

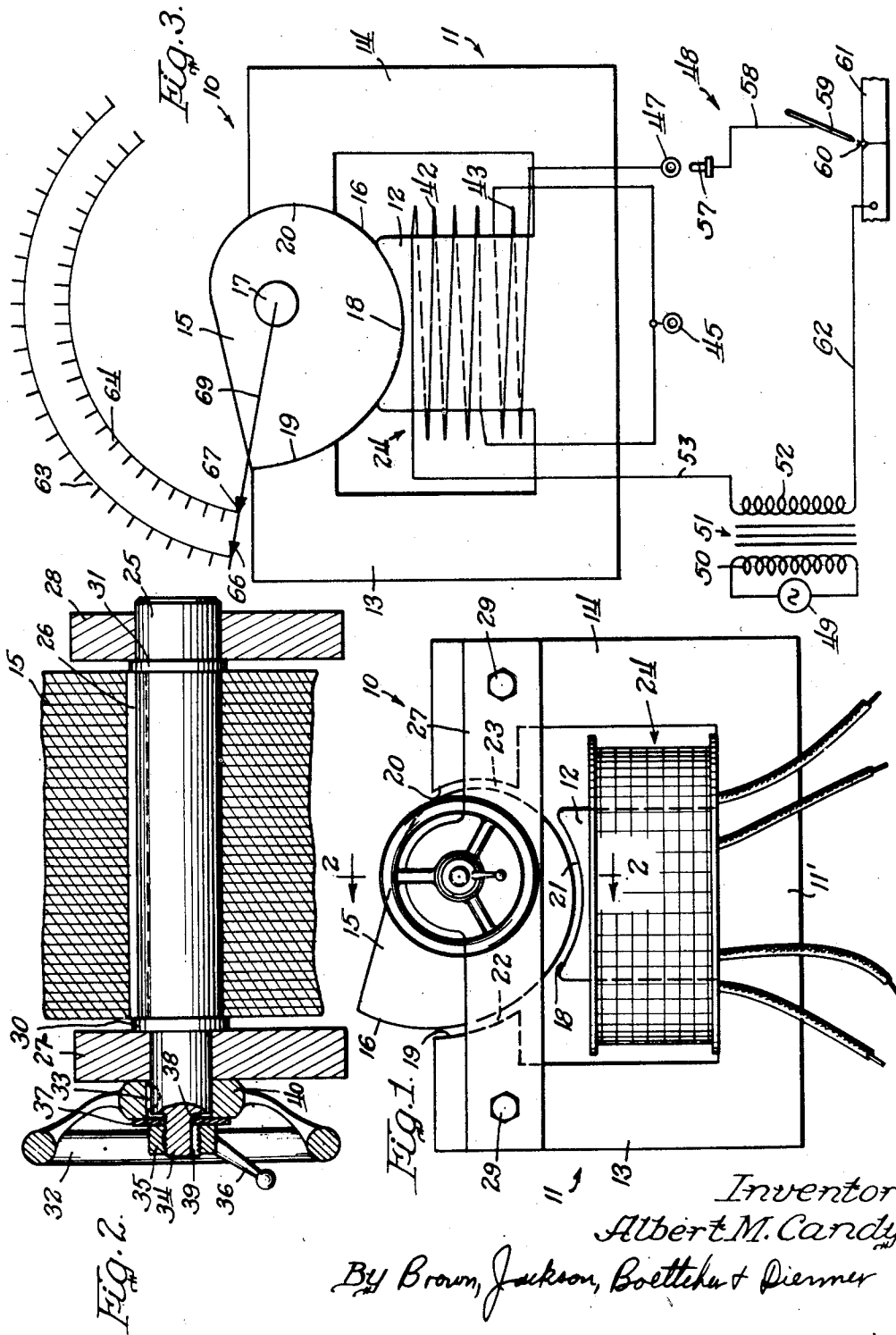
Feb. 8, 1949.

A. M. CANDY

2,460,922

MAGNETIC CORE WITH VARIABLE AIR GAP

Filed Dec. 22, 1947



Inventor:
 Albert M. Candy
 By Brown, Jackson, Boettcher & Diemer

Attys.

UNITED STATES PATENT OFFICE

2,460,922

MAGNETIC CORE WITH VARIABLE AIR GAP

Albert M. Candy, La Grange, Ill., assignor, by
mesne assignments, to National Cylinder Gas
Company, Chicago, Ill., a corporation of Dela-
ware

Application December 22, 1947, Serial No. 793,158

6 Claims. (Cl. 171-119)

1

My invention relates, generally, to magnetic control systems and it has particular relation to such systems in which the control is effected by variation in air gap length. My invention, as disclosed herein, is an improvement over the invention disclosed in my copending application Serial No. 691,357, filed August 17, 1946, and assigned to the assignee of this application.

As disclosed in my copending application I provide for varying the length of an air gap in a magnetic circuit in such manner that the length of the air gap is uniform over the entire area of the juxtaposed surfaces which constitute the boundaries of the air gap. This is accomplished by shaping the juxtaposed surfaces so that, as they are rotated relative to each other this relationship is maintained. The particular shape of surface which provides this relationship is an involute of a base circle. Where solids are involved the surfaces are involute surfaces of a base cylinder whose longitudinal axis coincides with the axis of relative rotation of the members.

Among the objects of my invention, as disclosed herein, are: To provide a magnetic circuit having a plurality of air gaps whose lengths are varied uniformly and the magnetic circuit makes optimum use of the material of which the same is constituted; to employ a rotor having an involute surface for uniformly and simultaneously varying the length of three air gaps in the magnetic circuit; to employ a three legged magnetic core for the magnetic circuit with the rotor cooperating with each leg; to provide a winding on the middle leg the magnetic flux through which is varied on movement of the rotor; and to construct the middle leg so that its cross sectional area equals the sum of the cross sectional areas of the end legs.

Other objects of my invention will, in part, be obvious and in part appear hereinafter.

My invention is disclosed in the embodiment thereof shown in the accompanying drawing and it comprises the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the appended claims.

For a more complete understanding of the nature and scope of my invention reference may be had to the following detailed description, taken together with the accompanying drawing in which:

Figure 1 is a view, in side elevation, of a mag-

2

netic control device constructed in accordance with my invention;

Figure 2 is a detail sectional view, at an enlarged scale, taken along the line 2-2 of Figure 1; and

Figure 3 illustrates diagrammatically how the magnetic control device shown in Figure 1 can be employed for varying the current flow in an arc welding circuit.

Referring now particularly to Figure 1 of the drawing, it will be observed that the reference character 10 designates, generally, a magnetic core structure that is formed of laminated transformer steel. The core structure 10 includes a stator which is indicated, generally, at 11. The stator 11 comprises a middle leg 12 and end legs 13 and 14. In order to work the material constituting the stator 11 at the highest efficiency the cross sectional area of the middle leg 12 is equal to the sum of the cross sectional areas of the end legs 13 and 14. This arrangement is provided since the flux flowing through the middle leg 12 is divided equally between the end legs 13 and 14. As shown, the middle leg 12 and the end legs 13 and 14 are joined by a common member 11' in accordance with conventional practice.

With a view to varying the magnetic flux in the core structure 10 a rotor 15 is employed which has an involute surface 16 whose base cylinder is indicated at 17 in Figure 3. In my copending application above referred to, the manner in which the involute surface 16 is generated is described in more detail. Accordingly, the same is omitted here.

It will be noted in Figure 1 that the ends of the legs 12, 13 and 14 have surfaces 18, 19 and 20, respectively, which are juxtaposed to the surface 16 and are similarly shaped so that the air gaps 21, 22 and 23 therebetween can be varied simultaneously and uniformly as the rotor 15 is rocked about the longitudinal axis of the base cylinder 17 in a manner to be described presently. As the rotor 15 is rotated clockwise from its position shown in Figure 3 toward the position shown in Figure 1 and beyond, the length of each of the air gaps 21, 22 and 23 is increased simultaneously, uniformly and equally. That is, since the rotor 15 has an involute surface 16 and the juxtaposed surfaces 18, 19 and 20 of the legs 12, 13 and 14 conform thereto, for any position of the rotor 15, the length of each of the air gaps 21, 22 and 23 will be uniform and equal over the entire area of the surfaces 18, 19 and 20. Therefore, there is no concentration of flux or a shifting of flux

3

on surfaces 18, 19 and 20 as the rotor 15 is swung away from the position shown in Figure 3 but rather there is a uniform variation in the amount of magnetic flux in the core structure 10, the extent of the variation depending of course upon how far the rotor 15 is moved away from the position shown in Figure 3.

A winding, shown generally at 24, may be mounted on the core structure 10 and around the middle leg 12. As will appear hereinafter the winding 24 is arranged to be energized from a suitable source of alternating current and it is connected to function as a variable inductor as a result of shifting of the position of the rotor 15.

Any suitable means can be employed for rockably mounting the rotor 15. As shown in Figure 2 the rotor 15 can be mounted on a shaft 25 and secured thereto against rotation by a key 26. The ends of the shaft 25 extend through plates 27 and 28 of non-magnetic material which may be secured to opposite sides of the core structure 10 by through bolts 29. Spacer rings 30 and 31 serve to space the rotor 15 from the plates 27 and 28 in which the shaft 25 is journaled.

The rotor 15 can be controlled from a remote point or it can be rotated directly by a hand wheel 32 which is slidable on the outer end of the shaft 25 but is prevented from relative rotation therewith by a key 33.

It is desirable to lock the rotor 15 in any position to which it may be adjusted in order to prevent its being shifted as a result of the rotational force exerted thereon by the magnetic flux in the core structure 10. For this purpose the outer end 34 of the shaft 25 may be threaded for receiving a nut 35 which has an arm or handle 36 to facilitate its rotation. Between the nut 35 and the hub of the hand wheel 32 is a washer 37. The washer 37 has a finger 38 which enters a slot 39 in the outer end 34 of the shaft 25 to prevent relative rotation. When the nut 35 is tightened against the washer 37, it forces the hub 40 of the hand wheel 32 against the adjacent face of the plate 27. The gripping action exerted therebetween is sufficient to prevent rotation of the rotor 15 until the nut 35 is backed off on the shaft 25.

Referring now particularly to the diagrammatic representation in Figure 3 it will be observed that the winding 24 comprises winding sections 42 and 43. These sections 42 and 43 have different numbers of turns in order to provide different current ranges when the device is employed for varying current flow in a circuit, such as a welding circuit. For illustrative purposes it is pointed out that the winding section 42 may comprise twenty-three turns while the winding section 43 may comprise seven turns. With the section 42 only connected in a load circuit, the current flow therethrough can be varied from 200 amperes when the rotor 15 occupies the position where the air gaps 21, 22 and 23 are of maximum length to about 75 amperes when it is rotated to a position providing minimum air gap length in the core structure 10 as shown in Figure 3. Similarly when the winding sections 42 and 43 are connected in series in the load circuit and the rotor 15 is moved in a similar fashion the current can be varied from a maximum of about 100 amperes to a minimum of about 20 amperes. It will be understood that these values are merely indicative of what can be accomplished in practicing my in-

4

vention and are not to be considered as limiting its application in any way.

In order to facilitate making electrical connections to the winding sections 42 and 43 certain of their end turns are brought out to sockets 45 and 47 as shown.

It will be noted in Figure 3 that the load circuit may be a welding circuit which is indicated, generally, at 48 of the arc welding type. The welding circuit 48 may be energized from a source 49 of alternating current, such as a 60 cycle source. The source 49 may be connected to energize a primary winding 50 of a transformer, shown generally at 51, having a secondary winding 52 which energizes the welding circuit 48, through winding 42 or through windings 42 and 43 in series.

One terminal of the secondary winding 52 may be connected by a conductor 53 to one terminal of the winding 42. A plug 57 may be employed for insertion in the socket 45 or 47 and it may be connected to a conductor 58 which extends to a welding electrode 59. An arc 60 can be maintained between the welding electrode 59 and work 61 on which the welding operation is to be performed. The work 61 may be connected by a conductor 62 to the other terminal of the secondary winding 52. It will be understood that the current flowing in the welding circuit 48 can be varied by shifting the position of the rotor 15 with respect to the stator 11.

When it is desired to use the winding section 42 only, and the higher current range for the same, the plug 57 is inserted in the socket 45. The current flowing in the welding circuit 48 then can be varied by rocking the rotor 15 as described. For the lower current range the plug 57 is withdrawn from the socket 45 and inserted in the socket 47. This connects the winding sections 42 and 43 in series with the welding circuit 48.

With a view to indicating the current flow which is available for any given setting of the rotor 15, scales 63 and 64 may be provided for cooperation with pointers 66 and 67 that may be carried by an arm 69 which rotates with the rotor 15. When the winding section 42 is connected in the welding circuit 48, the scale 63 may be read while the scale 64 may be read when the winding sections 42 and 43 are connected in series in the welding circuit 48. Obviously a single scale can be employed with a suitable multiplying factor or other well known means can be employed for indicating the current flow for any position of the rotor 15 and any arrangement of the winding sections 42 and 43.

Since certain further changes can be made in the foregoing construction and different embodiments of the invention can be made without departing from the spirit and scope thereof, it is intended that all matter shown in the accompanying drawing and described hereinbefore shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. In combination, a magnetic core structure comprising a central leg and end legs on opposite sides thereof, and a relatively rotatable member for coaxing with said legs to change the lengths of the air gaps therebetween, the surface of said member constituting one terminus of each air gap being an involute of a base cylinder whose longitudinal axis coincides with the axis of relative rotation of said legs and member and the surface of each leg constituting the

5

other terminus of each air gap substantially coinciding with the juxtaposed surface of said member whereby on relative rotation of said legs and said member the length of each air gap is uniform and equal over the area of the juxtaposed surfaces at any relative position of said legs and member; and an electrically energizable winding on said core structure.

2. The invention, as set forth in claim 1, wherein the legs constitute a generally rectangular core structure with the central leg having a cross sectional area substantially equal to the sum of the cross sectional areas of said end legs.

3. The invention, as set forth in claim 2, wherein the winding is located on the central leg.

4. The invention, as set forth in claim 3, wherein the legs are stationary and the member is rotatable.

5. The invention, as set forth in claim 4, where-

6

in locking means cooperate with the member to hold the same in any operative position.

6. The invention, as set forth in claim 2, wherein windings are located on more than one leg.

ALBERT M. CANDY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,699,142	Hendricks	Jan. 15, 1929
2,431,860	Friedlander	Dec. 2, 1947

FOREIGN PATENTS

Number	Country	Date
441,751	Great Britain	Jan. 24, 1936