May 14, 1963 F. E. DOLE 3,090,025

POTENTIOMETER

Filed Feb. 3, 1961 2 Sheets-Sheet 1

FIG. 1.

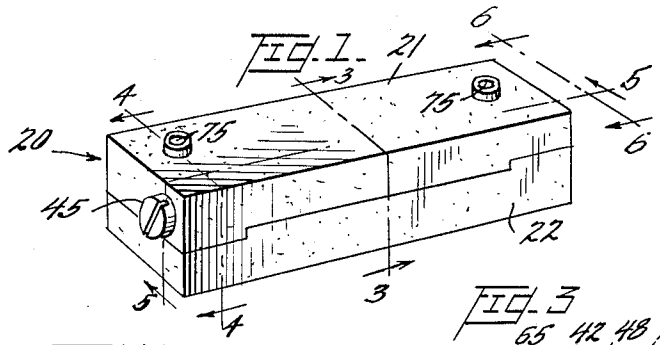


FIG. 3

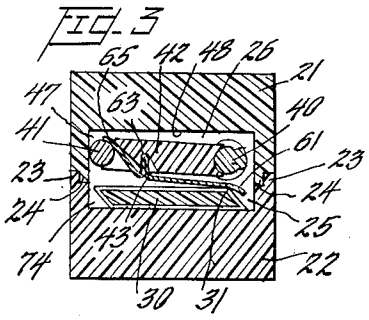


FIG. 2.

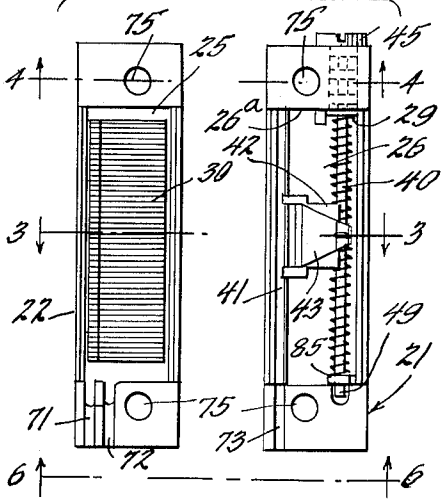


FIG. 4.

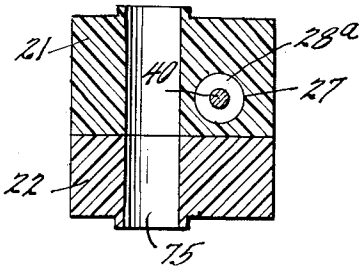
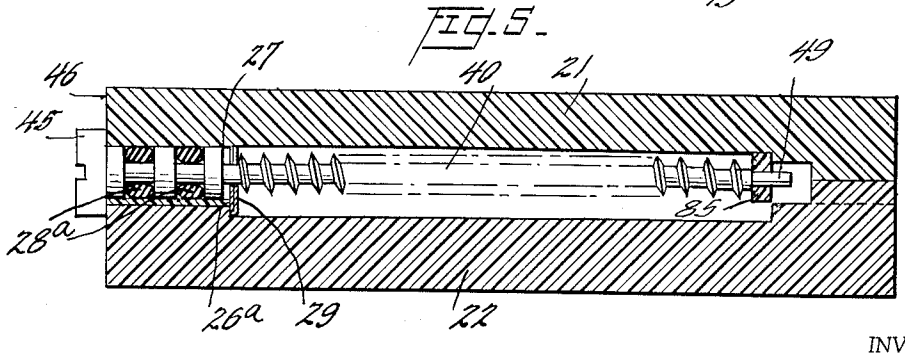


FIG. 5.



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May 14, 1963 F. E. DOLE 3,090,025

POTENTIOMETER

Filed Feb. 3, 1961 2 Sheets-Sheet 2

FIG. 6.

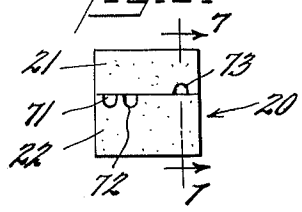


FIG. 7.

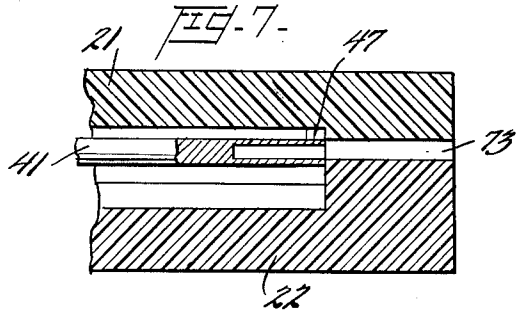


FIG. 8.

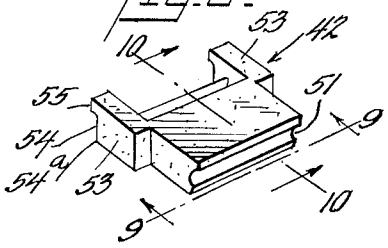


FIG. 9.

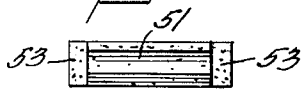


FIG. 10.

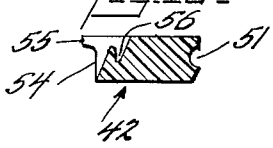


FIG. 11.

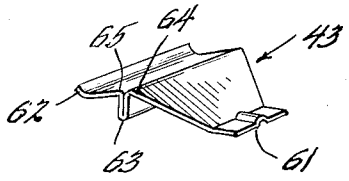


FIG. 12a.

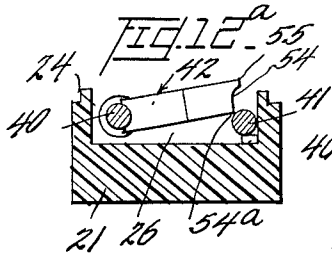


FIG. 12b.

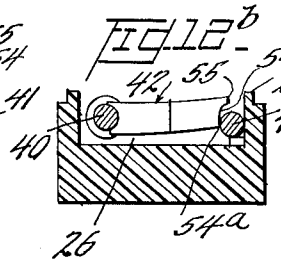
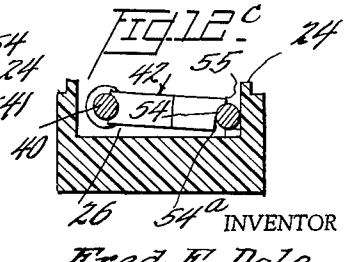


FIG. 12c.



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3,090,025

POTENTIOMETER

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Filed Feb. 3, 1961, Ser. No. 87,013
11 Claims. (Cl. 338—183)

The present invention relates to potentiometers or rheostats, particularly rectilinear units, and is concerned primarily with a novel arrangement and relationship of the parts thereof, resulting in substantial economies and simplifications in manufacture, assembly, and fabrication thereof.

A potentiometer manufacturer normally produces several lines of potentiometers. All the potentiometers of any given line are usually mechanically identical, but there are numerous variations in the line with respect to the electrical characteristics of different units, in accordance with the particular uses for the potentiometers and the widely varying requirements and specifications of different customers. In accordance with one aspect of the present invention, the potentiometers are fabricated in two subassemblies, one subassembly containing and housing all the mechanical parts, and the other subassembly containing and housing the resistance unit. Thus, a complete stock of mechanical subassemblies can be fabricated in advance and stocked on an economical long run basis. Thereafter, resistance subassemblies can be fabricated as required to meet the needs and electrical characteristics of orders as received. The completed resistance subassemblies are then united with the prestocked mechanical subassemblies to complete the order, thereby eliminating the time delay of fabricating the mechanical portion of the potentiometer to order, and the expense of short run fabrication of the mechanical portion.

In accordance with another aspect of the present invention, the above-mentioned mechanical subassembly is arranged and constructed to facilitate an economical and efficient assembly of the components thereof. Conventionally, many rectilinear potentiometers include a contact element for traversing the resistance element, a carrier for the contact element, a lead screw or the like for causing and controlling the traverse of the contact element over the resistance element, and a slip ring or bar also traversed by the contact element for tapping the electrical value represented by the position of the contact element on the resistance element. In accordance with the present invention, the contact carrier is inserted between the lead screw and slip bar with a toggle-like action that at once completes the assembly of and locks these elements in operative relationship. This snap-in operation effects a substantial simplification of potentiometer assembly operations, which is of particular value in subminiature units where intricate fabrication and assembly operations are difficult, tedious, and consequently expensive.

The contact carrier and the contact element per se are further constructed and related so that the reaction force resulting from the bearing of the contact element on the resistance element is additive to the above-mentioned toggle-like locking force exerted by the contact carrier.

It is accordingly one object of the present invention to provide a potentiometer formed from two subassemblies, with the mechanical elements of the potentiometer contained and housed in one subassembly, and the resistance element contained and housed in the other subassembly.

Another object of the present invention is to provide said mechanical subassembly, comprising a lead screw, slip bar, and variable contact unit, wherein the contact unit is retained between said lead screw and bus bar with a toggle-like action to lock the elements of the mechanical subassembly in operative relation.

Still another object of the present invention is to provide a potentiometer, comprising a lead screw, slip bar, and variable contact unit, wherein the contact unit is located between said lead screw and bus bar with a toggle-like action to lock these elements in operative relation.

Other objects and advantages of the present invention will become apparent to those skilled in the art from a consideration of the following detailed description of one embodiment of the invention, had in conjunction with the accompanying drawings, in which like numerals refer to like or corresponding parts, and wherein:

FIG. 1 is a perspective view of an assembled rectilinear potentiometer embodying the present invention;

FIG. 2 is a plan view of the two subassemblies going to form the assembled potentiometer of FIG. 1, opened up to show the interiors thereof;

FIG. 3 is an enlarged cross-sectional view of the present potentiometer, taken along the line 3—3 of FIG. 1, which section is also designated by line 3—3 in FIG. 2;

FIG. 4 is an enlarged cross-sectional view of the present potentiometer, taken along the line 4—4 of FIG. 1, which section is also designated by line 4—4 in FIG. 2;

FIG. 5 is an enlarged longitudinal sectional view of the present potentiometer, taken along the line 5—5 of FIG. 1;

FIG. 6 is an end view of the present potentiometer taken as indicated by line 6—6 of FIG. 1, which view is also designated by line 6—6 in FIG. 2;

FIG. 7 is an enlarged longitudinal fragmentary sectional view of the present potentiometer taken along the line 7—7 of FIG. 6;

FIG. 8 is a perspective view of the traveling contact carrier pursuant to the present invention;

FIG. 9 is a view of the contact carrier as indicated by the line 9—9 of FIG. 8;

FIG. 10 is a cross-sectional view of the contact carrier, taken along the line 10—10 of FIG. 8;

FIG. 11 is a perspective view of the traveling contact element per se, pursuant to the present invention; and

FIGS. 12A–C constitute a schematic presentation of successive stages of operation of one feature of the present invention.

The specific embodiment of the present invention shown in the drawings is a rectilinear potentiometer, housed in an elongate casing 20 of rectangular or square cross-section. The casing 20 is formed of two parts 21 and 22 adapted to be secured together by cement or the like to form the completed housing. For this purpose the thin longitudinal wall portions of the two casing halves are formed with mating and overlapping outer and inner lips 23 and 24. The casing halves 21 and 22 are formed of electrical insulating material, and preferably are molded plastic parts formed for example from a phenolic resin.

One half 22 of casing 20 houses a wire wound resistance card 30 in rectangular recess 25 formed in said casing half. As shown particularly in FIG. 3, the resistance card 30 is formed in substantially a parallelogram cross-sectional shape, for purposes to be subsequently described. In assembling the resistance card 30 to casing half 22, it is contemplated that the wire wound card will be cemented in the recess 25.

Casing half 21 is also formed with a rectangular recess designated by numeral 26. Recess 26 houses the mechanical subassembly of the present potentiometer, in-

cluding the lead screw 40, electrically conducting slip bar 41, electrically insulating traveling contact carrier 42, and the electrically conducting traveling contact element 43. At one end, casing half 21 is provided with a hole 27 for entry and mounting of the lead screw 40 in recess 26. At the opposite end of recess 26, a small apertured tab element 85 is located for supporting and mounting the tail end 49 of the lead screw 40. The portion of lead screw 40 housed in aperture 27 is formed with three circumferential land areas 28 between which are housed two O-rings 28a, for sealing the interior of casing 20 when the potentiometer is completely assembled. A slotted flat spring retainer 29 is applied over lead screw 40 to bear between the threads of screw 40 and the inner end wall 26a of recess 26, to retain the lead screw and to urge the head 45 of the lead screw into engagement with exterior end surface 46 of the casing 20, and take up all axial play in the lead screw.

Slip bar 41 is oriented in axially parallel relation to lead screw 40 and is located in recess 26 along the side wall opposite from the lead screw. Spacing lugs 47 are formed in the recess 26 to locate slip bar 41 a small distance from the bottom wall 48 of recess 26. A salient feature of the present invention is the relative location of slip bar 41 and lead screw 40. The axis of slip bar 41 is slightly offset from the axis of lead screw 40, so that the former is slightly closer to the bottom wall 48 of recess 26 than is the latter. Contact carrier 42 extends between the lead screw and slip bar, and functions to retain the slip bar seated against the spacing projections 47.

Contact carrier 42 is fabricated from an insulating material having some degree of resilience and compressibility, such as Teflon, and is more or less in the form of a flat block. One edge of the carrier block is provided with an arcuate groove 51 preferably subtending an arc of not more than 180°. This groove is adapted to seat on lead screw 40, and cooperate therewith for moving the block along the lead screw in response to rotation of the screw. Groove 51 is preferably not threaded, relying upon the screw threads to cut or impress themselves into the block 42. The edge of the block 42 opposite from the groove 51 is provided with two corresponding leg portions 53, whose ends are each contoured to provide a flat at 54 forming a right angle or squared corner at 54a, and a projecting stop tab at 55. This carrier block is designed with a linear distance between flats 54 and groove 51 that is slightly greater than the corresponding distance between lead screw 40 and slip bar 41. Thus, with the carrier block 42 inserted between the lead screw and slip bar as shown in FIG. 3, the block 42 is under a small compression force between the slip bar and lead screw. At the same time the corner 54a of block 42 is over center of the plane common to the axial centers of the slip bar 41 and lead screw 40, in the direction of the bottom wall 48 of recess 26. The over center movement of the corner 54a is limited by engagement of tabs or lugs 55 with slip bar 41. It will be seen with particular reference to FIGS. 8 and 12c that when assembled the portion of the carrier 42 engaging the slip bar 41 has three areas: the first being at 54 and being located substantially in the plane common to the central axes of both the slip bar 41 and lead screw 40, the second being at 55, and the third being at 54a. The latter two areas lie on opposite sides of said common plane. The distance from the lead screw axis to the second and third areas is greater than to the first area. Also, the distance from the lead screw axis to the end areas of the projecting tabs 55 is greater than to any portion of areas 54a. Thus, as a result of the compression of block 42, the force between groove 51 and leg flat portion 54 retains the block 42 in position, its over center relation relative to the axes of bar 41 and screw 40 keeps the block 42 from working out of position in a direction away from surface 48 of recess 26, and the bearing of tabs 55 against slip bar 41 keeps the block 42 from working out of position in a direction toward the surface 48. Since the plane common to the axes of lead screw 40 and slip bar 41 is over center relative to that plane in which the axis of screw 40 lies and which is perpendicular to the side wall of recess 26 adjacent bar 41, the bar 41 and block 42 will not move as a unit outwardly away from the botom wall of recess 26. Accordingly, the contact carrier block 42 has an over center toggle-like action in relation to the bus bar 41 and lead screw 40, to retain these parts in operative relation.

Assembly of the above described mechanical subassembly in casing half 21 is accomplished by first inserting lead screw 40 through opening 27, seating the lands 28 and O-rings 28a in said opening, and seating the tail end 49 of the lead screw in the apertured tab element 85. The flat retaining spring 29 is then slipped over the lead screw adjacent wall 26a, to lock the lead screw in place and take up all axial play. The slip bar 41 is placed in position adjacent the spacer tabs 47. The arcuate surface 51 of the contact carrier block is then seated on the threads of lead screw 40, and the leg portions 53 pushed against the slip bar 41 with sufficient force to snap the block 42 into the over center position shown in FIG. 3, with tabs 55 bearing against slip bar 41, thereby locking the parts in assembled relationship. Rotation of lead screw 40 by means of its head 45, causes carrier block 42 to traverse along the length of the lead screw. It may be mentioned, that when block 42 reaches either end of lead screw 40, further rotation of the screw does not bind the block, but because of the block resilience and the absence of definite machined threads thereon, rotation of the screw is permitted without movement of the block.

The insertion of carrier block 42 is illustrated in FIGS. 12A–C. In FIG. 12A, the block 42 is engaged with the threads of screw 40, and corner 54a abuts bar 41. Corner 54a delineates the point on flat 54 presentnig the longest dimension from the center of rotation of block 42 about screw 40. Further inward pressure on block 42 compresses and buckles the block and/or axially bows lead screw 40 as corner 54a passes through the plane common to the axes of screw 40 and bar 41, as shown in FIG. 12B. As corner 54a passes through this plane, the block 42 snaps into parallelism with said plane, representing the position of least compression on the block, as shown in FIG. 12C. In order to insure a tight and play free assembly, the size of block 42 is chosen to exceed slightly the distance between screw 40 and bar 41, so that even in FIG. 12C block 42 is under some compressional force, although not as great as in FIG. 12B.

Referring to the contact element per se, denoted by numeral 43, it is formed from a flexibly resilient conductive material, and includes a wiper tip 61 adapted to engage and traverse the resistor 30, and a slip contact 62 adapted to engage and traverse the slip bar 41. Intermediate the wiper tip 61 and slip contact 62, the contact element is formed with a reversely folded projecting section 63, providing a flexure area 64 associated with the wiper tip 61, and a flexure area 65 associated with the slip contact 62. Contact carrier block 42 is formed with recess 56 adapted to receive the reversely folded projection 63 and provide a bearing for the contact element. As shown in FIG. 3, the projection 63 is seated in the recess 56 with the slip contact 62 passing behind slip bar 41 and the wiper tip located in front of the lead screw 40.

With the mechanical subassembly in this relationship, the casing half 22 carrying a mounted resistance card 30 is brought into mating union with and cemented to the casing half 21, with the longitudinal edge 31 of the card 30 bearing against the wiper tip 61. The force of this engagement reacts on the projection 63 of the contact element seated in recess 56 of the carrier block to resiliently flex the contact element about its flexure areas 64 and 65, and thereby effect firm electrical contact between the wiper tip 61 and resistor 30, and between the slip contact 62 and the slip bar 41. At the same time fulcrum

63, 56 of this resilient contact force is located so as to operate in the same direction as the toggle force acting on contact carrier block 42.

Prior to assembling the two casing halves 21 and 22 it is necessary to provide the appropriate electrical input and output leads. These leads have not been shown in the drawings; however, as is conventional for potentiometers, a lead is provided to each end of the resistance element 30, and a lead is provided to the slip bar 41 thereby connecting with the tap point on the resistor 30 engaged by the contact element 43. The two leads to the ends of the resistance element 30 enter through the two channels 71 and 72 formed in casing half 22. One of these leads is connected to the end of the resistance 30 immediately adjacent, while the other lead passes along the space 74 provided under the overhanging longitudinal edge of the resistance element 30 to the opposite end of the resistance element. The third lead enters the casing 20 through the channel 73 provided in casing half 21, and is there connected to the end of slip bar 41.

In order to facilitate the orderly stacking of a plurality of completed potentiometers, the ends of the casing 20 are provided with holes 75 to receive guide pins or rods, or assembly bolts, as is conventional in the art. Additionally, small bosses 52 are formed around the ends of holes 75, to function as spacers when a plurality of potentiometer units are stacked, thereby facilitating heat dissipation from between adjacent units.

There is thus provided, in accordance with the present invention, a rectilinear potentiometer or rheostat, enclosed within an elongated housing, longitudinally split to provide two casing halves. One casing half houses the resistance element, whereas the other casing half houses a complete mechanical subassembly for the potentiometer, including a lead screw, slip bar, and variable tap carrying block. These mechanical parts are relatively related to provide an over center toggle-like lock-in feature for the contact carrier block, which also functions to lock-in the slip bar. Accordingly, the mechanical subassembly is completely self sustaining, and is readily assembled without any complex or intricate assembly operations. This potentiometer therefore enables the efficient manufacture of stock mechanical subassemblies, which may be utilized as required with resistors fabricated to order to meet the wide variety of electrical parameters that are variously ordered. Completion of the potentiometer merely requires uniting of the casing half housing the desired resistance element with the casing half housing the preassembled mechanical components.

The foregoing features and advantages of the present invention have been illustrated with reference to one specific embodiment of the invention shown in the accompanying drawings. Obviously, numerous modifications, variations, and adaptations of this embodiment will be apparent to those skilled in the art, and such as are embraced by the spirit and scope of the appended claims are contemplated as within the purview of the present invention.

What is claimed is:

1. In a potentiometer, a traversing contact structure comprising a lead screw, a slip bar, a carrier for a contact element, and means supporting said lead screw and slip bar in a desired spaced relative orientation, said carrier being interposed between and in bearing engagement with said lead screw and slip bar and being pressed therebetween, the portion of said carrier engaging said lead screw being arcuate to partially circumscribe and cooperate with said lead screw, the portion of said carrier engaging said slip bar having three areas, a first of said three areas being located substantially in the plane common to the two central axes of said lead screw and slip bar, a second of said three areas being that part of said portion lying to one side of said plane, and the third of said areas being that part of said portion lying to the other side of said plane, the distance from the central axis of said lead screw to said second and third areas being greater than the distance to said first area, and the distance from the central axis of said lead screw to at least a part of said second area being greater than the distance to any part of said third area.

2. In a potentiometer as set forth in claim 1, said supporting means comprising an elongate casing section having a recess formed in one surface, said lead screw extending along one side of said recess, said slip bar extending along the opposite side of said recess and being substantially axially parallel with said lead screw.

3. In a potentiometer as set forth in claim 2, the axis of said slip bar being located between the bottom of said recess and a plane parallel to said bottom and passing through the axis of said lead screw.

4. In a potentiometer as set forth in claim 2, said slip bar being located inwardly of said recess relative to said lead screw.

5. In a potentiometer as set forth in claim 4, said casing including means providing a reduction in the distance between said slip bar and lead screw on movement of said slip bar from its said desired orientation relative to said lead screw, said carrier being resiliently compressible, whereby movement of said slip bar is restrained by said carrier interposed between said lead screw and slip bar.

6. In a potentiometer as set forth in claim 2, said casing including means providing a reduction in the distance between said slip bar and lead screw on movement of said slip bar from its said desired orientation relative to said lead screw, whereby movement of said slip bar is restrained by said carrier interposed between said lead screw and slip bar.

7. In a potentiometer as set forth in claim 1, a resilient contact element having a first wiper surface adapted to engage a resistance element and a second wiper surface adapted to engage said slip bar, said contact element being pivotally seated on said carrier intermediate said two wiper surfaces with said carrier opposing the resilient forces of engagement between said two wiper surfaces and said resistance element and slip bar.

8. A rectilinear potentiometer comprising an elongate casing having two mating longitudinal sections, each section having an elongate recess formed in one surface thereof, means uniting said sections with said recesses located in face to face relation, an elongate resistance element fixedly seated in the recess of one section, a variable contact assembly mounted in the recess of the other section, said assembly comprising a lead screw rotatively supported along one longitudinal side of the last-mentioned recess, a slip bar located adjacent the opposite side of said last-mentioned recess, a contact carrier block seated under pressure between and in bearing engagement with said screw and bar and engaging said screw for adjustable movement longitudinally of said casing, and a contact element mounted on said carrier for movement therewith and in resilient sliding engagement with said resistance element and said bar.

9. A rectilinear potentiometer as set forth in claim 8, wherein the portion of said carrier engaging said slip bar has three areas, a first of said three areas being located substantially in the plane common to the two central axes of said lead screw and slip bar, a second of said three areas being that part of said portion lying to one side of said plane, and the third of said areas being that part of said portion lying to the other side of said plane, the distance from the central axis of said lead screw to said second and third areas being greater than the distance to said first area, and the distance from the central axis of said lead screw to at least a part of said second area being greater than the distance to any part of said third area.

10. A rectilinear potentiometer as set forth in claim 8, wherein said carrier is formed from a resiliently compressible material.

11. A rectilinear potentiometer as set forth in claim 8, wherein the portion of said carrier engaging said slip bar has three areas, a first of said three areas being located substantially in the plane common to the two axes of said lead screw and slip bar, a second of said three areas lying to one side of said plane, and the third of said areas lying to the other side of said plane, the distance from the axis of said lead screw to said second and third areas being greater than the distance to said first area.

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