Oct. 15, 1963 R. L. VALLEAU 3,106,849

STEP SWITCH MECHANISM

Filed May 20, 1960

Fig.1.

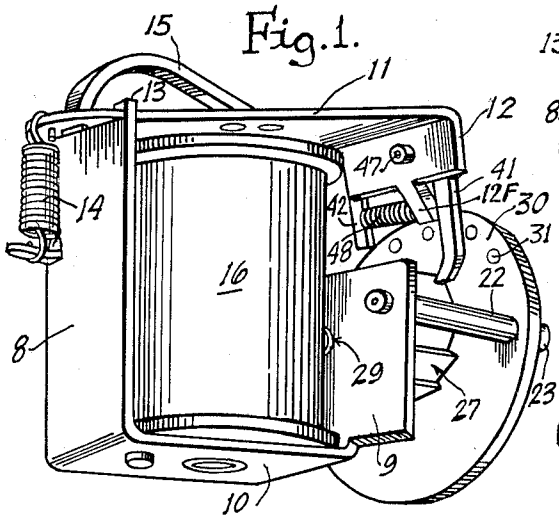


Fig.2.

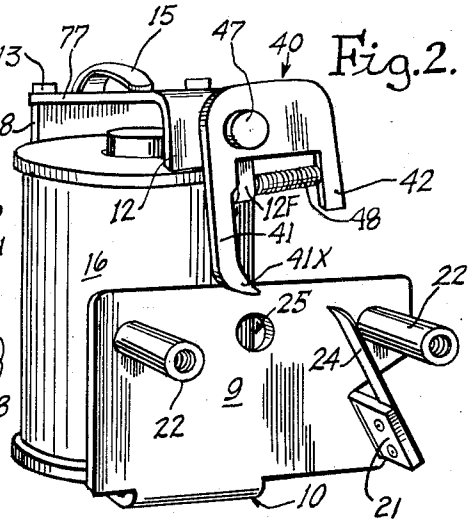


Fig.3.

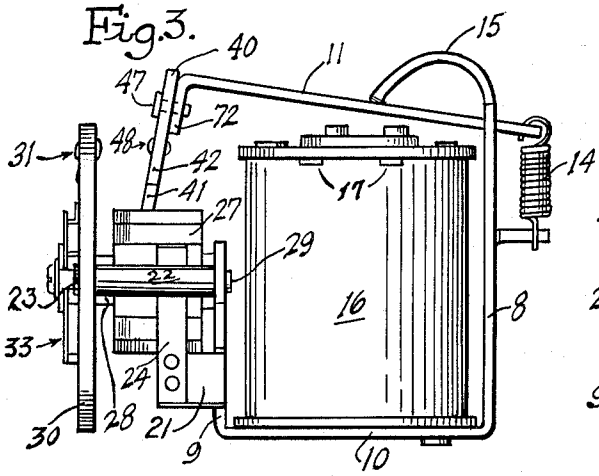


Fig.4.

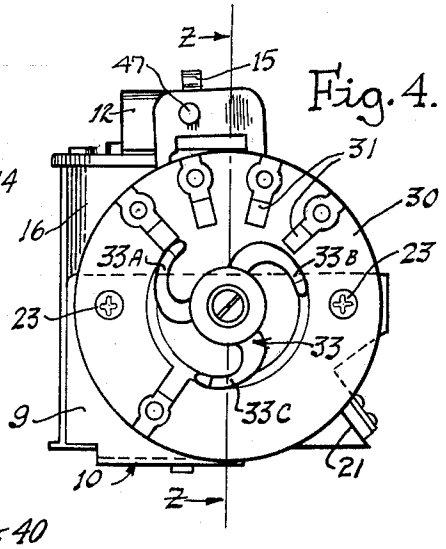


Fig.5.

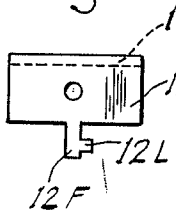
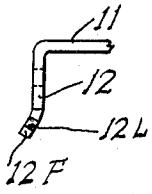


Fig.6.



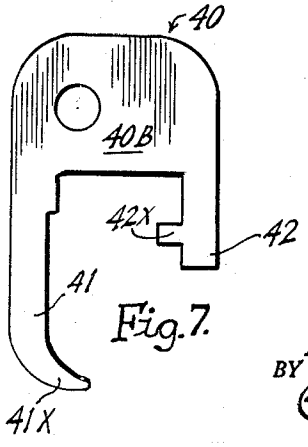
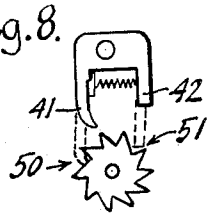


Fig.7.

Fig.8.



INVENTOR.
ROBERT L. VALLEAU
BY
ATTORNEY.

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STEP SWITCH MECHANISM

Robert L. Valleau, Chicago, Ill., assignor to Comar Electric Company, Chicago, Ill., a corporation of Illinois

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This invention has as its principal object the provision of improvements in electromagnetic stepping switches and the like; and more particularly in a simplified pawl and ratchet driving mechanism therefor which is economical to manufacture, and capable of reliable and rapid stepping action, the principal features of novelty relating to the shape of the driving pawl and the manner in which is mounted directly on the rocking armature of an electromagnet driver, and spring-urged relative to certain stop formations on the same, all of which will appear more fully as the following detailed description proceeds in view of the annexed drawing, in which:

FIG. 1 is a sidewise perspective view of the complete stepping switch;

FIG. 2 is a front perspective of the device with the switching means and ratchet wheel removed;

FIG. 3 is a side elevation of the complete device;

FIG. 4 is a front elevation of the device showing the switching means;

FIG. 5 is a front elevational detail of the electromagnetic armature;

FIG. 6 is a fragmentary side elevation of the armature parts seen in FIG. 5;

FIG. 7 is an enlarged plan view of the stepping pawl;

FIG. 8 is a schematic operating detail of the pawl and ratchet wheel.

The complete step switch unit seen in FIG. 1 comprises a U-shaped magnetic frame stamping, including opposite legs 8 and 9 joined by a bight portion 10 and having an armature 11 rockably seated on the top edge of the leg 8 and captured in part by integral lugs 13 and in part by a normalizing spring 14.

Armature stop means is provided by a long bendable finger 15 integral with the frame and projected through an opening in the tail of the armature and bent over at a desired position overlying the same at the desired normal stopping position.

Mounted on the bight of the frame stamping is an electromagnet 16 having terminals 17 (FIG. 3) adapted for connection with a desired operating circuit.

The front leg 9 of the frame stamping is made quite wide to provide a broad panel (FIG. 2) having staked thereon a pair of tapped switch-panel mounting posts 22 and an integral upwardly-pitched, spring-seating offset or tab 21 with an indexing blade spring 24 secured thereon.

The panel 9 is also provided with a hole 25 serving as a journal for the rear spindle end 29 of a molded nylon ratchet wheel 27, as in FIG. 3, the wheel having another front spindle projection 28 which seats in a bore provided centrally in a Bakelite or like insulating switch panel 30 mounted on the posts 22 by screws 23 (FIGS. 1, 3, and 4).

The switching means comprises the panel 30 and contacts 31 fixed thereon, together with commutating and arcuate wiper commutation contact 32 concentric with the ratchet spindle and contacts 31.

A spring spider contact 33 (FIG. 4) is fitted onto the outer end of the ratchet spindle and secured for rotation with the latter by means such as a washer 34 and a screw 35 threaded into the front spindle end, the spring legs 33A, 33B, 33C of the spider pressing down to wipe over the contacts 30 and commutation ring 32 as the ratchet

wheel steps around its circuit, some one of the three spider legs always being in contact with the nearly circular wiper ring 32, so that electrical connection between the connection terminal 32T of the ring and the rotatable contacting spider is at all times effected.

The principal feature of the improved stepping mechanism is the stepping pawl shown in FIG. 7 and certain associated parts, as will appear, the pawl 40 being in the form of a flat and somewhat asymmetrically-shaped yoke having a relatively large base portion 40B from opposite sides of which project two parallel fingers 41 and 42, one of which is substantially longer than the other and has an inwardly-directed offset 41X, while the shorter finger is provided near its free end with a short, inwardly projecting spring-seating ear or tab 42X.

As seen in FIGS. 1 to 3, the armature 11 has an outer end portion struck down to define a pawl-seating flange 12, a front view of which is seen in FIG. 5 From the center of the lower margin of this flange depends a stop finger 12F which is outwardly offset away from the plane of the outside face of the flange 12, said finger having a small spring-seating lug or tab 12L projected from a side thereof to afford a complement to the like tab 42X on the pawl.

The pawl 40 is pivotally mounted on the armature flange 12 by means of a headed pin 47 (FIGS. 1 to 4) and a somewhat soft compression spring 48 has one of each of its opposite ends fitted upon one of the spring-mounting tabs 12L or 42X, so that as a result of the expansive action thereof the pawl is rocked into a normal position, such as shown in FIG. 2 (or 8), in which an inner margin of the longer finger 41 abuts the stop finger 12F, which serves to locate the pawl in a predetermined normal starting position relative to the armature and also to a vertical reference axis Z—Z (FIG. 4) passing through the rotative axis of the ratchet wheel (at right angles thereto), it being noted here that the center of the pawl at pivot pin 48 is offset substantially from said vertical reference axis Z—Z and hence from the ratchet axis, as a result of which, when the armature 11 is raised to its normal, unattracted position against stop finger 15, the inturned finger portion 41X of the pawl will overlie one of the leading teeth of the ratchet wheel, as at 50 in FIG. 8, in position to bear down upon such tooth and turn the wheel one step.

The two pawl fingers 41, 42 are spaced apart so as to lie on opposite sides of the pivotal axis of the pawl at 47, and also to lie on opposite sides of the reference axis Z—Z (as at 50, 51, dotted lines, FIG. 8) so that the ends of said fingers will be disposed to engage ratchet teeth on opposite sides of said wheel when moved down toward the latter in turning the wheel the distance of one tooth, as aforesaid.

By reason of the aforesaid finger spacing and offset relation of the pivotal center of the pawl at 47 to the reference axis Z—Z of the ratchet wheel, the long pawl finger 41 tends to be shifted away (toward the left, FIG. 8) from the reference axis Z—Z so as to pivot the pawl clockwise (FIG. 8, dotted lines) until the end of the shorter pawl finger 42 abuts a ratchet tooth as at 51 on the opposite side of the ratchet wheel, whereby the latter is stopped dead in an indexed position, which will be accurately repeated in each stepping operation.

On deenergization of the electromagnet, the armature will be snapped up to normally raised position (FIGS. 1 to 3) while the pawl will be rocked back against the offset stop 12S by action of spring 48 in readiness for the next cycle, the blade spring 24 acting to hold the gain of the wheel as the pawl moves upwardly and the offset

tip 41X thereof glides back over the ratchet teeth, the compression spring 48 being soft enough to make this return travel of the pawl a minimum load on the armature movement.

By the time the armature is restored in readiness for the next stepping pulse the pawl will be turned back against the offset stopping lug 12F in proper alignment with the ratchet teeth for the next step.

The pivotal axis of the pawl through its pin 47 is not symmetrically located relative to the two pawl fingers but, as in FIG. 2, is much closer to the long driving finger 41 than it is to the short stopping and indexing finger 42, and this fact, in addition to the relatively offset relation of the armature and ratchet axis, locates the long driving finger a sufficient distance at one side of the rotative axis of the ratchet wheel to permit a considerable amount of play in the pivotal seating of the armature 11 without affecting the reliability of the stepping action, which is an advantage especially in lower-priced utility units.

I claim:

1. In a ratchet mechanism, a rotatable ratchet wheel, a driving member mounted at one side of said wheel with an end portion movable from a starting position in a driving stroke in a radial sense toward the wheel and away therefrom back to starting position; a fork-shaped pawl having a long prong and a shorter prong spaced apart and rockably carried at said driving member end portion to oscillate in a direction laterally of the rotative axis of the wheel with the ends of said prongs disposed to engage in the ratchet teeth on opposite sides of the wheel axis when the driving member moves in said driving stroke, the longer prong engaging first to advance the wheel and the pawl pivoting from said normal starting position to dispose the shorter prong into position to engage between other teeth to stop the wheel; spring means disposed between said prongs and acting between one of the same and a part carried by said driving member to urge the pawl to said starting position together with stop means carried by the driving member and projected in the path of one of said prongs to stop the spring-urged pawl at said starting position.

2. In a ratchet mechanism for rotary switches and the like, a rotatable ratchet wheel adapted to drive a switch member, an oscillating driving member mounted with an end portion situated above said wheel for motion from a normal position in a driving stroke toward the wheel and back to normal position and means for moving the driving member as aforesaid, the rotative axis of the wheel being normal to the axis through the center of oscillation of the driving member; and an asymmetrically configured fork-shaped pawl having two fork fingers spaced oppositely apart and of different lengths, rockably mounted at said end of the driving member with said fingers overlying the teeth of the ratchet wheel, one on each side of the axis thereof with their respective ends disposed to engage in said teeth in the driving stroke of said driving member, the longer one first to turn the wheel, then the shorter finger to stop the wheel; spring means acting on said pawl to rock it to a starting position with the end of the longer finger angled in a direction toward the wheel axis; and stop means carried by said driving member to limit spring movement of the pawl to said starting position.

3. In an electromagnetic stepping ratchet mechanism, a frame, an electromagnet and cooperative rockable armature carried by the frame; spring means urging the armature to a normal position; a ratchet wheel and means cooperable with the frame for supporting said wheel beneath the armature with its rotative axis extending in a direction transverse to the rocking axis of the armature and in approximate parallelism with the armature in the attracted position thereof; and stepping pawl means comprising a yoke-shaped pawl of asymmetric configuration including a base part pivotally mounted at a particular end of said armature overlying said ratchet wheel to pivot about an axis approximately paralleling that of the wheel but offset therefrom relative to a reference axis through the wheel axis and pawl, said pawl having a long and a short finger spaced apart to lie on opposite sides of its own pivotal axis and said reference axis, whereby movement of the pawl toward the ratchet wheel by attraction of the armature engages the longer finger in a ratchet tooth to advance the wheel a certain distance and bring the end of the shorter finger into a tooth on the opposite side of the wheel to stop the latter accurately; stop means located at said particular end of the armature with an abutment portion disposed adjacent said pawl for engagement by the latter and spring means carried partly by said pawl and partly by said stop means urging the pawl into engagement with said abutment portion and a normal starting position relative to the armature and rachet wheel in the normal position of the armature.

4. A pawl and ratchet wheel mechanism for actuation by a rockable member comprising a yoke-shaped pawl having opposite parallel fingers of different length spaced apart a certain distance, means pivotally mounting the pawl at an end of said rockable member to pivot about an axis which is closer to one certain finger than the other, and at right angles to the rocking axis of the rockable member, a ratchet wheel mounted beneath said member and the ends of said pawl fingers to rotate about an axis parallel to, but out of alignment with the pivotal axis of the pawl with respect to a reference axis through the wheel axis and a point on the pawl closer to said certain finger than the other; said rockable member rocking from a normal position toward the wheel.

5. In an electromagnet stepping mechanism of the type having a rockable armature spring-urged to a normal position with coil means for attaching the armature to an advanced position, and a ratchet wheel to be stepped by an armature-driven pawl, improvements in a stepping pawl means comprising, namely: a pawl of approximately U-shape having opposite legs connected by a bight portion, one of the legs being an indexing and stopping finger adapted to engage in the teeth of the ratchet wheel and the other leg being a driving finger also adapted to drivingly engage in the teeth of the ratchet wheel, said driving finger being longer than said indexing finger, said fingers being disposed on opposite sides of an axis approximately parallel thereto and passing through said bight portion; means pivotally mounting said pawl on a portion of said armature to oscillate about a center located at one side of said pawl axis and also at one side of the axis of said ratchet wheel which is nearer to the driving finger than to the indexing finger; stop lug means carried by said armature and located in a particular direction and position at one side of the pawl axis so as to be struck by the pawl in rocking in said particular direction; a mounting projection on one of said pawl fingers; a compression spring seated at one of its ends upon said mounting projection, and at its other end upon lug means carried by said armature.

6. A pawl and ratchet wheel mechanism for actuation by a rockable armature member in an electromagnetic device and comprising a yoke-shaped pawl having opposite parallel fingers of different length spaced apart a certain distance, means pivotally mounting the pawl at a particular end of said rockable armature member to pivot about an axis which is closer to one certain finger than the other, and at right angles to the rocking axis of the rockable member, a ratchet wheel mounted substantially beneath said particular end of the armature member and the ends of said pawl fingers to rotate about an axis parallel to, but out of alignment with the pivotal axis of the pawl with respect to a reference axis through the wheel axis and a point on the pawl closer to said certain finger than the other; said rockable armature member rocking from a normal position to move said particular end thereof toward said ratchet wheel to engage the end of the longer finger in the ratchet teeth first and turn the wheel, and

thereafter to engage the end of the shorter finger in the ratchet teeth to stop the wheel accurately; and spring means carried at said particular end of the armature and acting on said pawl in a direction to dispose the end of the longer finger closer to the ratchet teeth than the end of the shorter finger; together with means providing a stop lug at said particular end of the amature member against which the pawl is normally urged by said spring means to limit the movement of the pawl and its longer finger toward the ratchet teeth by said spring means.

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