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E. L. SWAINSON
DYNAMO TRANSFORMER
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2,930,010

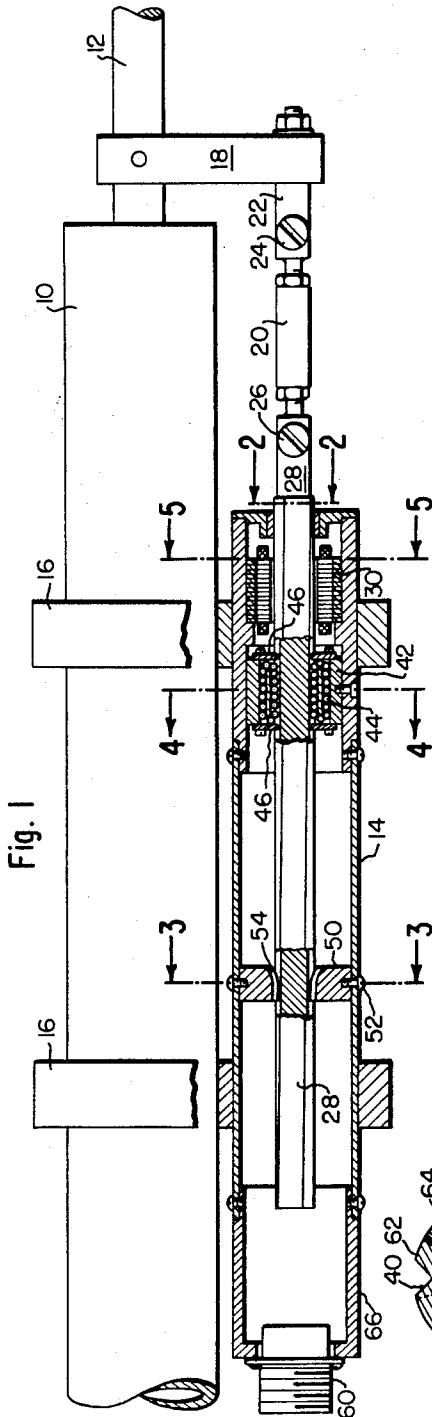


Fig. 1

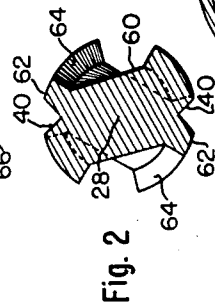


Fig. 2

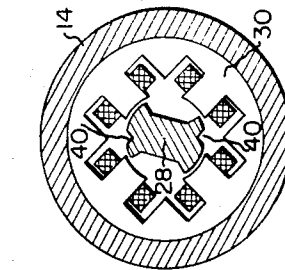


Fig. 3

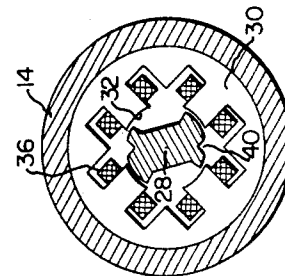


Fig. 4

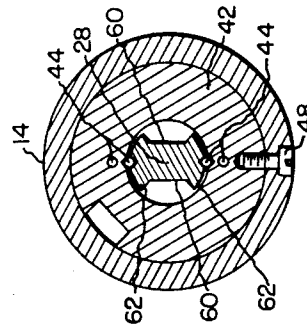


Fig. 5

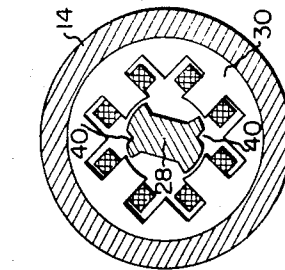


Fig. 5a

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2,930,010

DYNAMO TRANSFORMER

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6 Claims. (Cl. 336—30)

This invention relates to dynamo transformers of the type disclosed, for example, in United States Letters Patent No. 2,488,734 to Mueller, granted November 22, 1949, and reference is made to that patent for the details of construction and general theory of operation of such devices.

Customarily a dynamo transformer includes an annular stator having inwardly directed spaced pole pieces carrying various windings and associated with a rotor. When the rotor is turned, the character and dimension of the air gap between the rotor and poles is altered to influence current flowing through the windings. Hence the dynamo transformer is an extremely satisfactory means for translating rotation into an electrical signal.

It is the primary object of this invention to convert rectilinear movement of an actuator into an electrical signal efficiently and by relatively inexpensive means.

An important feature of the invention resides in a shaft mounted to slide through a stator and having longitudinal channels forming elongated arcuate segments, the long axis of said channels being helically inclined with respect to the axis of the shaft, the result being that the segments are effectively shifted circumferentially as the shaft slides through the stator, thus altering the air gap between the segments and the stator poles.

These and other objects and features of the invention will be more readily understood and appreciated from the following detailed description of a preferred embodiment thereof selected for purposes of illustration and shown in the accompanying drawing, in which:

Fig. 1 is a view partly in elevation and partly in cross-section through a device constructed in accordance with the invention,

Figs. 2-5 are views in cross-section along the lines 2-2, 3-3, 4-4, and 5-5 of Fig. 1, and

Fig. 5a is a view in cross-section similar to that of Fig. 5 but showing the appearance of the rotor when it is in extreme extended position.

In Fig. 1 there is shown at 10 a tubular casing or cylinder within which may be housed a piston or other device (not shown) connected to a rod or actuator 12 projecting from the end of the cylinder. It will be understood that the cylinder 10 is but suggestive of devices with which the invention may advantageously be employed. For example, a piston within the cylinder might be moved hydraulically in response to the movement of a control surface of an aircraft, or move with a slide valve, or the like. In any event the shaft 12 is moved axially by some means for some purpose, and it is assumed that it is desired to produce an electrical signal related to the direction and extent of movement of the actuator shaft 12.

The transducer of this invention is conveniently organized about a cylindrical housing 14 secured to the cylinder 10 by appropriate brackets or clamps 16, the axis of the two cylinders being substantially parallel. Pinned to the shaft 12 is a crosshead 18 carrying at its outer end a rod 22 secured by a pin 24 to a turnbuckle

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20 which in turn is secured by a pin 26 to the end of a long slender shaft or rod 28 projecting from the end of the cylinder 14. The turnbuckle 20 and pins 24 and 26 provide an adjustable coupling by means of which the relative positions of the crosshead 18 and shaft 28 may be varied as desired.

Within the cylinder 14 is mounted a stator assembly 30 including an annulus 34 having four, spaced, inwardly directed pole pieces 32; suitable coils or winding 36 are carried by the pole pieces 32, the arrangement being selected appropriately from the alternatives disclosed in the Mueller patent. The number of poles is not critical, and in fact a twenty-four-pole stator has been used with considerable success.

The shaft 28 is formed with relatively small upper and lower longitudinal grooves 40 spaced 180° apart and extending throughout the length of the shaft. The grooves 40 are provided for cooperation with the balls 44 recirculating in closed-circuit raceways within two parallel, longitudinal grooves or bores in a bearing collar 42 apertured to receive the shaft 28, said balls 44 circulating as the shaft 28 is moved back and forth. The collar 42 is fixed within the cylinder 14 by means of one or more machine screws 48. Hence the engagement of the balls 44 with the sides of the channels in the fixed collar 42 and the sides of the grooves 40 effectively prevents rotation of the shaft 28, while at the same time facilitating its axial translation. The balls 44 are retained within the channels and grooves by means of end caps 46 screwed to the faces of the bearing collar 42 and provided with pointed projections extending loosely into the grooves 40 in the shaft 28.

Spaced from the linear ball bearing and within the cylinder 14 is a second collar 50 apertured to receive the shaft 28 and provided with opposed inwardly projecting pointed ribs 54 loosely engaging the grooves 40 in the shaft. The ribs 54 further inhibit rotation or twisting of the shaft 28 and also act as guides facilitating sliding movement of the shaft as well as providing support therefor. The collar 50 is anchored in the cylinder 14 by means of screws 52.

Coming now to the specific configuration of the shaft 28, one will observe that the shaft is provided with wide grooves or channels 60 cut into the opposite sides of the shaft to leave opposed segmental end portions 62 having arcuate outer surfaces concentric with the stator 30. The longitudinal channels 60 form elongated arcuate segments 62 of longitudinally unchanging dimensions, the long axis of said channels and the walls 64 defining the segments 62 being helically disposed about the axis of the shaft 28, and not parallel therewith, as best shown in Fig. 2. The cross-sections through the shaft at different points are of constant shape and area and are different only in rotational orientation of the channels and segments. The result is that when the shaft 28 is translated axially, the end segments 62 appear to rotate (see Figs. 5 and 5a) and are effectively shifted circumferentially with respect to the pole pieces 32 of the stator 30. Consequently the magnetic flux relationship between the shaft 28 and the stator is altered by axial movement of the shaft substantially in the same manner as by rotation of a conventional rotor. The output of the stator windings therefore reflects changes in position of the actuator shaft 12, and the device functions as a rectilinear transducer.

The end of the cylinder 14 is provided with a cap 66 in which is mounted a lead-through conduit for the wires (not shown) which supply the electrical input and output circuits for the stator.

It should be pointed out that the pitch or degree of helical inclination of the arcuate segments and channels may be calculated to give a wide variety of mathematical relationships between the rectilinear motion of the shaft

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28 and the output signal from the stator. If the pitch is limited to a few degrees of arc, a linear response may be secured.

Having thus disclosed my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A dynamo transformer comprising a stator having at least four poles directed radially inward, windings disposed on said poles, a shaft mounted to slide axially through said stator and having longitudinal channels forming elongated arcuate segments of constant dimensions, the long axis of said channels being inclined with respect to the axis of the shaft, whereby axial movement of the shaft through the stator causes an apparent rotation of the segments, cross-sections through the shaft at different points being of constant shape and area and different only in rotational orientation of the channels and segments.

2. A dynamo transformer comprising a stator having at least four poles directed radially inward, windings disposed on said poles, a shaft mounted to slide axially through said stator and having longitudinal channels forming elongated arcuate segments of constant dimensions, said shaft characterized in that said channels and arcuate segments are helically inclined with respect to the axis of the shaft, cross-sections through the shaft at different points being of constant shape and area and different only in angular relation of the channels and segments to the stator poles, whereby axial translation of the shaft through said stator causes an apparent rotation of said arcuate segments.

3. A dynamo transformer comprising a multi-pole stator with poles directed radially inward, windings disposed on said poles, a shaft movable axially through said stator and having longitudinal channels forming elongated arcuate segments of unchanging dimensions, said shaft characterized in that said channels and segments are helically disposed about the axis of the shaft, whereby axial displacement of the shaft through said stator causes an apparent rotation of the segments.

4. A dynamo transformer comprising a multi-pole

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stator with poles directed radially inward, windings disposed on said poles, a shaft movable through said stator and having longitudinal channels forming elongated arcuate segments, cross-sections through the shaft at different points being of constant shape and area and different only in rotational relation of channels and segments to the stator poles, the axis of said channels being helically inclined about the axis of the shaft, whereby axial movement of the shaft changes the angular relation of the segments to said poles.

5. A dynamo transformer comprising a multi-pole stator with poles directed radially inward, windings disposed on said poles, a shaft movable through said stator and having longitudinal channels forming elongated arcuate segments of constant dimensions, said shaft characterized in that said channels and segments are helically disposed about the axis of the shaft, whereby axial movement of the shaft causes an apparent rotation of said segments.

6. A dynamo transformed comprising a stator having at least four axially straight poles, windings disposed on said poles, a shaft mounted to slide substantially through said stator and having longitudinal channels forming elongated arcuate segments, cross sections through the shaft at different points being of constant shape and area and different only in rotational relation of channels and segments to the stator poles, the axis of said channels being helically inclined about the axis of the shaft, whereby axial movement of the shaft through said stator causes an apparent rotation of the segments.

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