

Feb. 10, 1970

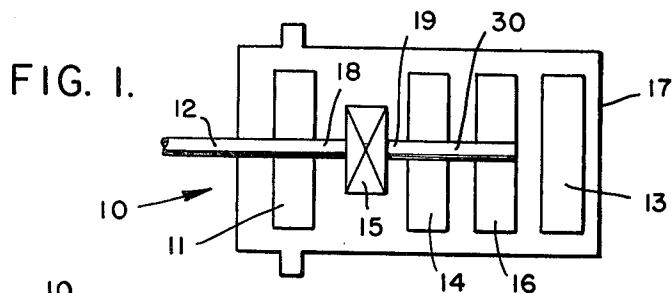
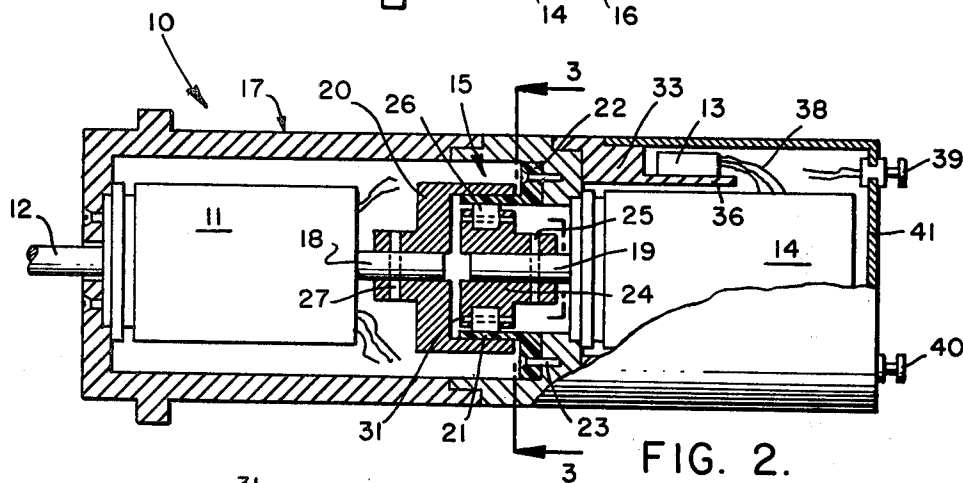
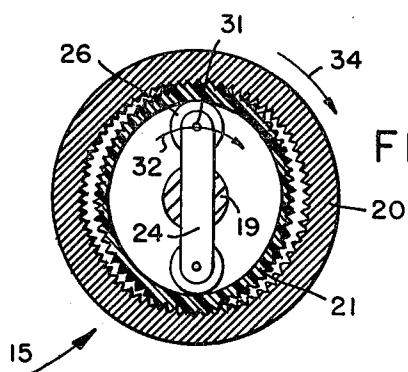
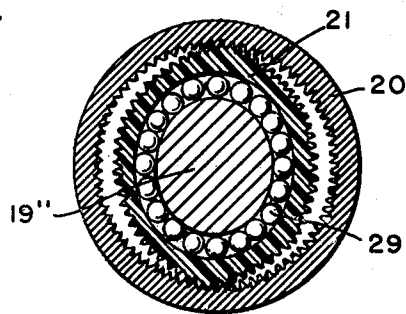
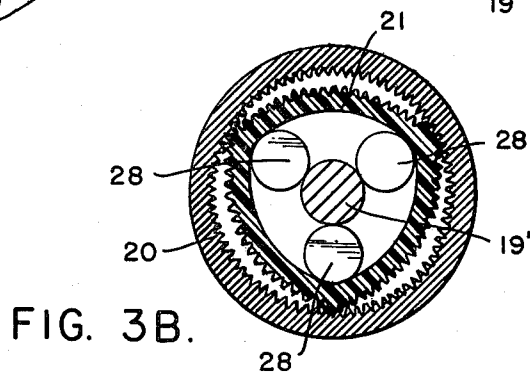
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3,495,108

SELF-CONTAINED SERVOMECHANISM

Filed March 19, 1968

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

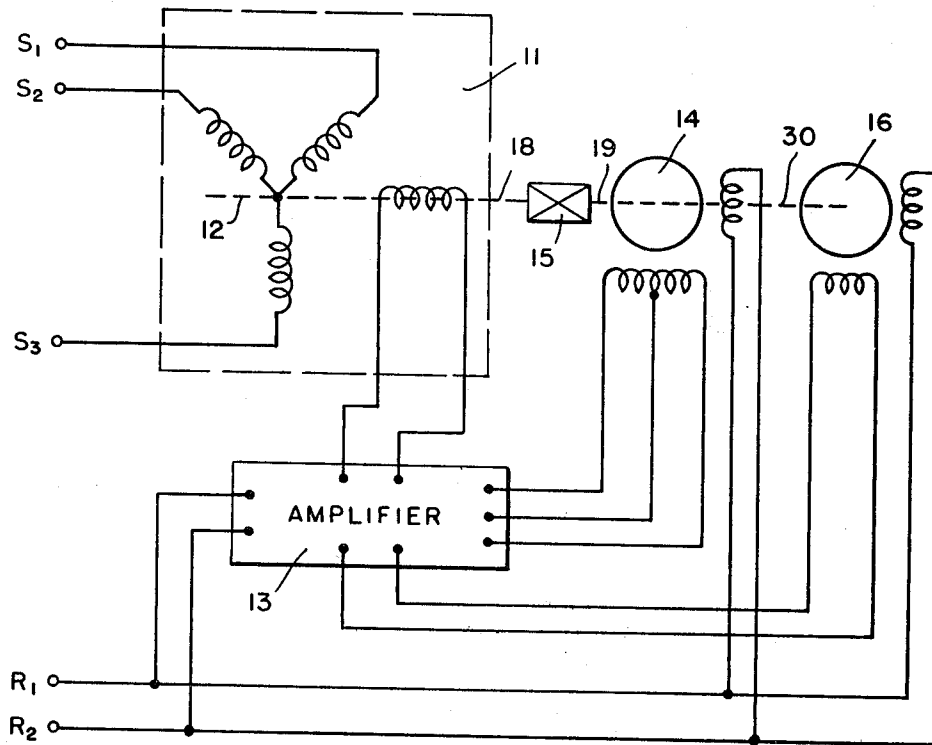


FIG. 4.

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SELF-CONTAINED SERVOMECHANISM

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1 Claim

ABSTRACT OF THE DISCLOSURE

A modular amplifier circuit is included in the housing of a synchro receiver to provide a unitary package. The housing is designed to provide easy access to the circuit module without disturbing the wiring.

BACKGROUND OF THE INVENTION

The present invention relates to a device for the positioning of one shaft in response to the angular positioning of another in an accurately controlled ratio. More specifically, the invention relates to a direct drive generator-transformer servo-system arranged in a unitary package along with a module containing the necessary electrical circuitry.

Prior devices of this type have suffered from numerous disadvantages, for example, (1) the electrical components required space outside of the servomechanism housing or (2) the electrical components were inaccessibly contained in a housing made larger to accommodate the components.

The present invention incorporates the electrical circuitry in an easily replaceable module fitted into the available space in a conventional servomechanism by modification of a portion thereof to provide a heat sink mounting for the components of the module. The electronic module may be easily inspected by removal of a cup-shaped cover without disturbing the connections. The motor generator according to the invention also may include a tachometer in conjunction with the motor and, in a preferred embodiment includes a reduction gearing between the motor and the generator.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is a diagrammatic view of a motor generator servomechanism according to the invention;

FIG. 2 is a planned view of a servomechanism with parts broken away and in cross section to illustrate the arrangement of parts;

FIG. 3 is a cross sectional view taken along line 3-3 of FIG. 2;

FIG. 3A is a cross sectional view similar to FIG. 3 showing a modification of the drive mechanism;

FIG. 3B is a similar view showing yet a second modification of the drive mechanism; and

FIG. 4 is a diagrammatic representation of the invention illustrating typical electrical circuitry.

DETAILED DESCRIPTION OF THE INVENTION

As shown in FIG. 1 the servomechanism 10 comprises a control transformer 11 having an output shaft 12. The control transformer 11 is connected to a drive mechanism 15 by means of connecting shaft 18. The drive mechanism 15 is preferably a reduction gearing as will be more fully described in relation to FIG. 2. The coupling 15 is connected to a motor 14 and tachometer 16 by means of shaft 30, the end 19 of which may be splined to fit into a complementary splined portion of gearing 15. The power supply for the servomechanism is indicated at 13 as being inside the modified servo housing 17.

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A more detailed description of the servomechanism 10 is possible by referring to FIG. 2 wherein housing 17 is shown composed of several interfitting parts. One part 33 of housing 17 is provided with a flange 36 which acts as a carrier for the electronic component module including the power supply 13. Since the part 33 and flange 36 are of metal, the portion 36 acts as a heat sink for the components as necessary. The member 33 is also adapted to receive a cup-shaped housing member 41 which acts as a cover for motor 14 and the power supply 13. Cup 41 is provided at its outer end with a plurality of terminals indicated generally at 39 and 40 and the connecting conductors 38 are long enough to allow removal of the cup 41 without disturbing the internal connections.

Although the motor 14 and the control transformer 11 may be directly connected, the device according to the present invention contemplates the use of a reduction gearing 15 which may be advantageously in the form of a harmonic drive. For example, as shown in FIG. 2, the motor shaft 19 has a carrier 24 fastened thereto by a pin 25. Carrier 24 has a plurality of rollers 26 on the periphery thereof which are retained in place by shaft 31. A flexible gear 22 is fastened to the housing at 23 and has a flange portion 21 which overlies the rollers 26 of the carrier 24. At the points where the rollers 26 contact the flexible gear 22, the flexible gear 22 is deformed so that the external teeth of a gear 20 (see FIG. 3), gear 20 is fastened to the input shaft 18 of the control transformer as by a pin 27.

Turning now to FIG. 3 it may be seen that, if gear 20 be provided with 200 teeth and gear 21 be provided with 198 teeth, when the carrier 24 is rotated in the direction of arrow 32, the gear 20 will then rotate in the same direction (arrow 34) at a speed reduced by a ratio of 100.

An even greater gear reduction may be accomplished by the use of a planetary system as shown in FIG. 3B wherein a modified shaft 19' is frictionally engaged with three rollers 28 to provide a planetary system causing flexible gear 21 to engage the gear 20 in three places. Because of the planetary arrangement of the input gearing, however, the rollers 28 will move around the flexible gear 21 at a much slower rate than did the rollers 26 of FIG. 3.

FIG. 3A shows a further modification of the harmonic gear drive in which a modified shaft 19'' has an oval shape and is grooved to retain ball bearings 29 in contact with the flexible gear 21. This arrangement accomplishes the same result as the two roller system shown in FIG. 3.

FIG. 4 shows a circuit diagram in which leads S_1 , S_2 and S_3 represent the input from a conventional synchro transmitter operatively connected to control transformer 11. In response to the signals received from S_1 , S_2 and S_3 , an error signal is generated in coil 42. The error signal is fed into amplifier 13 which in turn energizes center tapped coil 43. It should be noted that coils 45 and 46 are always energized by AC main lines R_1 and R_2 , thus two phase AC motor 14 will turn in response to the error signal generated from coil 42. As two-phase AC motor 14 turns output shaft 30, which is connected to tachometer 16, a current is generated in coil 44 which cancels the error signal generated by coil 42. Simultaneously, two-phase AC motor 14 causes shaft 19 to turn drive 15 and shaft 18. Shaft 18 in turn causes shaft 12 to turn so that the angular displacement of control transformer 11 returns to a zero error position where coil 42 no longer generates an error signal and the system returns to its stable state. It is further noted that the system may operate without the use of a tachometer 16. In this case the error signal generated by coil 42 will drive coil 43 and amplifier 13 causing two-phase AC motor 14 to operate shaft 19 to turn drive 15 and shaft 18 to cause shaft 12 to

rotate to cancel the electrical error signal generated within coil 42. The advantage of tachometer 16 is that it provides additional stability to the system by generating a second error signal in coil 44 which helps to stabilize amplifier 13.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claim the invention may be practiced otherwise than as specifically described.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:

1. In a synchro receiver including;

a control transformer,

a drive motor, and

a drive coupling between said motor and said control transformer;

the improvement comprising:

an enclosing housing including;

a cylindrical main body portion, and

a cylindrical cup shaped end cover portion;

said main body portion including a hollow cylindrical solid metal segment having oppositely extending first and second axial flanges;

said flanges respectively providing means for attaching said segment to said main body and

means forming an annular shelf between said drive motor and said end cover;

said shelf forming, with said cover portion, a toroidal cavity surrounding said drive motor; and a toroidal electronics module, including power supply means for said receiver, mounted on said shelf so that, all necessary electronics is included within said housing, said shelf acts as a heat sink for electronics components and inspection of said electronics module may be made by removing said cup shaped end cover without disturbing internal electrical connections.

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