United States Patent [19]

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[11] **3,736,114**

[45] **May 29, 1973**

[54] **THREE POINT CONTACT STEADY REST**

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[22] Filed: **Dec. 6, 1971**

[21] Appl. No.: **204,953**

[52] **U.S. Cl.** .....**51/238 S,** 82/38, 82/39

[51] **Int. Cl.** **B24b 41/06**

[58] **Field of Search** .....51/238 R, 238 GG, 51/238 S; 82/39, 38; 269/229, 232, 235, 237, 238, 218, 156

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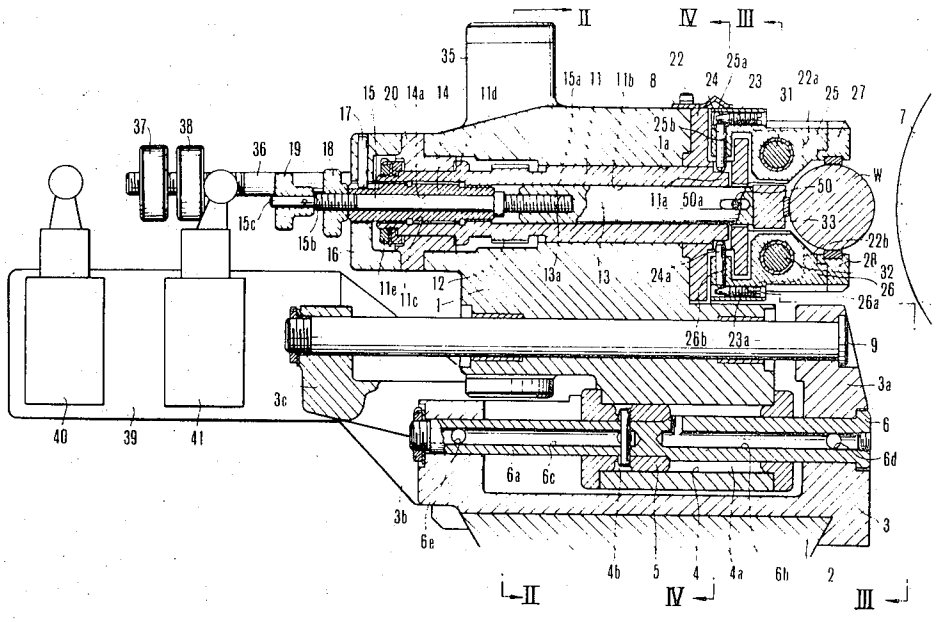
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[57] **ABSTRACT**

In a steady rest for supporting a workpiece of the type comprising upper, lower and side contact shoes adapted to engage the workpiece and means for simultaneously moving the contact shoes toward and away from the workpiece, there are provided a main body of the steady rest having a bore, a sleeve rotatably received in the bore, means provided for the main body for rotating the sleeve, a rest shaft slidably contained in the sleeve, means for mounting the side contact shoe on one end of the rest shaft, means responsive to the rotation of the sleeve for axially moving the rest shaft, an upper contact shoe supporting member pivotally mounted on the main body, a lower contact shoe supporting member pivotally mounted on the main body, and means responsive to the rotation of the sleeve for pivotally rotating the upper and lower contact shoe supporting members in the opposite directions whereby the upper, lower and side contact shoes are moved simultaneously toward and away from the workpiece by the rotation of the sleeve.

7 Claims, 4 Drawing Figures



PATENTED MAY 29 1973

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SHEET 1 OF 2

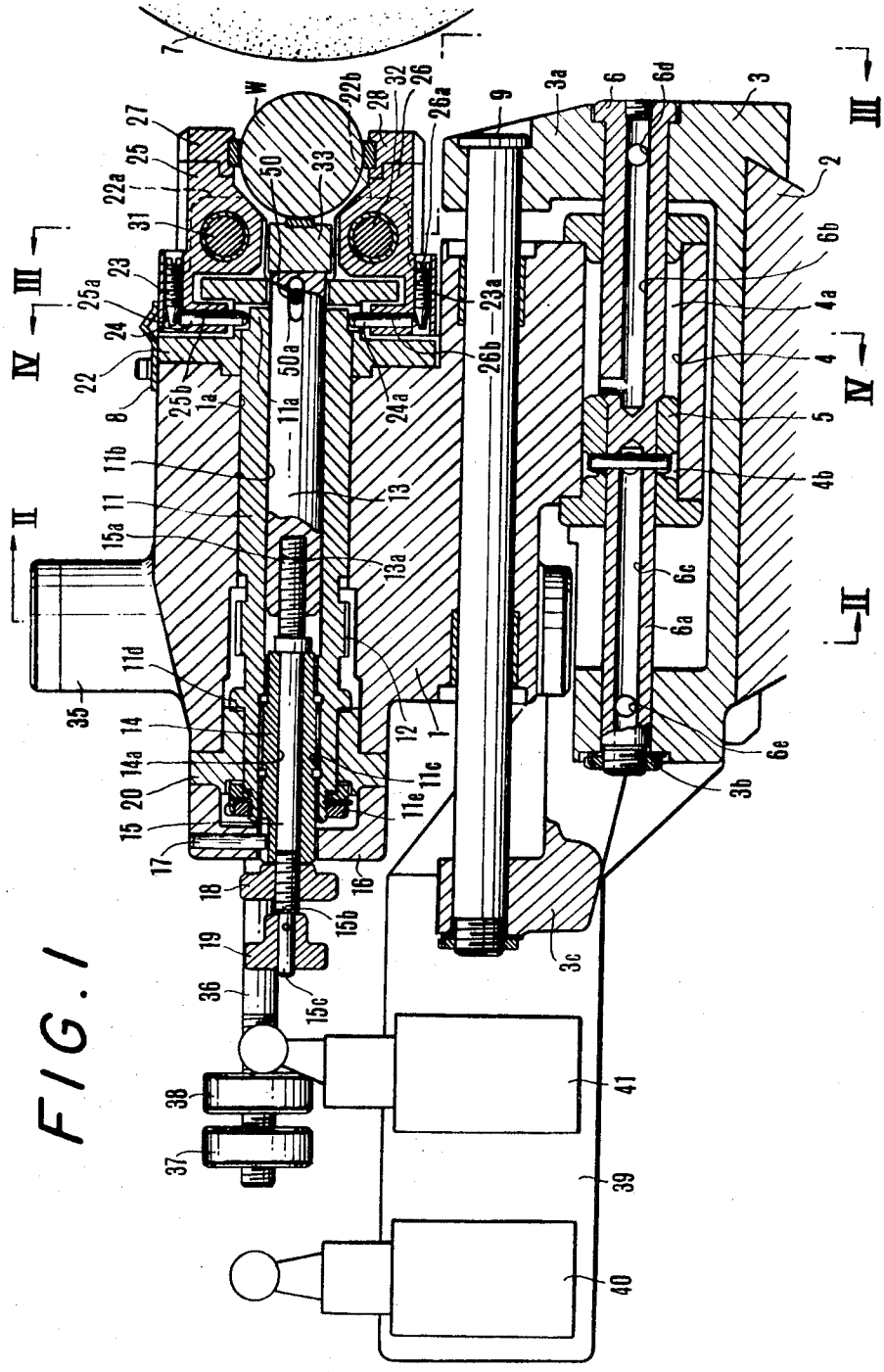


FIG. 1

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FIG. 4

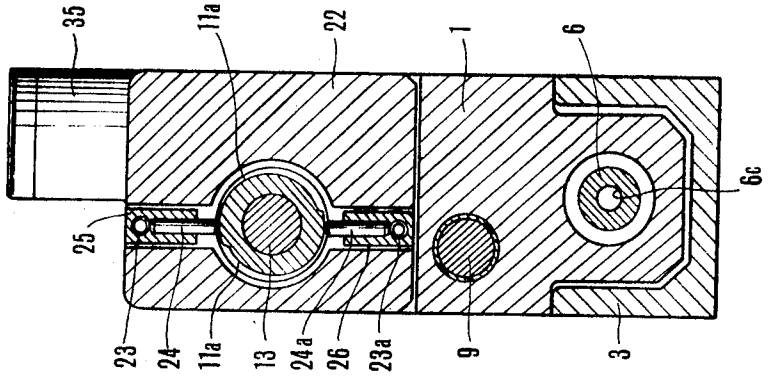


FIG. 3

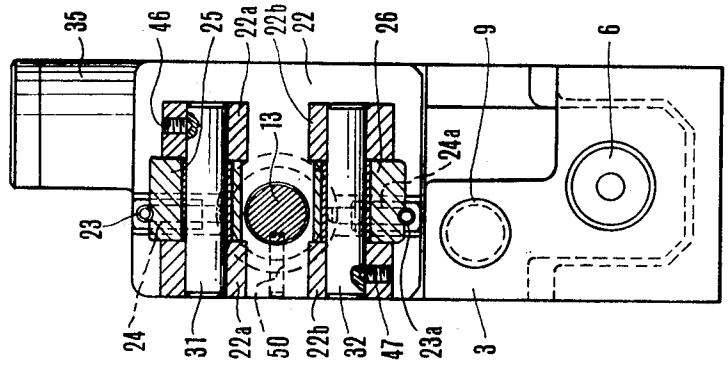
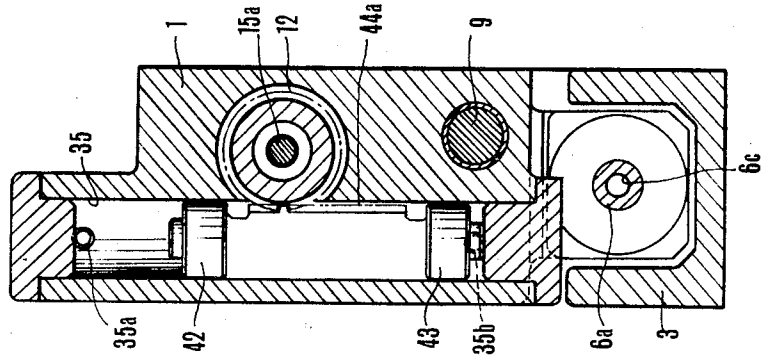


FIG. 2



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THREE POINT CONTACT STEADY REST

BACKGROUND OF THE INVENTION

This invention relates to a three point contact type steady rest for a workpiece capable of precisely working a relatively long workpiece without deformation caused by cutting resistance or grinding resistance. A prior art steady rest used for steadily supporting a workpiece on a grinding machine, for example, generally comprises two contacts, one supporting the lower side and the other the lateral side of the workpiece. With such a two point contact type steady rest, where the contact point between the workpiece and the grinding wheel moves in the vertical direction as in the case of grinding a cam of a cam shaft, or where the center of gravity of the workpiece does not coincide with the center of rotation so that the workpiece becomes unbalanced during working, it is impossible to positively prevent the vibration of the workpiece, thus permitting the workpiece to vibrate in the vertical direction. In a modern high speed grinding operation wherein the peripheral speed of the grinding wheel has been increased twice it is also necessary to correspondingly increase the peripheral speed of the workpiece with the result that the workpiece tends to move upwardly away from the supporting pieces of the steady rest thus greatly degrading the accuracy of the working.

SUMMARY OF THE INVENTION

It is an object of this invention to provide an improved steady rest capable of eliminating the difficulty described above.

Another object of this invention is to provide an improved steady rest of compact design wherein upper, lower and side contact shoes adapted to engage a workpiece can be operated simultaneously by a single operating device.

Still another object of this invention is to provide a new and improved steady rest in which the upper, lower and side contact shoes can be adjusted individually with respect to the workpiece and after such adjustment can follow reduction in the diameter of the workpiece so as to engage therewith always with a constant contact pressure.

According to this invention, there is provided a steady rest for supporting a workpiece of the type comprising upper, lower and side contact shoes adapted to engage the workpiece and means for simultaneously moving the contact shoes toward and away from the workpiece, characterized in that there are provided a main body of the steady rest having a bore, a sleeve rotatably received in the bore, means provided for the main body for rotating the sleeve, a rest shaft slidably contained in the sleeve, means for mounting the side contact shoe on one end of the rest shaft, means responsive to the rotation of the sleeve for axially moving the rest shaft an upper contact shoe supporting member pivotally mounted on the main body, a lower contact shoe supporting member pivotally mounted on the main body, and means responsive to the rotation of the sleeve for pivotally rotating the upper and lower contact shoe supporting members in the opposite directions whereby the upper, lower and side contact shoes are moved simultaneously toward and away from the workpiece by the rotation of the sleeve.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention can be more fully understood from the following detailed description taken in conjunction with the accompanying drawings, in which

FIG. 1 shows a longitudinal section of a steady rest constructed in accordance with the teaching of this invention;

FIG. 2 shows a cross-sectional view taken along a line II—II in FIG. 1; and

FIG. 3 and 4 show cross-sectional views taken along lines III—III and IV—IV, respectively in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The embodiment of this invention illustrated in the accompanying drawings comprises a main body 1 supported on a base 3 mounted on a slide table 2 of a grinding machine, for example. Upward projections 3*a*, 3*b* and 3*c* are formed on the opposite sides of base 3, and a pilot bar 9 is provided between projections 3*a* and 3*c* to mount the main body 1 to be slidable toward and away from the axis of a workpiece W. The main body 1 is moved by means of a cylinder 4 containing a piston 5 including a piston rods 6 and 6*a* located beneath the main body 1. The opposite ends of the piston rods 6 and 6*a* are secured to projections 3*a* and 3*b* so that when fluid under pressure is introduced into the cylinder, the main body 1 is moved therewith instead of moving piston 5. On the upper portion of the main body, is formed a through bore 1*a* for rotatably receiving a sleeve 11. A cylinder 35 is provided at a right angle with respect to the axis of sleeve 11 for containing a pair of spaced apart pistons 42 and 43 as shown in FIG. 2. Pistons 42 and 43 are interconnected by a rack 44*a* meshing a pinion 12 mounted at the center of sleeve 11. A thrust bearing member 20 secured to main body 1 is interposed between a flange 11*d* formed on sleeve 11 and a nut 11*e* applied onto the left hand end of sleeve 11 thereby preventing the axial movement of sleeve 11. Two spiral cams 11*a* which are symmetrical with respect to the axis of rotation are formed on the outer periphery of the fore (or right hand) end of sleeve 11. Sleeve 11 is formed with an axial bore 11*b* formed with screw threads 11*c* at the rear end. A rest shaft 13 is slidably received in bore 11*b* and is prevented from rotating by means of a pin 50 engaging an elongated slot 50*a*. Screw threads 11*c* received a threaded plug 14 which is prevented from rotating by means of a pin 17 extending through a cap 16 secured to thrust bearing member 20. Plug 14 is formed with an axial bore 14*a* to rotatably receive an adjusting bolt 15. The inner end of this bolt is provided with screw threads 15*a* adapted to be received in a threaded opening 13*a* on the left hand end of rest shaft 13. Screw threads 15*b* are formed on the outer end portion of adjusting bolt 15 and a reduced diameter portion 15*c* is formed on the outer end. A nut 18 is used for securely fixing adjusting bolt 15 to plug 14 and a knob 19 is secured to reduced diameter portion 15*c*. On the right hand end of rest shaft 13 is secured a side contact shoe or workpiece engaging member 33 adapted to engage the lateral side of workpiece W. Upper contact shoe 27 and lower contact shoe 28 adapted to engage the upper and lower sides of the workpiece W are secured to the outer ends of the upper and lower supporting members 25 and 26, respectively, which are pivotally mounted

on pivot pins 31 and 32 extending through projections 22*a* and 22*b* of a bracket 22 secured to the right hand end of main body 1. Axial threaded openings 25*a* and 26*a* and vertical openings 25*b* and 26*b* communicating with openings 25*a* and 26*a*, respectively, are formed on the inner ends of the upper and lower supporting members 25 and 26. Openings 25*b* and 26*b* receive radial pins 24 and 24*a*, having their inner ends engaged with cams 11*a*. Mating with threaded openings 25*a* and 26*a* are adjusting screws 23 and 23*a*, respectively having tapered ends engaging the outer ends of pins 24 and 24*a*. A threaded dog mounting bar 36 is connected to the left hand side of main body 1 to receive a pair of dogs 37 and 38 which are used to operate a pair of limit switches 40 and 41 for detecting the forward and rearward movements of the steady rest.

Before explaining the operation of the novel steady rest, adjustment of the positions of contact shoes will first be described. A master piece (not shown) finished to a prescribed dimension is mounted between a head stock and a tail stock (not shown) of a grinding machine, for example. Then, the positions of respective contact shoes 27, 28 and 33 are adjusted such that they lightly engage the periphery of the master piece on the upper, lower and lateral sides. This adjustment is made by moving the main body 1 to the extreme forward position shown in FIG. 1 and then advancing pistons 42 and 43 in cylinder 35 to their extreme forward positions shown in FIG. 2.

At this time, since rack 44*a* is engaging pinion 12, sleeve 11 is rotated to advance plug 14 mating with screw threads 11*c* provided for bore 11*b* of sleeve 11. When plug 14 is advanced to the forward position, nut 18 for fixing adjusting bolt 15 to plug 14 is loosened and then knob 19 is rotated to move forwardly rest shaft 13 so as to cause the side contact shoe 33 secured to one end of the rest shaft 13 to engage the peripheral surface of the master piece. After this adjustment, nut 18 is fastened to lock adjusting bolt 15. When sleeve 11 is rotated as above described, pins 24 and 24*a* are urged radially outwardly by the action of cams 11*a* whereby the upper and lower supporting members 25 and 26 are rotated about pivot pins 31 and 32 through adjusting screws 23 and 23*a* thus advancing the upper and lower contact shoes 27 and 28 toward the center of the master piece. At this time, adjusting screws 23 and 23*a* are adjusted to ensure uniform contact between shoes 27 and 28 and the peripheral surface of the master piece.

After adjusting the positions of contact shoes 27, 28 and 33 by using the master piece in a manner described above, the main body is retracted. Then, the master piece is removed and instead the workpiece W is mounted between the head stock and the tail stock of the grinding machine. Thereafter, the grinding wheel 7 is fed toward the workpiece to commence the grinding operation. Concurrently with the feeding of the grinding wheel 7, oil under pressure is admitted into a cylinder chamber 4*a* from an oil inlet port 6*d* through a conduit 6*b* extending through piston rod 6. As the main body 1 reaches the extreme fore end, dog 38 carried by bar 36 actuates limit switch 41 thus detecting the forward movement of the main body. After that, the oil under pressure is admitted into cylinder 35 through an oil inlet port 35*a* thus advancing pistons 42 and 43 to rotate pinion 12 and hence sleeve 11 by rack 44*a*. Rotation of the sleeve 12 causes rest shaft 13 to move toward the workpiece W through adjusting bolt 15 because plug 14 threaded into screw threads 11*c* is prevented from rotating by stop pin 17, whereby the side contact shoe 33 mounted on the fore end of rest shaft 13 is urged against the side surface of the workpiece W. Further, when sleeve 11 is rotated, cams 11*a* on one end thereof urge radially outwardly pins 24 and 24*a* received in openings 25*b* of the upper and lower supporting members 25 and 26. Outward movement of pins 24 and 24*a* which are normally held in engagement with adjusting screws 23 and 23*a* received in openings 25*a* and 26*a*, respectively, cause to rotate in the clockwise direction the upper supporting member 25 about pivot pin 31 and to rotate in the counterclockwise direction the lower supporting member 26 about pivot pin 32. Consequently, the upper and lower contact shoes 27 and 28 are caused to engage the upper and lower surfaces of the workpiece W. During the grinding operation the outer diameter of the workpiece is decreased gradually. However, since pistons 42 and 43 are urged by the oil of constant pressure, respective contact shoes 27, 28 and 33 are caused to follow the decrease in the outer diameter while always maintaining contacts therebetween. When the piston 43 reaches the extreme forward position, movements of the contact shoes 27, 28 and 33 are stopped. At this time feeding of the grinding wheel 7 is also stopped to perform spark out operation. After finishing the spark out operation, the grinding wheel 7 is retracted and oil under pressure is admitted into cylinder 35 through an inlet port 35*b* to retract pistons 42 and 43. As pistons 42 and 43 retract, rack 44*a* will rotate pinion 12 and hence sleeve 11 in the opposite direction to move plug 14 away from workpiece W, thus disengaging side contact shoe 33 from the workpiece via adjusting bolt 15. Further, when sleeve 11 is rotated in the opposite direction, cams 11*a* cause pins 24 and 24*a* to retract inwardly so that lower contact shoe 28 will be rotated about pivot pin 32 in the clockwise direction by its own weight while the upper contact shoe 27 will be rotated in the counterclockwise direction about pivot pin 31 by the action of a spring 8 interconnecting main body 1 and upper contact shoe 27. When contact shoes 27, 28 and 33 are simultaneously disengaged from workpiece W in this manner, oil under pressure is admitted into cylinder chamber 4*b* from an oil inlet port 6*e* through conduit 6*c* extending through piston rod 6*a*. Then, main body 1 will be retracted away from the workpiece. Then the finished workpiece is removed and another workpiece is mounted between the head stock and the tail stock and the operation described above is repeated.

As above described the upper, lower and side contact shoes are simultaneously moved toward and away from the workpiece by means of a single driving device through screws and cams. Moreover, it is possible to cause the upper and lower contact shoes to engage the workpiece with equal contact pressure and at definite positions. Accordingly, it is not only possible to simplify the construction of the steady rest but also to clamp the workpiece more positively than the well known two point contact type steady rest. In other words, it is possible to accurately maintain the axis of the workpiece at a definite position so as to prevent vertical vibration of the workpiece during high speed machining.

It is also possible to adjust individually the upper lower and side contact shoes by adjusting screws **23**, **23***a* and adjusting bolt **15** so as to cause the shoes to engage the workpiece with equal contact pressure. Thereafter, since these contact shoes are operated by the same fluid pressure piston cylinder assembly **35, 42, 43,** the contact shoes can be displaced equally to follow the reduction in the diameter of the workpiece.

Although the invention has been shown and described in terms of a preferred embodiment thereof, it will be clear that many changes and alternations will be obvious to one skilled in the art within the true spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. In a steady rest for supporting a workpiece of the type comprising upper, lower and side contact shoes adapted to engage the workpiece and means for simultaneously moving said contact shoes toward and away from said workpiece, the improvement comprising a main body of the steady rest having a bore, a sleeve rotatably received in said bore, means provided for said main body for rotating said sleeve, a rest shaft slidably contained in said sleeve, means for mounting said side contact shoe on one end of said rest shaft, means responsive to the rotation of said sleeve for axially moving said rest shaft, an upper contact shoe supporting member pivotally mounted on said main body, a lower contact shoe supporting member pivotally mounted on said main body, and means responsive to the rotation of said sleeve for pivotally rotating said upper and lower contact shoe supporting members in the opposite directions whereby said upper, lower and side contact shoes are moved simultaneously toward and away from said workpiece by the rotation of said sleeve.

2. The steady rest according to claim **1** wherein said main body is slidably mounted on a pilot bar and is moved along said pilot bar by driving means.

3. The steady rest according to claim **2** wherein said driving means comprises a piston-cylinder assembly located beneath said main body.

4. The steady rest according to claim **1** wherein said sleeve rotating means comprising a fluid pressure piston-cylinder assembly mounted on said main body, a rack operated by the piston of said fluid pressure piston cylinder assembly, and a pinion formed on said sleeve, said pinion meshing said rack.

5. The steady rest according to claim **1** wherein said means responsive to the rotation of said sleeve for axially moving said rest shaft comprises a plug having screw threads mating with screw threads provided on the inner surface of sleeve, means for preventing rotation of said plug but permitting axial movement thereof, an adjusting bolt extending through said plug and operatively connected to the opposite end of said rest shaft.

6. The steady rest according to claim **1** wherein said last mentioned means for operating said shoe supporting members comprises a pair of cams formed on the periphery of said sleeve, a pair of radially extending pins respectively interposed between said cams and said upper and lower contact shoe supporting members.

7. The steady rest according to claim **6** wherein said pins are operatively connected to said upper and lower contact shoe supporting members through adjusting screws, each of said adjusting screws having a tapered head engaging one end of said pin.

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