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2,482,464

ELECTRICAL JACK AND CONTROL MEANS

Filed Sept. 25, 1942

2 Sheets-Sheet 1

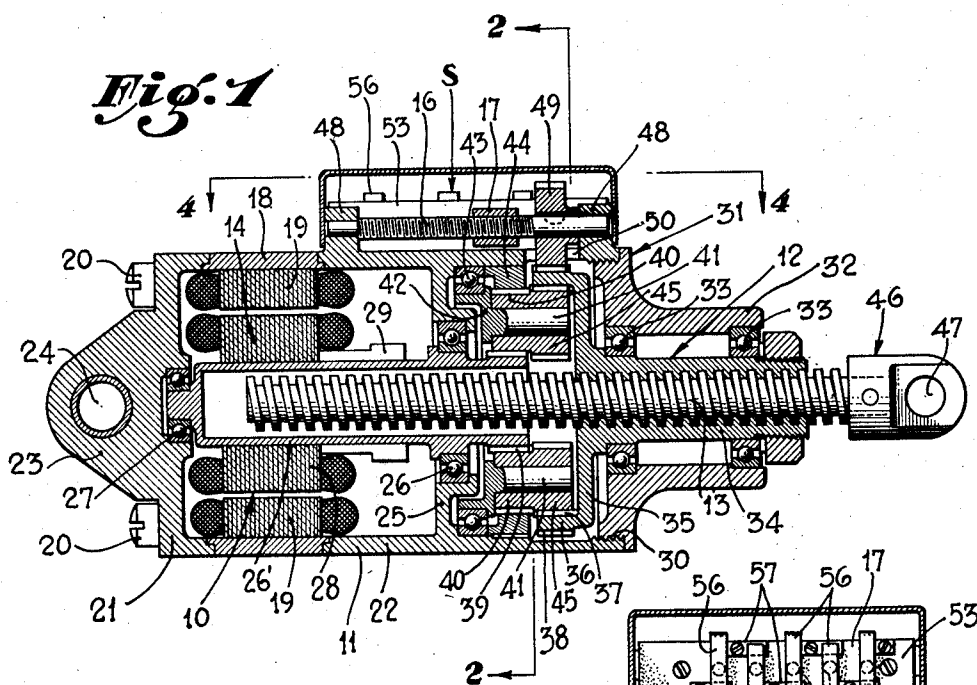


Fig. 2

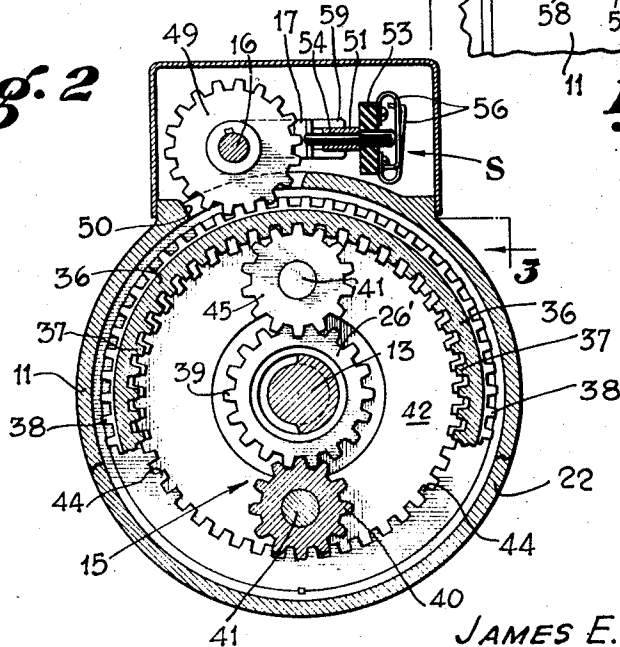


Fig. 3

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2 Sheets-Sheet 2

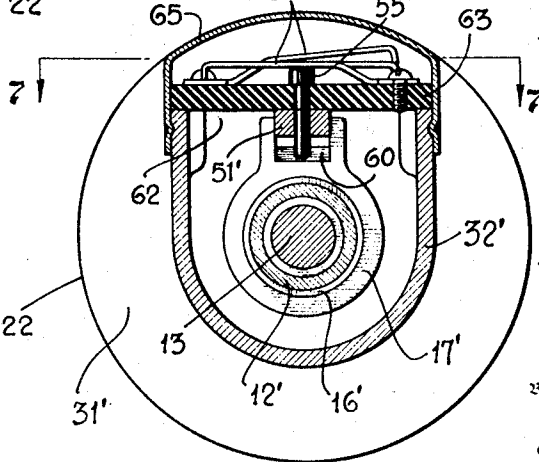
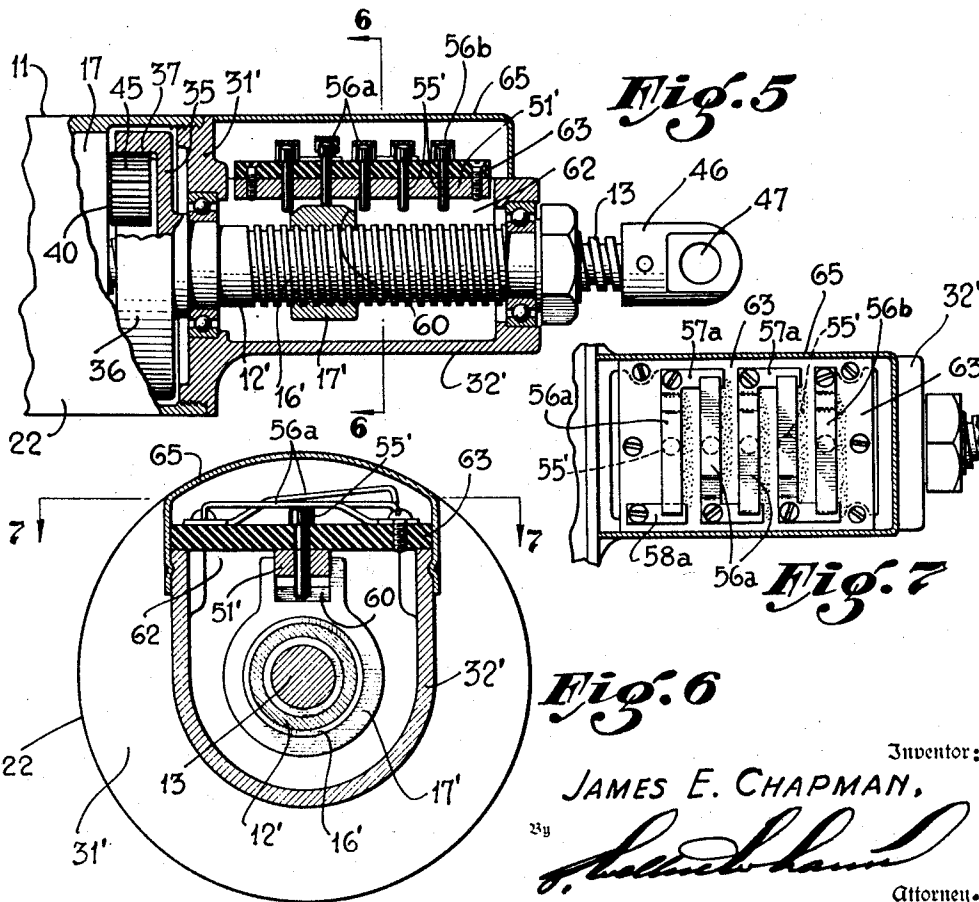
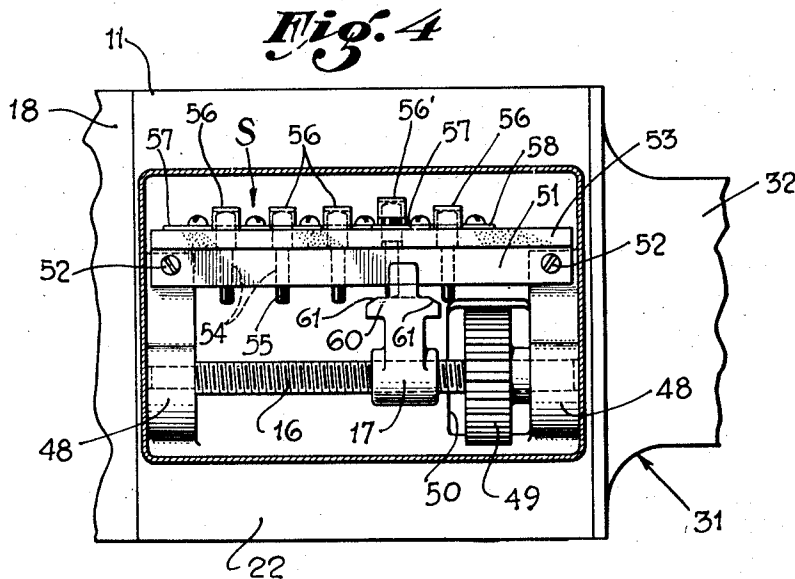


Fig. 6

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ELECTRICAL JACK AND CONTROL MEANS

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5 Claims. (Cl. 192-142)

1

My invention relates to a power jack or extensible strut having particular utility in the operation of movable parts of aircraft. It is an object of the invention to provide a simple and compact device having a motor body which is ordinarily attached to a stationary part and an extensible thrust bar which may be connected to the part to be moved, there being a reversible motor in the motor body for extending and retracting the thrust bar. The invention enables the making of a dependable device of this character which is extremely light in weight, considering the force and range of movement which it is capable of imparting to a movable part of an aircraft, for example, a radiator duct flap or other member which is swung from one position to another.

It is a further object of the invention to provide a simple jack of the character described in the foregoing having novel means for operating a control member in accordance with the movement of the thrust bar. This control member may be associated with or embodied in a switch mounted directly upon the motor casing of the device, wherein the control of the motor is correlated with movement of the thrust bar through a prescribed range of movement.

A further object is to provide an electric jack of this character which is slender in form and therefore may be located in spaces of comparatively small size. By slender I intend to convey the meaning that lateral extension of the motor body is maintained at a minimum.

A further object of the invention is to provide a power operated jack having a reduction gear so formed and in such cooperative relation to the motor and to the driven parts that slenderness and compactness are achieved.

A further object of the invention is to provide a jack wherein a motor driven part operates a screw which in turn reciprocates through a path of movement a traveler arranged so that it will actuate switch means employed in the control of the motor of the device. Such switch means may be of any desired character and may cooperate in control circuits in different ways, so long as the ultimate effect thereof is to produce a control of the operation of the motor in accordance with different positions of the thrust bar of the jack. For example, the switch means may be merely a limit switch, but is preferably a series type multiple switch capable of use in the control circuits and system disclosed in the copending application of Hannon, Serial No. 430,949, filed February 14, 1942, now Patent No. 2,314,937.

Further objects and advantages of the invention

2

may be brought out in the following part of the specification.

Referring to the drawings which are for illustrative purposes only,

Fig. 1 is a longitudinally sectioned view of the jack.

Fig. 2 is an enlarged cross sectional view taken as indicated by the line 2-2 of Fig. 1.

Fig. 3 is a fragmentary section taken as indicated by the line 3-3 of Fig. 2.

Fig. 4 is an enlarged fragmentary sectional view taken as indicated by the line 4-4 of Fig. 1, to show a plan view of the switch mechanism.

Fig. 5 is a partly sectioned view showing an alternative form of switch mechanism for use in the jack.

Fig. 6 is a slightly enlarged cross section taken as indicated by the line 6-6 of Fig. 5.

Fig. 7 is a plan view of the series switch device shown in Figs. 5 and 6.

The preferred embodiment of the invention shown in Fig. 1 includes a small reversible motor 10 included within a slender casing 11 which rotatably supports a driven member 12 having threaded engagement with a thrust bar 13 which will move axially in response to rotation of the member 12.

The motor 10 has a rotor 14 which drives the member 12 through a novel arrangement of gears 15 disposed in a position surrounding the inner portion of the thrust bar 13 when this thrust bar is in retracted position as shown in Fig. 1. The driven member 12 is arranged to rotate a screw 16 which moves a traveler 17 back and forth through a range of movement in accordance with the movement of the thrust bar 13 through different positions in its relatively larger range of movement. The traveler 17 cooperates or forms a part of a switch device S which is connected into electrical circuits associated with the motor 10. The motor circuit forms no part of the present invention, and although the switch device S may be a simple limit switch for stopping the motor when the thrust bar 13 approaches the end of its range of movement, the switch device is so formed that it will cooperate in a control circuit such as disclosed in the copending application of Hannon, Serial No. 430,949, previously referred to.

The motor 10 is built into the cylindric section 18 of the casing 11 and includes field pieces 19. The cylindric section 18 is clamped between a cap 21 and the front section 22 of the casing 11 by means of screws 20. The cap 21 has a projection 23 with an opening 24 therein whereby

the rear end of the casing 11 is connected to a stationary part.

Within the section 22 there is a radial wall 25 which supports a bearing 26 in which a tubular member 26' is rotatable. The left or rear end of the tubular member 26' is rotatably supported in a bearing 27 carried by the cap 21. The tubular member 26' comprises the hollow shaft of the rotor 14 and supports thereon the motor armature 28 and the commutator 29, both of which parts are diagrammatically indicated. The hollow shaft 26' is of such size that the threaded thrust bar 13 may extend thereinto when it is retracted as shown in Fig. 1.

The rightward end of the casing section 22 has threads 30 to receive an end member 31 which has a projecting tubular portion 32 carrying bearings 33 which support the driven member 12. The bearings 33 engage a threaded tubular portion 34 of the driven member 12 and support the same for rotation on the axis of the casing 11. The driven member 12 includes a circular plate 35 at the inner end of the tubular portion 34, this plate 35 supporting a short cylindrical section 36 comprising an internal gear 37 and an external gear 38. The rightward end of the hollow shaft 26' projects beyond the bearing 26 and has a drive pinion 39 formed thereon. This drive pinion engages planetary gears 40 which are supported in outward relation relatively thereto by pins or axles 41 which are carried by a ring 42 supported for rotation around the axis of the shaft 26' by a ring bearing 43. A ring gear 44 is secured in the casing section 22 in a position adjacent the ring bearing 43, this ring gear engaging the outwardly directed teeth of the planetary gears 40 so that when the motor 10 is operated to rotate the pinion 39, the planetary gears 40 will be caused to roll around the interior of the ring gear 44. Second planetary gears 45 are rotatably supported on the axles 41 and are directly connected to the planetary gears 40 so as to be rotated thereby. The second planetary gears 45 are of a different diameter than the first planetary gears 40, and the teeth thereof engage the internal gear 37 of the driven member 12. This difference in diameter of the first and second planetary gears 40 and 45 results in a slow rotation of the driven member 12 as the planetary gears 40 roll through their circular path of movement within the internal gear 44. This reduction in the speed at which the member 12 is driven as compared to the motor speed is of course accompanied by a corresponding increase in torque applied to the driven member 12. The threaded thrust member 13 has a head 46 fixed thereon having an opening 47 to receive a bolt or pin carried by the part which is to be moved by the jack. Accordingly, rotation of the threaded thrust bar 13 is prevented, and as the member 12 is rotated, the thrust bar 13 is caused to move axially, thereby changing the distance between the openings 24 and 47 and producing relative movement of the parts to which the motor casing 11 and the head 46 are respectively connected.

The screw 16 is supported on the casing section 22 by bearings 48. A small gear 49 is fixed on the screw 16 near the front end thereof, and the lower portion of this gear 49 projects through an opening 50 in the casing section 22 into engagement with the external gear 38 of the driven member 12, so that the shaft 16 will be given a rotation corresponding to the rotation of the member 12, and the traveler 17 which comprises a nut in threaded engagement with the screw 16 will have

movement along the screw 16 corresponding to the movement of the thrust bar 13 in axial direction as the driven member 12 is rotated.

As shown in Figs. 2 and 4, a guide bar 51 is secured in parallel relation to the screw 16 by screws 52, and on the outer face of this guide bar 51 a wall 53 of insulating material is mounted. Spaced openings 54, through the guide bar 51 and the wall 53, receive thrust pins 55, the outer ends of which engage spring contacts 56, which are secured to the outer face of the wall 53. Each of these spring contacts 56 has a laterally extended supporting base 57, positioned so as to be engaged by the movable end of the preceding contact 56, whereby a series arrangement of these switch members is obtained. Referring to Fig. 3, a contact 58 is disposed at the leftward end of the switch assembly, this contact being engageable by the first or left hand switch 56. Progressing rightwardly through the arrangements of switches, it will be noted that each succeeding switch 56 engages the base 57 of the preceding switch.

The traveler has fingers 59 to engage the upper and lower faces of the guide bar 51, as shown in Fig. 2, and the traveler 17 has a cam 60, faced toward the guide bar 51 and having sloped ends 61. This cam 60 forces either one or two of the pins 55 outward, depending upon the position of the cam 60, thereby lifting corresponding switch members out of engagement with the cooperating switch contacts formed by the base portions 57 of other contacts 56, or the end contact 58, as shown, for example, at 56' in Fig. 4. These series-arranged switches cooperate with the circuits of a motor controlled system such as shown in said copending application, Serial No. 430,949, Patent No. 2,314,937, previously herein set forth. The jack is therefore adapted for uses under conditions wherein a part is to be operated or controlled from a remote position.

In Figs. 5, 6, and 7 I show an alternative construction wherein screw threads 16', analogous to the screw 16 of the switch device S, are formed on the tubular driven member 12' which is analogous to the driven member 12 shown in Fig. 1. The jack shown in Fig. 5 embraces the motor casing 11 and the parts included therein, as will be indicated by the duplication in Fig. 5 of numerals employed in Fig. 1. The changes in the structure are as follows. The front end cap 31 is replaced by an end cap 31' having an elongated tubular wall 32' to support the driven member 12'. This wall 32' has an opening 62 along a side thereof across which the switch plate 63, of nonconductive material is supported. A guide bar 51' is supported on the inner face of the switch plate 63 in parallel relation to the axis of the driven member 12' and thrust pins 55' are extended through the switch plate 63 and the guide bar 51' as shown in Figs. 5 and 6. The inner ends of the pins 55' are positioned so that they will be engaged by a cam surface 60 formed on an internally threaded traveler 17' which engages the screw threads 16', so as to be moved lengthwise of the driven member 12' as the result of the rotation of this driven member 12', the movement of the traveler 17' being proportionate to the movement of the thrust bar 13 in consequence of the greater lead of the screw threads formed on the thrust bar 13.

So as to be confined by a cover 65, switch parts 56a, 56b, and 58a are secured on the outer face of the switch plate 63. The switch part 58a is a stationary contact which is engaged by the

swingable end of a leaf switch 56a as shown at the left of Fig. 7. This leaf switch 56a has a lateral extension 57a, and in series arrangement additional leaf switches 56a are arranged in rightward consecutive order along the switch plate 63, with a simple leaf switch 56b at the rightward end of the switch plate 63. These leaf switches 56a and 56b are arranged over the heads of the thrust or lift pins 55', whereby the leaf switches will be lifted in consecutive order as the traveler 17' is moved from end to end of its range of movement.

I claim as my invention:

1. In a power jack of the character described, the combination of: a motor having a rotor; an externally threaded thrust bar supported for axial movement; an internally threaded driven member supported for rotation, the threads of said driven member engaging the threads of said thrust bar; a connection to drive said driven member from said rotor at a reduced speed; an external screw on said driven member; a traveler in threaded engagement with said external screw so that it will be moved through a path of movement in response to rotation of said driven member; and switch means for control of said motor disposed contiguous to said path of movement so as to be actuated by said traveler in timed relation to the movement of said thrust bar.

2. In a power jack of the character described, the combination of: a support having spaced bearings; a tubular member rotatably carried by said bearings, said tubular member having an internal thread and an external thread; motor means to rotate said tubular member; a thrust bar extending within said tubular member and having threads to engage said internal threads of said tubular member so that rotation of said tubular member will cause an axial movement of said thrust bar; a traveler having thread means to engage said external threads of said tubular member so that rotation of said tubular member will cause movement of said traveler through a short distance as said thrust bar is moved through a relatively long distance by rotation of said tubular member; and switch means for controlling said motor comprising at least two switches and actuators for said switches disposed along the path of movement of said traveler so as to be engaged and operated by said traveler in a prescribed relation to the different positions into which said thrust bar is moved by rotation of said tubular member.

3. In a power jack of the character described, the combination of: a support having spaced bearings, a member rotatably carried by said bearings, said member having a first screw thread and a second screw thread; motor means to rotate said member; a thrust bar having threads engaging said first threads so that rotation of said member will cause an axial movement of said thrust bar; a traveler having thread means to engage said second threads of said member so

that rotation of said member will cause movement of said traveler through a short distance as said thrust bar is moved through a relatively long distance by rotation of said member; and switch means for controlling said motor comprising at least two switches and actuators for said switches disposed along the path of movement of said traveler so as to be engaged and operated by said traveler in a prescribed relation to the different positions into which said thrust bar is moved by rotation of said member.

4. In a power jack of the character described, a combination of: a motor; an externally threaded thrust bar supported for longitudinal movement; a threaded driven member supported for rotation, the threads of said driven member engaging the threads of said thrust bar; connecting means between the motor and driven member; a second screw on said driven member; a traveler in threaded engagement with said second screw so that it will be moved through a path of movement in response to rotation of said driven member; and switch means for control of said motor, disposed contiguous to said path of movement so as to be actuated by said traveler.

5. In a power jack of the character described, the combination of: a motor having a rotor; an externally threaded thrust bar supported for axial movement; an internally threaded driven member supported for rotation, the threads of said driven member engaging the threads of said thrust bar; a connection to drive said driven member from said rotor; an external screw on said driven member; a traveler in threaded engagement with said external screw so that it will be moved through a path of movement in response to rotation of said driven member; and switch means for control of said motor, said switch means including a series of movable members disposed contiguous to the path of movement of the traveler so as to be successively actuated by said traveler in predetermined relationship to the movement of said thrust bar.

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