

[54] DIFFERENTIAL TRANSFORMER

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[58] Field of Search 336/130, 135, 120, 83

[56] References Cited

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[57]

ABSTRACT

A rotary variable differential transformer is provided. The transformer comprises an elongated bobbin formed of nonmagnetic, non-conductive material about which a primary coil is circumferentially wound. A secondary coil adjacent to the primary coil is also wound about the bobbin extending longitudinally from a first position proximal the primary coil to a second position distal the primary coil and thereafter returning to the first position along a substantially axial line. A core is disposed for rotation within the bobbin. The core carries an elongated magnetic member which serves to couple the primary and secondary coils, the position of coupling being determined by the position of the core. The output of the differential transformer may be linear (or have some other desired shape) over a relatively wide angle of rotation of the core.

8 Claims, 5 Drawing Figures

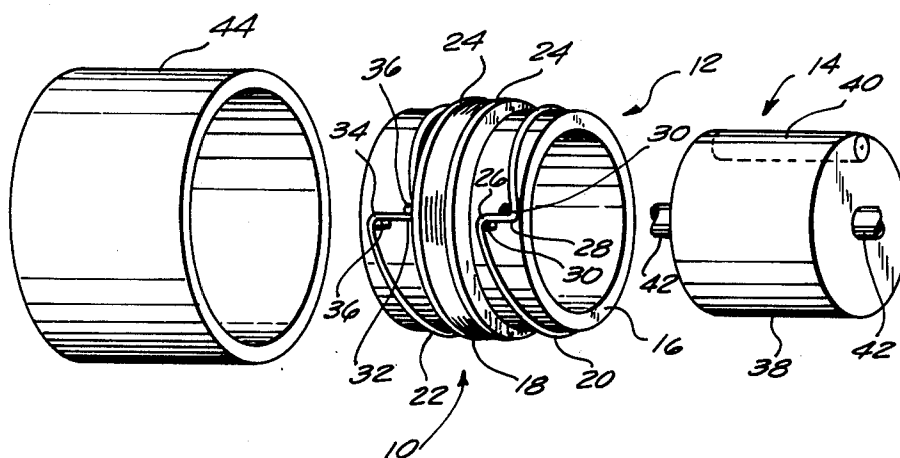


FIG. 1

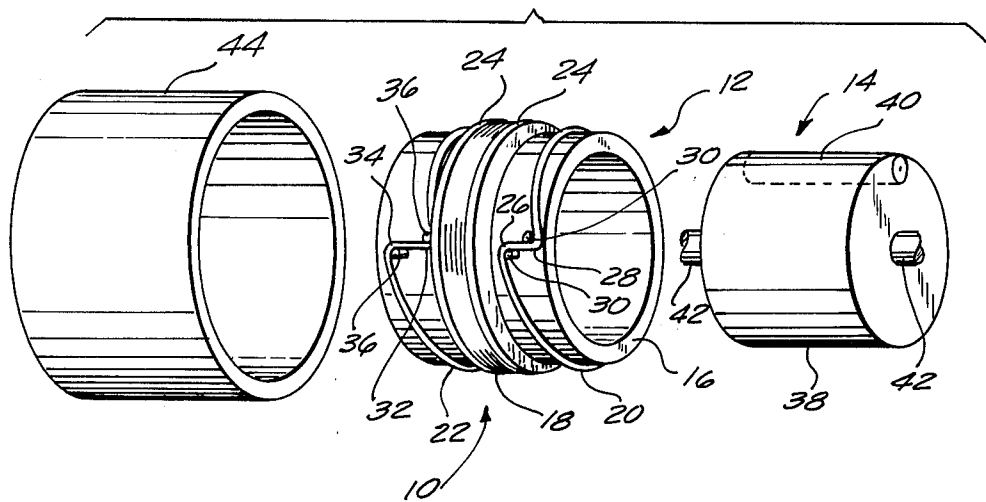


FIG. 2

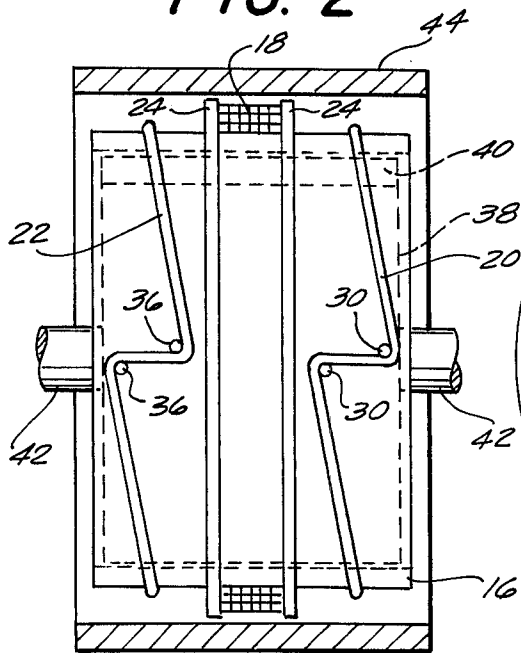


FIG. 3

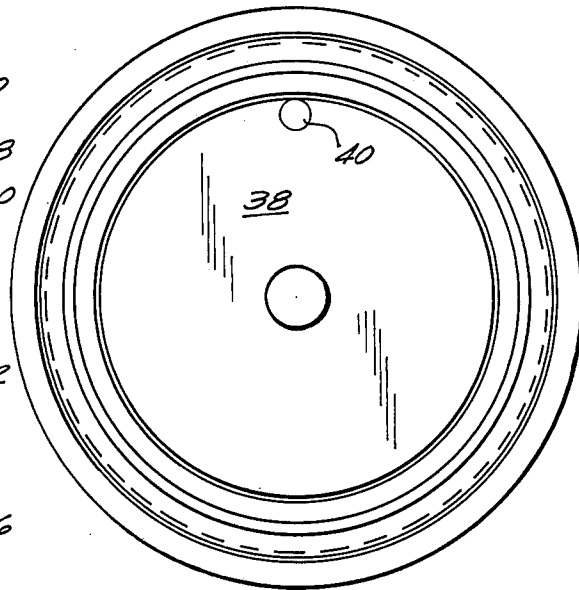
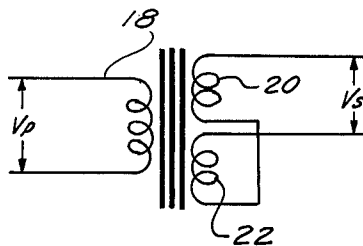


FIG. 4

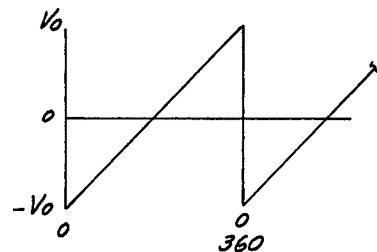


FIG. 5

DIFFERENTIAL TRANSFORMER

BACKGROUND OF THE INVENTION

The present invention relates to differential transformers and more particularly to a rotary variable transformer having an output with a linear or other desired configuration over a wide angle.

Rotary variable differential transformers of the type composed of primary and secondary coils and a movable member, the position of which determines the secondary voltage of the transformer for a given primary voltage, are well known. Such transformers are utilized for purposes of determining orientation both on various types of machinery and equipment as well as navigational devices. The theory of operation of such transformer is that the orientation of the movable member with respect to the coils can be determined as a function of the secondary voltage.

The principal object of the present invention is to provide a rotary variable differential transformer wherein the secondary voltage for a given primary voltage is related to the angular position of a rotatable member.

A further object is to provide such a transformer having a high degree of accuracy over a wide angle range approaching 360°.

SUMMARY OF THE INVENTION

The above and other beneficial objects and advantages are attained in accordance with the present invention by providing an improved rotary variable differential transformer. The present transformer comprises an elongated bobbin formed of non-magnetic, non-conductive material about which a primary coil is circumferentially wound. A secondary coil adjacent to the primary coil is also wound about the bobbin extending longitudinally from a first position proximal the primary coil to a second position distal the primary coil and thereafter returning to the first position along a substantially axial line. A core is disposed for rotation within the bobbin. The core carries an elongated magnetic member which serves to couple the primary and secondary coils, the position of the coupling being determined by the position of the core. The output of the differential transformer may be linear (or have some other desired shape) over a relatively wide angle of rotation of the core.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. 1 is an exploded perspective view of a rotary differential transformer in accordance with the present invention;

FIG. 2 is a side elevational sectional view of the assembled differential transformer;

FIG. 3 is a top plan view of the present differential transformer;

FIG. 4 is a schematic view of the coil windings and connections; and,

FIG. 5 is a diagrammatic showing of the output characteristics of the present transformer.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference is now made to the drawings wherein similar components bear the same reference numeral throughout the several embodiments. In FIG. 1, a dif-

ferential transformer 10 in accordance with the present invention is shown as comprising a stator 12 and rotor assembly 14. The stator 12 is in the form of a hollow, cylindrical bobbin 16 about which a primary coil 18 and a pair of identical secondary coils 20 and 22 are circumferentially wound. To this end, the primary coil 18 extends about the substantial midpoint of the bobbin between a pair of flanges 24.

The secondary winding 20, in addition to extending circumferentially about the bobbin, extends longitudinally along the bobbin between a first position 26 proximal to the primary coil and a second position 28 distal from the primary coil, with the second position. The winding then returns to the proximal position 26 from distal position 28 as depicted in FIG. 1 by the section of the winding extending between the pins 30 being substantially axially aligned with the first position. A pair of outwardly extending pins 30 about which the coil is wound, maintains the coil in the desired position. If necessary, an adhesive may be applied over the secondary coil to secure it in position. In a similar manner, the other secondary coil 22, extends circumferentially about the bobbin and extends longitudinally along the bobbin between a first position 32 and a second position 34. As before, the positions 32 and 34 are substantially axially aligned. Pins 36 similar to pins 30 and tape or the like (if necessary) are utilized to hold secondary coil 22 in position.

As shown in FIG. 1, the longitudinal displacement of coil 20 is opposite from that of coil 22. That is, extending about the bobbin clockwise, as coil 20 approaches primary coil 22 moves away from the primary coil. In addition, as shown in FIG. 4, the two secondary coils 20 and 22 are connected to each other in series bucking relationship. That is, the voltage in one of the secondary coils is opposite from that in the other coil.

The rotor assembly 14 comprises a core 38 positioned for rotation within the hollow bobbin. Both the rotor 38 and bobbin 16 are formed of non-magnetic material. An elongated core of ferromagnetic material 40 is secured to the periphery of the rotor. Member 40 provides coupling between the primary and secondary coils. A shaft 42 extends from the ends of rotor 38.

The complete transformer assembly further includes a shell or casing 44 formed of a ferromagnetic material. The casing 44 and stator 12 are usually maintained stationary while the rotor assembly 14 rotates although under special circumstances the reverse may be the case.

Referring briefly to FIG. 2, it can be seen that the pins 30 and 36 are disposed in substantially a straight line which is more or less parallel to the axis of the bobbin. In this manner, the drop-off from the first to second position for each of the secondary coils is sharp and abrupt. It should be apparent that the more abrupt the drop-off, the wider the angle of response of the transformer. It should also be noted, referring to FIG. 2, that each of the secondary coils extends linearly longitudinally along the bobbin. In this manner, the output of the secondary windings varies substantially linearly between 0° and something slightly less than 360° as shown in FIG. 5. If, for some reason, something other than a linear output was desired, the configuration of the longitudinal displacement of the secondary coils would have to be changed accordingly.

Thus, in accordance with the above, the aforementioned objects are effectively attained.

Having thus described the invention, what is claimed is:

1. A rotary variable differential transformer comprising: an elongated bobbin formed of non-magnetic, non-conductive material; a primary coil wound circumferentially about said bobbin; a secondary coil adjacent said primary coil wound circumferentially about said bobbin and extending longitudinally from a first position proximal said primary coil to a second position distal said primary coil and thereafter returning to said first position; a rotor assembly disposed for rotation within said bobbin; and an elongated ferromagnetic core secured to said rotor assembly for rotation therewith, said core extending longitudinally between said primary and secondary coils and providing magnetic coupling therebetween.

2. The transformer in accordance with claim 1 further comprising a ferromagnetic shell disposed about said bobbin.

3. The transformer in accordance with claim 1 further comprising a second secondary coil disposed adjacent said primary coil opposite said first secondary coil, said second secondary coil extending longitudinally from a first position proximal said primary coil to a second position distal said primary coil and thereafter returning to first position.

4. The transformer in accordance with claim 1 wherein said bobbin is cylindrical and said secondary coil first and second positions are on a line substantially parallel to the axis of said cylindrical bobbin.

5. The transformer in accordance with claim 3 wherein said bobbin is cylindrical; said secondary coil first and second positions are on a line substantially parallel to the axis of said cylindrical bobbin and said second secondary coil first and second positions are on a line substantially parallel to the axis of said cylindrical bobbin.

6. The transformer in accordance with claim 5 wherein said secondary coil first and second positions and said second secondary coil first and second positions are all on a common line, said line being substantially parallel to the axis of said cylindrical bobbin.

7. The transformer in accordance with claim 6 wherein said secondary coil and second secondary coil have identical windings and are connected in bucking series relationship.

8. The transformer in accordance with claim 7 wherein said core comprises a non-magnetic cylindrical member and said ferromagnetic core is secured at the periphery of said rotor assembly closely adjacent to said bobbin.

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