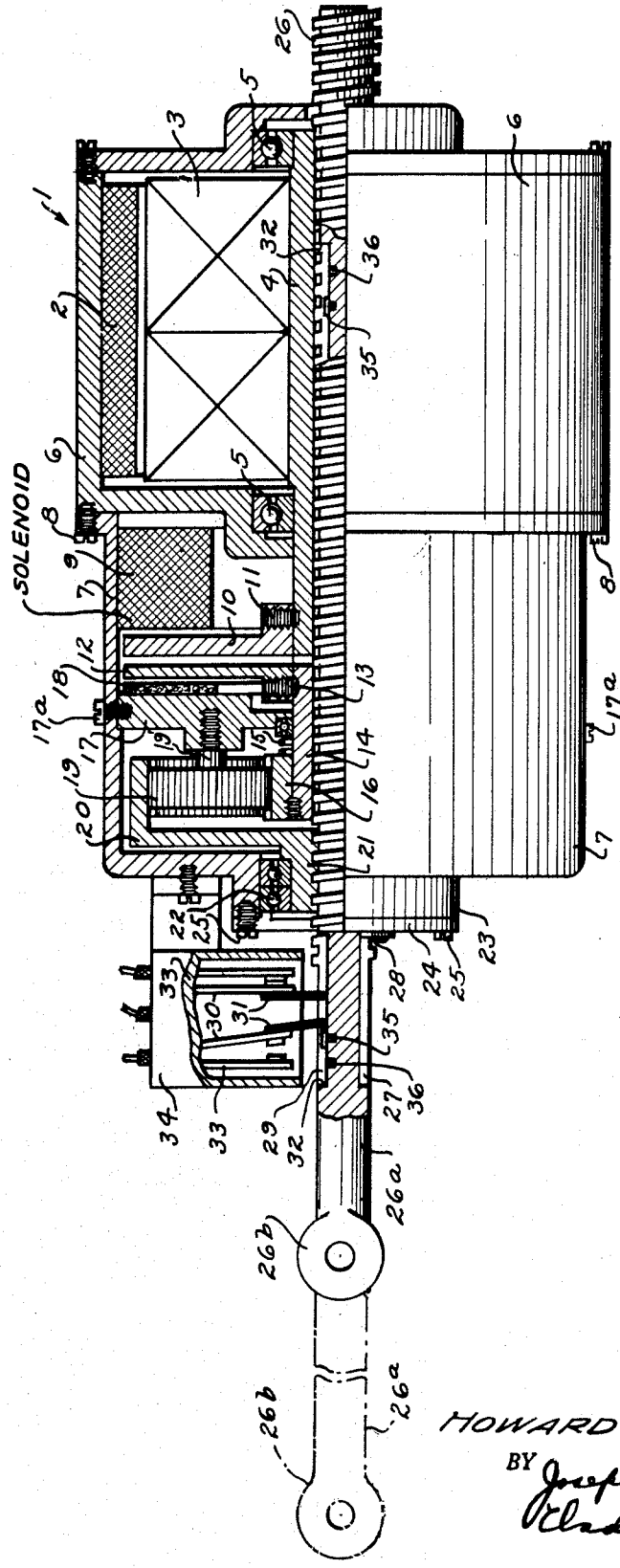
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ELECTRICAL JACK

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ELECTRICAL JACK

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to electrical governor controls for hydraulically operated variable pitch airplane propellers. Among other objects, the invention aims to provide a positively acting mechanism of the character indicated which may be used with automatically governed propellers, particularly of the hydraulic type. More specifically, the invention provides a mechanism which permits a fine adjustment of the governor spring lever by electrical means, thus making possible remote control and synchronized action on several propellers simultaneously, also automatic and adjustable control of the limits of motion. In its broader aspects, the invention provides an improvement in electrical jacks which converts the high speed rotary motion of a motor shaft into slow speed reciprocation of a rod which may actuate various devices, with sharply defined limits of motion of the rod in either direction. There are many uses for such a compact remotely controlled "push-pull" servo mechanism particularly in aircraft in the retraction of landing gears, engine cowl and wing flaps, control surface trim tabs etc.

It has been proposed in the Houston Patent No. 1,942,100, dated January 2, 1934, to adjust the pitch of propellers during operation by means of a linkage operated by a screw-threaded sleeve reciprocated by a nut driven by a worm gearing which derives its power from a reversible motor under the control of the pilot. According to the Martin Patent No. 2,144,429, dated January 17, 1939, a reversible motor drives a limit switch mechanism of the traveling nut type which adjusts a governor to control the speed of an airplane engine by controlling the pitch of the propeller, the propeller pitch being governed by varying the opening of the valve which controls the supply of hydraulic fluid to the propeller. In the Lear et al. patent, No. 2,267,114, dated December 23, 1941, a servomotor is shown with a magnetic clutch which is energized along with the servomotor that drives the clutch and which brakes the load when the servomotor is de-energized. My invention employs one or more of the features of each of these patents, but provides a unique mechanism having certain advantages which are not found in any prior art devices, so far as I know.

In the accompanying drawing showing somewhat diagrammatically a preferred embodiment of the invention, the single figure is a longitudinal quarter section, with parts broken away for clearness.

Referring particularly to the drawing, a reversible motor 1 is shown having a field winding 2 and armature 3 with a motorshaft 4 which is hollow end to end and is supported by anti-friction bearings 5 in the motor housing 6. The motorshaft projects from one end of the housing into a casing 7 which is preferably secured directly to the motor housing by studs 8. Thus the motor housing and casing form in effect a single housing which in the preferred form completely encloses all of the mechanisms that make up the unit except the power-delivering or push-pull member to be described.

Fixed on the inside of casing 7 is a solenoid 9 which is in series with the field winding 2, as will be understood without illustration, and which, therefore, is energized only when the motor is energized. Adjacent to the solenoid, and in the magnetic field thereof, is a clutch plate 10 of magnetizable metal, such as soft iron, secured as by set screws 11 to the outer end of the motorshaft so as to revolve therewith. Hence plate 10 may be termed the driving clutch plate. Another clutch plate 12 of soft iron is fixed as by set screws 13 to a slidable sleeve 14 which also carries a coil spring 15 under compression between a gear 16 secured to the sleeve, and a stationary brake disk 17 secured to the casing 7 as by screws 17a. Sleeve 14 may be of non-magnetic material to confine the magnetic field of the solenoid as far as possible to the clutch plates. Spring 15 constantly tends to force the driven clutch plate 12 into frictional engagement with brake segments 18 fixed upon the stationary brake disk 17. However, the magnetic attraction of the driving clutch plate 10 for the driven plate 12 is of such power as to overcome the resistance of the spring and bring the two clutch plates into contact, whereupon magnetism will hold them together without slippage so long as the solenoid is energized. Indeed, the heavier the load on the motor, consequently on the clutch, the stronger the magnetic field which unites the clutch plates. But when the motor circuit is broken, clutch plate 12 will be moved away by spring 15 and will engage the brake segments 18 to stop the sleeve 14 and the parts driven thereby. As the rapidly rotating armature is then unclutched from the sleeve, the latter is stopped quickly, while the armature is free to spin until stopped by friction etc.

Gear 16 is preferably part of a planetary reduction gear system and may be termed the sun gear of that system. A plurality of idler or planet gears 19, preferably three, mesh with the sun gear 16 and also mesh with a ring gear 20. The idler gears 19 are each rotatable on spindles 19' secured upon the fixed brake disk 17 and hence never move around the axis of the sun gear. Preferably integral with the ring gear is a nut 21, rotatably mounted on an anti-friction bearing 22 secured in a boss 23 integral with cas-

ing 7. A plate 24 may be secured by studs 25 to the outer end of the boss to enclose the nut completely and to give access to the bearing. The ring gear and nut assembly is restrained against any motion except rotation. Slidable in the motorshaft 4 is a lead screw or jack screw 26 having single or multiple threads with which the nut 21 engages so as to reciprocate the lead screw as the nut is driven in opposite directions by the reversible motor. One or both ends of the lead screw project beyond the motor housing 1 and casing 7, and either or both ends may have an unthreaded portion 26a with an eye 26b which exemplifies a power take-off and facilitates securing a lever or any other member that is to be actuated by the lead screw. The tangential frictional component tending to turn the lead screw is normally resisted by whatever element is attached to the eye 26b. However, a longitudinal slot 27 may be cut in the lead screw to receive a key 28 fixed to the plate 24, thus preventing any rotation of the lead screw or any rotative tendency which might bind or injure the limit switch mechanism.

To limit movement of the lead screw in either direction, another longitudinal slot 29 is cut in the smooth portion 26a of the lead screw and a pair of switches 30 have insulating arms 31 which enter the slot 29 and are moved by contact with a shoulder 32 at either end of the slot to break the motor circuit, which is completed through fixed contact members 33. Switches 30 and contact members 33 are preferably enclosed in a switch box 34 mounted on casing 7. Adjustment of the limit of movement in either direction may be effected by employing screws 35 placed in any one of a series of tapped bores 36 leading from the bottom of the slot 29. The closer together the screws 35 are placed, the shorter the strokes of the reciprocating lead screw, since the insulating arms 31 will break the motor circuit that much sooner.

The present invention provides a very powerful, compact unit which may have many uses on an airplane or wherever space is limited and a push-pull power take-off is advantageous. The magnetic clutch permits the armature to instantaneously start without appreciable load until magnetic force is sufficient to compress the spring 15 coupling the lead screw to the motor. When power is cut off, the lead screw stops almost instantly, or in other words, the action is "dead-beat," which is likewise advantageous since it permits a very nice control of any part operated by the lead screw. This braking action also prevents creeping of the lead screw under vibration. Other types of reduction gearing may be employed in lieu of the planetary gears disclosed herein.

Obviously, the invention may be embodied in several forms neither described nor shown.

What I claim is:

1. In combination, a reversible motor; reduction gearing; a clutch automatically engaging and disengaging the motor from the reduction gearing when the motor is energized and de-energized, respectively; braking means for the gearing, said braking means acting when the clutch disengages the motor from the gearing; a nut driven by the gearing; a lead screw reciprocated by the nut; means for preventing rotation of the lead screw; and power take-off means on the lead screw.

2. In combination, a reversible electric motor and a circuit therefor; a solenoid electrically connected in the motor circuit to be energized when the motor is energized and to be de-energized when the motor circuit is open; a clutch plate directly driven by the motorshaft, said clutch plate being in the magnetic field of the solenoid; a second magnetizable clutch plate fixed to a sleeve, said sleeve being slidable toward and from the first clutch plate; a spring holding the two clutch plates apart except when said plates are engaged by magnetic action; reduction gearing driven by said sleeve; a fixed braking disk which the magnetizable clutch plate frictionally engages by action of said spring when the solenoid is de-energized; a lead screw supported so as to move longitudinally of the axis of the motorshaft; means to prevent rotation of the lead screw; and a nut rotated by the reduction gearing and engaging the threads of the lead screw, so that rotation of the nut moves the lead screw longitudinally.

3. The invention according to claim 2, wherein there is a casing which houses the solenoid, the clutch, the braking disk, the reduction gearing and the nut, also part of the lead screw and motorshaft; the casing providing a rigid support for the solenoid and the braking disk; the clutch having the second magnetizable plate supported slidably by the lead screw; a portion of the reduction gearing being supported by the lead screw, and another portion of the reduction gearing being supported by the braking disk.

4. A power driven jack construction comprising a reversible electric motor having a hollow armature shaft, a jack screw journalled in said hollow shaft and axially slidable therein, a hollow sleeve slidably and rotatably mounted on said jack screw, electromagnetic clutching and brake elements associated with said armature shaft and sleeve operable to connect said sleeve for rotation with said armature shaft when said motor is energized and to disconnect said sleeve and brake the same when the motor is deenergized, a nut mounted on said jack screw, means for restraining said nut against axial movement with respect to said screw whereby rotation of said nut causes axial feeding movement of said screw, and constant mesh reduction gearing interconnecting said sleeve and nut whereby power is transmitted to said nut to rotate the same.

5. In combination, an electric motor having a hollow shaft and a motor circuit; a solenoid in the motor circuit which is energized when the motor is energized; a lead screw slidable but non-rotatable within the hollow shaft; a clutch including a driving plate fixed to the motorshaft and a driven plate slidable on the lead screw and magnetized by the energized solenoid to move into engagement with the driving plate; a fixed brake disk; a spring urging the driven clutch plate into engagement with the brake disk whenever the magnetization of the driven clutch plate has less power than the spring; a sun gear secured to the driven clutch plate to be rotated thereby; a ring gear surrounding said sun gear; idler gears rotatably supported on the fixed brake disk and each meshing with both the ring gear and sun gear; a nut secured to the ring gear to rotate therewith and meshing with the lead screw to reciprocate the same when rotated; and power take-off means on one end of the lead screw.

HOWARD M. McCOY.