No. 786,425. PATENTED APR. 4, 1905.

H. H. CUTLER.

MAGNETIC CLUTCH OR SPEED ACCELERATOR.

APPLICATION FILED JULY 23, 1903.

2 SHEETS—SHEET 1.

Fig. 2.

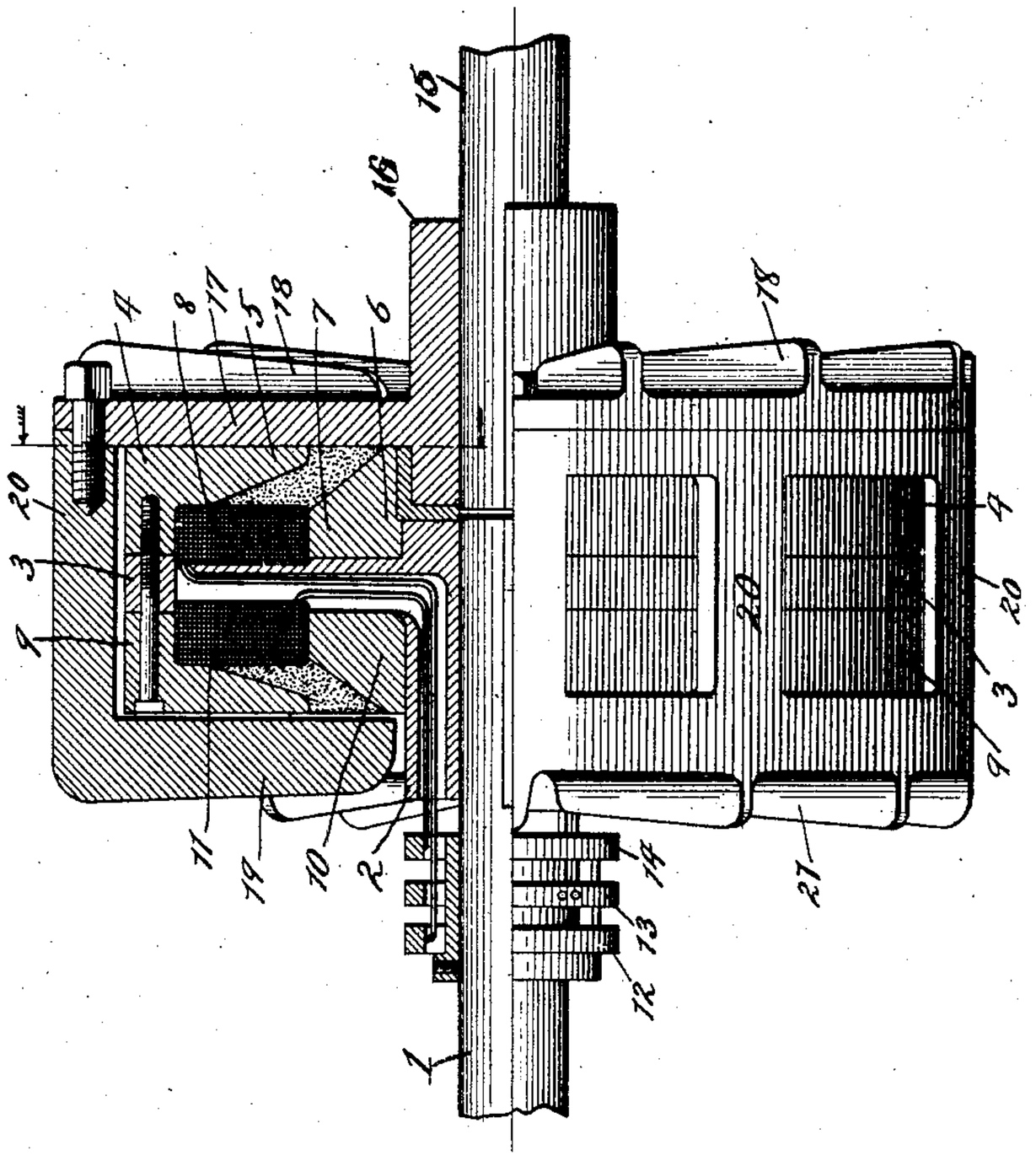
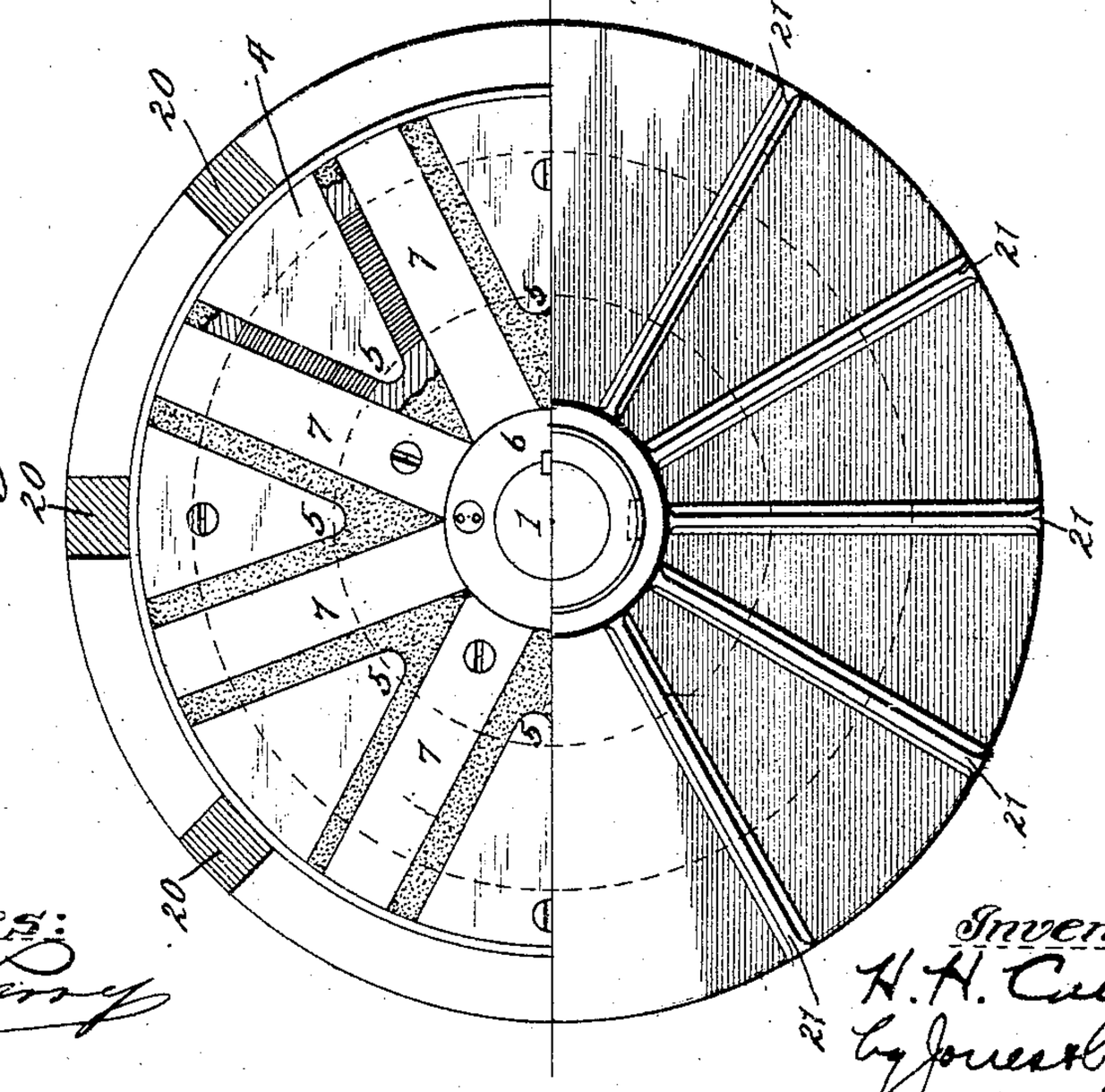


Fig. 1.



Witnesses:
Fred D. Perry
J. B. Weir

Inventor:
H. H. Cutler
by Jones & Addington
Attys.

No. 786,425. PATENTED APR. 4, 1905.

H. H. CUTLER.

MAGNETIC CLUTCH OR SPEED ACCELERATOR.

APPLICATION FILED JULY 23, 1903.

2 SHEETS—SHEET 2.

Fig. 4.

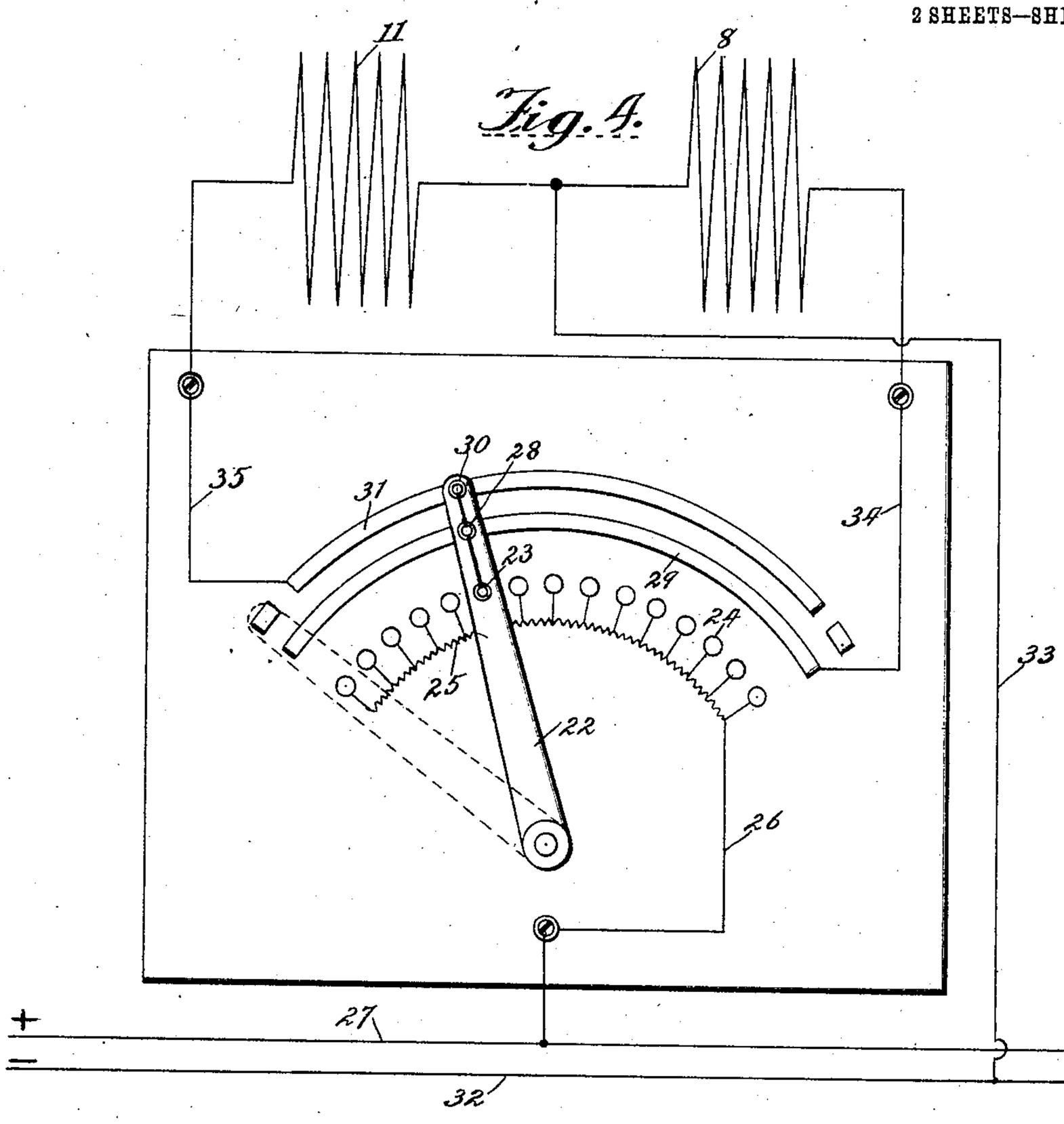
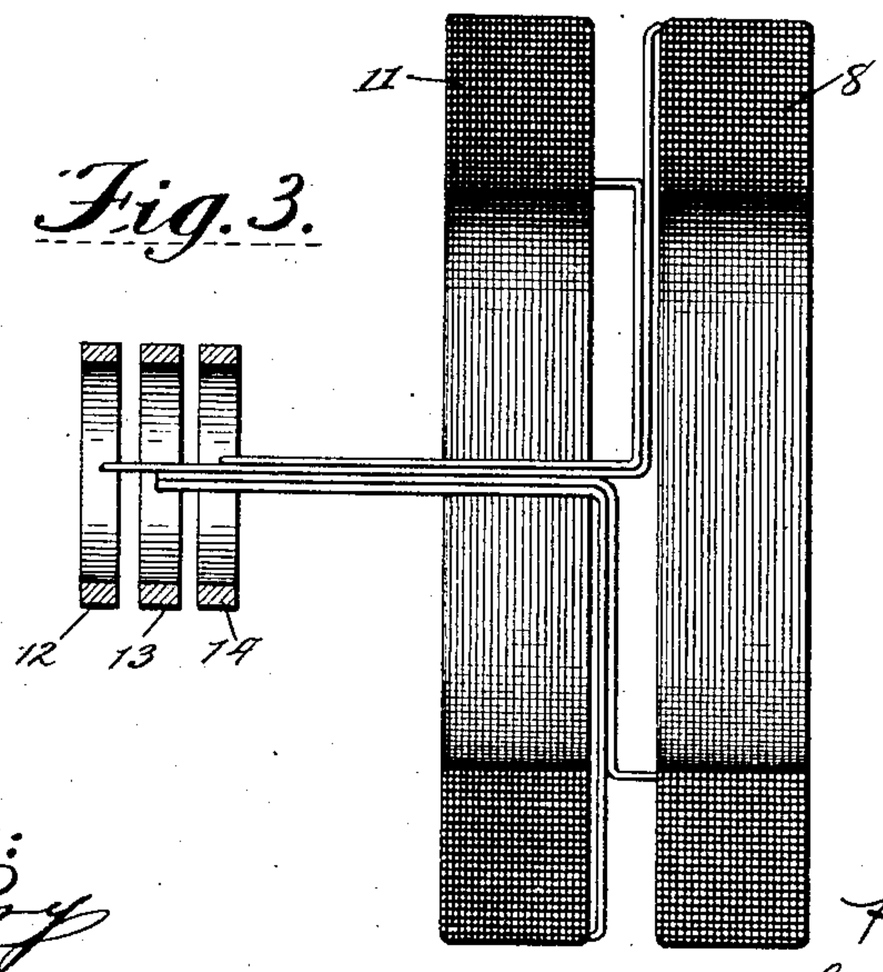


Fig. 3.



Witnesses:
Ira D. Landy
J. B. Wen

Inventor:
H. H. Cutler
by Jones & Addington
Attys.

No. 786,425. Patented April 4, 1905.

UNITED STATES PATENT OFFICE.

HENRY H. CUTLER, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO ARNOLD MAGNETIC CLUTCH COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

MAGNETIC CLUTCH OR SPEED-ACCELERATOR.

SPECIFICATION forming part of Letters Patent No. 786,425, dated April 4, 1905.

Application filed July 23, 1903. Serial No. 166,702.

To all whom it may concern:

Be it known that I, HENRY H. CUTLER, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Improvement in Magnetic Clutches or Speed-Accelerators, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to a magnetic clutch or speed-accelerator, my object being to provide an electromagnetic element whereby a driven part may be rotated at any desired speed equal to or less than that of the driving part.

In an application filed by me August 5, 1903, Serial No. 168,388, I have described and claimed an improved form of magnetic clutch or speed-accelerator; and the present invention relates to one of the several modifications or embodiments of which the generic invention set forth in said application is susceptible. For the purpose of describing the invention I have illustrated in said application above mentioned a form of the clutch or accelerator in which a single winding is provided on the primary or inducing member adapted to inductively influence a suitable secondary or induced member. I have referred to the fact in my said prior application that when the accelerator is employed in a connection wherein it is never desired to bring the driven part to full speed the inductive effect alone may be relied upon for producing the turning effort, and I have also called attention to the fact that where it is desired to employ the clutch or accelerator for bringing the driven part to the full speed of the driving part it is essential to aid the turning effort due to induction by the turning effort due to friction. In the form of the invention which I have illustrated in my said application above mentioned I have shown the induced or secondary member as subjected continuously during the starting interval to the full frictional effect.

In the present application I have illustrated and described a modification of my invention wherein the secondary or induced member is subjected continuously to a portion only of the full frictional effect. This reduction of the frictional effect may be accomplished in a number of ways—as, for instance, by mechanical means through the agency of springs or the like or by electrical means through the agency of a balancing-coil or equivalent means. In the present application I have illustrated the counterbalancing means in the form of a second winding carried on the inducing member, this winding serving to counterbalance a portion of the pull with which the secondary member is magnetically attracted to the primary member, whereby the frictional effect is reduced to the desired extent.

In accordance with the present invention I utilize the magnetic influence of the second winding which is employed for balancing purposes to inductively act upon a second armature or induced member, whereby the second coil aids the main coil or winding in accelerating the induced element. The embodiment of my invention wherein the reduction of the frictional effect is accomplished through the agency of mechanical means or by a balancing-coil having no inductive turning effect has been made the subject-matter of another application filed July 2, 1904, Serial No. 215,082.

The accelerator set forth is applicable as a starting device and may also be used as a speed-varying device. I may when it is desired associate with the clutch or accelerator special means for radiating and dissipating the heat produced during the operation of the device. This special means is particularly advantageous when the device is used as a speed-varying device, since in this connection the driven part will frequently rotate for prolonged intervals at a less speed that the driving part, thereby developing considerable heat.

I have illustrated my invention in the accompanying drawings, in which—

Figure 1 is an end view of the improved clutch or accelerator of my invention, the up-

per portion thereof being shown in section. Fig. 2 is a side view of the clutch or accelerator, the upper portion thereof being shown in section. Fig. 3 is a detached view of the windings and collecting-rings. Fig. 4 is a diagrammatic view of a controller which may be employed in connection with the clutch or accelerator.

Like numerals refer to like parts in the several figures.

Upon the shaft 1 is keyed a sleeve 2, carrying a disk or back plate 3. Upon one side of this plate a ring 4 is mounted, this ring carrying inwardly-projecting pole-pieces 5. A ring 6 is also mounted upon this back plate, which ring carries outwardly-extending pole-pieces 7. The pole-pieces 5 are substantially triangular in form, while the pole-pieces 7 are rectangular, these forms being advisedly adopted in order that the lines of force may be caused to occupy the most advantageous paths. The main winding 8 of the clutch is mounted in an annular space provided between the back plate 3 and the rings 4 and 6. Upon the opposite side of the back plate 3 a ring 9 is provided, carrying inwardly-extending pole-pieces, and a ring 10 is also mounted upon the face of the plate, which ring carries outwardly-extending pole-pieces, the pole-pieces being the same in form as the pole-pieces 5 and 7, heretofore described. The rings are secured to the back plate by means of bolts, as illustrated. The supplemental winding 11 is placed in an annular space formed by the back plate and the rings 9 and 10. The spaces between the pole-pieces may be filled with some suitable non-magnetic material, such as Babbitt metal. The windings 8 and 11 are connected with the collecting-rings 12 13 14 by conductors which extend through suitable channels provided in the back plate 3 and in the sleeve 2.

Upon the shaft 15 is carried the secondary or induced member of the clutch. A hub 16 is keyed to the shaft 15, and upon this is mounted the disk-like armature 17, which cooperates with the main field-magnet energized by the coil 8. Upon the outer face of this armature a plurality of wings or ribs 18 are provided for the purpose of dissipating the heat generated in the secondary member. The armature 19, which coöperates with the supplemental field-magnet energized by the coil 11, depends from an annular ring 20, which is secured to the armature 17. This annular ring 20 is cut away at intervals to assist in ventilating the structure. Upon the exterior face of the armature 19 the ribs or wings 21 21 are provided for dissipating the heat developed in the supplemental armature.

The controller for the clutch is illustrated in Fig. 4 and consists of a pivoted arm 22, having a brush 23 adapted to move over a series of terminals 24, between which are connected the resistances 25, one end of the series of resistances being connected by conductor 26 with one of the supply-mains 27. The contact-arm also carries a brush 28, adapted to travel on contact-segment 29, and a brush 30, adapted to travel upon contact-segment 31. The main 32 of the supply-circuit is connected by conductor 33 with one side of each of the coils 8 and 11. The opposite side of the coil 8 is connected by conductor 34 with segment 29, and the opposite side of the coil 11 is connected by conductor 35 with segment 31.

The contact-arm initially rests to the left and out of contact with the face of the contact-segments 24. In this position the circuits through both windings of the clutch are open. When it is desired to start the driven part, (which may be either the primary or the secondary member, as desired,) the contact-arm 22 is moved to the position shown in dotted lines at the left. In this position circuit is closed through the main winding 8, with all of the resistance 25 in circuit, this circuit being traced from main 27, through conductor 26, resistance 25, brush 23, brush 28, contact-segment 29, conductor 34, winding 8, conductor 33, to the opposite main 32. The winding 8 being energized, the armature 17 of the main field-magnet is attracted and drawn against the face of the main field-magnet. The driven part is thus started from rest. The acceleration of the driven part is due to induction and also to the frictional effect between the armature and the field-magnet. As the contact-arm 22 is moved to the right brush 30 is moved into contact with contact-segment 31, and circuit is thus closed through supplemental winding 11, this circuit being traced from main 27, through conductor 26, resistance 25, brush 23, brush 30, contact-segment 31, conductor 35, winding 11, conductor 33, to the opposite main 32. As it is desired to further accelerate the driven part, the contact-arm 22 is moved farther to the right, thus gradually removing the resistance 25 from circuit and permitting increased current to flow through the main and supplemental windings. When the contact-arm reaches the final position, the supplemental coil is removed from circuit, and the main coil alone remains in circuit. This main coil is sufficient to maintain the driven part locked to the driving part by the magnetic attraction during the time the driven part is operated to the full speed of the driving part. It will be noted that the circuit is first closed through the main winding, then closed through the supplemental winding, the circuit through the main winding remaining closed, and, finally, the circuit through the supplemental winding is opened, leaving the main winding alone in circuit. The closing of the circuit through the main winding in advance causes the armature associated with the main winding to make mechanical contact with the face of the main field-magnet, and the

subsequent closing of the circuit through the supplemental winding causes the supplemental winding to assist the main winding in producing the turning effort due to induction. When the driven part has been brought to the full speed of the driving part, the assistance of the supplemental winding in producing induction is no longer needed, and the supplemental winding accordingly may be removed from circuit. Moreover, during the starting period it is desired to reduce the friction between the main field-magnet and its armature, and during this period the supplemental winding is in circuit to counterbalance a portion of the attractive effect of the main winding. When the driven part has been brought to the full speed of the driving part, it is desired to effectively clamp the driven part to the driving part, and accordingly the cutting out of the supplemental winding permits the main winding to exert its full attractive effect upon its armature.

Inasmuch as the armature of the main field-magnet moves in mechanical contact with its field-magnet during starting, while an air-gap is interposed between the supplemental field-magnet and its armature, it is apparent that the supplemental winding may, if desired, be made of lower resistance than the main winding, whereby a greater current will flow through the supplemental winding to produce an increased magnetized flow to overcome the increased reluctance of the magnetic circuit due to the presence of the air-gap. The resistance of the supplemental winding should in this case preferably be adjusted relatively to the resistance of the main winding, so that the armature of the main winding will remain continuously in mechanical contact with the main field-magnet. Of course it is not essential that the armature of the main winding should thus remain continuously in mechanical contact, and the windings might be so adjusted relatively that the main armature would first make mechanical contact with its field-magnet, the supplemental armature making mechanical contact with its field-magnet when the circuit through the supplemental winding is closed and the main armature again making contact with its field-magnet when the supplemental winding is removed from circuit. I preferably, however, so adjust the windings and the current flowing that the main armature will remain continuously in mechanical contact with its field-magnet during the operation of the device.

The supplemental winding performs two functions—first, it serves as a counterbalancing-coil to reduce the pressure between the main field-magnet and its armature, and, second, it assists in producing rotation due to the inductive influence of the supplemental field-magnet upon its armature. The main and supplemental windings may be so wound relatively that the resultant pressure between the main field-magnet and its armature may be gaged as desired. Inasmuch as the rubbing of the main field-magnet and its armature tends to produce heat and, moreover, tends toward cutting of the contact-surfaces unless precautions are introduced, it is desirable to reduce the pressure between these parts to as great an extent as practicable, while still retaining sufficient pressure to produce the friction necessary for starting purposes. Inasmuch as the inductive effect depends upon relative movement of the field-magnet and its armature, it is apparent that the driven part cannot be brought to the full speed of the driving part unless this inductive effect be aided by the turning effect of friction. This frictional effect may be reduced as desired through the agency of the supplemental winding in cases where it is not desired to bring the driven part to the full speed of the driving part, in which instance induction alone may be relied upon for the turning effect. The supplemental winding may, if desired, be made of such strength as to practically balance the main winding, whereby the pressure between the main field-magnet and its armature is practically *nil*. Even in this case, however, the pressure should be sufficient to maintain the main field-magnet and its armature in mechanical contact to thereby eliminate the air-gap, as the presence of an air-gap will materially reduce the efficiency of the apparatus.

One of the features of the present invention is the provision of effective means for dissipating the heat produced by the eddy-currents which flow in the armature or armatures. In the present instance the field-magnets are arranged between the main and the supplemental armatures and in this manner the outer faces of the armatures are exposed, whereby the heat may be readily dissipated, and to facilitate this dissipation I provide ribs or wings upon the outer faces of the armature, whereby the air is caused to circulate to assist in the cooling effect. Moreover, openings are provided in the annular ring supporting the supplemental armature to assist in the ventilation. It is apparent that the ventilating and heat-dissipating feature of my invention is applicable to a clutch or accelerator in which a single armature and a single winding are employed.

While I have illustrated herein a form of clutch wherein the main and supplemental armatures are mounted upon the exterior of the field-magnets, it will be understood that I do not consider this arrangement essential to produce an effective ventilating and heat-dissipating result, and any other modification of this arrangement may be used, if desired, without departing from the spirit of my invention as set forth in the appended claims.

Having described my invention, what I

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

1. The combination with a primary clutch member having two magnetic fields, of a secondary member having parts thereof subjected to the influence of said fields, said parts being oppositely influenced by said fields.

2. The combination with a primary clutch member having two magnetic fields, of a secondary member having the parts thereof subjected to the influence of said fields, said parts being oppositely influenced by said fields, and said fields adapted to produce a torque upon said secondary member.

3. The combination with a primary member having two oppositely-disposed magnetic fields, of a secondary member having parts thereof subjected to the inductive influence of said fields, said fields being adapted to reduce the frictional effect of the primary member upon the secondary member.

4. The combination with a primary member having a pair of magnetic fields, of a secondary member having a part adapted to rest in mechanical contact with the face of said primary member and being subjected to the combined inductive and frictional effect of said primary member, said second member having a part subjected to the inductive influence only of one of said fields.

5. The combination with a primary clutch member having two magnetic fields, of a secondary member having two armatures, one of said armatures being subjected to the inductive torque-producing influence of one of said fields, and the other being subjected to the inductive torque-producing influence of the other field, said first-mentioned armature being adapted to mechanically engage the face of said primary member and said second-mentioned armature being associated therewith so as to reduce the frictional effect.

6. The combination with a primary member having a pair of suitable polar surfaces, and a pair of energizing-windings therefor, of a secondary member having a suitable part subjected to the inductive influence of said windings, and means whereby said armature part may be caused to move in frictional contact with one of said polar surfaces, the inductive influence of said windings being adapted to reduce the frictional effect of said primary member upon said secondary member.

7. The combination with a primary clutch member having a pair of windings, of a secondary member having a pair of armature parts respectively subjected to the inductive influence of said windings, and means whereby one of said armature-faces may be caused to move in mechanical contact with said primary member.

8. The combination with a primary clutch member having a main winding and a supplemental winding, of a secondary member movable relatively to said primary member and having two armatures or armature parts, and means for dissipating the heat developed in said secondary member.

9. The combination with a primary member having a main and a supplemental winding, of a secondary member movable relatively to said primary member and having two armatures or armature parts, one of said parts being arranged to mechanically engage the primary member and to be inductively influenced by said main winding, and the other of said parts being arranged out of mechanical contact with said primary member and to be inductively influenced by the supplemental winding.

10. The combination with a primary member having a main and a supplemental winding, of a secondary member movable relatively to said primary member and having two armatures or armature parts, one of said parts being arranged to mechanically engage the primary member and to be inductively influenced by said main winding, and the other of said parts being arranged out of mechanical contact with said primary member and to be inductively influenced by the supplemental winding, and means for rapidly dissipating the heat developed in said secondary member.

11. The combination with a primary clutch member having a pair of windings and a polar surface corresponding to each winding, of a secondary member having an armature-face opposite each of said polar surfaces, one of said armature-faces being adapted to mechanically engage its corresponding polar surface.

12. The combination with a primary clutch member having a pair of windings and a polar surface corresponding to each winding, of a secondary member having an armature-face opposite each of said polar surfaces, one of said armature-faces being adapted to mechanically engage its corresponding polar surface, and ribs or wings upon said armature-face for increasing the radiating-surface thereof and causing ventilation.

13. The combination with a primary clutch member, of a secondary clutch member, and suitable means associated with said secondary member for dissipating the heat developed.

14. The combination with a primary clutch member having a suitable energizing winding or windings, of a secondary clutch member coöperating with said primary member, and suitable means associated with said secondary member for dissipating the heat developed.

15. The combination with a primary clutch member, of a secondary clutch member inductively influenced thereby, and suitable means associated with said secondary member for dissipating the heat developed.

16. The combination with a primary clutch member, of a secondary clutch member having parts or armatures on opposite sides of said

primary member, and suitable means associated with said secondary member for dissipating the heat developed.

17. The combination with a primary clutch member having a pair of suitable energizing polar surfaces, of a secondary member having an armature-face opposite each of said polar surfaces, and suitable heat-dissipating means associated with said secondary member.

18. The combination with a primary clutch member, of a secondary member inclosing the same, and suitable heat-dissipating means associated with said secondary member.

19. The combination with a primary clutch member, having two suitable energizing polar surfaces, of a secondary member having two armature parts arranged opposite to each of said polar surfaces, and heat-dissipating ribs or wings associated with said armature parts.

20. The combination with a primary clutch member having a pair of suitable energizing polar surfaces, of a secondary member having an armature part resting opposite each of said polar surfaces, and upon opposite sides of said primary member, and ribs or wings upon the exterior sides of said secondary member for dissipating the heat.

21. The combination with a primary clutch member having polar surfaces upon opposite sides thereof, of a secondary member having an armature or part coöperating with each of said polar surfaces, and heat-dissipating means associated with each of said armatures.

22. The combination with a primary clutch member having a main winding and a supplemental winding, of a secondary member movable relatively to said primary member and having two armatures, one of said armatures being arranged upon each side of said primary member, and means for dissipating the heat developed in said armatures.

23. The combination with a primary clutch member having a main winding and a supplemental winding, of a secondary member movable relatively to said primary member and having an armature arranged upon each side of said primary member, said armatures being arranged to be inductively influenced by said main and supplemental windings, and means for rapidly radiating the heat developed in said armatures.

24. The combination with a primary member having a main and a supplemental winding, of a secondary member movable relatively to said primary member and having an armature arranged upon each side of said primary member, one of said armatures being arranged to mechanically engage the primary member and to be inductively influenced by said main winding, and the other of said armatures being arranged out of mechanical contact with said primary member and to be inductively influenced by the supplemental winding, and means for rapidly dissipating the heat developed in said armatures.

25. The combination with a primary clutch member having a pair of windings and polar surfaces upon opposite sides thereof, of a secondary member having an armature arranged opposite each of said polar surfaces, and ribs or wings upon said armatures for increasing the radiating-surface thereof and causing ventilation.

26. The combination with a primary clutch member, having a pair of windings and polar surfaces upon opposite sides thereof, of a secondary member movable relatively to said primary member and having an armature arranged opposite each of said polar surfaces, and ribs or wings upon said armatures for increasing the radiating-surfaces thereof and for producing ventilation.

27. The combination with a primary clutch member having a pair of windings, of a secondary member having a pair of armatures, one of said armatures being arranged upon each side of said primary member, and means surrounding said primary member for retaining said armatures at a fixed distance from each other, said armatures being adapted to be inductively influenced by said windings.

28. The combination with a primary clutch member, having a pair of windings, of a secondary member having a part subjected to the influence of each of said windings and to be inductively influenced thereby, and means for regulating the inductive influence of said windings.

29. The combination with a primary clutch member, having a pair of windings, of a secondary member having an armature arranged to be inductively influenced by said windings, and a controller for varying the resistance in circuit with said windings to regulate the inductive influence of said windings upon said armatures.

30. The combination with a primary clutch member having a main and a supplemental winding, of a secondary member having an armature arranged to be inductively influenced by said windings, and a controller for first energizing said main winding, then energizing said supplemental winding and increasing the inductive influence of said windings upon said armature, and finally deënergizing said supplemental winding.

31. The combination with a primary clutch member having a main and a supplemental winding, of a secondary member having two armatures arranged to be inductively influenced by said windings, and means for first energizing said main winding to bring one of said armatures into mechanical engagement with the primary member, then energizing said supplemental winding to reduce the friction between said primary and said secondary member and to increase the inductive influ-

ence of said windings upon said armatures, and finally deënergizing said supplemental winding to attain the full attractive effect between said primary and secondary members caused by said main winding.

32. The combination with a primary clutch member, having a pair of windings, of a secondary member having a part subjected to the influence of each of said windings and to be inductively influenced thereby so as to induce torque-producing currents, and means for regulating the inductive influence of one of said windings.

In witness whereof I have hereunto subscribed my name in the presence of two witnesses.

HENRY H. CUTLER.

Witnesses:
W. CLYDE JONES,
M. R. ROCHFORD.