March 3, 1953 C. L. GARRISON 2,629,972

GRINDING MACHINE

Filed March 9, 1948 2 SHEETS—SHEET 1

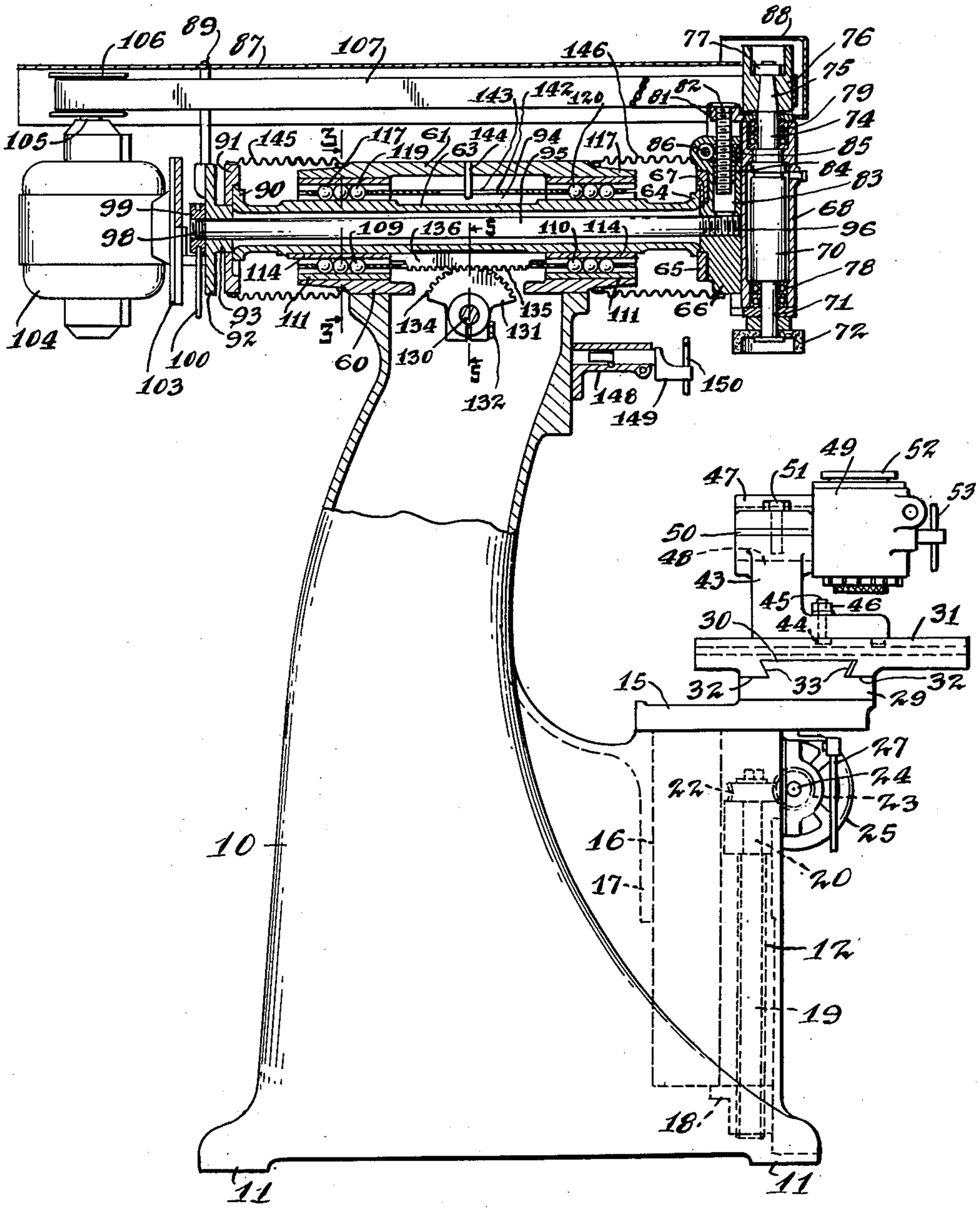

FIG-1-

Inventor
Clifford L. Garrison

By
Harry O. Ernsberger
Attorney

March 3, 1953 C. L. GARRISON 2,629,972

GRINDING MACHINE

Filed March 9, 1948 2 SHEETS—SHEET 2

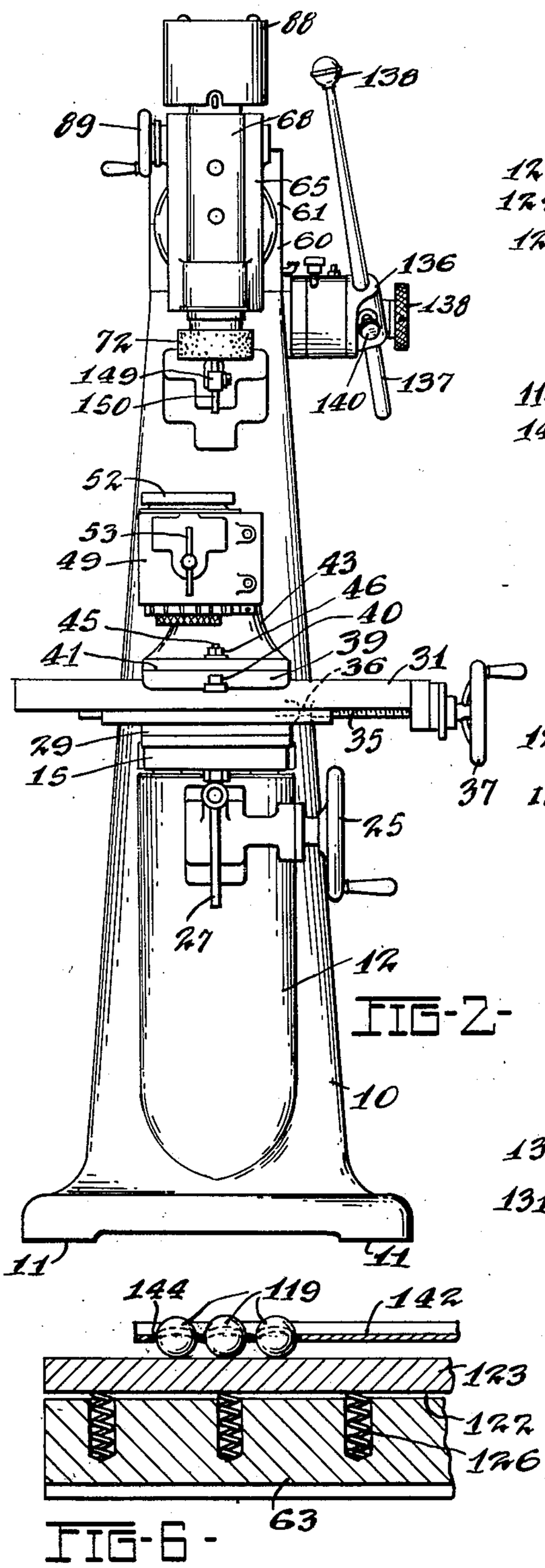

FIG-2-

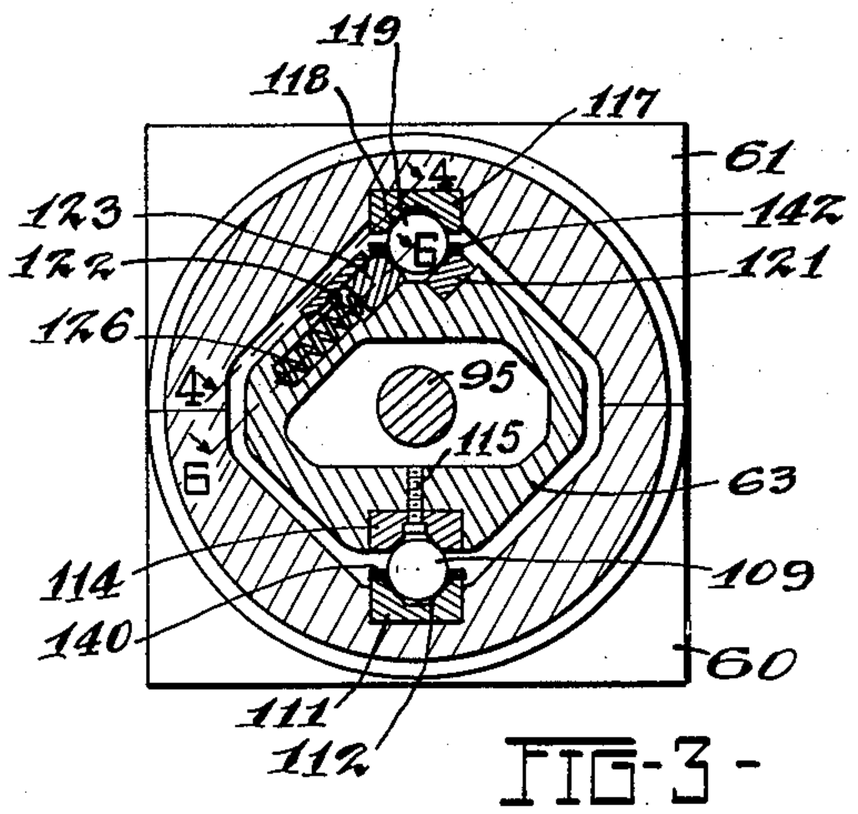

FIG-3-

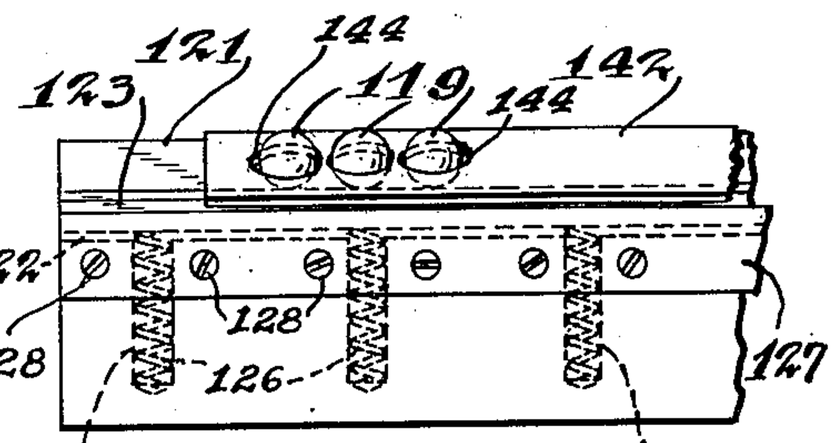

FIG-4-

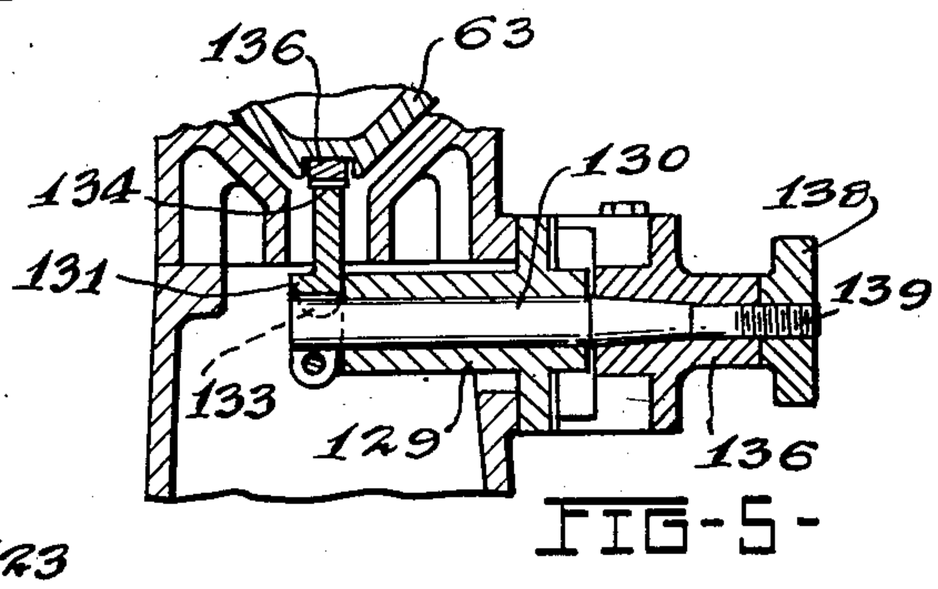

FIG-5-

FIG-6-

Inventor
Clifford L. Garrison

By
Harry O. Ensberger
Attorney

Patented Mar. 3, 1953

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UNITED STATES PATENT OFFICE

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GRINDING MACHINE

Clifford L. Garrison, Adrian, Mich., assignor to Oliver Instrument Company, Adrian, Mich., a corporation of Michigan

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6 Claims. (Cl. 51—56)

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This invention relates to anti-friction supporting means for longitudinally movable elements and more especially to mounting means for a reciprocable element of a machine tool or other precision instrumentality.

In the manufacture of precision instruments such for example as grinding machines having a reciprocable element, difficulties have been encountered in mounting or supporting such an element to provide for longitudinal movement and at the same time eliminate all relative lateral movement of the element. The presence of even the slightest amount of lateral movement renders the instrument unsatisfactory for precision use especially where close working tolerances are required.

My invention embraces the provision of anti-friction means arranged to support and guide a member movable in linear direction whereby the effort required to move the member is reduced to a minimum.

Another object of the invention resides in the provision of an anti-friction supporting and guiding means for machine elements, said means embodying an arrangement for automatically eliminating lost motion and compensating for wear of the parts.

Another object of the invention is the provision of anti-friction means for supporting and guiding a longitudinally movable ram wherein an arrangement is provided for biasing pressure on said means to eliminate lost motion, said pressure being biased in a direction so that it is unaffected by the weight of the ram and members associated therewith.

Still another object is the provision of an anti-friction support for a grinding machine ram wherein bearing balls are arranged in groups above and below the ram in combination with an arrangement for continuously applying lateral pressure upon the uppermost groups of bearing balls to automatically compensate for wear of the parts and eliminate lost motion in lateral directions.

A further object of the invention is the provision of means for maintaining the anti-friction elements for supporting and guiding the ram in proper operable relation.

Further objects and advantages are within the scope of this invention such as relate to the arrangement, operation and function of the related elements of the structure, to various details of construction and to combinations of parts, elements per se, and to economies of manufacture and numerous other features as will be apparent from a consideration of the specification and drawing of a form of the invention, which may be preferred, in which:

Figure 1 is a side elevational view of a grinding machine, certain parts being shown in section illustrating my invention;

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Figure 2 is an end elevational view of the machine shown in Figure 1;

Figure 3 is an enlarged transverse sectional view taken substantially on the line 3—3 of Figure 1;

Figure 4 is a fragmentary detail sectional view taken substantially on the line 4—4 of Figure 3;

Figure 5 is a detail sectional view taken substantially on the line 5—5 of Figure 1, and

Figure 6 is a detail sectional view taken substantially on the line 6—6 of Figure 3.

While I have illustrated a form of my invention utilized as a support and guiding means for a reciprocable ram of a grinding machine, it is to be understood that I contemplate the use of my invention with any device or apparatus wherever the same may be found to have utility.

Referring to the drawings in detail, the grinding machine embodying my invention is inclusive of a frame or base 10 provided with supporting feet 11, the frame 10 being integrally formed with a forwardly extending pedestal portion 12 upon which is mounted mechanism for supporting tools or other articles to be operated upon by the grinding wheel. The mechanism for supporting a tool or other article to be ground is inclusive of a horizontally disposed table portion 15 secured to the upper end of a ram or post 16 vertically disposed in suitable guiding means 17 formed within the pedestal 12. Secured to the lower end of the ram 16 is an interiorly threaded portion 18 within which extends a threaded shaft or screw 19 arranged in parallelism with the axis of movement of the ram 16. The upper portion of the screw 19 terminates in a tenon portion 20 upon which is fixedly secured a worm wheel 22 adapted to be driven by means of a worm 23 secured upon a transversely extending shaft 24, the latter being rotated through the medium of a suitable hand wheel 25. Rotation of the hand wheel 25 will elevate or lower the table 15 dependent upon the direction of rotation of the wheel. Suitable locking means (not shown) is provided for securely retaining the ram 16 in adjusted position, the locking means being manipulated by a handle 27.

Securely mounted upon the horizontal table 15 is a member 29 formed with an upwardly-extending dove tail-shaped tang 30 upon which is slidably mounted a member 31. The horizontal surfaces 32 and angularly disposed surfaces 33 of member 29 cooperate with correspondingly configurated surfaces on portion 31 so that the latter may be adjusted transversely of the member 29. The adjusting means for member 31 includes a revoluble screw 35 cooperating with a threaded portion 36 carried by member 29. The screw 35 is provided with a suitable hand

wheel 37 for rotating the screw to secure slidable adjustment of member 31.

Member 31 is provided with a raised portion 39 provided with a T-shaped slot 40 extending at right angles to the axis of the threaded shaft 35. The upper surface 41 of the raised portion 39 is adapted to support a bracket 43. The bracket 43 is provided with suitable depending projections 44 which extend into the slot 40 to properly position the bracket 43 upon the boss 39. A bolt 45 extends downwardly through the bracket 40 and is formed with a head portion adapted to fit within the enlarged portion of the T-shaped slot 40. The bracket 43 may be adjusted forwardly and rearwardly and locked in adjusted position by manipulating the securing nut 46 on the bolt 45. The bracket 43 is provided with a boss portion 47 bored horizontally to accommodate a tenon 48 formed upon a fixture 49, the boss portion 47 of bracket 43 being split at one side as shown at 50 and provided with a bolt 51 which may be drawn down to securely hold the tenon 48 within the boss portion 47. By this means, the fixture may be adjusted angularly with respect to the bracket 43. The fixture 49 is formed with a hollow interior in which is disposed suitable bearings (not shown) adapted to support an arbor 52, the latter being adapted to support cutters and other types of tools to be ground upon the machine. A locking means 53 is provided for securing the arbor 52 in adjusted position in the fixture 49. The arbor 52 is arranged for rotation in order to bring various portions of a cutter or tool into a position to be operated upon by the grinding wheel.

The upper portion of the frame 10 is configurated to support the grinding wheel, means for driving the wheel and an arrangement for reciprocating the grinding wheel to carry on grinding operations. Mounted upon the frame 10 is a semi-cylindrical member 60 which mates with a similarly shaped member 61, the members 60 and 61 being secured together by suitable means (not shown). The members 60 and 61 together provide a hollow chamber through which extends an element or ram 63 which is arranged to carry or support the grinding wheel and driving means therefor. The ram 63 is formed at its forward extremity with a flange 64 which is secured to a plate 65. Mounted upon the plate 65 is a member 66 which is formed with a tenon portion 67 extending into a cylindrical central bore formed in plate 65 whereby member 66 may be rotated with respect to the plate 65 and ram 63. The member 66 is formed with vertically extending ways (not shown) within which is slidably mounted a cylindrically shaped housing 68. The housing 68 is formed with a hollow interior in which is disposed a shaft or arbor 70 provided with a tenon 71 at its lower portion, the latter being arranged to support a grinding wheel 72. The arbor 70 is formed at its upper end with a cylindrical tenon portion 74 terminating in a tapered shank 75 upon which is mounted a pulley 76, the latter being held in position by means of a nut 77 threaded upon a projection formed on the shank 75. The grinding wheel supporting arbor 70 is mounted in suitable anti-friction bearings 78 and 79 respectively disposed adjacent the tenons 71 and 74. Projecting rearwardly of the housing 68 at its upper portion is a member 81 which is secured to a threaded shaft 82, the latter depending into a bore or well 83 formed in member 66. Disposed in the well 83 and having its interior surface in threaded engagement with the shaft 82 is a nut or sleeve 84. Formed upon the sleeve is a worm wheel 85 having a threaded bore in threaded engagement with the shaft 82 the worm wheel being driven by means of a worm 86 formed upon a shaft extending transversely of the grinding machine. The worm wheel 86 and supporting shaft are rotated by means of a hand wheel 89. By manipulation of the hand wheel, the housing 68, grinding wheel 72 and parts associated therewith may be elevated or lowered to regulate the relative position of the grinding wheel in a direction axially of the arbor 70.

The rear end of the ram 63 is formed with a flange portion 90 to which is secured a circular plate 91. Disposed rearwardly of the plate 91 is a member 92 having a centrally disposed tenon 93 fitting into a cylindrical opening formed in plate 91. Extending through the hollow interior 94 of the ram 63 is a rod or shaft 95, its forward end being threaded as at 96 and extending into a threaded bore in member 66. The rear extremity of shaft 95 is threaded as at 98 and is adapted to receive a securing nut 99 provided with a handle 100 for ease of manipulation. When the nut 99 is "backed off," this effects a release of member 66 with plate 65 and member 92 with plate 91 so that the mechanism carried by members 66 and 92 may be rotated or radially adjusted about the axis of the shaft 95 for the purpose of changing the relative angular position of the grinding wheel 72 with respect to the axis of the ram 63.

Secured to the plate 92 is a bracket 103 upon which is supported a motor 104, the latter providing a driving means for the grinding wheel 72. The motor is provided with a shaft 105 upon which is supported a pulley 106. The belt 107 takes over the pulley 76 carried by the grinding wheel supporting arbor 70 and the pulley 106 whereby rotation is imparted to the grinding wheel 72 when the motor 104 is energized. As will be seen from Figure 1, the motor and its mounting means carried by the plate 92 are also moved to an angular position whenever the members 66 and 92 are rotated about the axis of shaft 95. When the grinding wheel 72 and the driving means therefor have been adjusted to the desired angular position they may be locked in such position by drawing up the nut 99 through the medium of the handle 100. A belt guard 87 and a cover 88 are provided which are supported upon rods 89 and upon the housing 68.

The ram 63 is arranged to be supported by two groups of anti-friction bearing means 109 and 110 which in the embodiment illustrated are disposed beneath the ram 63 as particularly shown in Figure 3, each of the groups of bearing balls 109 and 110 being disposed in ways 111 carried in the frame portion 60 and secured thereto by suitable means (not shown). The ways 111 have longitudinally extending V-shaped configurations 112 for the purpose of guiding the bearing balls in a straight line. The ways 111 are preferably fabricated of hardened metal to minimize wear. The lower portion of the ram 63 is provided with ways 114 similar in shape to the ways 111 which engage the bearing balls in the manner shown in Figure 3. The ways 114 are secured to the ram 63 by means of cap screws 115. The ways 114 are also preferably made of hardened metal.

Disposed above the ram 63 and carried by the

frame member 61 are ways 117 having V-shaped configurations 118 adapted for engagement with spaced groups or series of bearing balls 119 and 120 as shown in Figures 1 and 3. Secured to the ram 63 is a pair of bars of hardened metal 121 each being adapted for engagement with one of the groups of bearing balls 119 and 120 in the manner shown in Figure 3. The ram 63 is also provided with a longitudinally extending recess 122 adapted to accommodate a bar or relatively movable way member 123 which is arranged for lateral slidable movement in the recess 122 and is adapted for engagement with bearing balls 119 and 120 in the manner illustrated in Figure 3. The ram 63 is formed with a plurality of spaced wells or bores 125 within which are disposed resilient members 126 in the form of expansive coil springs for exerting a pressure or bias transversely against the way bar 123 to continuously urge the latter into contact with the groups of anti-friction members or bearing balls 119 and 120. The way bar 123 is maintained in the recess 122 by means of a plate or member 127 held in place by a plurality of screws 128.

As will be noted from Figure 3, the weight of ram 63 and associated parts carried thereby including the motor 104 and the grinding wheel assembly is borne by the lowermost groups of bearing balls 109 and 110. The upper groups of anti-friction members 119 and 120 while operating as guiding means for the ram 63 are subjected to substantially little or no weight of ram assembly. Thus the pressure bias exerted by bar 123 under the influence of coil springs 126 acting in an angular direction as shown in Figure 3 provides a means for at all times wedging the groups of bearing balls 119 and 120 between the ways 117 carried by frame member 61 and the ways 121 carried by the ram 63 so that any tendency for vertical or lateral lost motion to arise between the ram 63 and the frame members 60 and 61 is eliminated. Furthermore any wear of the anti-friction members or the guiding ways will be compensated by the automatic "take up" movement of the spring pressed bar 123. By this means the grinding machine is rendered especially adaptable for accurate or precision work as the ram 63 is at all times maintained against relative lateral or vertical movement.

An arrangement is provided in the embodiment illustrated for reciprocating the ram by manual means although other means may be utilized if desired. To this end, as shown in Figures 1 and 5, there is journaled in a bearing member 129 in the upper end of frame 10 a transversely extending shaft 130 upon which is mounted a sector 131 secured to the shaft 130 by a clamping screw 132 and a suitable key 133. The frame 10 is of hollow configuration as shown in Figure 1, not only for the purpose of reducing the weight of the grinding machine to a minimum but to accommodate the ram actuating sector 131. The peripheral portion of the sector 131 is provided with a plurality of teeth 134 which are adapted to mesh with teeth 135 formed on a toothed rack 136 carried by the ram 63.

Mounted upon the shaft 130 is a fitting 136 which is bored to accommodate a handle member 137 and having a manipulating knob 138. The handle 137 is held in position by means of a suitable screw 140. The fitting 136 is frictionally held to the shaft 130 by means of a knurled nut 138 cooperating with the threaded end 139 of the shaft 130. It will be apparent that movement of the handle 137 will actuate

sector 131 and move the rack 136, the ram 63, motor 104 and grinding wheel 72 in a fore and aft direction so as to reciprocate the grinding wheel into and out of engagement with the work that may be carried by the supporting member or work holder 52.

The groups of anti-friction members of bearing balls 109 and 110 are held in proper spaced relation by means of a spacing plate or cage 140, the plate being provided with independent circular openings to accommodate the bearing balls and a slot to accommodate the rack 136. The uppermost groups of bearing balls 119 and 120 are held in proper spaced relation by means of a spacing plate 142 which, like the plate 140 is provided with two groups of circular openings 144 as shown in Figures 4 and 6 to receive the bearing balls and retain them in slightly spaced relation at all times to minimize friction. The central portion of plate 142 is provided with a slot 143 as shown in Figure 1 to accommodate a pin 144 carried by the frame member 61. The pin 144 cooperating with the slot in plate 142 serves as a guide for the plate to limit the movement thereof, thus maintaining the groups of anti-friction members at all times in proper spaced relation in the ways.

Means are provided to prevent the ingress of dust, abraded metal particles and other foreign material from reaching the anti-friction bearing members and associated elements. To this end there is secured to the ends of the frame members 60 and 61 bellows-like members 145 and 146 which are respectively connected to the plate 91 and to member 66. The bellows-like members 145 and 146 are made of flexible material such as fabric or rubber and are extensible and contractable to permit the reciprocating of the ram 63 and members carried thereby. The bellows-like members at all times provide closed chambers for the ram supporting mechanism contained within the frame of the grinding machine.

Secured to the forward wall of the frame 10 is a bracket 148 which supports a fitting 149 provided with a grinding wheel truing tool or diamond 150. The fitting 149 and diamond 150 are adjustable in order that the diamond may be brought into cooperative relation with the grinding wheel 72.

It is apparent, that within the scope of the invention, modifications and different arrangements may be made other than is herein disclosed, and the present disclosure is illustrative merely, the invention comprehending all variations thereof.

What I claim is:

1. In combination, a support member, a member mounted for reciprocable movement on said support member, said support member having a way thereon at one side thereof and said member having an opposed way, a series of bearing balls disposed between and in contact with said two opposed ways, said support member having a second way at another side thereof and said member having a second way opposed to the second way of said support member, a second series of bearing balls disposed between and in contact with the two second opposed ways, one of said second ways comprising a fixed bar fixed to its respective member, and a movable bar, both bars extending longitudinally of said raceway, and spring means engaging said movable bar and resiliently holding said movable bar in engagement with said second series of bearing balls.

2. In combination, a support member, a member mounted for reciprocable movement on said

support member, and means for slidably mounting said member for reciprocating movement on said support member comprising a V-shaped way carried by said support member, an opposed V-shaped way carried by said member at one side thereof, a series of bearing balls disposed between and in contact with said two opposed ways, a second V-shaped way carried by said support member, a second V-shaped way carried by said member at another side thereof and opposed to the first-named second V-shaped way, a second series of bearing balls disposed between and in contact with the two second opposed ways, one of said V-shaped ways comprising a fixed bar fixed to its respective member constituting one leg of its V-shape, and a movable bar constituting the other leg of its V-shape, and spring means engaging said movable bar and resiliently biasing said movable bar constantly into engagement with said second series of bearing balls.

3. In combination, a support member, a member mounted for reciprocable movement on said support member, and means for slidably mounting said member for reciprocating movement on said support member comprising a V-shaped way carried by said support member, an opposed V-shaped way carried by said member at one side thereof, a series of bearing balls disposed between and in contact with said two opposed ways, a second V-shaped way carried by said member at the opposite side of said member, a second V-shaped way carried by said support member and opposed to the second V-shaped way carried by said member, a second series of bearing balls disposed between and in contact with the two second opposed ways, one of said V-shaped ways comprising a fixed bar fixed to its respective member constituting one leg of its V, and a movable bar constituting the other leg of its V, and spring means engaging said movable bar and resiliently biasing said movable bar constantly into engagement with said second series of bearing balls.

4. In combination, a support, a ram mounted upon the support for horizontal reciprocating movement relative thereto, two bearing raceways carried by said support and disposed, respectively, above and beneath said ram, two bearing raceways carried by said ram and disposed, respectively, at the upper and lower sides thereof and opposed, respectively, to the two raceways on said support, groups of bearing balls disposed between and in engagement with opposed raceways, the upper raceway on said ram comprising two bars that extend longitudinally of said upper raceway and at least one of which is movable, said bar engaging the upper group of bearing balls in a plane angularly disposed with respect to a plane passing through the loci of movement of the upper and lower groups of bearing balls, and a plurality of springs engaging said one movable bar and constantly biasing said bar into engagement with said upper group of bearing balls.

5. In combination, a support having a substantially horizontal passage therethrough, a ram reciprocable longitudinally in said passage, bearing means supporting said ram for reciprocating movement in said passage comprising a generally V-shaped raceway on said support beneath said ram and extending longitudinally of said ram, an opposed generally V-shaped raceway on said ram at the lower side thereof and extending longitudinally of said ram, a series of bearing balls

disposed between and in contact with said opposed raceways, a generally V-shaped raceway carried by said support and disposed above said ram and extending longitudinally thereof, a generally V-shaped raceway carried on the upper side of said ram and disposed longitudinally thereof and opposed to the last-named raceway, a second series of bearing balls disposed between and in contact with the two last-named raceways, the upper raceway on said ram comprising a bar fixed to said ram and extending longitudinally thereof and disposed at one side of a plane bisecting said raceway, a second bar movably mounted on said ram and extending longitudinally thereof and disposed at the opposite side of said plane, and resilient means disposed between said second bar and said ram and pressing normally against said second bar and holding the second bar resiliently constantly in engagement with said second series of bearing balls.

6. In combination with a grinding machine having a frame, and a ram reciprocable horizontally on said frame and carrying a grinding wheel and driving means therefor, of means for supporting said ram for reciprocation on said frame comprising a pair of generally V-shaped raceways carried by said frame and extending longitudinally of said ram and disposed, respectively, above and below said ram, a generally V-shaped raceway carried by said ram at the lower side thereof and extending longitudinally thereof and opposed to the lower of said pair of raceways carried by the frame, a generally V-shaped raceway carried by said ram at the upper side thereof and extending longitudinally thereof and opposed to the upper of the two raceways carried by the frame, a series of bearing balls between and in contact with the two opposed lower raceways, and a series of bearing balls between and in contact with the two opposed upper raceways, the upper raceway on said ram comprising a bar that is disposed longitudinally of said ram at one side of a plane bisecting all said raceways, and spring means carried by said ram and acting on said bar in a direction normal thereto to bias said bar constantly into engagement with said second series of bearing balls.

CLIFFORD L. GARRISON.

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