Nov. 4, 1947. T. W. MILLNS 2,430,405

ELECTROMAGNETICALLY OPERATED JACK-TYPE ACTUATOR

Filed Dec. 18, 1945 2 Sheets-Sheet 1

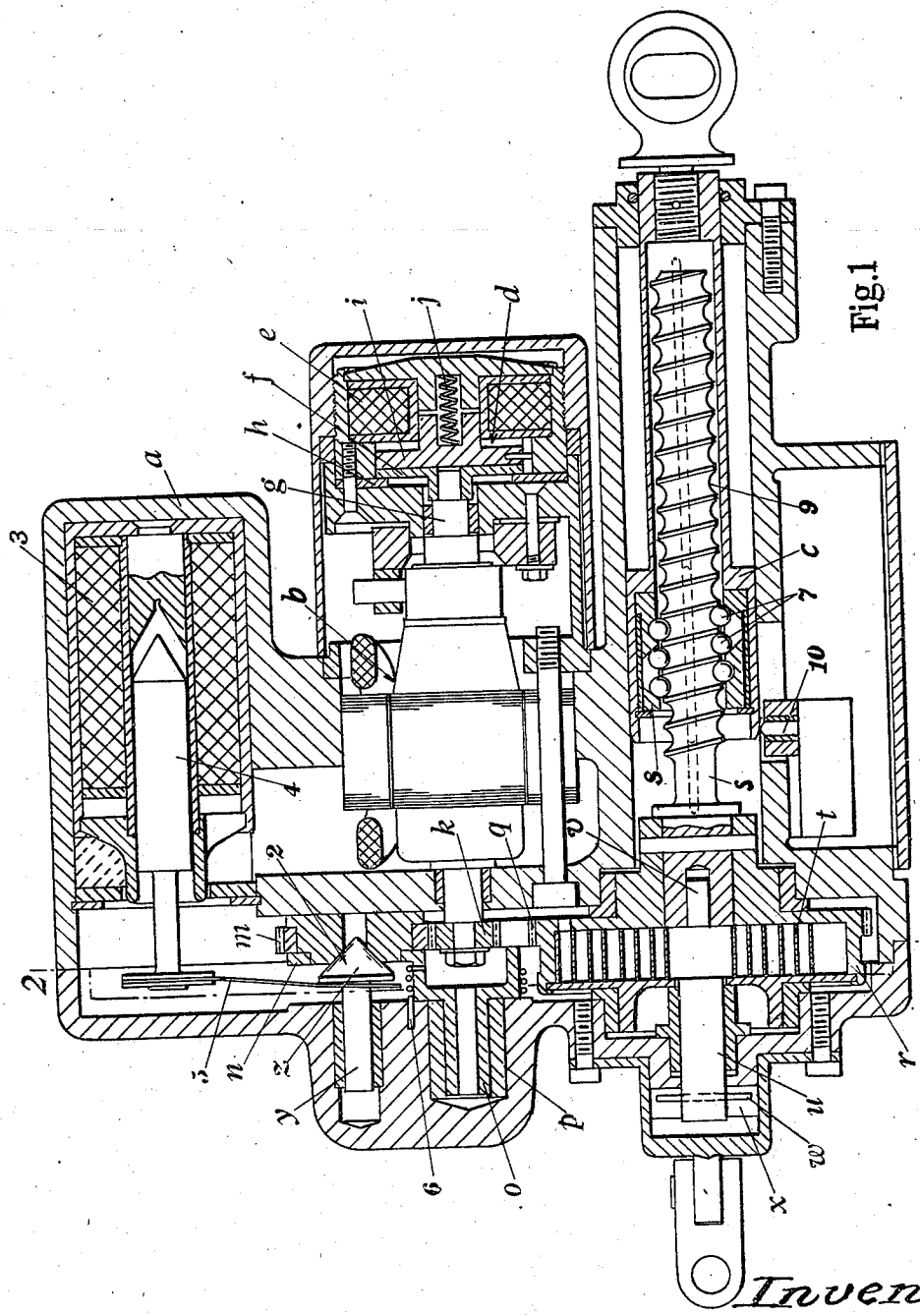


Fig. 1

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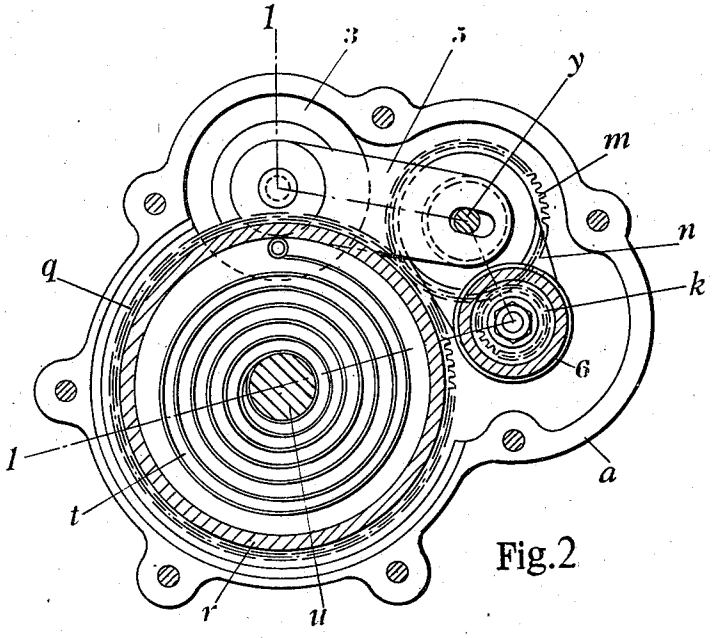


Fig.2

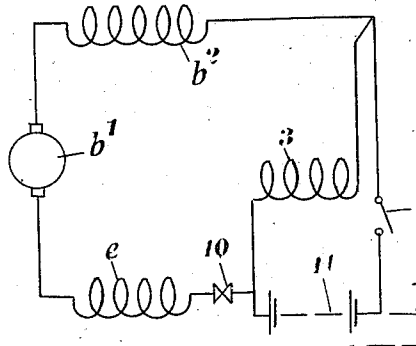


Fig.3

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UNITED STATES PATENT OFFICE

2,430,405

ELECTROMAGNETICALLY OPERATED JACK-TYPE ACTUATOR

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In Great Britain December 18, 1944

5 Claims. (Cl. 74—472)

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This invention relates to electro-magnetically operated mechanisms of the kind sometimes referred to as actuators, and comprising the combination of an electric motor, and means for converting the rotary motion of the motor into a linear motion of a slidable member through which motion is imparted to an apparatus to be actuated. The object of the invention is to provide an actuator of the said kind.

The invention comprises the combination of an electric motor, a slidable member, a rotary spindle having a screw-thread or equivalent connection with the slidable member, disengageable gearing for transmitting motion from the motor to the spindle, and a spring which can also impart rotary motion to the spindle, the arrangement being such that the spring is energised by the motor when the latter actuates the spindle.

In the accompanying sheets of explanatory drawings:

Figure 1 is a sectional side view, and Figure 2 a sectional end view, of an electromagnetically operated mechanism, embodying the invention, Figure 1 being taken on the line 1—1 of Figure 2, and Figure 2 being taken on the line 2—2 of Figure 1.

Figure 3 is a diagram illustrating the electrical connections of the mechanism shown in Figures 1 and 2.

In carrying the invention into effect as shown, I employ any convenient housing *a*, and in one part of this housing I arrange an electric motor *b*. In another part of the housing *a* I arrange a hollow cylindrical slidable member *c* having its axis parallel with that of the motor *b* and having a spline or like connection with the housing.

In association with one end of the motor *b* I arrange within the adjacent part of the housing *a* a spring loaded friction brake *d* which is releasable by an electromagnet *e*, the purpose of the brake being to hold the motor against undesired movement. In the example shown the brake *d* consists of a disc *f* carried by one end of the motor armature spindle *g*, and adapted to be gripped between a stationary annular member *h* and a spring loaded member *i*, the latter being slidably supported by the electromagnet *e*, and being movable against the action of its loading spring *j* to release the said disc in response to energisation of the electromagnet.

At the other end of the motor *b* there is secured to the armature spindle *g* a pinion *k* which engages an idle pinion *m* carried by one end of a link *n*, the other end of this link being pivotally supported by a trunnion *o* engaging a socket *p* in an

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adjacent part of the housing *a*. The idle pinion *m* is adapted to engage a toothed wheel *q* formed on a drum *r*, the latter being secured to one end of a rotary spindle *s*, which is arranged coaxially with and is located in part within the slidable member *c*. Within the drum *r*, is arranged a coiled spring *t* which at one end is anchored to the drum, and at the other end is anchored to a stationary shaft *u* arranged coaxially with the rotary spindle *s*. At one end the shaft *u* is formed with a spigot *v* which engages a complementary socket in the adjacent end of the spindle *s*, and the other end of the shaft is supported by a fixed part of the housing *a*, any convenient means, such as a pin *w* extending through the shaft and engaging a slot *x* in the said part of the housing, being provided to prevent rotational movement of the shaft.

The idle pinion *m* is movable into and out of engagement with the toothed wheel *q* on the drum *r* in any convenient manner. Preferably and as shown we employ for this purpose a plunger *y* having a conical head *z* which engages an axially arranged conical recess **2** in one side of the idle pinion *m*. The plunger *y* is movable by an electromagnet **3** into an operative position in which its head *z* is pressed into the recess **2**, in the idle pinion *m*, the electromagnet having a movable core **4**, which is adapted to act on the plunger head through the medium of a resilient arm **5**, so that when the magnet is energised the plunger head moves into the said recess and swings the idle pinion into engagement with the toothed wheel *q*. When the electromagnet **3** is de-energised, the plunger *y* allows the idle pinion *m* to be moved out of engagement with the toothed wheel *q*, by the reaction between the teeth of this wheel and the idle pinion or by a torsion or other spring **6** acting on the pivoted link *n*.

The spindle *s* has a screw-thread or equivalent helical connection with the slidable member *c*. Preferably and as shown this connection comprises an assembly of balls **7** carried by a cage **8** on the slidable member *c* and engaging a helical groove **9** formed around the spindle *s*.

In addition I may provide in association with the slidable member *c* a limit switch **10** for interrupting the circuit of the motor *b* automatically when the said member reaches the limiting position of its range of movement wherein the spring *t* is energised.

The electromagnets *e*, **3** are adapted to be connected to the circuit of the motor *b* in the manner illustrated in Figure 3 in which b^1 indicates the

motor armature, and b^2 the motor field winding. Also arranged in the motor circuit is the limit switch 10 above mentioned, a source of electric current 11, and a manually operable control switch 12.

The arrangement of the mechanism above described is such that when the motor *b* is at rest its armature is held by the brake *d*. On supplying current to the motor *b* the brake *d* is released, and the electromagnet 3 is energised for causing the idle pinion *m* to engage the toothed wheel *q* on the drum *r* connected to the spindle *s*. The latter is now rotated by the motor *b* through the gearing *k*, *m*, *q* causing the slidable member *c* to be moved in its inward direction. During this phase the spring *t* in the drum *r* connected to the spindle *s* is also energised. When the slidable member *c* reaches the end of its outward movement the motor circuit is opened and the motor *b* is held by re-application of the brake *d*. Meanwhile the electromagnet 3 remains in action. To effect return of the slidable member *c*, the electromagnet 3 is de-energised, allowing the idle pinion *m* to be disengaged from the toothed wheel *q*. The previously energised spring *t* now comes into action and causes the spindle *s* to rotate in the opposite direction and move the slidable member *c* to an extended position. Alternatively the slidable member *c* may be moved to its outermost position by the motor *b* and retracted by the spring *t*.

An actuator as above described is applicable to a variety of uses, but it is intended more particularly for actuating the change mechanisms of variable speed power transmission gearing, and the like, and subordinate details may be modified to suit different requirements.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. An electromagnetically operated mechanism of the kind specified, comprising the combination of an electric motor, a slidable member, a rotary spindle having a helical connection with the slidable member, disengageable gearing for transmitting motion from the motor to the spindle, and a spring which can also impart rotary motion to the spindle, the arrangement being such that the spring is energised by the motor when the latter actuates the spindle.

2. A mechanism as claimed in claim 1 and having in combination a spring loaded friction brake for holding the motor stationary, and an electromagnet for releasing the brake.

3. An electromagnetically operated mechanism of the kind specified, comprising the combination of an electric motor, a slidable member, a rotary spindle having a helical connection with the slidable member, a toothed wheel connected to the rotary spindle, a pinion connected to the motor, an idle pinion for interconnecting the toothed wheel and the first mentioned pinion, electromagnetically operated means for bringing the idle pinion into action, and a spring which can also impart rotary motion to the spindle, the arrangement being such that the spring is energised by the motor when the latter actuates the spindle.

4. A mechanism as claimed in claim 3, in which the electromagnetically operated means for bringing the idle pinion into action comprise in combination a pivoted link carrying the idle pinion, a plunger adapted to move the idle pinion into its operative position, and an electromagnet for actuating the plunger.

5. A mechanism as claimed in claim 3 and having a drum through which the toothed wheel is connected to the spindle, and which contains the spring for imparting motion to the spindle.

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