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J. C. WILSON

2,419,979

TRANSFORMER PICKOFF

Original Filed Oct. 24, 1942

FIG. 1

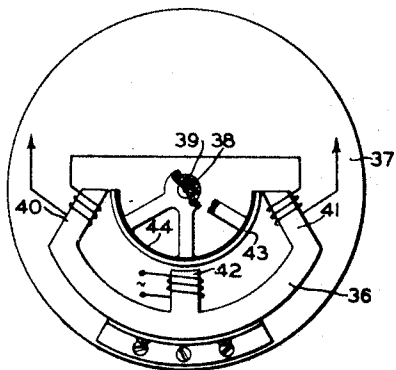


FIG. 2

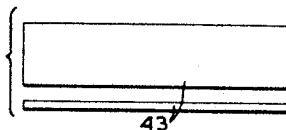


FIG. 3

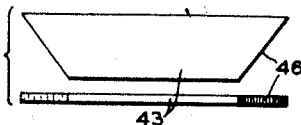


FIG. 4

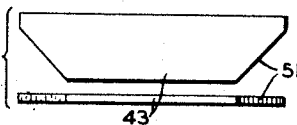


FIG. 5

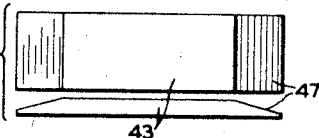


FIG. 6

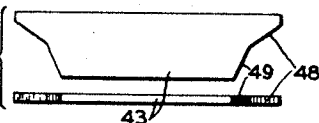


FIG. 7

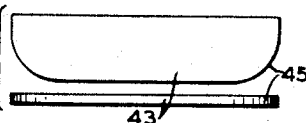


FIG. 8

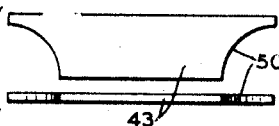
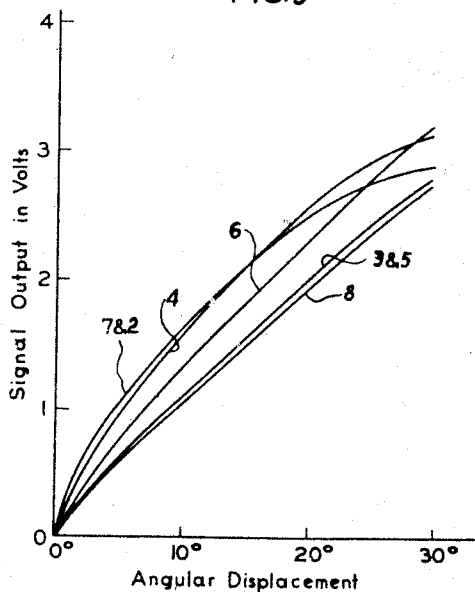


FIG. 9



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TRANSFORMER PICKOFF

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Original application October 24, 1942, Serial No.
463,286. Divided and this application July 17,
1943, Serial No. 495,170

8 Claims. (Cl. 177-380)

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This invention relates to a pickoff of the transformer type which generates a signal responsive to the displacement of two relatively movable objects. The improved pickoff is particularly adapted to produce a signal that is approximately proportional to the angular displacement of two relatively rotatable objects. This application is a division of application S. N. 463,286 filed jointly with O. E. Esval on October 24, 1942, now Patent No. 2,407,657 issued September 17, 1946.

A feature of the invention resides in the utilization, in a transformer-type pickoff, of an armature in the form of a curved sheet of magnetically permeable material which is arranged to differentially change the opening in two separate open magnetic circuits.

Other features and structural details of the invention will be apparent from the following description when read in relation to the accompanying drawing, wherein:

Fig. 1 is a detail plan view showing a pickoff unit having the curved sheet type of armature constructed in accordance with the present invention;

Figs. 2 to 8 inclusive show top and side developments of various types of the improved curved armatures as they appear before being shaped for use as shown in Fig. 1; and

Fig. 9 is a diagram in which the signal output is plotted in relation to angular displacement for the pickoff having the respective types of armatures shown in Figs. 2 to 8.

With reference to Fig. 1, a pickoff constructed in accordance with the present invention is illustrated in detail. As shown, the three legged core 36 is fixedly mounted on a disc or plate 37 which is rotatably mounted on shaft 38 by means of bearing 39. The outside legs of the curved core are indicated at 40 and 41 and the center leg at 42. The coils on the respective legs are connected in phase opposition, as shown, so that the terminals produce a difference signal. A suitable alternating current may be supplied to the coil on center leg 42, as indicated. The parts of the pickoff are operative to generate a signal responsive to armature displacement, angular displacement in this instance, and the extending outside and central legs of the core are spaced to be effective over an angular displacement between the parts of ninety degrees.

The armature 43 of the pickoff is mounted on a wheel or hub 44 which is suitably fixed to shaft 38. The hub or wheel 44 is constructed of non-permeable material while the armature which

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is fixedly mounted thereon is formed of permeable material. The armature shown in Fig. 1 is constructed of a curved sheet or flexible strip of rectangular form whose development is clearly illustrated in Fig. 2. The curved armature sheet is a 180-degree segment whose ends are normally situated adjacent the pole tip of the outside legs 40 and 41 of the core as shown in Fig. 1. Armature segment 43 preferably is constructed to have uniform thickness as well as width. With reference to Fig. 9, curve 2 indicates the voltage signal or output of this type of pickoff as angular displacement between the parts occurs. It will be noted that a greater signal is obtained by this type armature at the start of angular displacement between the parts than is obtained by the other illustrated armatures. A pickoff with an armature of this character is consequently sensitive to small changes in angular displacement and is utilized where such sensitivity is desirable. The armature 43 shown in Fig. 7, whose ends are cut circularly as indicated at 45, when utilized in the described pickoff is similar in performance to the rectangular type segment armature in Fig. 2. The output obtained from a pickoff with this modified form of armature for all practical purposes is the same as that of the output obtained from the rectangular type armature segment. Consequently, curves 2 and 7 for these respective pickoff armature types are illustrated in superimposed relation in Fig. 9.

A further modified type of pickoff armature of this character is illustrated in Fig. 4, in which the ends of segments are partially cut out at an approximate angle of 45 degrees, as indicated at 51. The relation between output signal and displacement obtained from this armature is shown by curve 4 in Fig. 9.

Where it is necessary to obtain an output signal which is more closely proportional to angular displacement over a wider range of displacement, a pickoff having an armature with ends tapering or slant cut from the main or central portion in the manner shown in any of Figs. 3, 5, 6 and 8 is employed. All of the curved armatures are segments of uniform thickness except the one illustrated in Fig. 5. The trapezoidally shaped armature 43, in Fig. 3, has its respective ends obliquely cut at an approximate angle of 45 degrees, as indicated at 46. In Fig. 5, the armature segment 43 is of uniform width and the ends thereof are tapered or beveled to gradually diminish in thickness, as shown at 47. End cut-out portions of respectively 30 and 45 degrees, indicated at 48 and 49, respectively, are

provided in the segment armature shown in Fig. 6. Also, in Fig. 8, the circularly cut-out end portions indicated at 50 are provided in the segmental armature 43. The curves for each of the described armatures are designated in Fig. 9 by reference numbers corresponding to the respective figure numbers, namely 3, 5, 6 and 8. Curves 3 and 5, like curves 2 and 7, are superimposed.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. In a transformer-type pickoff having a three-legged magnetic core, a coil wound about each leg of the core, a signal circuit formed by connecting the coils on the outside legs of said core in electrical opposition, and means for energizing the winding on the central leg of said core from an alternating current source, the combination with said core of an armature concentrically pivoted for rotation relative to said core comprising a strip of magnetically permeable stock cut obliquely at an angle of substantially 45° adjacent both ends thereof and bent into a semicircular arc, said armature being effective to produce a signal linearly proportional to the displacement of said armature relative to said core over an angle of at least 30° by differentially changing the reluctance of the flux paths between the central leg and the two outside legs of said core upon rotation of said armature relative to said core.

2. In a transformer-type pickoff having a three-legged magnetic core, a coil wound about each leg of the core, a signal circuit formed by connecting the coils on the outside legs of said core in electrical opposition, and means for energizing the winding on the central leg of said core from an alternating current source, the combination with said core of an armature concentrically pivoted for rotation relative to said core comprising a strip of magnetically permeable stock cut obliquely at both ends thereof and bent into a semicircular arc, said armature being shaped to vary the cross-section of the flux path between the central leg of said core and either outside leg linearly from maximum to minimum area as said armature rotates through a distance substantially equal to its own width.

3. A transformer pickoff arranged to produce a signal substantially proportional to the displacement over a wide angle of two relatively rotatable elements, comprising a core fixedly mounted on one of said elements and providing two separate open magnetic circuits, means for supplying an alternating magneto-motive force to each of said circuits, an armature comprising a parallel-surfaced strip of permeable material having its ends obliquely cut and being circularly

mounted on the other of said elements with its center of curvature coincident with the axis of relative rotation of said elements, said armature being disposed with respect to said core to differentially change the dimensions of the flux paths in said two magnetic circuits, and an output coil associated with each of said magnetic circuits, said output coils being connected in opposition to produce an output signal which is phase-sensitive to the sense of relative displacement of said elements.

4. A pickoff for generating a signal having a substantially linear response to the angular displacement of two relatively rotatable elements through an arc of rotation of at least 30 degrees, comprising a transformer which includes a magnetic core with three legs, a coil wound about each of said core legs, means for energizing the coil associated with the center core leg with alternating current, said transformer core being fixedly mounted on one of said elements, an armature in the form of a trapezoidally shaped strip of permeable material, said armature being fixedly mounted on the other of said elements and being situated with relation to said core upon relative rotation to differentially change the effective cross-sectional area of the gap between the center leg and either of the two outside legs thereof at a substantially uniform rate, and a signal output circuit formed by connecting the coils on the outside legs of said core in opposition.

5. A pickoff as defined in claim 4, in which the ends of the armature are cut at an angle of approximately 45 degrees with respect to its longitudinal axis.

6. A pickoff as defined in claim 4, in which both of the ends of the armature are cut off at angles of approximately 30 and 45 degrees with respect to its longitudinal axis.

7. In an electrical pickoff, an armature formed of a circularly disposed strip of magnetic material having a central body portion of uniform cross-sectional area and end portions of uniform thickness but of diminishing cross-sectional area, said armature having its opposite end portions lying substantially on a diametral line passing through the center of curvature thereof.

8. An armature as defined in claim 7, wherein the end portions of said strip comprise obliquely cut edges extending from one lengthwise edge of said strip to a point closely adjacent the other lengthwise edge thereof, said obliquely cut edges being concave in shape.

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

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