inasmuch as the reversal takes place 90° out of phase with the movement of roller 1, that is, when roller 1 is halfway in its path to one side of its central position.

Resistances 16 and 17 are preferably so designed that clutch coils 20 and 21 are never completely de-energized, but that there is a continual leakage through lead 15 and through resistances 16 and 17 when there is no relative movement between the primary and secondary elements, nor is one side of the clutch completely de-energized when the other side is energized and drawing the secondary element to follow the movements of the primary element. The purpose being that any sudden energization or reversal in the energization from one side of the clutch to the other side is immediately transmitted to the driven parts without the delay commonly occasioned by the inertia of the moving parts. Such alternating energization, however, is insufficient to cause any appreciable frictional resistance or dragging in the clutch when it is driving the secondary element, since the virtually continuous hunting of the clutch is too rapid for the immediate response

of the secondary element, which accordingly always moves smoothly and positively.

The movement of roller 1 from its mid-position accordingly energizes the vibrator coils and the electro-magnetic clutch coils 20 and 21 which are mounted in a clutch ring 45 keyed upon and adapted to continually rotate with shaft 44, which is driven from a suitable power source. The coils are connected, through slip rings 75 on the ring 45, to their respective brushes 52 and 54 and the common brush 53. Clutch ring 45 also carries a pair of friction rings 58 and 59 which are always in close proximity to friction discs 60 and 61 which are securely attached to gears 49 and 50, respectively. Gears 49 and 50 are freely rotatable on ball bearings, the respective inner races 62 and 63 of which are slidably mounted on shaft 44. A slight axial motion between the gear units 49 and 50 and shaft 44 is provided for which is sufficient to allow gears 49 and 50 and their respective friction discs 60 and 61 to be drawn into frictional engagement with friction rings 58 and 59, respectively, as the electro-magnetic coils of the clutch are energized. A number of axially disposed pins 64 are slidably mounted in clutch ring 45 through friction discs 60 and 61, and their ends are embedded in or bear against the inner ball races 62 and 63 so that they have axial play. Accordingly, one disc is pushed away from its friction ring when the opposite disc is drawn to its friction ring due to the energization of one of the magnet coils, thus effecting a rapid clutching alternation from one side to another, or forward to reverse and vice versa. The forward and reverse drive of shaft 42 is effected through bevel gear 51 meshing with diametrically opposite bevel gears 65 and 66, which are integrally mounted with spur gears 67 and 68, respectively, upon a jack-shaft 70, so that spur gears 67 and 68 mesh with and are driven by gears 49 and 50, respectively, when the latter are clutched to rotating clutch ring 45.

In the manner hereinbefore described, each of the electro-magnetic coils is always at least slightly energized due to leakage in the electrical circuit, but such energization is not sufficient to offer resistance or dragging to the rotating clutch ring 45, but is intended to maintain each one of friction discs 60 and 61 in intimate proximity to their respective friction rings 58 and 59, so that there may be no delay between the time of energization and clutching, and thus a smooth motion of the follower is obtained since the pressure of the clutch varies as the degree of energization. For the same reason the masses of the moving clutching parts, namely discs 60 and 61 and gears 49 and 50, are preferably as small as possible so that their inertia is negligible.

If the member to which the roller 1 is con-

nected suddenly reverses its direction of movement and turns in the opposite direction, roller 1 will move to engage the opposite contact, such as contact 6 for example, and the circuit will be made primarily through lead 8, vibrator coil 10, lead 19, clutch coil 21 and lead 22 to the other side 3 of electrical supply line, but the vibrator will continuously operate to control the clutch as long as the movement of the roller continues. The energization of clutch coil 21, probably augmented an instant later by the circuit established between lever 23 and contact 25 due to the overrunning tendency of the sudden reversal, clutches disc 61 to friction ring 59, and the direction of rotation of shaft 42 is reversed through gears 50, 68, 66 and 51. Inasmuch as shaft 44 is driving clutch ring 45 at constant speed, and as the speed of the primary element usually varies periodically, there is necessarily some slippage between clutch ring 45 and friction discs 60 and 61 so that the actual primary input speed may be reproduced accurately. It is obvious that a larger motor or power source may be utilized whereby a greater power and a larger torque may be supplied to the following motion.

While only one step in the operation of the system in both directions has been described in detail, it is evident that the successive steps are instantaneous and continuous as the primary element moves, and also that, while a preferred embodiment of this invention has been illustrated and described, it is to be understood that modifications in design and detail may be freely made and that other forms of apparatus may be likewise controlled without departing from the spirit of this invention within the scope of the appended claims.

I claim:

1. In a clutch, a shaft, a double electro-magnet secured thereon, revoluble armatures on opposite sides of said magnet adapted to be magnetically clutched therewith, rotary members combined with said armatures, bearing carriers mounted on said shaft and displaceable axially thereof, anti-friction bearings interposed between said carriers and rotary members displaceable with the former and rotatively mounting the latter, power-conveying means operable with each of said rotary members, operable means connected with each power-conveying means for different directional actuation, and means to selectively energize said electromagnets.

2. In a clutch, a shaft, a double electro-magnet secured thereon, axially displaceable rotary members on opposite sides of said magnet adapted to be magnetically clutched therewith and rotated thereby, friction gripping means interposed between each of the rotary members and its respective magnet side, power conveying means operable with each of

said rotary members, operable means connected with each power conveying means for different directional actuation and means to selectively energize said electro-magnets, said axially displaceable members each comprising a shouldered bushing mounted on said shaft, a concentrically arranged multi-element anti-friction bearing having its inner element mounted on said bushing and abutting the shoulder thereof, an annular gear carried by the outer element of said bearing and coacting with said power conveying means and an annular armature disc removably connected to the annular gear extending inward beyond the inner periphery of the annular gear to form an abutment for the outer element of the anti-friction bearing.

3. In a clutch, a shaft, a double electro-magnet secured thereon, axially displaceable rotary members on opposite sides of said magnet adapted to be magnetically clutched therewith and rotated thereby, friction gripping means interposed between each of the rotary members and its respective magnet side, a power conveying gear train operable with each rotary member, operable means connected with each gear train for different directional actuation and means to selectively energize said electromagnets, each of said axially displaceable rotary members comprising a shouldered bushing mounted on said shaft with its shoulder proximate to the magnet side, a concentrically arranged multi-element anti-friction bearing having its inner element mounted on said bushing and abutting the shoulder thereof, an annular gear mounted on the outer element of the anti-friction bearing and meshing with a gear of said gear train, and an annular armature disc removably mounted on the side of said annular gear proximate the magnet side said armature disc extending inwardly beyond the inner periphery of said annular gear to serve as an abutment for said outer anti-friction bearing element and extending outwardly beyond the untoothed portion of the annular gear to serve as a stop to limit the axial movement of the axially displaceable rotary member in the direction of the mentioned gear of the gear train.

4. In a clutch, a driving shaft, a cylindrical member mounted thereon, a clutch ring mounted on said cylindrical member and rotatable therewith, radially spaced annular recesses in each side of said ring, electro-magnet coils in the inner of said annular recesses and frictional gripping rings fixedly held in the other recesses extending outwardly beyond the sides of the clutch ring, integral flanges extending beyond the outside periphery of said clutch ring defining a ring recess therebetween, a multi-recessed insulation ring in said ring recess, slip rings in said recesses electrically connected to said magnet coils, armatures on opposite sides of said

clutch ring, each armature having a plane surface opposite a plane surface of the adjacent frictional gripping ring, power-conveying mechanism connected with each armature, 5 a power output member connected with and reversely operable by the different power-conveying mechanisms, and means to selectively energize said coils.

5. In a clutch, rotatable driving and driven 10 elements comprising electro-magnets and armatures therefor, bearings mounting said driven elements and provided with members continuously connected to and rotatable with the driving element and displaceable longitudinally of the axis of rotation thereof, means 15 to selectively energize said magnets to attract their respective armatures, frictional gripping means interposed between each magnet and its armature and carried by one of 20 them and reversely operable means connected with and adapted to be reversely operated by different armatures when they are attracted.

In testimony whereof I affix my signature.  
HARRY L. TANNER.

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