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E. R. DOUGLAS.

MAGNETIC CLUTCH.

APPLICATION FILED JULY 28, 1902.

NO MODEL.

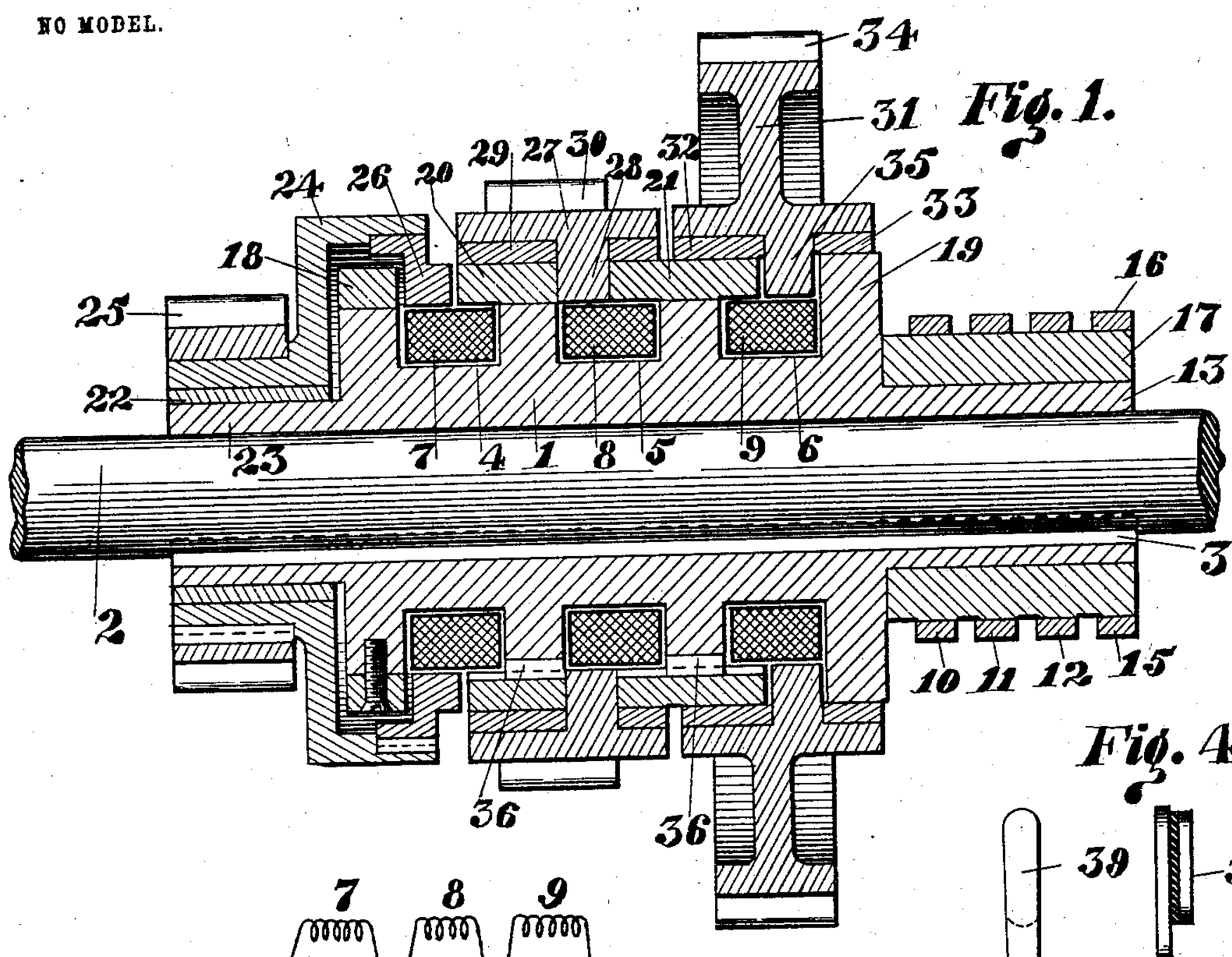

Fig. 1.

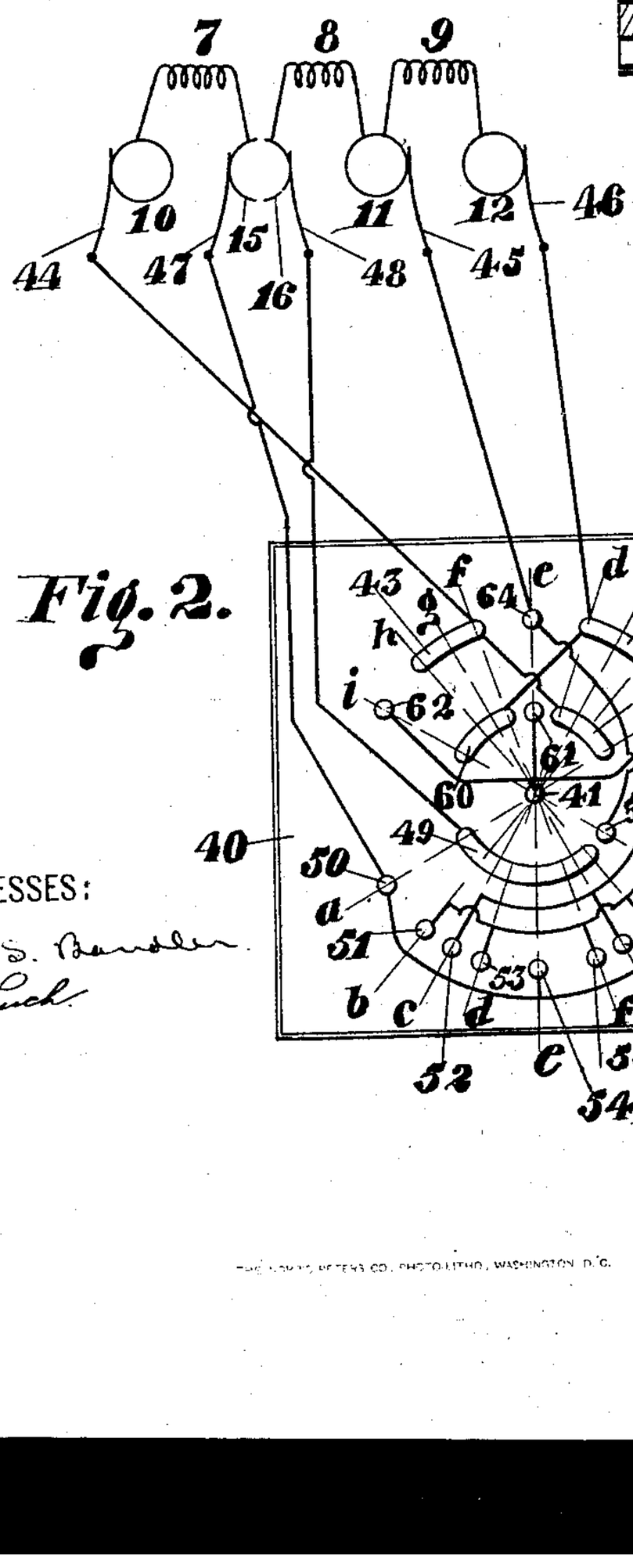

Fig. 2.

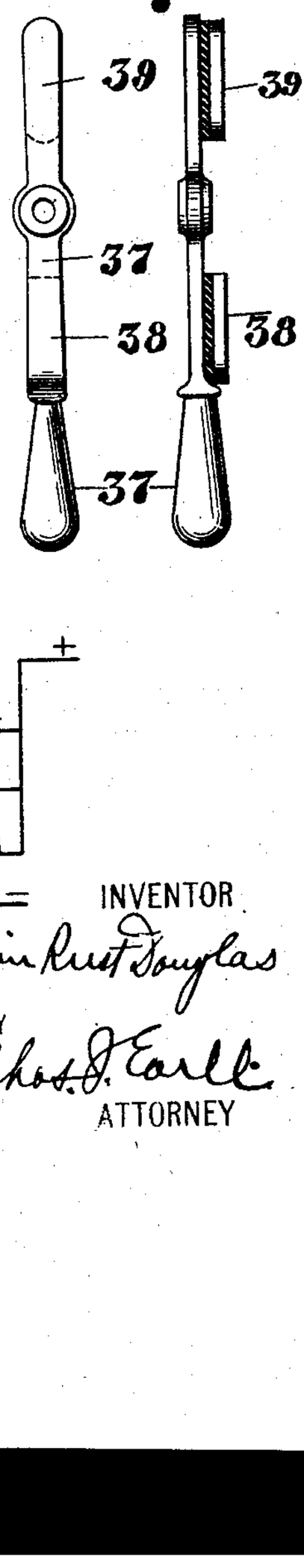

Fig. 3.

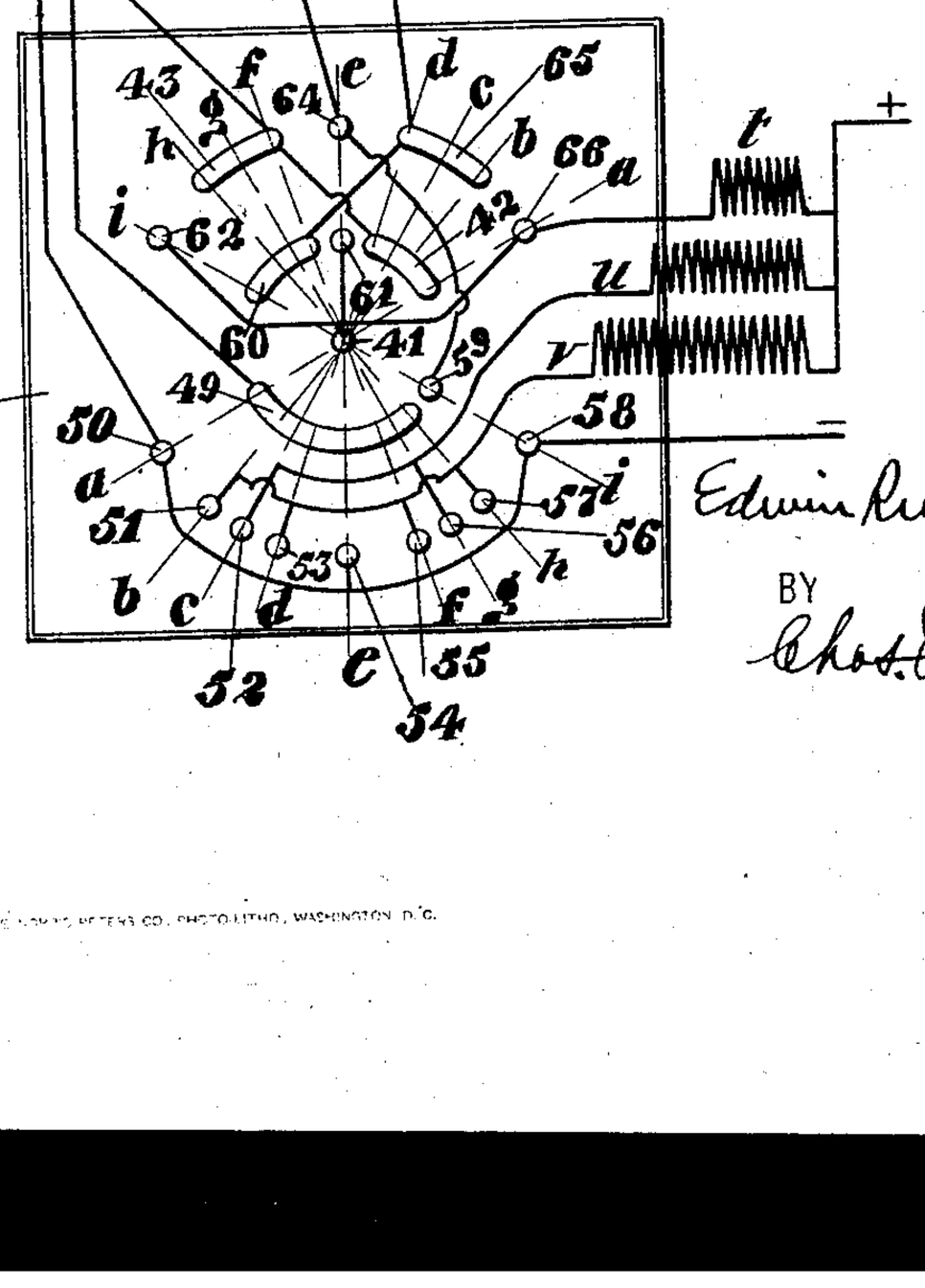

Fig. 4.

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MAGNETIC CLUTCH.

SPECIFICATION forming part of Letters Patent No. 721,679, dated March 3, 1903.

Application filed July 28, 1902. Serial No. 117,330. (No model.)

To all whom it may concern:

Be it known that I, EDWIN RUST DOUGLAS, a citizen of the United States of America, and a resident of East Orange, county of Essex, and State of New Jersey, have invented certain new and useful Improvements in Magnetic Clutches, of which the following is a specification.

My invention relates to electromagnetic clutches in which the engagement and disengagement of the members is effected by the magnetic action induced by an electric current.

The object of my invention is to produce a clutch of this class which shall be simple and effective in its construction and operation, which shall automatically adjust its friction-surfaces to meet the varying conditions produced by wear, one in which the magnetic circuit when the clutch is in engagement shall not be interrupted either by an air-space or non-magnetic material, and at the same time one in which the disengagement shall not be retarded by residual magnetism.

My object is, further, to produce a clutch of this class in which a single rotary member may be clutched at will to any one or more of several coacting rotary members.

My invention consists in providing a cylindrical body rotatably mounted, in providing said body with annular recesses in which suitable energizing-coils are placed, which said cylindrical body I will hereinafter refer to as the "main" clutch-body, in providing fixed and movable poles upon said main clutch-body, said movable poles always remaining in contact with the main clutch-body, in providing rotary members which are concentric with and mounted upon said main clutch-body, said rotary members being provided with poles which are adapted to be engaged by the poles of the main clutch-body in such a way that any one or more of the rotary members may at will be engaged by the poles of the main clutch-body, and in providing means whereby when one of the rotary members is thrown out of engagement the corresponding energizing-coil receives an alternating current, thereby causing rapid demagnetization and disengagement.

My invention consists in other novel features of construction, to be hereinafter more fully described and explained.

In the drawings accompanying and forming part of this specification, Figure 1 represents a longitudinal section through the center of a clutch embodying my present invention. Fig. 2 represents a diagram of the energizing-coils and the controller or switch with the electrical connections. Fig. 3 represents the switch-lever.

The reference characters are used in the same sense in all of the figures and the specification.

Numeral 1 represents the main clutch-body, mounted on the shaft 2, to which it is fixed by means of the key 3.

4, 5, and 6 represent grooves or annular recesses in the main clutch-body, in which are placed the energizing-coils 7, 8, and 9.

10, 11, and 12 represent metal contact-rings mounted on the hub 13 of the main body, from which they are insulated by the sleeve 14.

17 represents a commutator, composed of segments 15 and 16. The commutator 17 may be divided into any even number of segments, but for the sake of simplicity is here shown as being composed of two segments only. One end of the coil 7 is connected with the contact-ring 10, and the other end is connected with the segment 15 of the commutator, and one end of the coil 8 is connected with the segment 16, while the other end is connected with the ring 11. One end of the coil 9 is connected with the ring 11, and its other end is connected with the ring 12.

18 represents a ring secured to the main body, which forms one of the poles for the coil 7.

19 represents a corresponding pole for the winding 9. This pole is made integral with the main body portion, the purpose of making the pole 18 a separate piece being to permit the other parts to be assembled.

20 represents a movable pole between the coils 7 and 8, and 21 represents a similar movable pole between the poles 8 and 9. The poles 20 and 21 are in the form of cylindrical rings and fit freely upon the outer circumference of the main body portion. Thus

these poles may be moved freely longitudinally of the axis of the clutch, but are at all times in magnetic contact with the main body portion.

36 represents keys or feathers secured to the main body and projecting above the main body into the pole-pieces 20 and 21, whereby said pole-pieces are compelled to turn with the main body, but are permitted to slide longitudinally thereon.

22 represents a sleeve of good bearing material, which is at the same time a non-magnetic material, such as brass, upon the hub 23 of the main body portion. On this sleeve 22 is mounted the rotary member 24, to which is secured the gear 25 and the pole or armature 26.

27 represents a second rotary member mounted on the bearing-sleeve 29, said bearing-sleeve 29 being mounted on the movable pole 20. The rotary member 27 is provided with a gear 30 and flange 28, which forms the armature for the movable poles 20 and 21 and coil 8.

31 represents a third rotary member mounted on the bearing-rings 32 and 33 and provided with a gear 34 and flange 35, said flange 35 forming the armature for the fixed pole 19 and the movable pole 21.

The bearing-rings 29, 32, and 33, like the sleeve 22, are composed of non-magnetic and antifriction material, such as brass.

In Fig. 2 the energizing-coils 7, 8, and 9, the contact-rings 10, 11, and 12, and the commutator 17 are shown side by side diagrammatically instead of in their true relation, mounted on the main body concentrically, as shown in Fig. 1.

The switch-lever 37 (shown in Figs. 3 and 4) is provided with insulated contact-pieces 38 and 39, which are adapted to connect, respectively, the inner and outer rows of contact-points on the controller 40 above and below the fulcrum 41 as the lever is moved in its successive positions in a manner that is well understood.

62, 43, 64, 65, 66, 60, 61, 42, 49, 59, 50, 51, 52, 53, 54, 55, 56, 57, and 58 represent contact-points upon the controller 40, which are adapted to be engaged by the switch-lever 37.

t represents a resistance-coil connecting the positive main with the contact-points 61, 62, and 66.

u represents a resistance-coil between the positive main and the contact-points 52 and 56, and *v* represents a resistance-coil between the positive main and the contact-points 51, 53, 55, and 57.

I prefer to make the resistance *v* greater than *u* and resistance *u* greater than *t*. These resistances, however, may be varied to meet the requirements and conditions of any particular case.

The different positions of the switch-lever are indicated by the lines *a a*, *b b*, *c c*, *d d*, *e e*, *f f*, *g g*, *h h*, and *i i*.

Referring now to Fig. 1, suppose a continuous direct current is caused to traverse the coil 7. This will energize the poles 18 and 20 and cause the movable pole 20 to move to the left, as seen in Fig. 1, and clamp between it and the pole 18 the armature 26, thereby completing the magnetic circuit, causing the clutch member 24 to revolve with the main body 1. If now the current is broken and an alternating current is caused to flow through the coil 7, the poles 18 and 20 of the main body and the pole 26 of the armature will become rapidly demagnetized and the armature will be released. In the same way a current flowing through coil 8 will cause the poles 20 and 21 of the main body to clamp the pole 28 of the armature 27 and cause it to revolve with the main body, and a current through the coil 9 will cause the armature 31 to be engaged by the poles 21 and 19 of the main body.

I will now trace the course of the current for the different positions of the switch-lever in order to make it clear how any one of the members 24, 28, or 31 may be engaged or disengaged at will.

Take first the position of the switch-lever corresponding to the line *a a*. In this position the contact-lug 66 is electrically connected with 42, and 49 with 50, and the current flows from the positive main through resistance *t*, 66, 42, 43, brush 44, ring 10, coil 7, segment 15, and thence either through brush 47, 50, 58 to the negative main, or through brush 48, 49, 50, 58, and negative main. For this position of the switch-lever there is therefore a direct current caused to flow through the coil 7, thereby putting the armature 24 in engagement.

In position *b b* contact-lug 65 is electrically connected with 42, and 49 with 51, and the current flows through resistance *v*, 51, 49, brush 48 and thence either through segment 16, coil 8, ring 11, coil 9, ring 12, brush 46, points 65 42 43, brush 44, ring 10, coil 7, segment 15, brush 47, points 50 and 58 to the negative main, or through segment 15, coil 7, ring 10, brush 44, points 43 42 65, brush 46, ring 12, coil 9, ring 11, coil 8, segment 16, brush 47, points 50 and 58, and the negative main. It will be understood that in this circuit, after leaving the brush 48, the current passes through all three coils 7, 8, and 9 in one direction when the segment 16 is in contact with brush 48 and in an opposite direction when the segment 15 is in contact. There is therefore for this position of the switch-lever an alternating current flowing through all of the coils, said alternating current having in its circuit the resistance *v*.

For position *c c* of the switch-lever the current flows from the positive main through resistance *u*, 52, 49, 48, and thence either through 16, 8, 11, 9, 12, 46, 65, 42, 43, 44, 10, 7, 15, 47, 50, 58, and the negative main, or 15, 7, 10, 44, 43, 42, 65, 46, 12, 9, 11, 8, 16, 47, 50, 58, and the negative main, in this case, as in position *b b*, causing an alternating cur-

rent to flow through all of the coils; but with resistance *u* instead of resistance *v* in the circuit, resistance *u* being less than resistance *v*, the alternating current for this position is of greater strength.

For position *d d* the current flows from the positive main through resistance *v*, 53, 49, 48, and thence either through 16, 8, 11, 9, 12, 46, 65, 42, 43, 44, 10, 7, 15, 47, 50, 58, and the negative main, or 15, 7, 10, 44, 43, 42, 65, 46, 12, 9, 11, 8, 16, 47, 50, 58, and the negative main. For this position, as in position *b b*, an alternating current flows through all of the energizing-coils, having in its circuit resistance *v*.

In position *e e* the current flows from the positive main through resistance *t*, 66, 61, 64, 45, 11, 8, 16, and thence either through 48, 49, 54, 58, and the negative main, or through 47, 50, 58, and the negative main, thereby causing a continuous current to flow through coil 8, causing the engagement of the armature 27.

In position *f f* the current flows from the positive main through resistance *v*, 55, 49, 48, and thence either through 16, 8, 11, 9, 12, 46, 65, 60, 43, 44, 10, 7, 15, 47, 50, 58, and the negative main, or 15, 7, 10, 44, 43, 60, 65, 46, 12, 9, 11, 8, 16, 47, 50, 58, and the negative main, causing an alternating current to flow through all of the coils with the resistance *v* in its circuit.

In position *g g* the current flows from the positive main through resistance *u*, 56, 49, 48, and thence either through 16, 8, 11, 9, 12, 46, 65, 60, 43, 44, 10, 7, 15, 47, 50, 58, and the negative main, or 15, 7, 10, 44, 43, 60, 65, 46, 12, 9, 11, 8, 16, 47, 50, 58, and the negative main, producing the same result as in position *c c*.

In position *h h* the current flows from the positive main through points 57, 49, 48, and thence same as in position *f f*.

For position *i i* the current flows from the positive main through resistance *t*, points 66, 62, 60, 65, 46, 12, 9, 11, 45, 64, 59, 58, and the negative main, causing coil 9 to be energized by a direct current, thereby engaging member 31. It is thus seen that any one of the coils 7, 8, or 9 may be energized by a direct current by placing the switch-lever in the proper position and that as the switch-lever is moved from that position an alternating current at first weaker, then stronger, and then weaker is caused to flow through the coil and demagnetize the clutch. I have here shown only two degrees of strength for the demagnetizing-current, and in practice I have found that this is sufficient in ordinary cases. It is, however, obvious that a greater number of different degrees of strength for the demagnetizing-current could be provided without in any way departing from the scope of my invention.

When the lever 37 is allowed to remain midway between positions *a a* and *b b*, or between *d d* and *e e*, or *e e* and *f f*, or between *h h* and *i i*, no current at all will flow through any of the coils or the controller.

This clutch is especially applicable in cases where it desired to be able to transmit power from one shaft to another at different speeds, as is the case in many machine-tools, in power-driven vehicles, and a vast number of other instances which might be mentioned.

Having thus described my invention, what I claim is—

1. In a magnetic clutch, the combination with a main body provided with a cylindrical recess adapted to receive an energizing-coil, and having a fixed pole on one side and a movable pole on the other side of said cylindrical recess, of an armature having a pole-piece adapted to be clamped between said fixed and said movable poles.

2. In a magnetic clutch, the combination with a main body having an annular recess in its cylindrical surface adapted to receive an energizing-coil, and movable poles on either side of said recess, of an armature mounted on the hub of said main body, said armature having a pole adapted to be clamped between said movable poles.

3. In a magnetic clutch, the combination with a main body having an annular recess in its cylindrical surface adapted to receive an energizing-coil, and poles on either side of said recess, of an armature rotatably mounted concentric with said main body, having a pole adapted to be clamped between the poles of said main body.

4. In a magnetic clutch, the combination with a main body having an annular recess in its cylindrical surface adapted to receive an energizing-coil, and a fixed pole on one side and a movable pole on the other side of said cylindrical recess, of an armature mounted on the hub of said main body, separated therefrom by a sleeve of non-magnetic material, said armature having a pole adapted to be clamped between the fixed and movable poles of said main body.

5. In a magnetic clutch, the combination with a main body having a plurality of recesses formed in the cylindrical surface of said main body adapted to receive energizing-coils, and movable poles mounted on said main body between said annular recesses, with rotary armatures having annular poles located between said movable poles.

6. In a magnetic clutch, the combination with a cylindrical body having annular recesses formed in its cylindrical surface adapted to receive energizing-coils, of fixed poles on said main body located adjacent to the outer edges of the end recesses in said main body, and movable poles between adjacent annular grooves, with clutch members rotatably mounted on said main body, and having poles adapted to be engaged by the poles of said main body.

7. In a magnetic clutch, the combination with a main body having a plurality of annular grooves formed in its cylindrical surface, energizing-coils in said annular grooves, mov-

able poles mounted on said main body between said annular grooves, armatures rotatably mounted on said main body having poles adapted to be engaged by the poles of said main body, energizing-coils in said annular grooves, and means for causing an electric current to flow through any one of said energizing-coils exclusive of the others.

8. In a magnetic clutch, the combination with a main body having a plurality of annular grooves formed in its cylindrical surface, energizing-coils in said annular grooves, movable poles mounted on said main body between said annular grooves, armatures rotatably mounted on said main body, having poles adapted to be engaged by the poles of said main body, energizing-coils in said annular grooves, insulated contact-rings and commutator-ring mounted on said main body connected electrically with said energizing-coils, and means for causing an electric current to flow through any one of said energizing-coils exclusive of the others.

9. In a magnetic clutch, the combination with a main body having a plurality of annular grooves formed in its cylindrical surface, energizing-coils in said annular grooves, movable poles mounted on said main body, armatures rotatably mounted on said main body having poles adapted to be engaged by the poles of said main body, energizing-coils in said annular grooves, insulated rings mounted on said main body connected electrically with said energizing-coils, and a controller and controller-lever and connections between said controller and said rings whereby said controller-lever may be placed to cause an electric current to energize at will any one of the energizing-coils or cause alternating currents of different strengths to flow through said energizing-coils.

10. In a magnetic clutch, the combination with a main body having a plurality of annular grooves formed in its cylindrical surface, energizing-coils in said annular grooves, movable poles mounted on said main body between said annular grooves, armatures rotatably mounted on said main body having poles adapted to be engaged by the poles of said main body, energizing-coils in said annular grooves, insulated contact-rings and commutator-ring mounted on said main body, connected electrically with said energizing-coils, and a controller and controller-lever and connections between said controller and said contact and commutator rings, whereby said controller-lever may be placed to cause an electric current to energize at will any one of the energizing-coils or to cause alternating currents of different strengths to flow through said energizing-coils.

11. In a magnetic clutch, the combination with a plurality of energizing-coils, as coils 7, 8 and 9, contact-ring 10 connected with the coil 7, contact-ring 11 connected with the coils 8 and 9, contact-ring 12 connected with the coil 9, a commutator-ring having its alternate segments connected respectively with the coils 7 and 8 and the controller 40 substantially as shown and described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EDWIN RUST DOUGLAS.

Witnesses:
GEO. W. BOWER,
S. N. THOMAS.