July 9, 1940. E. O. THOMPSON 2,206,926

STEP-BY-STEP SWITCH

Filed June 3, 1939

Fig. 1.

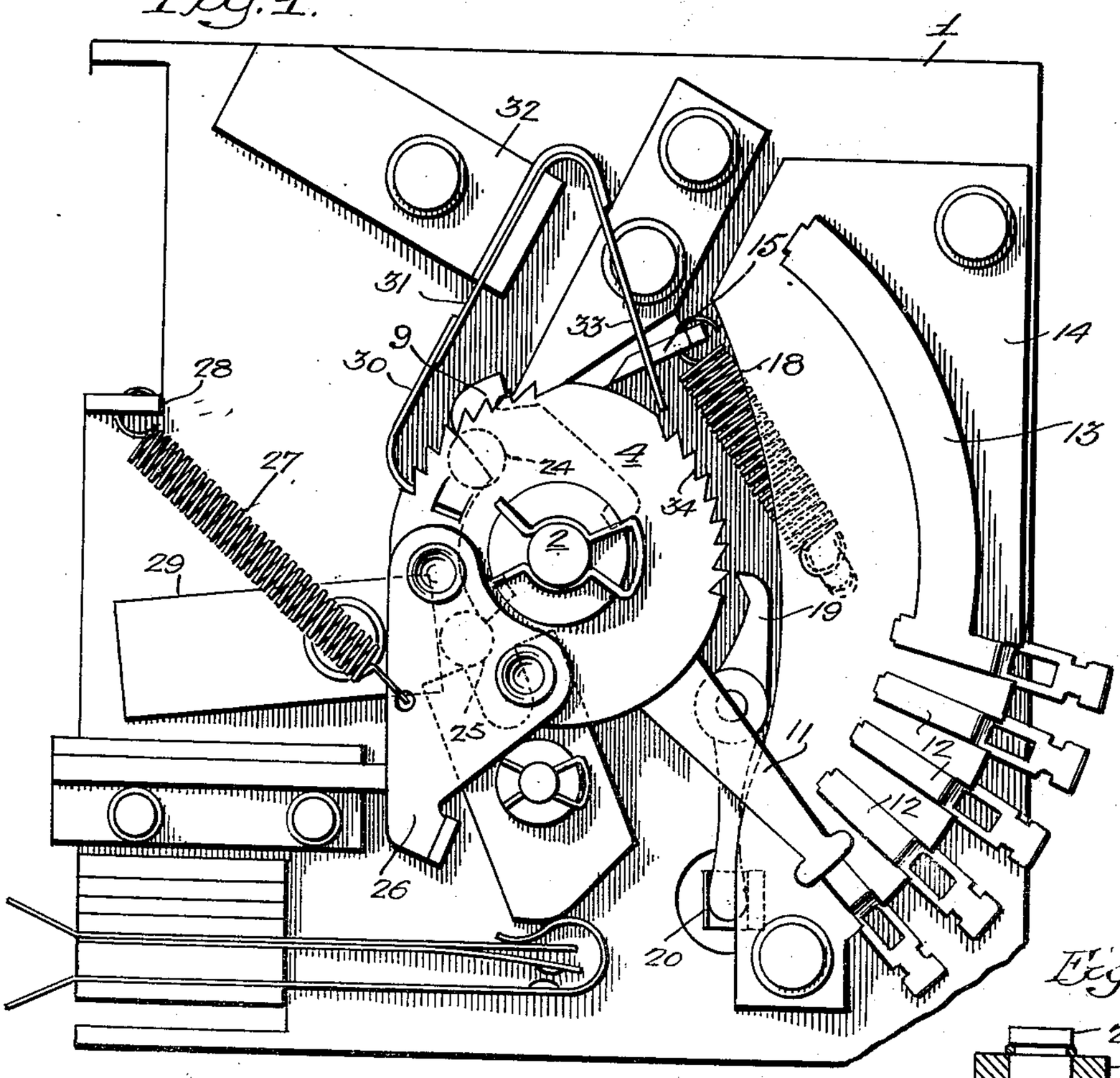


Fig. 3.

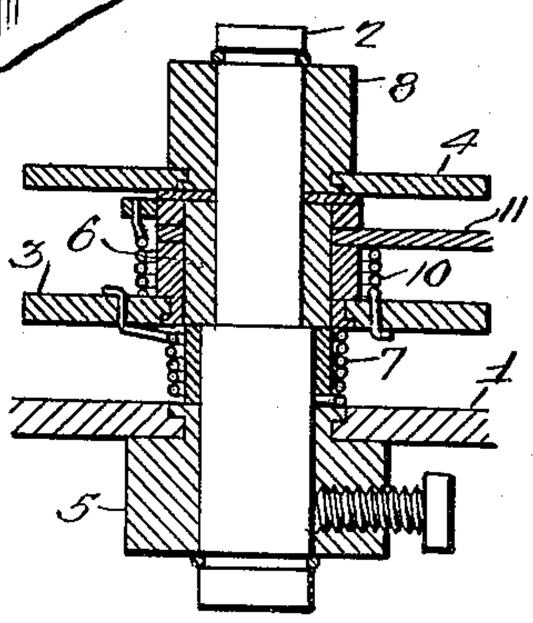


Fig. 2.

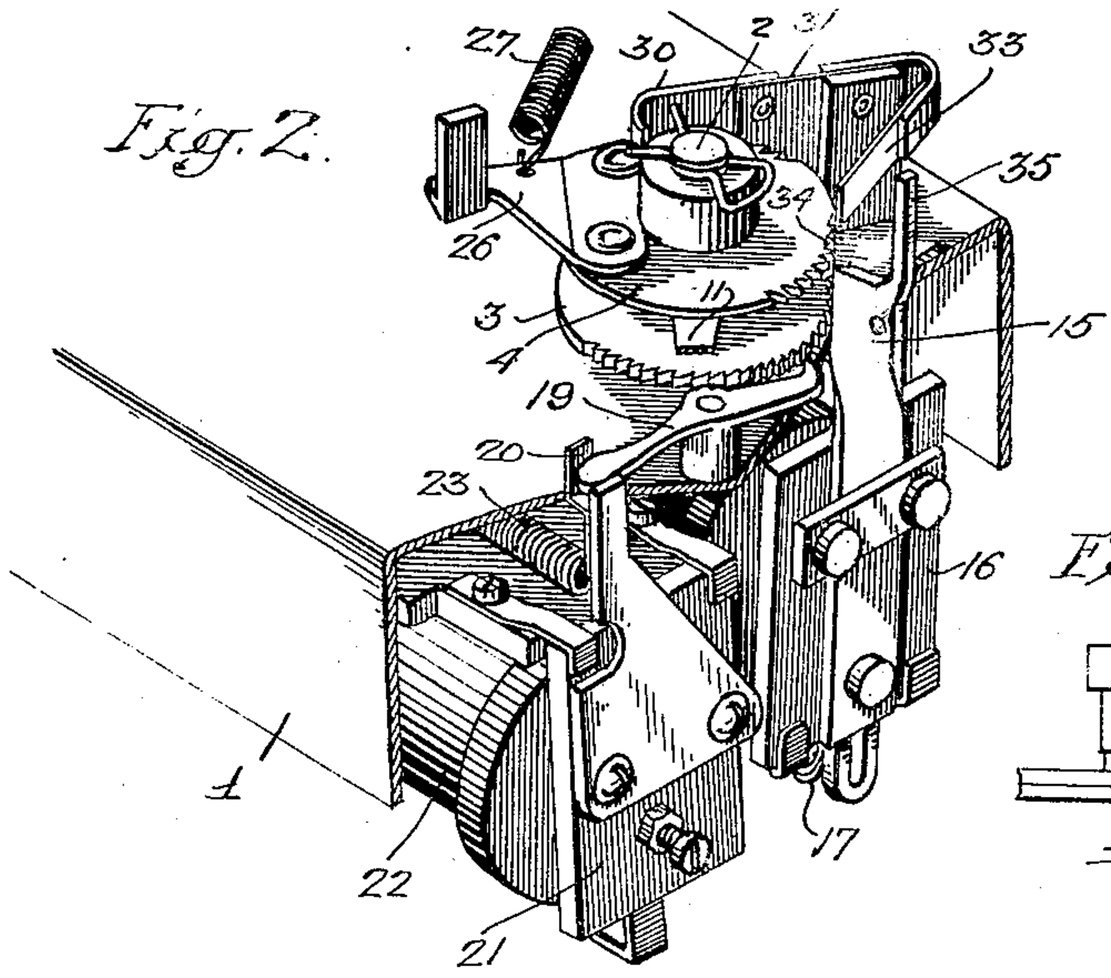
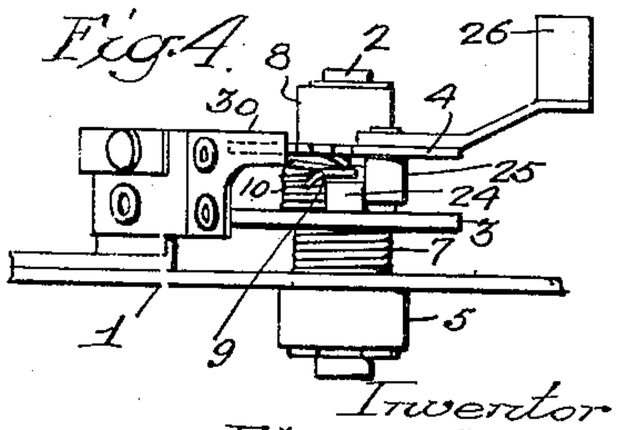


Fig. 4.



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UNITED STATES PATENT OFFICE

2,206,926

STEP-BY-STEP SWITCH

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Application June 3, 1939, Serial No. 277,270

8 Claims. (Cl. 74—142)

This invention relates to step-by-step positioning devices of the type wherein a primary stepping mechanism is operated by controlling impulses to actuate a first step-by-step switch, and a secondary mechanism is actuated by the primary stepping mechanism over a portion of the operating range of the latter, the secondary mechanism functioning to position a second step-by-step switch. More particularly, the invention relates to novel means for preventing excess movement of the secondary mechanism and the associated second switch, which have a tendency to move excessively due to momentum acquired from the rapidly occurring control impulses, as will be more clearly understood later.

A step-by-step device of the character above mentioned is useful, for example, in a control system for a radio receiver or the like, such as that disclosed and claimed in the co-pending Grimes and Thompson application, Serial No. 220,366, filed July 20, 1938. When the device is thus used, the first step-by-step switch may function to control a volume-varying device for the radio receiver when the switch is operated over a portion of its range by control impulses, and the same switch may serve to actuate a muting means when operated over another portion of its range simultaneously with the operation of the second switch, which may actuate tuning means for the receiver. The present invention, however, is not concerned with the function or use of the device in any particular instance, and mention is made here of the adaptability of the device for controlling a radio receiver merely to point out one use of which the device is capable.

Various specific forms of a step-by-step device of the character above mentioned are disclosed in several copending applications, viz. the above-mentioned application, the Grimes application, Serial No. 220,365, filed July 20, 1938; Richardson application, Serial No. 220,381, filed July 20, 1938, and the Barry application, Serial No. 277,273, filed June 3, 1939. Reference is made particularly to the said Grimes application and the said Barry application which disclose in detail the specific form of device which has been chosen for illustration in the present application. In the present case, however, there is no need to illustrate and describe the complete details of structure of the step-by-step device, since the invention may be clearly understood by general reference to the structure of the device, as set forth hereinafter.

The principal object of the present invention, therefore, is to provide an improved step-by-step positioning device of the type above mentioned.

A more specific object of the invention is to provide novel means for preventing excessive movement of the second switch or switch section of such a device.

The invention may be fully understood by reference to the accompanying drawing wherein—

Fig. 1 is a face view of the operating mechanism of the device;

Fig. 2 is a fragmentary perspective view of the mechanism;

Fig. 3 is a detail sectional view of the ratchet assembly; and

Fig. 4 is a fragmentary elevational view illustrating the cooperative action between the primary and secondary ratchets.

Referring to the several views of the drawing and particularly to Fig. 1, there is provided a base or support 1 on which there is mounted a stationary pin or stud 2 which, in turn, rotatably supports a primary ratchet 3 and a secondary ratchet 4. As shown in Fig. 3, the pin 2 is held by a sleeve 5 extending through and secured to base 1. The primary ratchet 3 is carried by a sleeve 6 which is rotatably mounted on the pin or stud 2. A spring 7 having one end secured to ratchet 3 and its other end anchored to base 1 serves to maintain ratchet 3 in a normal or home position and urges the ratchet toward that position whenever it is moved therefrom. The secondary ratchet 4 is carried by a sleeve or collar 8 which is also rotatably mounted on the pin 2. Thus, the two ratchets are arranged for rotation on pin 2 independently of one another except for the cooperative action hereinafter described.

The sleeve or collar 6, which carries ratchet 3, also carries a cam member 9 which is resiliently supported in an axial direction by a spring 10 having one end secured to the cam member and its other end secured to ratchet 3. The purpose of this resiliently-mounted cam member will be brought out later.

As shown in Fig. 1, the primary ratchet 3 carries a contact arm 11, the outer end of which is adapted to engage successively a plurality of spaced contacts 12 and is also adapted to engage an arcuate contact 13, all of these contacts being carried by an insulating plane 14 mounted on the base 1. The primary ratchet 3 is actuated by a stepping pawl 15 which is carried by the armature 16 of a stepping magnet, as shown in Fig. 2. The armature 16 is biased to its normal inoperative position by a spring 17 which, together with the

spring 18, maintains the stepping pawl normally disengaged from ratchet 3. As may be seen in Fig. 1, spring 18 has one end connected to the stepping pawl and has it other end anchored to the base 1. The ratchet 3 is maintained by a holding pawl 19 in the successive positions to which it is advanced. The holding pawl is pivotally mounted on base 1 and is engaged by a forked member 20 carried by the armature 21 of a homing magnet 22. When the armature 21 is in its normal inoperative position to which it is urged by spring 23, the holding pawl 19 is disengaged from ratchet 3, but when the homing magnet 22 is energized, the pawl is moved by armature 21 into engagement with the ratchet. The two magnets may be connected in series relation so that the homing magnet is supplied with energy during the stepping operation, and this magnet may be designed so that it is slow to release, thus causing the holding pawl 19 to continue its engagement with ratchet 3 during the intervals between control impulses. Such a device is more completely disclosed in the above-mentioned Grimes application.

From the description thus far, it will be seen that the control impulses cause stepping of the primary ratchet 3 to effect step-by-step movement of the switch arm 11, the said arm being maintained in the successive switch positions by the engagement of holding pawl 19 with ratchet 3. When the control impulses cease, the holding pawl is released after a predetermined time interval following the last impulse, thus permitting the ratchet 3 and switch arm 11 to be homed under the influence of the homing spring 7.

The secondary ratchet 4 is operated by ratchet 3 through the medium of pins 24 and 25 carried, respectively, by the ratchets, as shown in Fig. 4. These pins are so arranged that the pin 24 on ratchet 3 engages the pin 25 on ratchet 4, and thus actuates ratchet 4, during movement of arm 11 over the arcuate contact 13. The ratchet 4 carries an extending arm 26 to which there is attached a spring 27, one end of which is anchored to lug 28 on the base 1. This spring normally maintains arm 26 against a stop 29 which defines a home position of the arm and associated ratchet. The ratchet 4 is maintained in successive positions to which it is moved by a holding pawl 30 carried by a leaf spring 31 which is mounted on a supporting bracket 32. The arm 26 may be connected to a second step-by-step switch (not shown) so that the movement of this arm operates the second switch in step-by-step fashion.

Assuming that both of the switch-operating mechanisms are in home position, as shown in Fig. 1, a series of control impulses will cause step-by-step movement of switch arm 11 but if the number of impulses is not sufficient to move the arm 11 onto contact 13, the secondary ratchet 4 and the switch-operating arm 6 will not be actuated. Such operation would correspond to control of the volume of a radio receiver where the device is so applied, as above mentioned. If a greater number of impulses are received, however, the pin 24 will engage pin 25 simultaneously with the engagement of arm 11 with contact 13. Consequently, the secondary ratchet 4 and the second switch controlled thereby will be actuated in step-by-step fashion simultaneously with the movement of arm 11 over contact 13. Such operation would correspond to the selection of a desired station by the second switch simultaneously with the muting of the radio receiver by the engagement of arm 11 with contact 13, as previously mentioned. After the last control impulse, the primary ratchet 3 and arm 11 are moved to home position as above described, but the holding pawl 30 maintains the secondary ratchet 4 in the position to which it has been actuated until some later time when another series of control impulses are received.

The purpose of the resiliently-mounted cam 9 which rotates with ratchet 3 is to permit homing of the secondary ratchet and the second switch when a subsequent series of control impulses are received. The extending cam portion of member 9 is so shaped that the cam releases pawl 30 during counter-clockwise rotation of the cam, as viewed in Fig. 1, but the cam is ineffective to move pawl 30 during clockwise rotation of the cam. Therefore, when the primary ratchet 3 moves counter-clockwise in response to control impulses, the cam 9 deflects pawl 30 just prior to engagement of arm 11 with contact 13, permitting homing of the secondary ratchet 4 preparatory to tandem operation of the two ratchets and their associated switches. When the primary ratchet 3 is homed, however, the engagement of cam 9 with pawl 30 does not move the pawl but the latter deflects the resiliently mounted cam so that it rides under the pawl when rotating clockwise. Consequently, the secondary ratchet is maintained in its actuated position, as above described.

It is characteristic of a device such as that thus far described that the secondary ratchet 4 has considerable inertia imparted to it by virtue of its inter-connection with the second switch (not shown) through the medium of arm 26, and there is a tendency for the secondary ratchet and switch to move in excess of the desired amount due to the momentum acquired from a succession of control impulses. There is, therefore, a tendency for the second switch to jump ahead so to speak, the result of which is to actuate the switch to a position other than that desired. When it is considered that the successive stepping movements are small are imparted by rapidly occurring impulses, each of which imparts a sudden force to the device, it may be readily appreciated that the undesired excess movement of the secondary ratchet may well occur. This undesired action has been aptly termed "galloping" action of the second switch section. The undesirability of such action may be readily seen by considering its effects where the device is used for controlling a radio receiver, as above mentioned. In such case, the effect of this undesired action will be to tune the radio receiver to a station other than the one desired.

By the present invention, this undesired action is eliminated by providing an auxiliary pawl 33, as shown clearly in Figs. 1 and 2. This pawl may comprise a piece of spring metal arranged in cooperative relation with the secondary ratchet 4 so that its free end may be inserted between the teeth 34 of the said ratchet. Conveniently, the pawl 33 may be formed as an integral part of the leaf spring 31, as illustrated. On the stepping pawl 15, there is provided an extending finger 35 (see Fig. 2) and the resilient pawl 33 is so arranged that the finger 35 engages this pawl and depresses its end into inter-locking engagement with teeth 34 immediately following each stepping action. Thus, during tandem operation of the two ratchets, the stepping pawl 15 engages ratchet 3 moving it one step and simultaneously moving ratchet 4 through the engagement of pins 24 and 25, and then the finger 35

deflects the pawl 33 into inter-locking engagement with ratchet 4. Consequently, the ratchet 4 is prevented from moving further than a single step at a time. Thus, there is provided an extremely simple device for locking the secondary ratchet 4 against movement after each stepping movement of such ratchet. This eliminates the above undesirable galloping action of the secondary ratchet and the second step-by-step switch controlled thereby.

It will be seen that the feature provided by this invention may take other specific forms and, while it is preferred to employ the simple structure illustrated, the invention is not limited thereto. It will be understood, therefore, that various modifications may be resorted to without departing from the scope of the invention.

I claim:

1. In a step-by-step positioning device, a first element to be positioned, a step-by-step mechanism for actuating said element, a second element to be positioned, actuating means for said second element movable relative to said mechanism and arranged for operation thereby, and means operable by said mechanism for preventing said last-mentioned actuating means from moving in excess of the movement imparted thereto by said mechanism during each stepping operation.

2. In a step-by-step positioning device, a first element to be positioned, a step-by-step mechanism for actuating said element, a second element to be positioned, actuating means for said second element movable relative to said mechanism and arranged for operation thereby, and means operable by said mechanism for momentarily locking said last-mentioned actuating means against movement after each stepping operation, to thereby prevent excess movement of said second element.

3. In a step-by-step positioning device, a first ratchet, a stepping pawl arranged to actuate said ratchet step-by-step, a second ratchet operable by said first ratchet, and means operable by said stepping pawl for preventing excess movement of said second ratchet during each stepping operation.

4. In a step-by-step positioning device, a first ratchet, a stepping pawl arranged to actuate said ratchet step-by-step, a second ratchet movable relative to said first ratchet, abutment means on said first ratchet, abutment means on said second ratchet engageable by said first-mentioned abutment means to actuate said second ratchet, and a pawl operable by said stepping pawl to prevent excess movement of said second ratchet during each stepping operation.

5. In a step-by-step positioning device, a first ratchet, a stepping pawl arranged to actuate said ratchet step-by-step, a second ratchet movable relative to said first ratchet, abutment means on said first ratchet, abutment means on said second ratchet engageable by said first-mentioned abutment means to actuate said second ratchet, and a resilient pawl element deflectable by said stepping pawl into interlocking engagement with said second ratchet to prevent excess movement of said second ratchet during each stepping operation.

6. In a step-by-step positioning device, a first movable element arranged for step-by-step movement to successive operating positions, means for effecting said movement, a second movable element arranged for movement to successive operating positions, means operable by said first movable element for effecting movement of said second element, and means operable by said first means for limiting the movement of said second movable element.

7. In a step-by-step positioning device, a first rotatable member, a ratchet connected to said member, a stepping pawl for actuating said ratchet, a second rotatable member operable by said first member, and means controlled by said stepping pawl for preventing said second member from getting out of step with said first member.

8. In a step-by-step positioning device, a first rotatable member, a ratchet connected to said member, a stepping pawl for actuating said ratchet, a second rotatable member, a second ratchet connected to said second member, means on said ratchets for operating said second member, and a second pawl controlled by said stepping pawl arranged to engage said second ratchet immediately following each stepping operation of said second member, whereby the latter is prevented from getting out of step with said first member.

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