May 6, 1958 G. J. KENNEDY ET AL 2,833,976

POSITIONING MECHANISM

Filed July 15, 1955 2 Sheets-Sheet 1

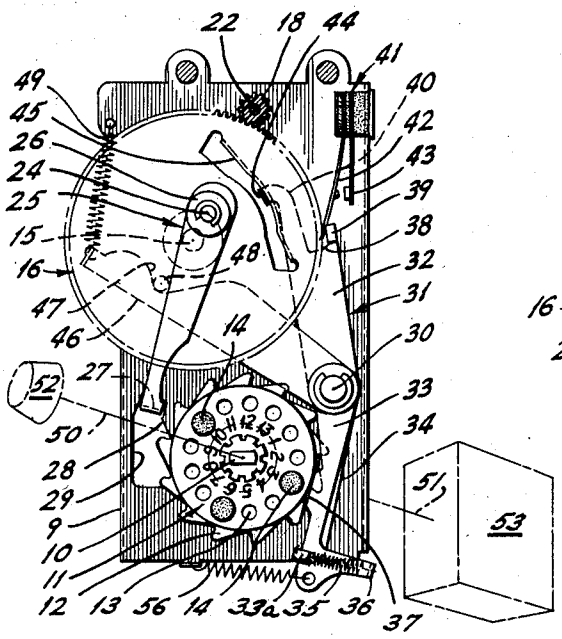

FIG. 1.

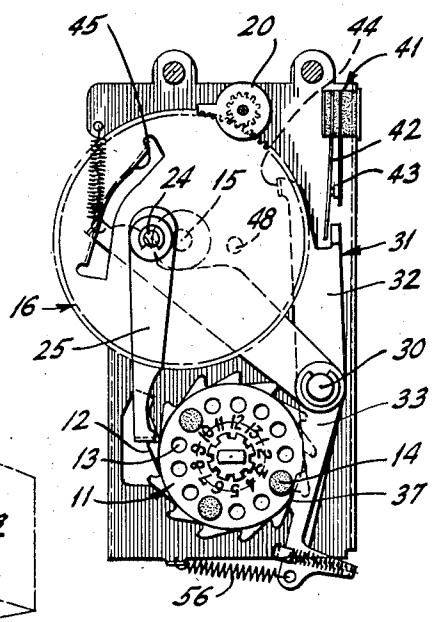

FIG. 2.

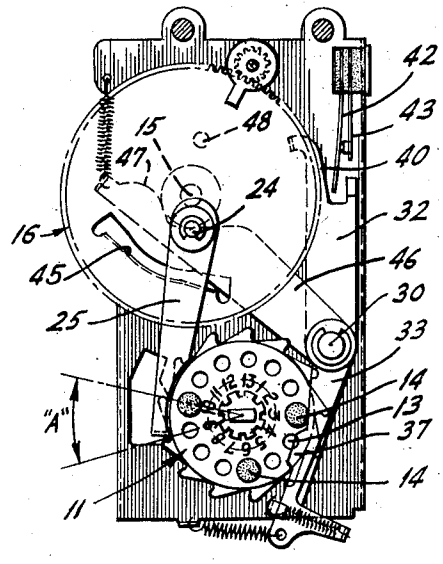

FIG. 3.

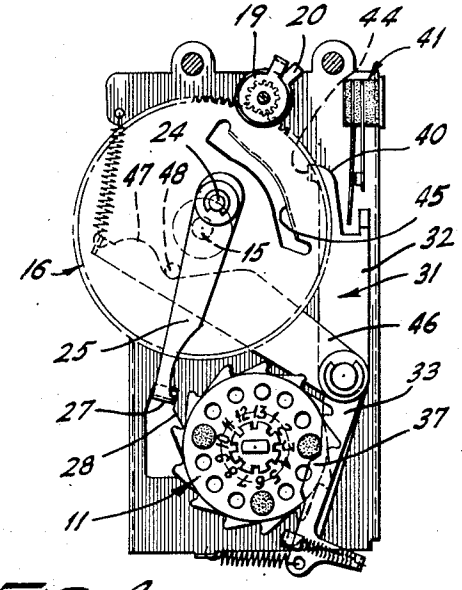

FIG. 4.

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POSITIONING MECHANISM

Filed July 15, 1955 2 Sheets-Sheet 2

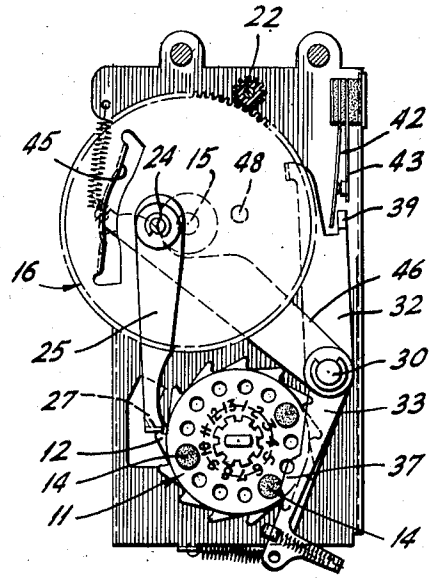

FIG. 5.

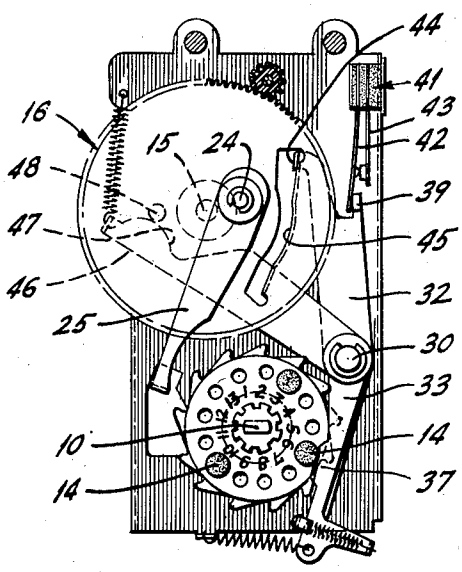

FIG. 6.

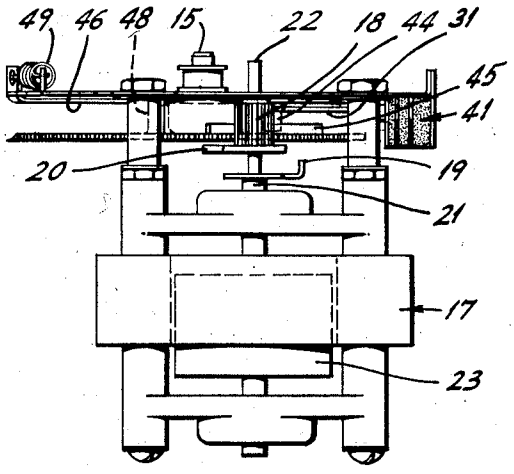

FIG. 7.

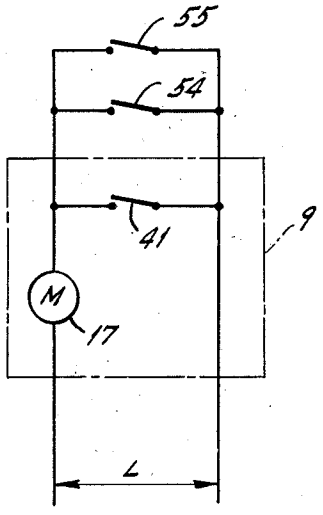

FIG. 8.

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POSITIONING MECHANISM

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Application July 15, 1955, Serial No. 522,293

4 Claims. (Cl. 318—467)

This invention relates to motorized positioning mechanisms, and more particularly to ratchet stepping mechanisms for positioning a rotary device by moving it in a step-by-step fashion.

The invention has as its broad and primary object to provide a novel and simple electromechanical mechanism for operating a rotary device step-by-step through predetermined sequential angular increments.

Another object of the invention is the provision of such a positioning mechanism which is automatically responsive to momentary closing of a control switch to operate a rotary device, moving it from one position to another, and then to shut itself off.

A further object of the invention is to provide a ratchet stepping mechanism which will "self-cycle" or step through a number of positions automatically.

It is also an object of the invention to provide such apparatus in which the rotary device is capable of being selectively operated either electrically or manually.

A specific object of the invention is the provision of a self-cycling ratchet stepping device adapted for remote control, and in which a single control impulse from a remote switch will cause the mechanism to step, or cycle, until a desired predetermined position is reached.

More specifically, it is an object of the invention to provide apparatus embodying the broad concepts of the invention and particularly suited for remote actuation of channel selector switches in television receivers.

Another specific object of the invention is to provide such apparatus whereby channel selection is predetermined, yet easily changeable, as desired.

A further and still more specific object of the invention is to provide mechanism of the above-stated type which is simple in construction and operation, easy to adjust, yet is characterized by rugged construction.

In accordance with the present invention, and first briefly described, the mechanism includes a motorized self-cycling stepping ratchet wheel which, in response to momentary closing of a starting switch in a power supply circuit, is moved sequentially and step-by-step through predetermined angular increments by a motor actuated pawl, each angular increment in the illustrated embodiment corresponding to a different television channel. Indexing stops or pins, at preselected positions on the ratchet wheel, operate mechanism controlling a holding switch in the motor circuit to retain the circuit closed during self-cycling of the ratchet wheel, and to shut off the motor when the ratchet wheel is stepped to the next preselected position or channel. Means is provided for stopping operation of the actuating mechanism at a predetermined initial or "rest" position whereby sequential cycles thereof all start at the same position.

The invention may be clearly understood from the following detailed description with reference to the accompanying drawings, wherein:

Figure 1 is an elevational view of apparatus embodying the concepts of the invention (the motor not being shown) and showing the device in its rest or starting position;

Figures 2, 3, 4, 5 and 6 are views similar to Figure 1, but showing sequential operational conditions of the apparatus;

Figure 7 is a top plan view of the apparatus; and

Figure 8 is a circuit diagram.

While in its broader aspects, as mentioned above, the invention is applicable to any appropriate device, the following description is in connection with its use as an operating agency for rotary switches of the type used for channel selection in television receivers.

As viewed in Figure 1, the apparatus comprises a base plate **9** having journalled therein a shaft **10** carrying a stepping ratchet wheel **11** provided with a number of teeth **12**, corresponding to the number of available V. H. F. television channels. Ratchet wheel **11** is provided adjacent each tooth **12** with an aperture **13** adapted to receive indexing stops or pins **14**, one being shown in each of the apertures designating channels **3**, **6** and **10**.

Also journalled in base plate **9**, upon a shaft **15**, is a drive gear **16** arranged to be rotated by motor **17**, Figure 7, through pinion **18**. The drive engagement between the motor and the pinion may be of any well-known type but, as shown, comprises driving element **19** and driven element **20**, element **19** being secured to the motor shaft **21** while element **20** is formed integrally with pinion **18**, the latter being mounted for free rotation upon extension **22** of the motor shaft **21**. The motor shown is of the type having an offset motor which, when the motor is energized, centers itself relative to the stator, moving element **19** forwardly in a position to engage element **20** and thereby rotate pinion **18** to drive gear **16**.

Journalled on a shaft **24**, carried by gear **16** eccentrically of gear shaft **15**, is a pawl **25** held against the gear under spring tension, as by spring washer **26**, and normally tending to rotate counter-clockwise, with gear **16**. However, the pawl is provided with an outturned end portion **27**, indicated in dotted line, which engages a cam surface **28** formed on one side of a slot or aperture **29** in base plate **9**, and thus is guided into engagement with the teeth on the ratchet wheel, the extent of the swinging movement of the pawl being determined by the width of slot **29**.

Also journalled on base plate **9**, as by shaft **30**, is suitable lever means which, in the present embodiment comprises rocker-arm or bell crank **31** including arm elements **32** and **33**. Element **33** is independently journalled on shaft **30** over element **32** but is releasably held against the lower portion **34** of element **32** by spring **35**. One end of spring **35** is connected to a lateral extension **36** at the lower end of the link **33**, and its other end connected to a portion **33***a* of arm **34** bent around the lower left-hand edge of link **33**. The bell crank has been constructed in this manner to provide independent movement of link **33**, if for some reason bell crank **31** fails to function properly while the ratchet wheel is being rotated.

It will be noted that link **33** of the bell crank is provided on its left-hand edge with a cam portion **37**, the purpose of which will be explained later. The upper end of the bell crank is bifurcated, providing a recess **38** and two finger elements **39** and **40**. A circuit holding switch **41** including a resilient contact element **42** and a fixed contact member **43** is mounted on panel **9** with the end of contact element **42** extending into recess **38**.

Finger **40** is provided with an outwardly turned cam follower or lug **44** which, as shown in Figure 1, is normally engaged by a cam surface or track **45** formed by a depending portion of gear **16**. Lug **44** is shown, in Figure 1, in a generally central position relative to the cam surface, the latter being formed with an arcuate central portion and outwardly flared end portions.

Also journalled on shaft **30** is a link **46** extending to

the left beneath gear **16**. The link is provided in an edge portion thereof with a detent **47** releasably engaging a pin **48** depending from the inner side of gear **16**. The link is biased clockwise against pin **48**, as by spring **49**. In Figure 1, the pin is shown at the bottom of detent **47** thus positioning the mechanism in its "rest" or starting position.

Shaft **10** is provided with extensions **50** and **51**, shown in broken lines in Figure 1. A knob **52** is shown attached to the end of shaft extension **50** for manually rotating the channel selector switch (not shown) in the tuner housing indicated by the numeral **53** at the end of shaft extension **51**.

Motor **17**, as shown in Figure 8, may be connected in circuit with a suitable source of energy, identified by the letter "L," through holding switch **41** and/or manually operable control switches **54** and **55**. Switch **54** may be mounted on the cabinet of the television receiver, while switch **55** may be situated at a position removed from the receiver thereby enabling the motor to be energized from a remote position. While only two operating switches have been shown, it is understood that any convenient number may be provided.

In the operation of the apparatus described above, either one of switches **54** or **55** (Figure 8) may be closed momentarily to energize motor **17**, at which time armature **23** centers itself relative to the stator, moving shaft **21** forwardly to engage driving element **20**, as is clearly shown in Figure 4, and rotate gear **16** in a counter-clockwise direction. It will be seen from Figure 1, showing the mechanism in the rest or starting position, that cam follower **44** of bell crank **31** is engaging cam surface **45**, and finger **39** is holding switch **41** open, while cam portion **37** of link **33** is held slightly spaced to the right of the indexing pin **14**, at channel **3**. Also, pawl **25** is in its retracted position at the upper end of the cam slot **29** in base **9**. When the mechanisms are in this condition it will be seen that ratchet wheel **11** is free to be rotated in either direction, thus permitting manual tuning, as by knob **52**, if desired.

Upon momentary closing of either of switches **54** or **55**, as mentioned above, gear **16** is rotated in a counter-clockwise direction. When it has rotated through approximately 90°, as shown in Figure 2, cam follower **44** has been released from cam track **45**, permitting arm **32** of bell crank **31** to be moved in a clockwise direction by spring **56**, permitting holding switch **41** to close, and moving cam portion **37** on link **33** against pin **14** at channel **3**. Pawl **25** is now engaging the tooth **12** opposite the aperture **13** at channel **9**. It will be understood that the condition shown in Figure 2 is arrived at almost instantaneously with the momentary closing of either of switches **54** or **55**. Note that the holding switch **41** now is closed and therefore the starting switch may be released without stopping the operation of motor **17**.

Continued rotation of gear **16**, as shown in Figure 3, urges pawl **25** to its completely advanced position to rotate the ratchet wheel **11** through one angular increment, indicated at "A." This moves the indexing pin **14** at channel **3** away from cam portion **37** of arm **33**, bringing the empty aperture **13**, at channel **4**, opposite the cam portion, and permitting the latter to move into the path of rotative movement of the next indexing pin, at channel **6**.

A single complete rotation, or cycle, of gear **16** is illustrated in Figure 4. Pawl **25** is again in its retracted position with its end **27** moved, as guided by cam surface **28**, out of the path of rotation of ratchet wheel **11**. Bell crank **31** has moved in a clockwise direction, and therefore cam lug **44** on the end of finger **40** is out of the path of movement of cam surface **45**, and holding switch **41** stays closed, leaving motor **17** energized. As a result, gear **16** is again conditioned to start through another cycle of rotation and will move ratchet wheel **11** through another angular increment, as described above, wherein the aperture at channel **5** will be moved opposite to cam portion **37**, and, as there has been no movement of the cam follower **44** in a counter-clockwise direction, completion of the second cycle will see holding switch **41** still closed and gear **16** will start another cycle.

With reference to Figure 5, illustrating the condition of the mechanism just after the beginning of the third cycle, it will be noted that pawl **25** is against the tooth **12** opposite channel **11**, and cam **37** on link **33** is in contact with the indexing pin **14** at channel **6**. Further rotation of gear **16** moves pawl **25** downwardly to rotate ratchet wheel **11** through another increment to the position shown in Figure 6. In reaching this position, indexing pin **14** at channel **6** has moved against the cam portion **37** rotating the bell crank in a counter-clockwise direction, a distance sufficient to place cam lug **44** in the path of rotation of the flared end of cam track **45**, the latter two elements being shown in Figure 6 at the actual point of contact just prior to completion of the third cycle. In this position, finger **39** of link **32** is moving against the flexible contact element **42** of switch **41**, and pin **48** is approaching detent **47** of link **46**. Continued rotation of the gear causes the cam track to move the bell crank farther in the counter-clockwise direction, opening switch **41** and deenergizing motor **17**, however inertia carries the mechanism to the fully "at rest" position, illustrated in Figure 1, wherein cam lug **44** is in the arcuate portion of cam track **45**, and pin **48** is at the bottom of detent **47**. The cam surface **45** is so formed as to move the bell crank still farther in a counter-clockwise direction, a distance sufficient to disengage cam **37** from the indexing pin at channel **6** at the completion of the cycle, whereby the equipment is conditioned to respond to channel **6** and shaft **10** is again free to be rotated manually by knob **52**.

Having described the operation of the apparatus as between two spaced channel positions, its operation between any two predetermined positions, as established by pins **14**, may be easily understood. It should also be understood that the apparatus may be made to cycle past the indexing pins merely by holding one of switches **54** or **55** closed. Release of the switch will cause the mechanism to stop at the next predetermined position established by one of pins **14**. It will, of course, be clear from the foregoing description that selection of the desired channels requires nothing more than insertion of the pins **14** in the proper corresponding apertures.

It is evident that various modifications may be made in the structure without departing from the invention. For example, the number of teeth **13** may be changed, the throw of pawl **25** may be modified, etc., to meet various operating conditions, as desired.

We claim:

1. A self-cycling ratchet stepping mechanism, comprising: a ratchet wheel to be rotated step-by-step through predetermined angular increments; means for rotating said wheel including, a pawl, a motor, and means interconnecting said pawl and said motor whereby, when energized, said motor will drive said pawl through reciprocatory movements; means for guiding said pawl against said wheel during such movement to move said wheel, one increment for each complete reciprocation of said pawl; a source of power; a control switch to energize said motor from said source; a circuit holding switch; a bell crank; means at predetermined positions on said wheel to condition said bell crank to open said holding switch; and means operable by said means interconnecting said pawl and said motor to effect movement of said bell crank to open said holding switch and stop operation of said motor.

2. A self-cycling ratchet stepping mechanism, comprising: a wheel having a plurality of ratchet teeth ar-

ranged to be rotated step-by-step through predetermined angular increments, each increment being equal to the distance between said teeth; means for rotating said wheel, including a gear, a pawl carried eccentrically upon said gear, and a motor for rotating said gear to drive said pawl through reciprocatory movement; means for guiding said pawl against said teeth during such movement in a manner to move said wheel one increment for each complete reciprocation of said pawl; a source of power; a circuit connecting said motor to said power source; a manually operable switch to close said circuit and energize said motor; a circuit holding switch; a bell crank; means at predetermined positions on said wheel to condition said bell crank to open said holding switch; and means associated with said gear to effect movement of said bell crank to open said holding switch and stop operation of said motor.

3. A self-cycling stepping mechanism, comprising: a shaft; a wheel mounted upon said shaft and having a plurality of ratchet teeth defining increments of rotation; a gear; a motor for driving said gear; a power circuit for energizing said motor including, a source of electrical energy, at least one manually operable normally open control switch for closing said circuit, and an automatically operable holding switch for retaining said circuit closed after said control switch is opened; a pawl having one end pivotally mounted upon said gear eccentrically of the axis of said gear and its other end arranged to engage said teeth whereby rotation of said gear moves said pawl through reciprocatory movements between a retracted position away from said wheel and an advanced position engaging one of said teeth and moving the wheel through one rotative increment; a bell crank; indexing stop means on said wheel; a cam track on said gear; cam follower means on one arm of said bell crank releasably

engaging said cam track; means on said bell crank for retaining said holding switch open when said cam follower is so engaged and to close said holding switch when disengaged therefrom; and cam means at the other arm of said bell crank cooperable with said indexing means to condition said cam follower to re-engage said cam track and open said holding switch to stop operation of said motor.

4. Apparatus for angularly positioning a rotatable shaft, comprising; drive means releasably coupled to said shaft and adapted to rotate the same through angular step-by-step increments; motor driven means for imparting the incremental motion to said drive means; switch means actuatable either to energize or deenergize said motor driven means; indexing means movable in step-by-step fashion with said shaft; and lever means pivotally mounted intermediate end portions thereof and including cam means adjacent one of the end portions operable to actuate said switch means to energize the motor driven means, and cam means adjacent the other of the end portions of said lever means operable by said indexing means, when the latter reaches a predetermined position, to provide for actuation of said switch means to deenergize the motor driven means.

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