Aug. 13, 1935. E. J. KINGSBURY 2,011,486

TURRET MECHANISM FOR MACHINE TOOLS

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Fig. 1.

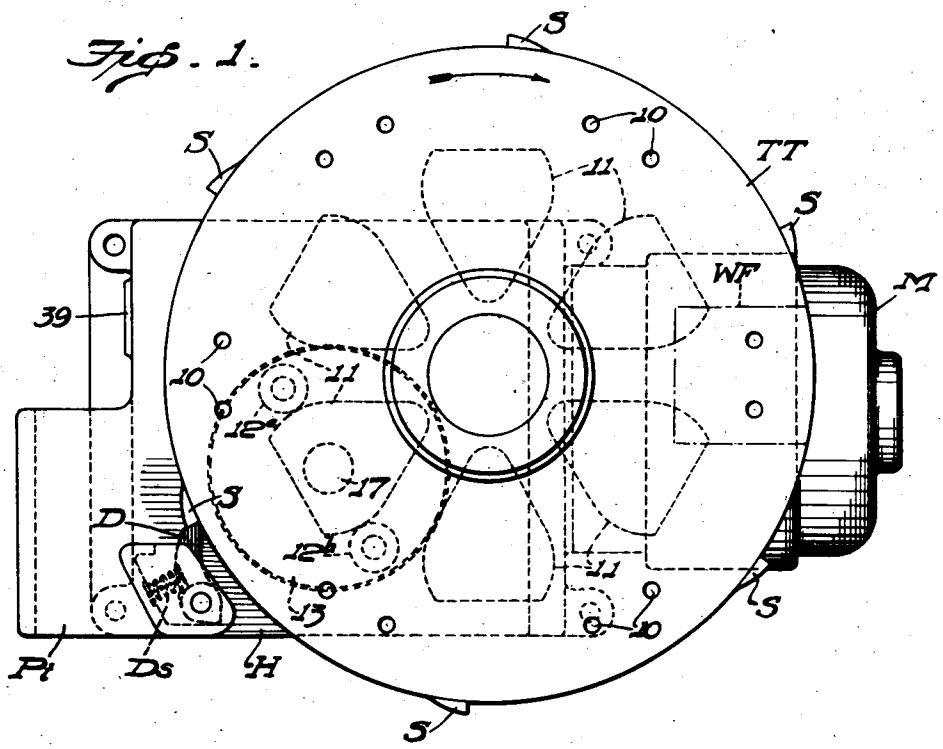
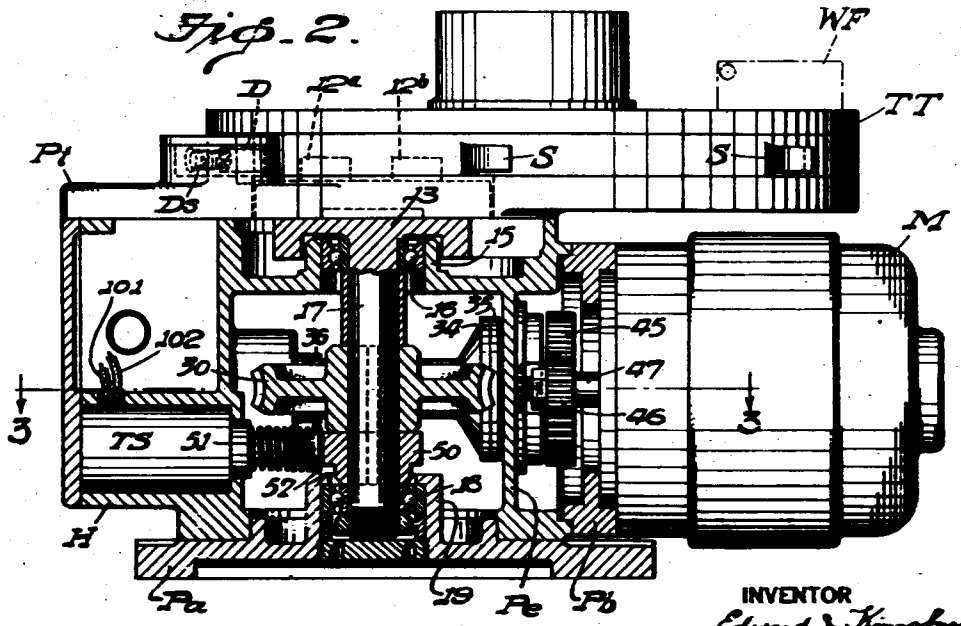


Fig. 2.



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Fig. 3.

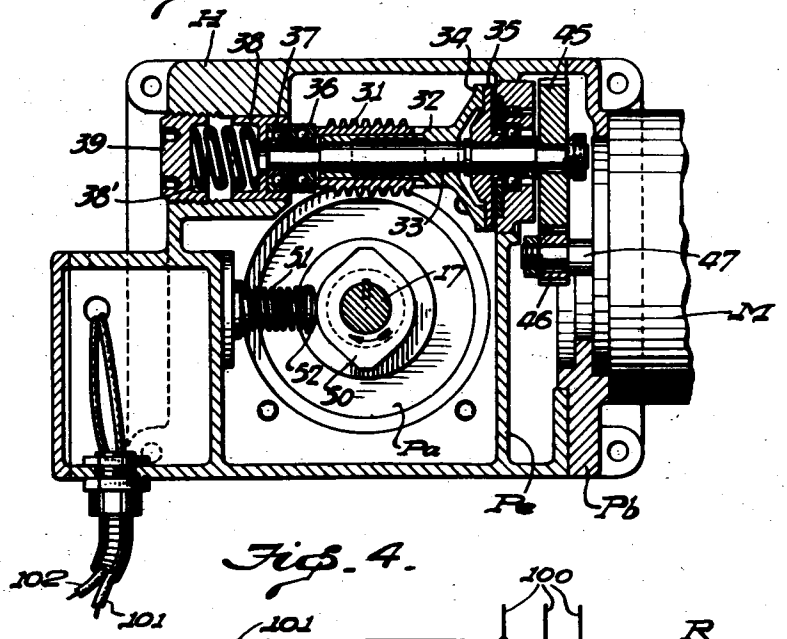
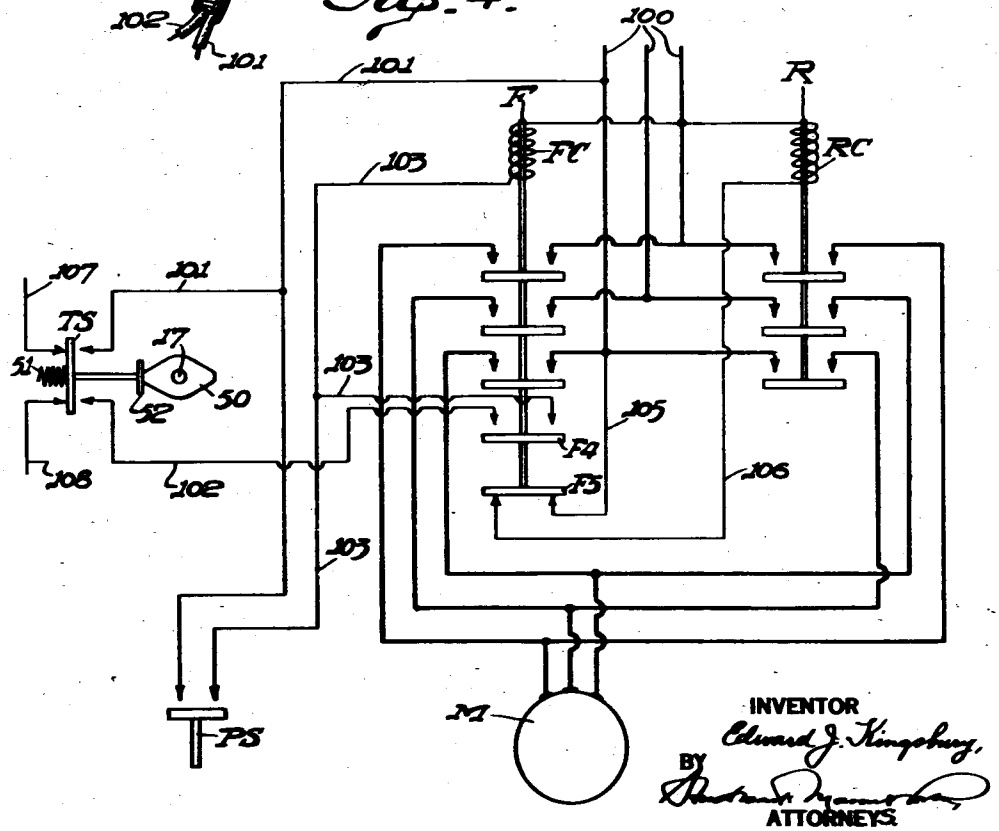


Fig. 4.



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TURRET MECHANISM FOR MACHINE TOOLS

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Application January 30, 1934, Serial No. 709,013

14 Claims. (Cl. 29—50)

This invention relates to improvements in turret mechanism for machine tools of the type broadly described in my co-pending application Serial No. 683,451, filed August 3, 1933.

A primary feature of the present invention is the provision of a turret moving or indexing mechanism which operates without a latch for preventing a further forward movement of the turret table, by the employment instead of means for exerting a return movement upon the table operative to hold it against a detent preventing such rearward movement while tools are operating upon the work.

Another feature of the present invention is the provision of a turret mechanism operated by a reversible source of power, in which the movement of the source in one direction is employed to advance or index the turret from station to station, while its movement in the other direction is employed for holding the turret at a standstill and in predetermined position during the operation of the tool upon the work.

A further feature of the invention is the provision of a turret mechanism operated by a reversible source of power, with advancing or indexing of the turret from position to position during intermittent forward energizations of the source, alternating with restricted reverse movements during reverse energizations of the source, each such reversing movement of the turret being limited in amount, and the mechanism thereafter being effective to hold the turret rigidly until released upon the succeeding forward energization of the source.

With these and other objects in view as will be set forth in the following specification and claims, an illustrative manner of practicing the invention is set out on the accompanying drawings, in which:

Figure 1 is a top view of a turret unit embodying the present invention.

Figure 2 is a side view, with parts in elevation and in section.

Figure 3 is a horizontal sectional view substantially on line 3—3 of Figure 2.

Figure 4 is a circuit diagram.

In these drawings, a turret table TT is advanced in rotation or indexed so that each of six work stations are brought successively to working position, these stations being indicated by the bolt holes 10 on the turret, at one of which a work holding fixture WF is mounted illustratively. This turret table TT is mounted for rotation on the top cover plate Pt of a housing H.

On the bottom of the turret plate TT are provided the driving plates 11 (6 in number, corresponding to the six stations). These plates are engaged by the rollers 12a, 12b pivotally mounted eccentrically on a plate 13 connected for rotation with the vertical shaft 17 which is supported at top and bottom by anti-friction bearings 16 and 18 carried by the walls 15 and 19 of the housing structure and its bottom closing plate Pa. A worm wheel 30 is fixed to the shaft 17 and is in mesh with a worm 31 slidable axially on and in splined relationship with the hollow shaft 32 which in turn is rotatable about the central shaft 33. The hollow shaft 32 has a flange 34 providing an end friction surface engageable with a similar surface on the radial flange 35 of a member keyed to the shaft 33 and carried by a bearing supported by web Pe of the housing H. The shaft 33 is keyed to a gear 45. A thrust bearing 36 accepts the leftward movement of the worm 31 (Fig. 3) and transmits this to a radial bearing 37 and thus to a sliding sleeve member 38 movable in the housing H. A spring 38' urges the worm 31 constantly toward the right, and with it the hollow shaft 32, and thus tends to maintain a frictional driving relationship between the surfaces of flanges 34 and 35. An end closing plate 39 is in threaded relationship to the housing and is used to adjust the spring pressure and therewith the frictional engagement.

The gear 45 is in mesh with a pinion 46 carried by the motor shaft 47 of the motor M. The motor is connected to an end plate Pb which closes the corresponding end of the housing H.

Fixed to the shaft 17 is also a cam 50 cooperative with the pressure plate 52 provided at the end of a switch actuating rod and serves to push this switch rod toward the left (Figs. 2, 3 and 4) against the action of a return spring 51, when a larger diameter of the cam is operating upon the pressure plate 52, and thereby opens an associated circuit by such actuation of the switch (Fig. 4).

The turret table TT is provided with stops S (six in number, corresponding to the six stations), which are brought against a detaining pawl D pivotally mounted on the housing H and forced toward the turret table TT by a spring Ds.

In the circuit diagram of Figure 4, the supply conductors 100 are provided for energizing the three-phase motor M through the operation of a forward relay F and a reverse relay R. The forward relay F is operated by energizing its coil FC so that the four upper bridges thereof are raised into circuit closing position. Circuits are thus established through the upper three bridges, from the main conductors 100 to the motor M to

cause the latter to turn in a forward direction, corresponding to the movement of the turret plate in a clockwise direction as shown by the arrow in Figure 1. The reverse relay R, upon energization of its coil RC closes the three bridges to establish a supply of current to the motor M with a reversal of two of the phase connections, so that the motor drives the turret table TT in the opposite, or counter-clockwise, direction. A control circuit extends from one of the main conductors 100 by conductor 101 to the pilot switch PS, with a return by conductor 103 through the coil FC to another main conductor 100. A maintaining circuit for the coil FC is provided in shunt of the pilot switch PS by the switch TS actuated by the head 52 described above. While the switch TS is closed, current may flow from conductor 101 to conductor 102 through the bridge F4 of the forward relay F and thus to conductor 103. A pilot circuit may also be established from one main conductor 100 by conductor 105 and the bridge F5 of the forward relay while the latter is open, with a further passage through conductor 106 and the coil RC of the reverse relay R.

The operation of the structure is as follows:

Assuming that the structure is in the position of Figure 1, with a stop S resting against the detent pawl D, with the reverse relay R in operation owing to the energization of its coil RC through the circuit 105, F5, 106 and RC, and the motor M being in rotation in a direction tending to produce a clockwise movement of the shaft 17 and counter-clockwise movement (Fig. 1) of the table TT for the action of roller 12a. This counter-clockwise or retrograde movement of the table has been limited by the engagement of stop S with the detent pawl D; but the roller 12a continues to press against the corresponding driving plate 11 and therewith tends to move the table TT in a counter-clockwise direction. The engagement of the roller 12a with the driving plate, however, is at a very small angle, as the plate at the corresponding point has a peripheral surface whose diameter is only slightly greater than its distance from the axis of the shaft 17 in this limit position; and thus a powerful wedging action is being exerted to hold the turret stop S against the detent D, on the one hand, and any tendency toward forward or clockwise movement of the table TT must occur almost parallel to the radius from the axis of shaft 17 to the point of contact between roller 12a and the plate 11 and, by reason of the aforesaid small angle of engagement, also substantially parallel to the direction of pressure between the roller 12a and the plate 11, on the other hand. Thus, the rollers 12a and 12b are brought to and held at a standstill by the successive plates 11; and at the same time cooperate with these plates to prevent any movement of the turret table. Such a position of the parts is hereinafter designated a "dead center" position. Thus, the turret table is directly held in position by its driving mechanism, without the use of a locating latch, and is ready for tooling operations.

The plate 11 also operates to prevent further movement of the roller 12a, as brought out above, and thus of the shaft 17 and worm wheel 30. The continued movement of the motor M has thus caused the worm 31 to turn in the worm wheel 30 and advance as though engaged with a rack, moving toward the left in Figure 3, against the action of spring 38. A very short movement, however, reduces the frictional engagement of flanges 34 and 35, until power is no longer being delivered from the motor M to the worm 31, and thus the flange 34 comes to a standstill while flange 35 continues to be driven. This worm lock is maintained until the motor is again energized for forward rotation, and serves to prevent the existence of any looseness or backlash in the driving train between the clutch flanges and the point of engagement of the turret table TT, through its stop S, with the detent D; and hence the table is held rigidly against movement in either direction. In particular, the illustrated form of construction thus provides two separate locking or blocking points for assuring rigid holding; one at the worm lock, and the other at the engagement of the roller 12a or 12b with the successive plates 11.

This condition continues so long as a tool is operated upon the work.

When it is desired to effect an advancing or index movement of the turret, the pilot switch PS is pressed. A circuit is now established by conductor 101, pilot switch PS, conductor 103, and coil FC, resulting in the closing of the four upper bridges of relay F and an opening of the lower bridge. The opening of the lower bridge effects a deenergization of the reverse relay coil RC and the reverse relay drops open. Energy is thereafter supplied to the motor M through the relay F, so that the latter now begins to rotate in a forward direction, the shaft 33 operating in this forward direction of rotation to release the worm lock and permit reengagement of the clutch flanges 34, 35. The shaft 17 is thus driven in a counter-clockwise direction, and roller 12a releases its wedging engagement with the driving plate 11. Roller 12b now operates to press this plate 11, and the turret table TT turns in a clockwise direction (arrow, Fig. 1), so that the stop S which has been against the detent D moves away from it, and ultimately the next stop S pushes the detent pawl D outward so that this pawl may then snap into position behind this new stop S.

The pilot switch PS is held closed for a time sufficient for a greater diameter of the cam 50 to depart from the plate 52 so that the switch TS is closed and a maintaining circuit is established by conductor 101, switch TS, conductors 102 and 103, through the coil FC. The pilot switch PS may be opened at any time thereafter but before the completion of the indexing movement without influencing the result. The shaping of the cam plates 11 is such that a rotation of the turret table TT through slightly more than 60° is thus accomplished before the cam 50 again presses the plate 52 outward and opens the switch TS. The new stop S therefore is carried past the detent pawl D.

The opening of the switch TS, however, has resulted in a deenergization of the forward coil FC, so that the relay F now drops to the open position of its upper four bridges and the closed position of its lowermost bridge. Current now flows through conductor 105, bridge F5 and conductor 106 to energize the reverse relay coil RC so that the latter brings the motor M into rotation in the reverse direction, resulting in a retrograde or counter-clockwise movement of the turret table TT until the latter presents its new stop S to the detent pawl D, and thereafter the turret is held in such position by this engagement on the one hand, and by the wedging action at dead center and worm lock as aforesaid.

It will be noted that the stops S are easily adjusted so that each station shall be brought

to the predetermined tooling position when it is to be presented thereto.

As set out in my co-pending application Serial No. 683,541, the switch TS may also be provided with contacts and conductors 107, 108, and thus serve for initiating the movement of tool units in the manner described in the aforesaid application.

It is obvious that the illustrated form of embodiment is not restrictive, but that the invention may be used within many ways of the scope of the appended claims.

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

1. Mechanism for producing a succession of forward movements of predetermined amounts, comprising a driven structure for performing the movements, a driving mechanism for moving said driven structure and including a rotatable member engaging the structure to move it forward and backward according to the direction of rotation of said member, and means actuated by the driving mechanism after a forward movement of the driven structure greater than the corresponding said amount has been accomplished for effecting a reversal of rotation of said member, and stop means for limiting the reverse movement of said structure so that the net forward movement equals the corresponding said amount, said rotatable member cooperating with the stop means for maintaining the driven structure rigidly in position.

2. Mechanism for producing a succession of forward movements of predetermined amounts, comprising a frame, a driven structure for performing the movements, a driving member, means connecting the driving member and driven structure for moving the latter in a forward direction and including a rotatable member having means engaging the driven structure for moving the same in forward and retrograde directions, means for effecting a forward movement of said driven structure from said driving member through said connecting means, means actuated by the driven structure after a forward movement thereof greater than the corresponding said amount has been accomplished for terminating the forward movement thereof and reversing said rotatable member for effecting a retrograde movement of the driven structure, and stop means on said driven structure and frame for limiting said retrograde movement so that the net forward movement equals the corresponding said amount.

3. Mechanism for producing a succession of forward movements of predetermined amounts, comprising a driven structure for performing the movements, a reversible driving member, means connecting the driving member and driven structure for moving the latter, means operable for producing a forward movement of said driven structure by said driving member, means actuated by the driven structure after a forward movement thereof greater than the corresponding said amount has been accomplished for reversing said driving member and effecting a retrograde movement of the driven structure, and stop means for limiting said retrograde movement so that the net forward movement equals the corresponding said amount.

4. A mechanism as in claim 3, in which said connecting means includes a slip clutch for permitting said driving member to continue turning in the reverse direction after said stop means operates to limit the retrograde movement of the driven structure.

5. Mechanism for producing a succession of forward movements of predetermined amounts, comprising a driven structure for performing the movements, a reversible driving member, means connecting the driving member and driven structure for moving the latter, circuit means operative for producing a forward movement of said driving member and driven structure and including a switch, means moved with said driven structure for operating said switch after a forward movement of said structure greater than the corresponding said amount and thereby controlling said circuit means for producing a retrograde movement of said driving member and driven structure, and stop means for limiting said retrograde movement so that the net forward movement equals the corresponding said amount.

6. Mechanism for producing a succession of forward movements of predetermined amounts, comprising a driven structure for performing the movements, a reversible motor, means connecting the motor and driven structure for moving the latter, a source of current for said motor, a forward relay, a reverse relay controlled by said forward relay for closing when said forward relay is open, circuits connecting said source, relays and motor, a pilot circuit closer for initially energizing said forward relay for closing to produce a forward movement of said driven structure, a second circuit closer cooperative with said forward relay to maintain the energization of said forward relay, means moved with said driven structure to actuate said second circuit closer and effect the opening of said forward relay and closing of the reverse relay, and stop means for limiting the retrograde movement of said driven structure.

7. A mechanism of turret type comprising a rotatable table, a reversible driving member, means connecting the driving member and table for rotating the latter, means operable for producing a forward movement of said member and table, means moved by said driving member after a forward movement of said table for reversing the direction of movement of said member and table, and stop means for limiting the retrograde movement of said table.

8. A mechanism of turret type comprising a rotatable table, a reversible driving member, means connecting the driving member and table for rotating the latter, means operable for producing a forward movement of said member and table, means moved by said driving member after a forward movement of said table for reversing the direction of movement of said member and table, a dog on said table, and a resiliently mounted pawl for engaging said dog and limiting the retrograde movement of the table, said pawl yielding for the passage of the dog during the forward movement.

9. A mechanism of turret type comprising a rotatable table, a reversible driving member, means connecting the driving member and table for rotating the latter, means operable for producing a forward movement of said member and table, means moved by said driving member after a forward movement of said table for reversing the direction of movement of said member and table, stop means for limiting the retrograde movement of said table, and a slip drive connection included in said connecting means for permitting said driving member to continue its retrograde motion.

10. A mechanism of turret type comprising a rotatable table, a reversible driving member, means connecting the driving member and table for rotating the latter and including a rotating element and a speed reducing drive between said element and table, means operable for producing a forward movement of said member, element and table, means moved by said element after a forward angular movement of said table which is a fraction of a revolution for reversing the direction of movement of said member, element and table, a plurality of stop members on said table spaced angularly around the axis of the same, and cooperating stop means for engaging one of said stop members during each retrograde movement of the table and thereupon limiting said retrograde movement to an angular amount less than said fraction of a revolution.

11. A mechanism of turret type comprising a fixed structure and a rotatable turret, a reversible driving member, stop means for limiting retrograde movement of said turret, means connecting the driving member and turret for rotating the latter and including a rotating device which is at substantially a dead center position when said turret is stopped by said stop means and by wedging action holds said stop means engaged to assure the rigid positioning of the turret, and means operated by the turret upon a predetermined forward movement for reversing said driving member and producing a retrograde movement of said turret for engagement of said stop means.

12. A mechanism of turret type comprising a fixed structure and a rotatable turret, a reversible driving member, stop means for limiting retrograde movement of said turret, means connecting the driving member and turret for rotating the latter and including an axially movable worm connected with the driving member and a cooperating worm wheel connected with the turret and a clutch between said worm and driving member releasable by axial movement of the worm during reverse movement of said driving member, means operated by the turret for reversing the movement of said driving member after a predetermined forward movement, said stop means operating to block said worm wheel and cause said axial movement of the worm to release the clutch, and means for initiating a further forward movement of the driving member for reengaging said clutch.

13. A mechanism of turret type comprising a rotatable table, means on said table for locating said table in predetermined set positions, means including a reversible member for moving the table from position to position and operating for first rotating the table in a forward direction slightly past one of said set positions and then operating in the reverse direction until said locating means acts to limit the retrograde movement of said table, and a device controlling said moving means and operative to initiate a further forward movement of the reversible member for starting the next cycle of operation.

14. A mechanism of turret type comprising a fixed structure and a rotatable turret having radial slots spaced at equal peripheral distances, stop means for limiting the movement of said turret, a driving shaft having its axis substantially parallel to the turret axis and having an eccentric member mounted thereon, said eccentric member moving in said radial slots relatively toward and from the axis of the turret for rotating the turret, said radial slots being so located in the turret relative to said stop means that the eccentric member is at substantially dead center position when said turret is stopped by said stop means and by wedging action holds the turret against said stop means to assure the rigid positioning of the turret.

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