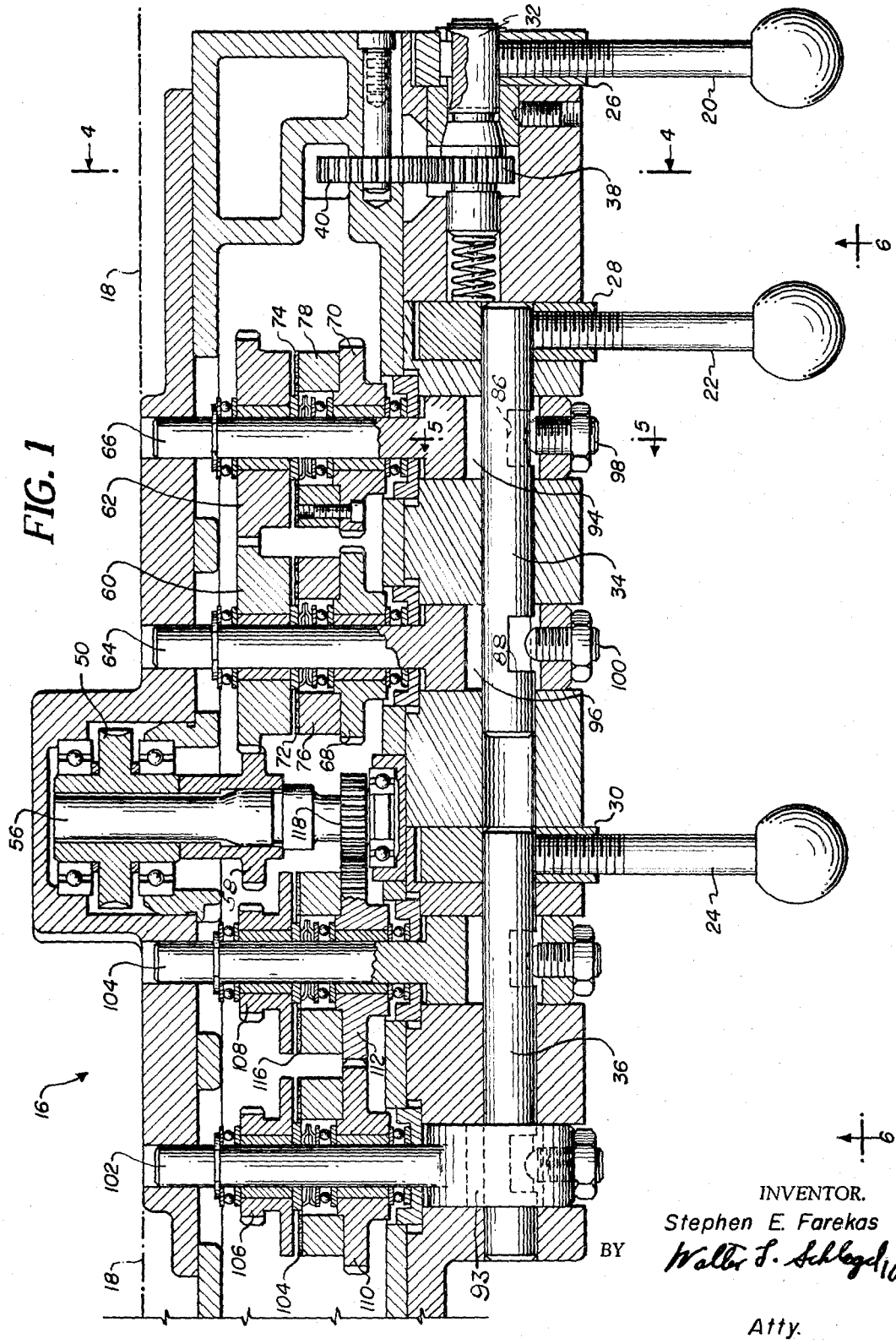
June 25, 1968 S. E. FAREKAS 3,389,616

LEVER INTERLOCK

Filed May 24, 1966 5 Sheets-Sheet 1

FIG. 1



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LEVER INTERLOCK

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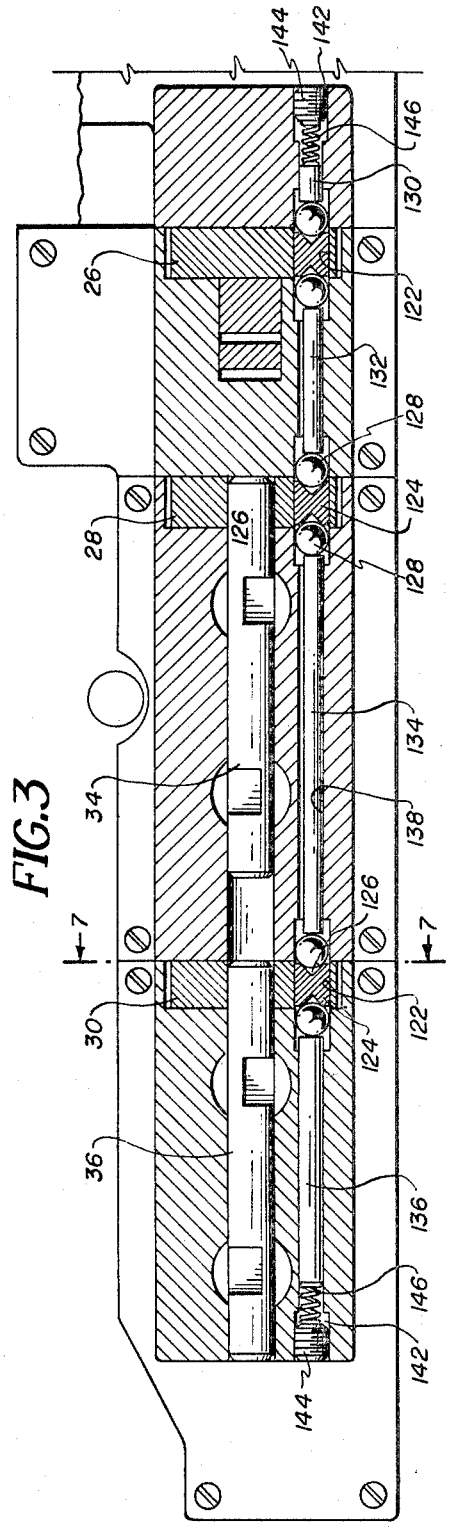

FIG. 3

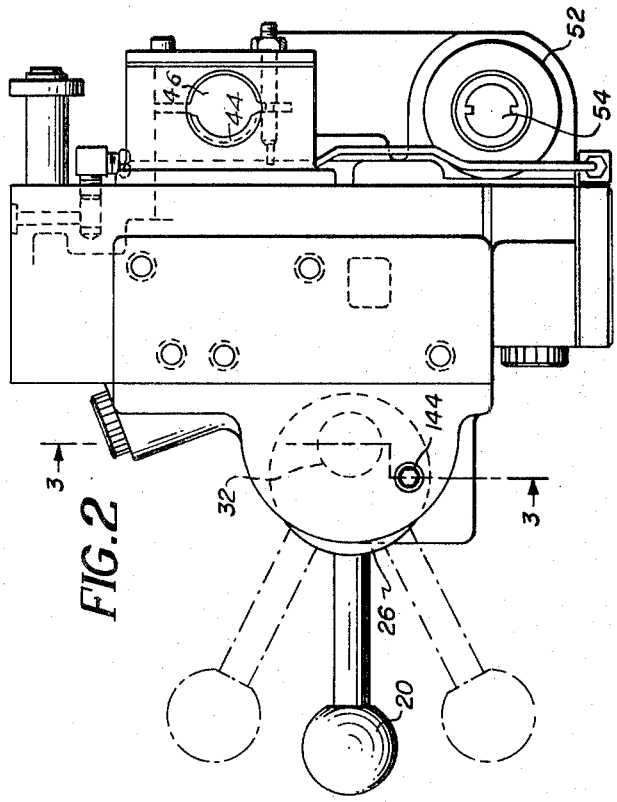

FIG. 2

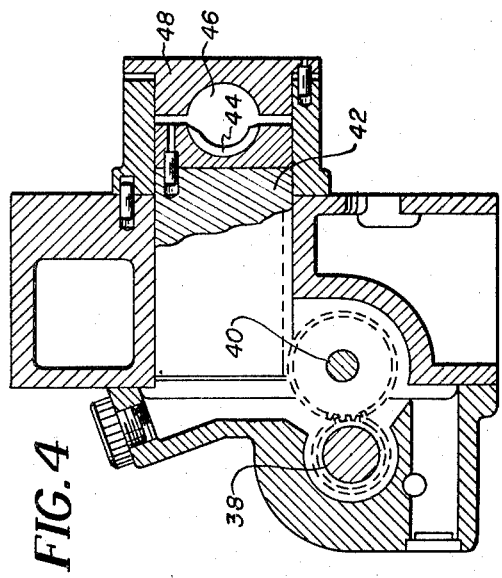

FIG. 4

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LEVER INTERLOCK

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Fig. 5.

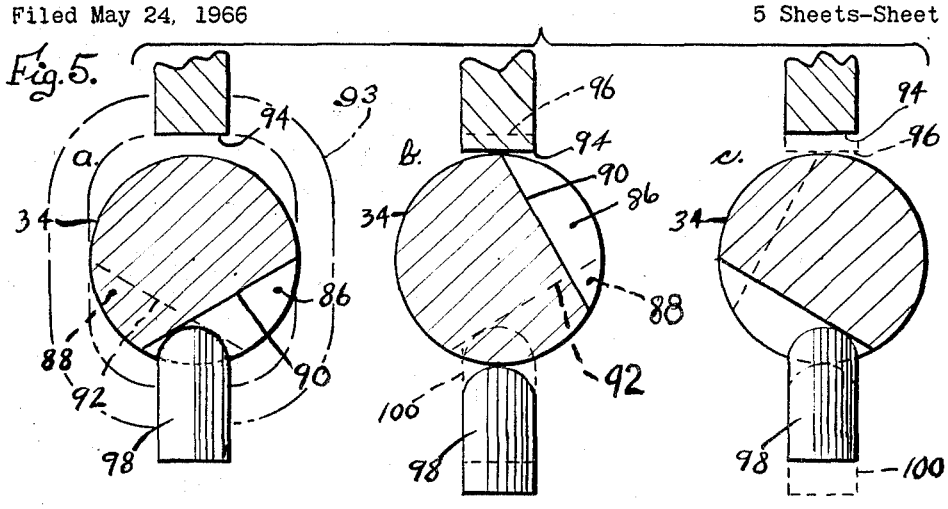
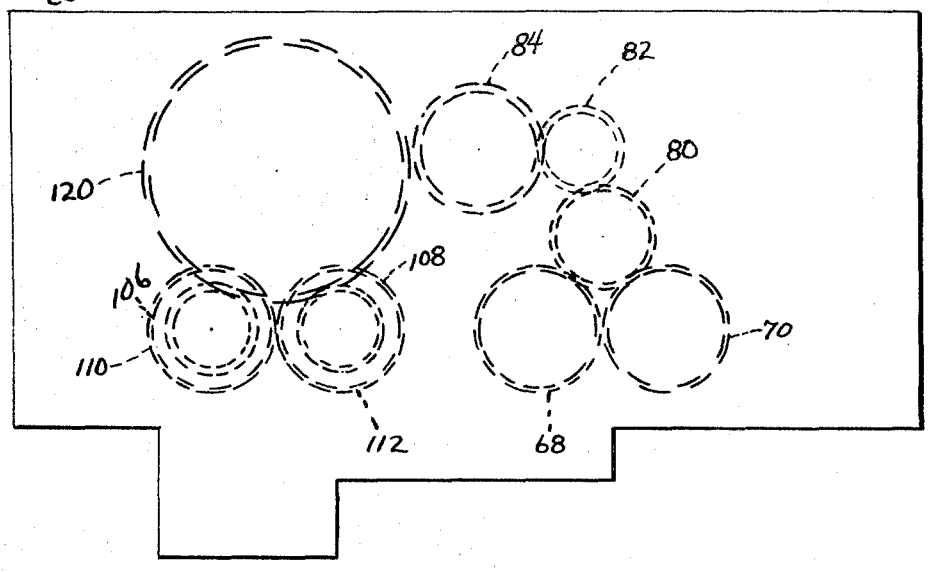


Fig. 6.



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LEVER INTERLOCK

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Fig. 7.

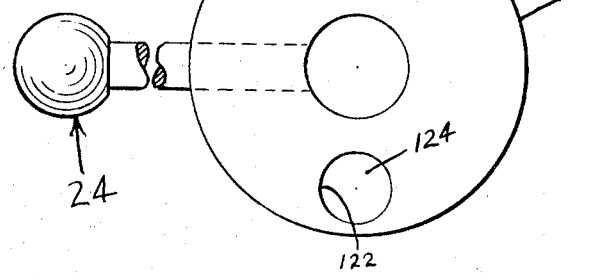


Fig. 7a.

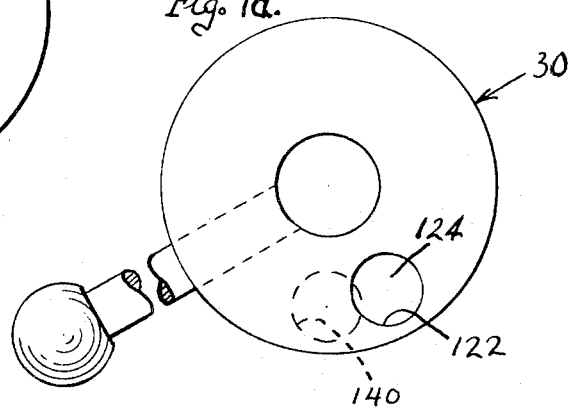


Fig. 7b.

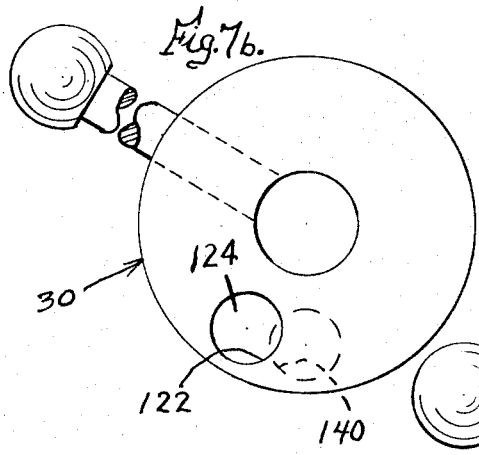
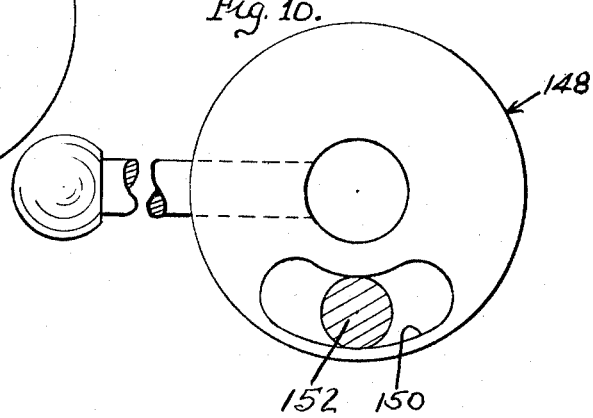


Fig. 10.



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LEVER INTERLOCK

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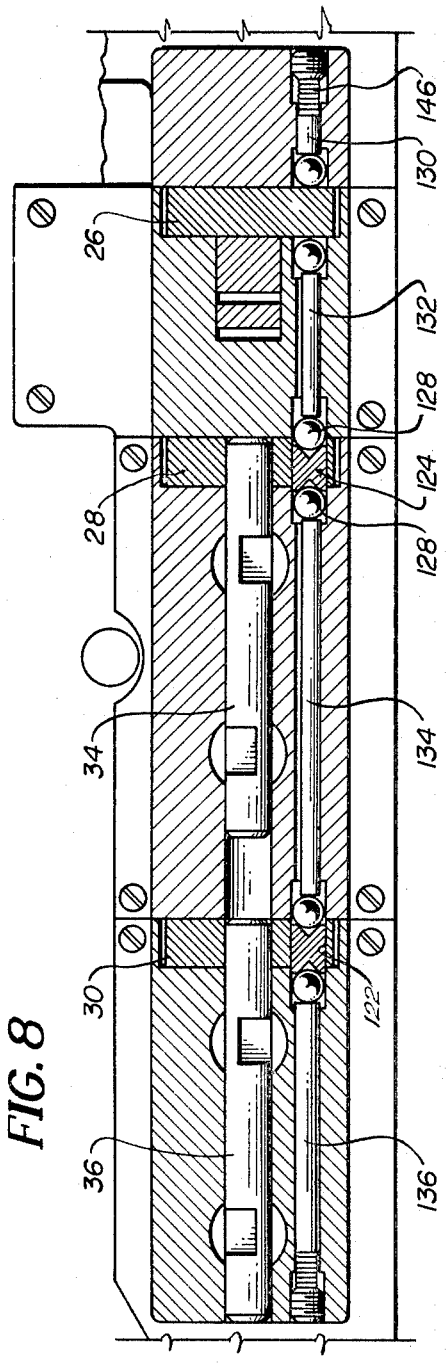

FIG. 8

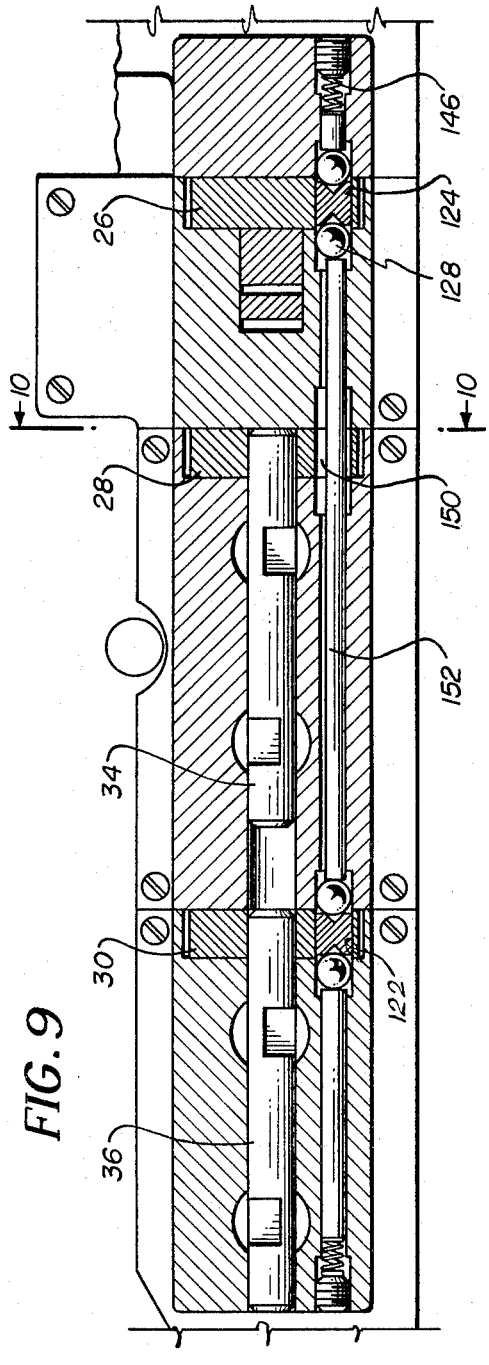

FIG. 9

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3,389,616

LEVER INTERLOCK

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Filed May 24, 1966, Ser. No. 552,469
16 Claims. (Cl. 74—483)

The present invention relates to a lever interlock.

The device of the invention is useful in a construction where a plurality of levers or other control members are movable between neutral and active positions and a principal feature thereof is an arrangement wherein only one of the levers can be moved at a time to active position; when it is so moved all of the others are locked in neutral position.

The invention is particularly useful in connection with lathes, but it is not limited thereto.

A principal object of the invention is to provide a construction of the foregoing general character wherein when one of the levers is moved to active position the remaining levers are positively locked in neutral position.

Another object of the invention is to provide a device of the foregoing general character which is simple in design and mauufacture, and hence inexpensive.

Still another object is to provide a lever interlock of the foregoing general character which is especially adapted to adjustability for wear.

A further object is to provide a device of the general character indicated which is highly versatile.

A more specific object is to provide a construction of the character indicated in which the levers or control elements are biased to neutral position by the same means that locks the levers in active position.

A further object of the invention is to provide, in a modified form, an arrangement in which a lever of different form may be substituted for an original lever, whereby the substituted lever can be moved to neutral and active positions independently of the remaining levers and in an arrangement in which all of the remaining levers are controllable with respect to positioning in neutral and active position.

Other objects and advantages of the invention will appear from the following detail description taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is a horizontal, central sectional view taken through the lever interlock mechanism of the invention;

FIGURE 2 is an end view taken from the right of FIGURE 1;

FIGURE 3 is a sectional view taken at line 3—3 of FIGURE 2;

FIGURE 4 is a sectional view taken at line 4—4 of FIGURE 1;

FIGURE 5 shows three views in section, taken at line 5—5 of FIGURE 1, the different views showing various elements in different positions;

FIGURE 6 is a small front fragmental view taken at line 6—6 of FIGURE 1;

FIGURE 7 is a fragmental view taken at line 7—7 of FIGURE 3;

FIGURES 7*a* and 7*b* are views similar to FIGURE 7 but with certain of the elements thereof in different positions;

FIGURE 8 is a view similar to FIGURE 3 but showing one of the levers in active position and the remaining levers locked in neutral position;

FIGURE 9 is a view similar to FIGURE 3 but showing a modified form of the invention, and

FIGURE 10 is a view taken at line 10—10 of FIGURE 9.

Referring now in detail to the accompanying drawings, attention is directed first to FIGURES 1, 2, 3 showing the

mechanism of the invention in its entirety. The mechanism includes a unit indicated as a whole at **16**, which is mounted on the frame **18** of a lathe for example, or other kind of machine. The unit includes a plurality of levers **20**, **22**, **24**, in this case three, these levers controlling such movements as longitudinal, transverse, and vertical, as in a lathe. The specific arrangements whereby these movements are accomplished will be referred to again herein below. The levers are secured in respective collars **26**, **28**, and **30** as by threading them radially therein where they grip shafts **32**, **34**, and **36** respectively on which the collars are mounted in the body of the unit for rocking movement of the levers, collars, and shafts between neutral position and advanced positions.

It will be understood that in the use of the device the levers **20**, **22**, **24** are actuated for connecting the elements of the unit with movable elements of the lathe for movement of the unit **16** in the various directions mentioned, for moving the tool held by the unit in the desired cutting operations by the tool on the work-piece held in the lathe. The levers assume a neutral position shown in full lines in FIGURE 2, which for convenience is horizontal. The levers are movable to two active positions indicated in dot-dash lines in FIGURE 2, the upper and lower active positions corresponding to respective opposite directions of movement of the respective components, e.g., upwardly-downwardly, right-left, etc. The collars are mounted in cavities in the body of the unit for rocking movement in the manner mentioned namely about the axes of the shafts **32**, **34**, **36**. In the case of the lever **20** and collar **26**, the associated shaft **32** has a pinion **38** (FIGURES 1 and 4) secured thereto in mesh with another pinion **40** which in turn meshes with the teeth of a rack **42** on which is mounted a half-nut **44** engageable with a screw (not shown) of the lathe working in an aperture **46** defined by the half-nut on one side and a counterpart member **48** on the other. The screw referred to is a standard element of the lathe and upon engagement therewith by the half-nut, movement is imparted to the unit along the screw and of course, when the half-nut is separated from the screw, the movement is terminated. The half-nut **44** is moved into and out of working engagement with the screw (in horizontal direction as viewed in FIGURE 4) upon swinging movement of the lever **20** about the axis of the shaft **32**.

The lever **22** is utilized for controlling another phase of movement through a worm gear **50** (FIGURE 1) which meshes with a worm **52** (FIGURE 2) mounted on a shaft **54**. The worm gear **50** is secured to a shaft **56** suitably mounted in the unit and having a pinion **58** on its inner end. The gear **58** meshes with another gear **60** which in turn meshes with a gear **62**. The gears **60** and **62** are rotatably mounted on shafts **64** and **66** which are fixed against rotation but shiftable longitudinally of their own axes. The gears **60** and **62** are movable with the shafts **64** and **66** in axial direction and when moved to active positions (downwardly as viewed in FIGURE 1) they engage corresponding gears **68** and **70** mounted on the same shafts, through the intermediary of friction clutch elements **72** and **74** interposed between the gears **60** and **62** and annular elements **76** and **78** secured to the gears **68** and **70**. The spacing between the gears **60** and **62** and the elements **76**, **78** is shown exaggerated, and upon shifting movement of the gears, friction driving engagement therebetween is established. It will be noted that the axial dimensions of the gears **58**, **60**, **62** is such as to enable shifting movement of either of the gears **60**, **62**, while maintaining effective meshing engagement between the gears in any positions thereof.

The gears **60**, **62** rotate in mutually opposite directions and depending upon which is in active position, i.e., engaged with the corresponding clutch element **72**, **74**, the

output element is rotated in a corresponding direction. For producing the output movement, the gears 68, 70 both mesh with another gear 80 (FIGURE 6) which in turn meshes with a gear 82 and the latter meshes with another gear 84 which constitutes the output element. This output element may be connected with any desired type of driving member or movable member according to the desired application of the invention. The gears 68 and 70, when the control member (lever 22) is in neutral position, idle with no driving action on the output element, but when either of those gears is activated by clutching engagement with the corresponding driving gear 60, 62, it drives the output element in the corresponding but opposite direction. It will be understood that the gears 60, 62 are in constant motion and they become active only upon actuation of the lever 22.

Only one of the gears 60, 62 can be activated at a time. The shaft 34 is provided with notches 86 and 88 providing flats 90 and 92 (FIGURE 5). The shafts 64, 66 have enlargements 93 at their lower ends (FIGURES 1 and 5) which are provided with transverse apertures 94 and 96 receiving the shaft 34 and at their lower ends (FIGURES 1 and 5) are provided with pins 98 and 100 engageable with corresponding flats. The flats are arranged so that upon swinging of the control lever 22 in first direction, e.g., downwardly as shown in FIGURE 2 or counterclockwise with reference to FIGURE 5, the flat 90 is displaced from the position shown in FIGURE 5*a*, and the pin 98 is thereby engaged by the outer cylindrical surface of the shaft 34 as shown at FIGURE 5*b*. This draws the shaft 66 downwardly (FIGURE 1) and engages the gear 62 with the gear 70 and produces rotation of the output element in a first direction. During this movement the other shaft 64 is not drawn downwardly, the flat 92 being positioned so that the pin 100 is not drawn downwardly.

In swinging movement of the lever 22 in the opposite direction, i. e., to upper position as viewed in FIGURE 2, the pin 100 is at that time engaged by the outer cylindrical surface of the shaft 34 as shown in FIGURE 5*c*, and the shaft 64 is drawn downwardly but the shaft 66 remains in its normal position. In tris movement the gear 60 is brought into driving engagement with the gear 68 which drives the output shaft in the direction opposite that driven by the gear 62.

The lever 24 controls operating elements in the manner similar to that of lever 22. The shaft 36 on which the collar 30 is mounted controls shafts 102 and 104 on which are mounted gears 106 and 108 operatively associated with gears 110 and 112 through clutch elements 114 and 116. The gear 110 and 112 intermesh, and the gear 112 is in constant mesh with a gear 118 on the shaft 56. Upon one or the other of the gears 106, 108 being brought into driving engagement with the corresponding gears 110, 112, it is rotated in the corresponding direction and it rotates a gear 120 (FIGURE 6) in corresponding direction, the gear 120 being in constant mesh with both the gears 105, 108. The gear 120 constitutes the output element and is operatively associated with the member which is to be controlled.

The interlock means is represented best in FIGURES 3, 7, and 8. Each of the collars 26, 28, 30 is provided with an axial aperture 122 adjacent its periphery. These apertures are aligned when the levers 20, 22, and 24 are in neutral position (FIGURE 2). In each of the apertures 122 is a locking insert 124 of axial dimension slightly less than that of the collar. Each insert has a conical recess 126 in each end forming a seat for a ball 128. The balls are engaged by interlocking pins 130, 132, 134, and 136 resting in a common bore 138 extending through the body and opening out through the ends of the body. The body is preferably made up of a plurality of sections, for convenience, as defined by cuts on transverse planes. The bore is provided with counter-bores 140 at opposite sides of each collar and adjacent thereto. These counter-bores are preferably substantially equal in diameter to the apertures 122 and the balls 128 are dimensioned to fit the counter-bores substantially without play. The bore 138 is also provided with counter-bores 142 at the ends in which threaded plugs 144 are inserted and between these plugs and the adjacent interlock pins are interposed compression springs 146. The bore 138 forms a plurality of cells, arranged on opposite sides of the collars 26, 28, 30.

The elements in the bore 138 constitute a continuous column; the compression springs 146 engage the end plugs 144 and the adjacent interlock pins 130, 136; those interlock pins engage the adjacent balls 128 which engage the adjacent locking inserts 124 and they in turn engage the balls on the opposite side thereof; the latter balls engage the interlock pins 132 and 134 which in turn engage the adjacent balls 128 and they engage the insert 124 in the collar 28. Thus, the continuous column is formed when the levers are in neutral position, the compression springs 146 reacting against the end plugs 144 to retain the elements therebetween in mutual contact engagement. The elements of this column, and particularly the interlock pins, are so dimensioned that in such neutral positions of the levers, the locking inserts 124 are centered axially in the apertures 122.

Any of the levers 20, 22, 24 when in such neutral position are capable of being moved to active position, i.e., rotated about the shafts on which they are mounted. Assuming as an arbitrary example, the lever 20 is swung upwardly the insert 124 therein cams the balls outwardly and in this movement the locking insert therein moves out of registration with the counter-bores 140 on opposite sides thereof, whereby that locking insert is confined axially by the opposed surfaces of the cavities in which the collar is disposed.

The camming action on the balls forces them back in the counter-bores and when the collar is displaced angularly, the balls bear against opposite sides of the collar 26. The outward movement of the balls forces the other elements of the column in the bore 138 outwardly to the position shown in FIGURE 8, i.e., the inserts 124 in both of the collars 28, 30 are shifted or displaced partially out of the apertures in the collars and they extend into the respective counter-bores 140. These locking inserts are thus partially in the apertures of the collars and partially in the corresponding counter-bores and provide positive locking effect against rocking or angular movement of those collars (28, 30) from their neutral position. It will be appreciated that the amount of displacement of the balls and other elements need not be great since a relatively small amount of projection of the locking inserts into the counter-bores is sufficient to provide effective positive locking action.

The interlocking action is the same regardless which one of the levers is moved to active position; i.e., whether the lever 20 in the example above described, or either of the other two levers, 22, 24. When any one of the three levers is moved to active position, it locks the remaining two levers in neutral position in precisely the same manner as that described above.

The construction eliminates the possibility of two or more levers being moved to active position simultaneously because the elements in the column that are between any two collars are solid and incompressible and therefore would prevent the simultaneous shifting to active position of two or more levers.

Adjustment is easily made so as to assure centering of the locking inserts 124, which may be done by adjusting the end threaded plugs 144.

The construction works toward automatic centering of the levers in neutral position, since the balls 128 are constantly biased into the seats 126 and since the counter-bores 140 are in register with the apertures in the collars, the balls perform a camming action on the conical surfaces to maintain alignment of the apertures with the

counter-bores and thus the levers in neutral position. It will be of course understood that any of the levers may be arranged for swinging movement in either one or both directions from neutral position.

Another advantage is that the requirements for precision in dimensions of the parts is at a minimum; for example in the locking means, the locking inserts **124** and apertures **122** in which they are fitted are substantially the only elements that require precision in their dimensions.

Although the construction illustrated and described includes three interlocking levers, it will be understood that the invention is applicable to an arrangement including other numbers of levers such as two, or four, or more. The maximum number of such levers is limited to practical considerations such as a massiveness of the element to be moved, friction, etc.

The invention is also applicable to an arrangement in which only certain of the levers are controlled by the interlocking means. Such an arrangement is illustrated in FIGURES 9 and 10, wherein the two outermost collars **26** and **30**, for example, are utilized with a third collar **148** therebetween. The collar **148** is provided with an arcuate aperture **150** instead of a cylindrical aperture such as the aperture **122** mentioned above. In the present instance a single interlocking pin **152** extends through the arcuate aperture **150** and directly engages balls **128** associated with the outer collars **26, 30**. This interlock pin **152** replaces five elements in the construction described above, namely, interlock pins **132, 134**, the balls **128** therebetween, and the locking insert **124** in the middle collar **28**. In the present instance (FIGURES 9 and 10) upon moving either of the levers **20, 24** and corresponding angular movements of the collars **26, 30**, the interlock pin **152** is shifted to interlock the other collar. This interlock pin is shifted relatively to the middle collar without affecting the latter. Then if it is desired to work the collar **158**, this can be done independently of the condition or position of either of the outermost collars; i.e., whether either of those collars is in neutral or active position. The arcuate extent of the aperture **150** is sufficient to accommodate the shifting movement of the collar the full amount in either direction, FIGURE 10 indicating neutral position of the collar.

While I have shown herein a preferred form of the invention, it will be understood that changes may be made therein within the scope of the appended claims.

I claim:

1. Interlock mechanism of the character disclosed, comprising, a body member having a plurality of cavities therein arranged in a line, an operating member movably mounted in each cavity, the operating members each having a neutral position and an active position, the body member having a cell extending along said line of cavities, extending longitudinally beyond outermost ones thereof, the operating members having apertures therein in alignment with said cell when the operating members are in neutral position, locking pins in said apertures, rigid interlock means in said cell engaging said locking pins in mutual camming surfaces, and yieldable means interposed between the outer ends of the interlock means and the ends of the cell.

2. The invention set out in claim **1** wherein the locking pins are movable between an unlocking position in which the operating members can be moved to active position and a locking position in which they extend partially out of the apertures into the cell for locking the corresponding operating members in neutral position, the yieldable means biases all of said locking pins to unlocking position, each operating member on being moved to active position being operative for moving other locking pins to locking position.

3. The invention set out in claim **2** wherein each locking pin is confined in unlocking position when the corresponding operating member is in active position.

4. The invention set out in claim **3** wherein rigid and incompressible means is interposed between adjacent locking pins, and each locking pin in response to movement of its operating member to active position being operative for camming the interlock means and moving remaining ones of the locking pins into locking position.

5. Interlock mechanism of the character disclosed comprising a body member, a plurality of operating members mounted in the body member for movement between neutral position and active position, the body member having longitudinally aligned cells, the operating members having apertures therein which, when the operating members are in neutral position, are aligned with the cells, and a continuous column of rigid elements in said cells and apertures, said column including locking elements associated with respective operating members, and each operating member being relative upon moving to active position for shifting remaining portions of the column and moving other locking elements to positions positively locking the corresponding operating members in neutral position.

6. The invention set out in claim **1** wherein each locking pin has concave seats in its opposite ends, the interlocking means include elements in said cells between adjacent operating members and longitudinally beyond both outermost locking members, the locking pins and interlock elements form a continuous column, the yieldable means bias the column to a position in which the locking pins are in a neutral position relative to the operating members and in such position are disposed within the confines of the operating members, each operating member upon being moved to active position is operative for performing a camming effect on the adjacent interlock elements and moving those interlock elements on both sides of that operating member and thereby moving the locking pins in remaining ones of the operating members partially out of the apertures therein and partially into the cells, thereby providing positive interlock between the operating members and the body member preventing the operating members from being moved from neutral position to active position.

7. The invention set out in claim **6** wherein the interlock elements include balls serially interposed therein, and directly engaging the seats in the locking pins.

8. The invention set out in claim **7** wherein the seats in the locking pins are of conical shape and the balls project into the seats beyond the corresponding confines of the operating member.

9. The invention set out in claim **8** wherein the cells at positions next to the operating members are dimensioned relative to the balls whereby the latter are substantially constrained against transverse movement.

10. The invention set out in claim **1** wherein the locking pins and the interlock elements together form a continuous column of rigid elements extending beyond the outermost operating members, the yieldable means bias the interlock elements to a position in which the locking pins are disposed entirely within the confines of the operating members, the interlock elements under the action of said yieldable means are operative for normally retaining the operating members in neutral position, and any of the operating members being operative upon being moved to active position for shifting the elements of the interlock means longitudinally along the column and thereby move the locking pins in other operating members partially into the cavities and thereby positively locking those operating members in neutral position.

11. The invention set out in claim **10** wherein the locking pins in the apertures of the operating members and those elements of the interlock means directly in engagement therewith, have mutually engaged surfaces forming camming means effective for biasing the operating members to neutral position, and effective upon movement of one of the operating members to active position for shifting the elements of the interlock means longitudinally in the direction of their alignment in the interlocking operation.

12. The invention set out in claim 1 wherein the operating members are generally circular disc-shaped and rockable about axes extending in the direction of alignment of the cells, the apertures in the operating members are displaced radially of their axis, the locking pins are generally cylindrical in shape with conical seats in the opposite ends and being of a length axially at least as small as the axial dimension of the operating members, said cavities include bores with counter-bores directly adjacent opposite sides of each operating member, the counter-bores are substantially of the same diameter as said apertures, balls are disposed between the ends of the interlock pins and respective conical seats in the locking pins, said balls are substantially the same diameter as said counter-bores whereby to substantially prevent transverse movement of the balls while enabling free-sliding movement thereof longitudinally of the bores, and adjustable plugs longitudinally outwardly of the yieldable means forming stop means for reaction of the yieldable means for biasing the interlock pins and balls inwardly, said plugs being adjustable for adjustably positioning the interlock pins and balls and for adjusting the compression on the biasing means.

13. The invention set out in claim 12 wherein the locking pins are of lesser dimension axially than the corresponding dimension of the operating members.

14. The invention set out in claim 1 wherein the aperture in a first of the intermediate operating members if of arcuate shape and of a circumferential length effectively equal to the full angular range of movement of the operating member, and the interlock means includes an element extending through said arcuate aperture and effectively engaging the operating members on opposite sides of the first operating member, whereby upon interlocking action produced by movement of one of the other operating members from neutral to active position, the element passing through the arcuate aperture in the first operating member moves independently of that operating member without producing any effect thereon, and whereby when one of the other operating members is in active position and the remaining ones of those other operating members are in locked position, said first operation member is capable of being moved throughout its full maximum range of movement.

15. Interlock mechanism of the character disclosed comprising, a body member having a longitudinal line of cavities therein, a plurality of operating members pivotally mounted in the body member and movable between neutral position and active position and having apertures therein displaced radially from their pivotal axes and so disposed that when the operating members are in neutral

position the apertures are in alignment with said cavities, certain of the operating members having apertures that are of substantially same dimension circumferentially and radially, and at least one other operating member having an aperture of circumferential extent effectively equal to the extent of angular movement of the operating member, locking pins in the apertures of the first ones of the operating members of axial extent at least as small as the corresponding dimension of the operating members, interlock elements in said cavities engaging said locking pins and one of them passing through the circumferentially elongated aperture in the other operating member, each of the first operating members being operative upon being moved from neutral position to active position for wedging the interlock elements longitudinally outwardly, and thereby shifting the locking pins in the remaining ones of those operating members partially out of the respective apertures and into the corresponding elements of the cavities whereby to positively lock the corresponding operating members in neutral position, the locking element passing through the circumferentially elongated aperture being shifted bodily therethrough without affecting the corresponding operating member, whereby when any of the first ones of the operating members are locked in neutral position, the other operating member can be shifted throughout its maximum angular range of movement.

16. The invention set out in claim 1 wherein said operating members includes a first group lockable in neutral position and a second group, locking means is provided for locking the operating members of the first group in neutral position, the operating members being arranged in longitudinal alignment and the locking means extend through the operating members of the second group, and each of the operating members of the first group is operative upon being moved to active position for shifting the locking means for locking all of the remaining operating members of the first group in neutral position without affecting those of the second group, whereby those of the second group can be moved throughout their full maximum range of movement independently of the conditions with respect to locking of those of the first group.

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F. D. SHOEMAKER, *Assistant Examiner.*