April 24, 1928. 1,667,109

P. E. GARLENT

LEAD TESTING MACHINE

Filed May 9, 1927 3 Sheets-Sheet 1

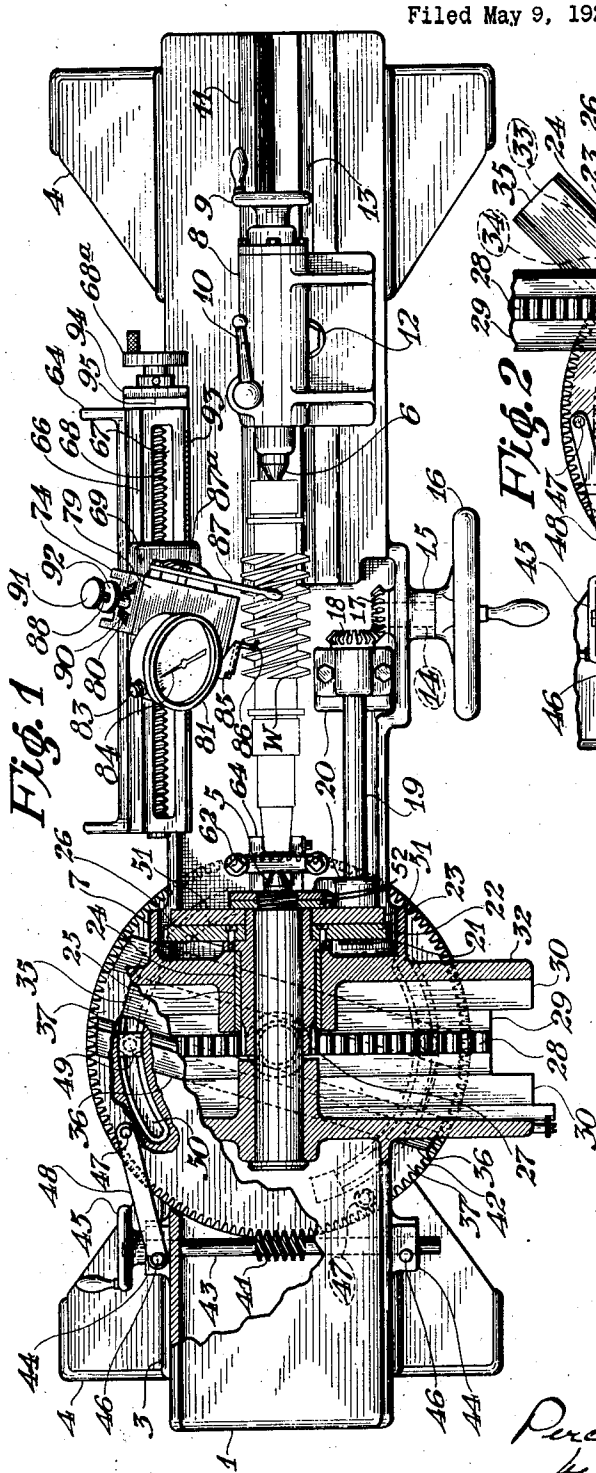


Fig. 1

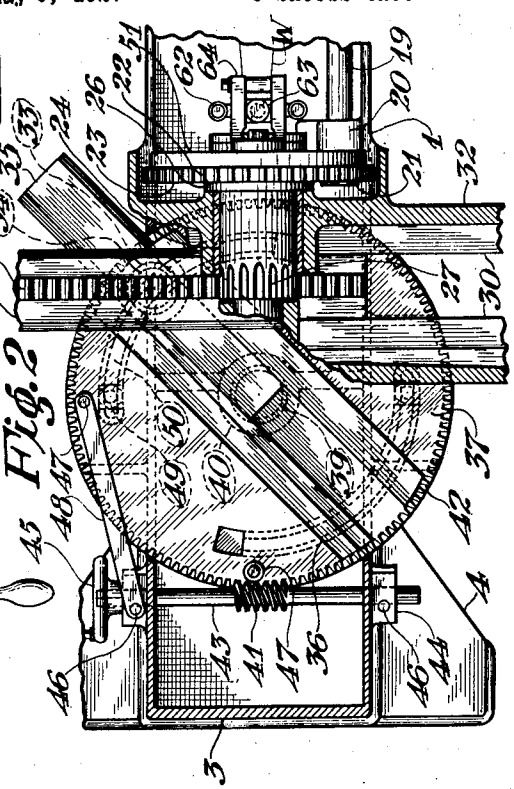


Fig. 2

Inventor:
Pierce E. Garlent
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LEAD TESTING MACHINE

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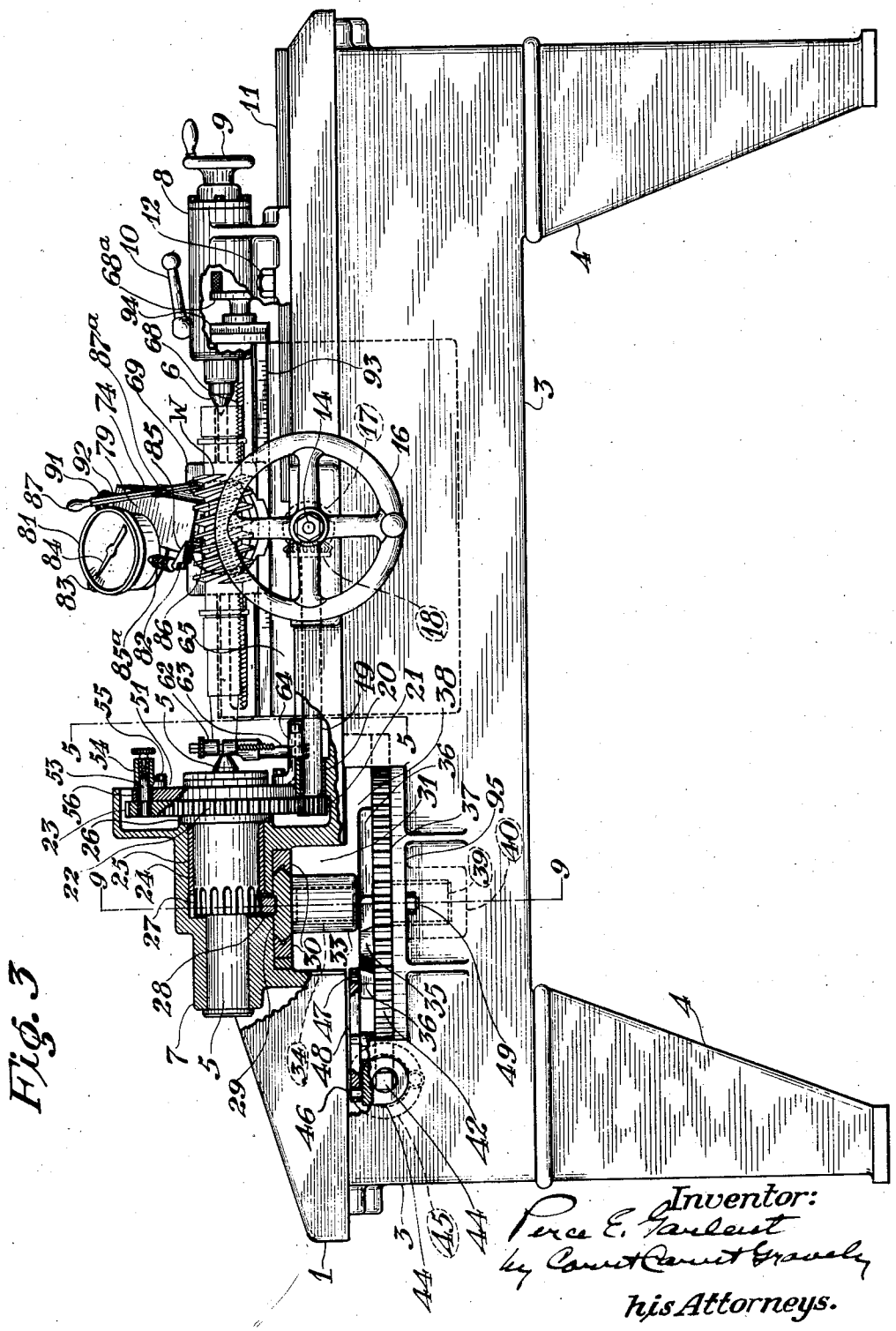


Fig. 3

Inventor:
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April 24, 1928. 1,667,109

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LEAD TESTING MACHINE

Filed May 9, 1927 3 Sheets-Sheet 3

Fig. 5

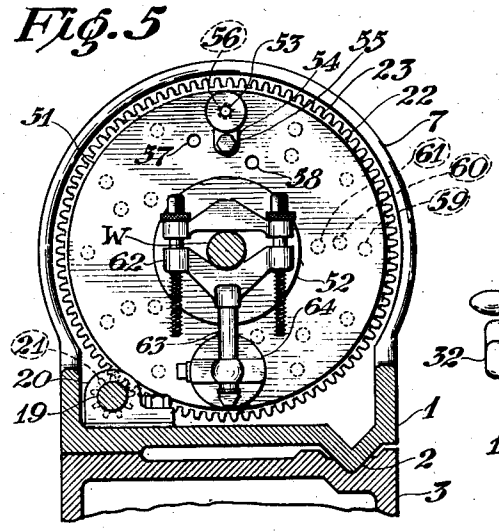


Fig. 4

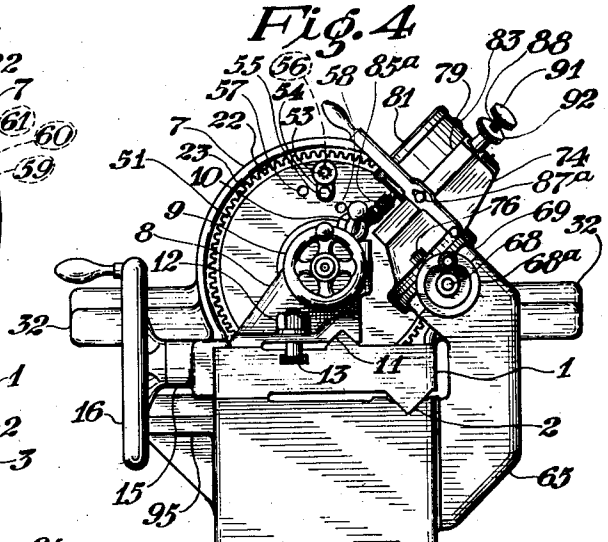


Fig. 6

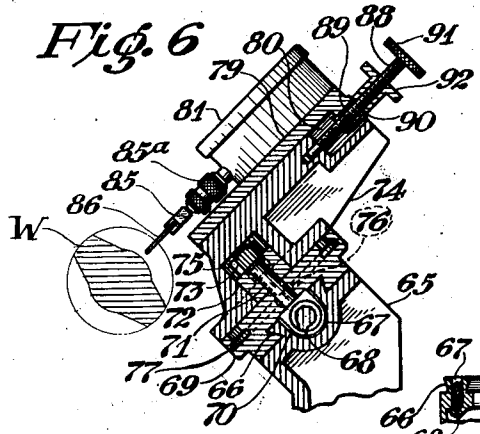


Fig. 7

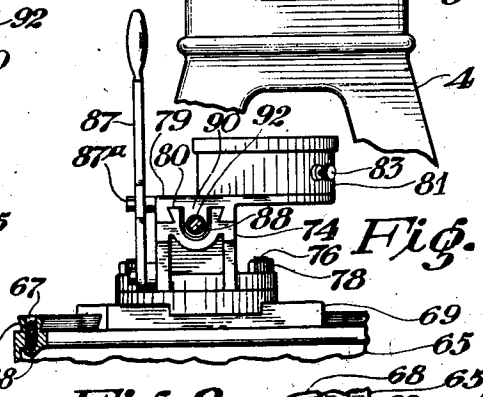


Fig. 9

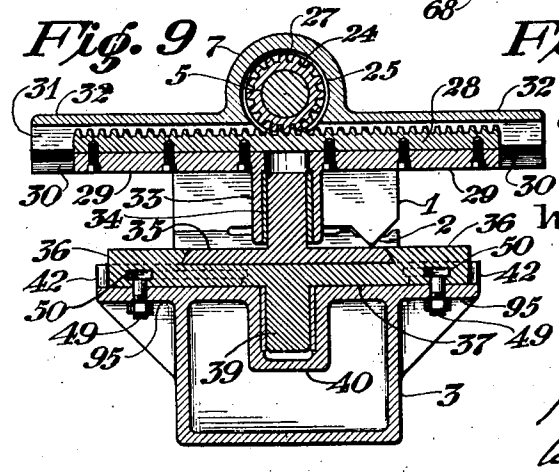
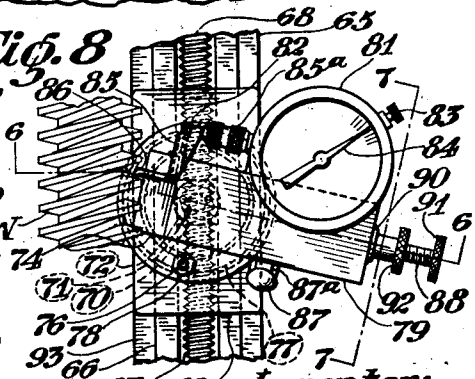


Fig. 8



Inventor:
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Patented Apr. 24, 1928. 1,667,109

UNITED STATES PATENT OFFICE.

PERCE E. GARLENT, OF DETROIT, MICHIGAN, ASSIGNOR TO THE TIMKEN-DETROIT AXLE COMPANY, OF DETROIT, MICHIGAN, A CORPORATION OF OHIO.

LEAD-TESTING MACHINE.

Application filed May 9, 1927. Serial No. 189,889.

This invention relates to lead testing machines and has for its principal objects to produce a machine that will accurately determine errors in the lead of screws and that can be adjusted to check the leads of single or multiple thread screws. Another object is to enable the machine to be set for any selected lead. Other objects are to provide means for measuring the pitch and the pressure angle of the thread and for checking the setting of the machine. The invention consists in the machine and in the parts and combinations of parts hereinafter described and claimed.

In the accompanying drawings which form part of this specification and wherein like symbols refer to like parts wherever they occur.

Fig. 1 is a plan view of a lead testing machine embodying my invention with the parts adjusted for gaging the double thread worm shown mounted therein, a portion of the head stock being shown in horizontal section to more clearly illustrate the invention;

Fig. 2 is a fragmentary view of the head stock portion of the machine, showing the bottom slide plate adjusted for a worm having a lead angle of 45 degrees;

Fig. 3 is a front elevation of the machine with a portion of the head stock shown in vertical section;

Fig. 4 is an end view of the machine;

Fig. 5 is a vertical section on the line 5—5 in Fig. 3;

Fig. 6 is a vertical section on the line 6—6 in Fig. 8;

Fig. 7 is a section on the line 7—7 in Fig. 8;

Fig. 8 is a fragmentary plan view of the parts shown in Figs. 6 and 7 looking at right angles to the plane of the top surface thereof; and

Fig. 9 is a vertical section through the head stock on the line 9—9 in Fig. 3.

My lead testing machine comprises a carriage 1 slidable on longitudinal ways 2 provided therefor along the top of a bed 3 supported on legs 4. The work that is to be tested is shown in the form of a worm, which is rotatably supported between the opposed conical ends of two axially alined horizontally disposed dead centers 5 and 6, which extend lengthwise of the carriage at the longitudinal center line thereof and are mounted, respectively, in a head stock 7 located at one end of the carriage 1, and a tail stock 8 located at at the other end of said carriage. The dead center 5 has a press fit in the small end of a bore in the head stock 7; and the dead center 6 is adjusted axially in the tail stock 8 by means of the usual hand wheel 9 and is clamped in the desired position of adjustment by means of the usual handle 10. As shown in the drawing, the tail stock is slidable on longitudinal ways 11 provided therefor along the top of the carriage 1 and is clamped in the desired position of sliding movement by means of a T-bolt 12 whose head fits within a T-slot 13 provided therefor in the carriage.

The mechanism for sliding the carriage 1 along the bed 3 preferably comprises a horizontal shaft 14 journaled in a bearing 15 in the front side of said carriage intermediate the head and tail stocks carried thereby. The shaft 14, which extends transversely of the longitudinal axis of the carriage, is provided at its outer end with a hand wheel 16 and at its inner end with a bevel gear 17. Said bevel gear 17 meshes with a similar gear 18 on one end of the horizontal shaft 19, which extends longitudinally of the carriage and is rotatably supported near its opposite ends in bearings 20 secured to the top of the carriage. The other end of the longitudinal shaft 19 is provided with a pinion 21 which meshes with gear teeth 22 formed in the peripheral surface of an index plate or disk 23 sleeved on the outer end of the tubular spindle 24 of the head stock 7. Said head stock spindle 24 comprises a cylindrical sleeve which is rotatably supported on the dead center 5 of the head stock and in bushing or bearing sleeve 25 pressed in the large end of the bore within whose smaller end is press fitted said dead center. The index plate or disk 23 is screwed and doweled to the front face of an annular flange 26 on the outer end portion of the spindle 24, whereby said spindle is forced to rotate with said index disk.

The inner end of the head stock spindle 24 is provided with external gear teeth 27 which mesh with the teeth of a horizontal rack 28 disposed beneath said spindle and extending transversely of the axis thereof. The rack 28 is screwed and doweled to the upper surface of a horizontal slide plate 29, which is supported for horizontal sliding

movement in directions transverse to the axis of the head stock spindle 24 in a slideway formed by spaced gibs 30 mounted in a channel 31 which extends from side to side of the carriage beneath the head stock and is extended on each side of said carriage by means of laterally extending channel-shaped brackets 32 formed integral with the head stock. The cross slide 29 is provided intermediate its ends with a depending bearing 33 within which is journaled an upstanding trunnion 34 on a slide plate 35 arranged for horizontal sliding movement in a radial slideway 36 formed in the upper surface of a horizontally disposed circular plate or disk 37 which rests flatwise in a recess 38 provided therefor in the upper surface of the bed. The disk 37 is provided at its center with a depending spindle 39 which is journaled in a pocket bearing 40 provided therefor in the bottom of the recess 38. As shown in the drawing, the axis of the rotary disk 37 intersects the axis of the head stock spindle and is perpendicular thereto, the radial slideway 36 in the upper surface of said disk extends through its center and is terminated at each end by the peripheral edge thereof, the slide plate 35 carried by said disk is substantially the same length as the diameter thereof, and the trunnion 34 on said slide plate is preferably formed integral therewith and is located substantially midway of the length thereof.

The disk 37, which slidably supports the lower slide plate 35, is turned or rotated to vary the angular position of said slide plate with relation to the upper slide plate 29 preferably by means of a worm 41 which meshes with teeth 42 cut in the peripheral surface of the disk. The worm 41 is carried on a horizontal worm shaft 43, which extends from side to side of the bed 3 with its ends rotatably supported in bearings 44 in the bed 3 and is rotated by means of a hand wheel 45 fixed to one end of said worm shaft.

In order to set the bottom slide plate 35 at an angle corresponding to the lead angle of the worm that is to be tested the machine is provided on each side of its longitudinal axis with a pair of upstanding pins 46 and 47 located, respectively, on the bed 3 and on the disk 37 which rotatably supports said bottom slide plate. Thus, with a certain spacing of the pins 46 and 47 a certain angular position of the bottom slide plate may be obtained. An accurate setting of the bottom slide plate may be readily obtained by means of a set of gaging devices in the form of links 48 provided with holes adapted to fit the pins 46 and 47. The holes in each link are spaced different distances apart; and a link which will set the bottom slide plate at an angle corresponding to the lead angle of a worm has the lead of such worm stamped thereon. Thus, the operator, knowing the lead of the worm that is to be tested, selects the link having such lead stamped thereon and uses said link to obtain an accurate setting of the bottom slide plate. As shown in the drawing a pair of pins 46 and 47 is located on each side of the machine to permit the bottom slide plate to be set for checking right and left hand worms. Although the links 48, when in engagement with the pins 46 and 47, prevent rotation of the disk 37 and thus hold the bottom slide plate in the proper angular position, said disk may also be locked against rotation by means of T-bolts 49, which extend through holes in the brackets 95 of the bed 3 and have their heads located in arcuate T-slots 50 in said disk.

Rotatably supported on the projecting forward end of the rotary head stock spindle 24 adjacent to outer face of the indexing disk 23 fixed thereon is a circular driving plate or disk 51 which is held on said spindle by means of jam nuts 52 threaded on the outer end of the dead center 5 of the head stock. The driving disk 51 is connected to and disconnected from the indexing disk 23 by means of a spring pressed indexing pin 53 slidable in a bracket 54 pivotally secured to the front face of said driving disk by means of a pivot screw 55. The bracket 54 may be swung on its securing screw 55 as a pivot to permit the spring pressed indexing pin 53 to enter any one of three holes 56, 57 and 58 which extend through the driving disk at equal distances from the pivotal axis of the bracket but at different distances from the spindle axis. The driving disk 51 is connected with the indexing disk 23 by passing the indexing pin through one of the three holes 56, 57 and 58 in said driving disk and a registering hole of one of three series of circularly arranged holes 59, 60 and 61 in said indexing disk. The three series of holes in the indexing plate are arranged in circles concentric to each other and to the spindle axis and at a distance therefrom which will permit each series of such holes to be brought into register with one of the three holes in the driving disk. By this arrangement the worm driving disk 51 may be connected to the gear driven indexing disk 23 by turning said driving disk to bring one of the three holes therein into register with one of the holes of one of the three series of holes in the indexing plate and then rotating the bracket 54 to a position which will permit the spring pressed indexing pin 53 to engage the registering holes in the two disks.

The worm is rotated on the dead centers of the head and tail stocks by means of a clamping dog 62 which engages the end of said worm located adjacent to the dead center of the head stock and is connected with the driving disk 51 for rotation therewith by means of an arm 63 which projects

radially from one member of said clamping dog and has its free end secured to a bracket 64 rigidly secured to the front face of said driving disk. By this arrangement, the worm is forced to rotates with the driving disk when the same is connected to the indexing disk.

Secured to the rear side of the base or bed 3 of the machine is an upstanding bracket 65 which projects above the carriage 1 and terminates in a way 66 which extends longitudinally of the machine parallel to the longitudinal axis thereof and is disposed at an angle of about 45 degrees to the surface of the carriage and is inclined towards the face of the carriage. Rotatably supported within a longitudinal channel or groove 67 in the way 66 at the upper end of the bracket 65 is a horizontal lead screw 68, which extends from end to end of the bracket parallel to the axes of the dead centers of the head and tail stocks and is rotated by means of a handle 68ª fixed to one end of said screw. Slidably mounted on the way 66 at the top of the bracket is an indicator carriage 69 operatively connected with the lead screw 68 by means of a nut 70 formed integral with the lower end of a bolt 71 which projects upwardly through registering holes in the carriage and in a cylindrical pivot piece 72 rigidly secured on top of said carriage by means of a nut 73 on the upper end of said bolt. Mounted on the carriage 69 is a bracket member 74 whose base is provided with a cylindrical recess 75 which receives the cylindrical pivoted piece 72 on top of the carriage, whereby said bracket member is rotatable on said carriage. The pivoted bracket member 74 is clamped to the indicator carriage by T-bolts 76 whose heads are located in arcuate T-slots 77 provided therefor in the top of said carriage and whose shank portions extend upwardly through holes in the bracket member 74 and are provided with nuts 78. By this arrangement, the T-bolts 76 may be tightened to lock the pivotally mounted bracket member 74 in any desired angular position.

Mounted on a plate 79, which is slidable transversely of the worm on a way 80 provided therefor on the upper surface of the bracket 74 pivoted on the indicator carriage 69, is an indicator 81. Said indicator is provided with a radially disposed longitudinally slidable stem 82 for actuating its indicating mechanism and has a handle 83 for limiting the outward sliding movement of said stem. Mounted on the indicator casing for swinging movement about the axis of the indicator stem 82 is an arm 85 which is clamped in any desired position of its swinging movement by means of a knurled collet 85ª. Pivotally supported on the arm 85 is a bent contact lever 86, one arm of which is adapted to engage one side of the thread of the worm and the other arm of which is adapted to bear against the outer end of the stem 82 of the indicator and thus actuate the indicating mechanism thereof. The indicator 81 is moved towards and away from the work by means of a lever 87 which is pivoted to the pivotal indicator supporting bracket 74 and has a slot and pin connection 87ª with the indicator slide 79. The indicator slide 79 is provided with an adjustable stop comprising a screw 88 threaded through a bushing 89 press fitted in a bore in a depending lug 90 at the rear end of said slide with the inner end of said screw in abutting relation to the pivoted supporting bracket 74. The stop screw 88 is adjusted by means of a knurled knob 91 at the outer end thereof and has a knurled lock collar 92 threaded thereon for locking said screw in the desired adjusted position. By this arrangement, the work engaging arm of the contact lever 86 of the indicator 81 may be brought into the same position with relation to the worm each time the indicator supporting slide 79 is slid in the direction of the worm.

The indicator is moved longitudinally of the work by rotating the lead screw 68; and the amount of said movement is indicated by a scale 93 marked on the front face of the bracket 65 which slidably supports the indicator carriage 69 and by a collar 94 fixed to said screw and provided with graduations adapted to register with a zero mark 95 on said bracket. In the present machine, the lead screw 68 is provided with forty threads per inch, and, therefore, one complete revolution of said screw will cause the indicator carriage 69 to move exactly twenty-five thousandths of an inch along the scale 93, which is graduated to give reading in inches, twenty-five thousandths of an inch and hundredths of an inch. The collar 94 fixed to the lead screw is provided with twenty-five equally spaced graduations, each representing one thousandth of an inch, whereby rotation of the lead screw a distance corresponding to the space between adjacent graduations will cause the carriage to move one thousandth of an inch.

The operation of the machine is as follows: The worm that is to be tested is placed between the dead centers 5 and 6 of the head and tail stocks 7 and 8, respectively, and said tail stock adjusted to bring the two dead centers into engagement with the conical recesses provided therefor in the ends of said worm. The driving dog 62 is then clamped on the worm, thereby connecting the worm to the driving plate 51. The bottom slide plate 35 is set at an angle corresponding to the lead angle desired for the worm that is to be tested by rotating the handle 45, which turns the disk 37 that supports said bottom

slide plate, until the pin 47 on said disk has moved far enough away from the pin 46 on the bed 3 to permit the holes in a link 48 marked with the lead selected to fit over said pins. The driving plate 51 is then connected to the indexing plate 23 by means of the indexing pin 53. When testing single-threaded worms the indexing pin 53 is engaged with any one of the three series of holes 59, 60 and 61 in the indexing plate 23. The indicator 81 is then brought into a position opposite the forward end of the thread of the worm by rotating the lead screw 68; and the arm 85 is then swung about the axis of the indicator stem 82 to bring the contact arm of the bent contact lever 86 into a position at right angles to the spiral angle of the thread, which lever is then locked in said position by means of the knurled collet 85[a]. The bracket 74, which slidably supports the indicator, is then swung on its pivot 72 so that the work engaging surface of the contact arm of the indicator will slide in a direction substantially parallel to the pressure angle or side of the thread when the lever 87 is actuated. The indicator is then shifted transversely of the work axis by means of the lever 87 to bring the contact point into engagement with the side of the forward end of the thread at the pitch line. The stop screw 88 is then adjusted to cause the contact arm of the indicator to stop at the pitch line of the worm each time said arm is moved into engagement therewith, said stop screw is then locked in such position of adjustment by means of the knurled lock collar 92, and the pointer of the indicator is then set at zero.

After setting the machine as above described, the operation of testing the lead of the single thread worm is as follows: The indexing disk 23 is rotated one complete revolution by means of the hand wheel 16, which operation also causes the tubular head stock spindle 24, the driving disk 51 and the worm to rotate one complete revolution. This rotary movement of the head stock spindle 24, by reason of its rack and pinion connection 28, 27 with the top slide plate 29, causes said slide plate to slide transversely of the spindle axis, which movement of said top slide plate, by reason of its pivotal connection 33, 34 with the angularly disposed bottom slide plate 35 causes said bottom slide plate to move at an oblique angle to the worm axis and thus moves the carriage 1 and the worm thereon in a direction parallel to said axis; whereupon the rotating worm is moved axially during each complete revolution thereof a distance corresponding to the lead desired therefor and in a direction opposite to that in which the thread advances. If the lead of the thread is correct, no movement will be imparted to the contact arm and the pointer of the indicator will remain at zero during this rotary and axial movement of the worm. If there is any variation in the lead the contact lever of the indicator will be actuated, and the indicator will indicate the amount in thousandths of an inch that the worm is long or short in the lead. After the first portion of the single thread worm has been checked as above described for a distance corresponding to the lead thereof the contact arm of the indicator is disengaged from said thread and the hand wheel 16 is rotated a reverse direction to return all parts to their original positions. The indicating mechanism is then moved longitudinally of the worm by means of the handle 68[a] a distance corresponding to the lead of the worm and the indicating mechanism operated to cause the contact lever to again engage the side of the thread at the point where it was removed from the thread after checking the first portion thereof. The next portion of the thread of the worm is then checked for a distance corresponding to the lead thereof; and the operations above described are repeated until the entire thread of the worm has been checked.

It is noted that there are twelve holes in the outer series of holes 59 in the indexing plate 23, that there are five holes 61 in the inner circle, and that there are seven holes 60 in the circle located between the inner and outer surface. By this arrangement, the machine may be used for checking the leads of worms having five or seven threads or any factor of twelve, as one, two, three, four, six and twelve. For instance, in checking the two thread worm W shown in the drawing the index pin 53 is inserted in one of the outer series of holes 59 in the index plate 23, and the first thread is checked for a distance corresponding to the lead of the worm in the manner above described. The parts are then returned to their original positions and the indicating mechanism disengaged from the worm. The index pin 53 is then withdrawn from the index plate, the driving plate 51 reversely rotated one-half of a revolution and the driving plate again connected with the index plate by inserting the index pin in the hole located diametrically opposite the hole which was engaged during the checking of the first thread. This reverse rotation of the driving plate imparts a similar movement to the worm coupled thereto and thus brings the forward end of the second thread into position to be engaged by the contact lever without moving the latter longitudinally of said worm. The contact lever 86 is then moved transversely of the worm into engagement with the side of the second thread which is then checked for a distance corresponding to the lead in the manner described for the first thread. The contact lever is then withdrawn from the work, the parts are then again returned

to starting position and the said lever shifted longitudinally of the worm a distance corresponding to the lead thereof and again moved into engagement with the first thread of the worm to check the next portion thereof. The step by step checking of the two threads is continued until both threads have been tested along their entire length. From the foregoing it will thus be seen that the indexing pin is engaged with the outer series of twelve holes when checking one, two, three, four, six, and twelve-thread worms, the inner series of five holes is used for checking five-thread worms and the intermediate series of seven holes is used for checking seven-thread worms.

With the above machine, the accuracy of its setting may be checked in several ways. When the disk is rotated to bring the bottom slide plate into a position at right angles to the axis of the head stock spindle, the distance between the two pins 46 and 47 on one side of the machine should be the same as the distance between the corresponding pins on the opposite side of the machine. With the parts in this position, a large disk may be mounted between the dead centers, and an indicator clamped on the base of the machine with its spindle in engagement with one side of said disk. The disk is then revolved by means of the hand wheel 16. If there is any movement of the indicator during this rotation of the disk, it indicates that the pins are out of position or that the bottom slide plate is not at right angles to the axis of the head stock spindle. Another way to check the setting of the machine is to set the bottom slide plate at an angle corresponding to a standard lead angle by measuring over the pins, then mounting between dead centers a worm having such standard lead and then moving the indicator into engagement with one side of the thread with the indicator pointer set at zero. The reading on the micrometer on the lead screw 68 is then noted and the indicator is disengaged from the worm thread. The lead screw is then rotated the exact distance of the linear pitch of two threads. The indicator is then brought back into position and should show the same zero reading as before. This would show whether the pitch is correct. Then by withdrawing the indicator from the thread once more and continuing the movement of the indicator the full length of the lead and again bringing the indicator into engagement with the side of the thread, another zero reading of the indicator would show that the lead established by measuring over the pins are correct.

Obviously, the hereinbefore described machine admits of considerable modification without departing from the invention; therefore, I do not wish to be limited to the precise arrangement shown and described.

What I claim is:

1. A machine for testing the lead of screws comprising means for rotating a screw on its axis, means for moving said screw axially during the rotation thereof in a direction opposite to that in which the thread advances and at a rate corresponding to the advance of the thread of a screw having the desired lead, and means engaging the side of the thread of said screw, whereby inaccuracies in the lead of the screw cause movement of said screw engaging means.

2. A machine for testing the lead of screws comprising means for rotating a screw on its axis, means for moving said screw axially during each complete revolution thereof a distance corresponding to the lead desired for the screw being tested and in a direction opposite to that in which the thread advances, said means being adjustable to accommodate screws with different leads, and means engaging the side of the thread of said screw, whereby inaccuracies in the lead of the screw cause movement of said screw engaging means.

3. A machine for testing the lead of screws comprising means for rotating a screw on its axis, means for moving said screw axially during the rotation thereof in a direction opposite to that in which the thread advances and at a rate corresponding to the advance of the thread of a screw having the desired lead, and yieldable means engaging the side of the thread thereof, whereby inaccuracies in the lead of the screw will cause movement of said yieldable screw engaging means.

4. A machine for testing the lead of screws comprising means for rotating a screw on its axis, means for moving said screw axially during the rotation thereof in a direction opposite to that in which the thread advances and at a rate corresponding to the advance of the thread of a screw having the desired lead, and an indicating mechanism having a yieldable contact arm adapted to engage the side of the thread of said screw during the rotation thereof, whereby inaccuracies in the lead of said screw will cause movement of said contact arm and thus cause the indicating mechanism to indicate the amount of such inaccuracies.

5. A machine for testing the lead of screws comprising means for rotating a screw on its axis, means for moving said screw axially during the rotation thereof in a direction opposite to that in which the thread advances and at a rate corresponding to the advance of the thread of a screw having the desired lead, an indicating mechanism having a yieldable contact arm adapted to engage the side of the thread of said screw during the rotation thereof, whereby inaccuracies in the lead of said screw will cause movement of said contact arm and

thus cause the indicating mechanism to indicate the amount that the screw is long or short in the lead, and means for adjusting said indicating mechanism longitudinally of and towards and away from said screw.

6. A machine for testing the lead of screws comprising means for rotating a screw on its axis, means for moving said screw axially during the rotation thereof in a direction opposite to that in which the thread advances and at a rate corresponding to the advance of the thread of a screw having the desired lead, means engaging the side of the thread of said screw, whereby inaccuracies in the lead of the screw cause movement of said screw engaging means, and means whereby said machine may be set for any selected lead.

7. A machine for testing the lead of screws comprising means for rotating a screw on its axis, means for moving said screw axially during the rotation thereof in a direction opposite to that in which the thread advances and at a rate corresponding to the advance of the thread of a screw having the desired lead, means engaging the side of the thread of said screw, whereby inaccuracies in the lead of the screw cause movement of said screw engaging means, and means whereby said machine is adapted for testing plural threaded screws.

8. A machine for testing the lead of screws comprising means for rotating a screw on its axis, means for moving said screw axially during the rotation thereof in a direction opposite to that in which the thread advances and at a rate corresponding to the advance of the thread of a screw having the desired lead, means engaging the side of the thread of said screw, whereby inaccuracies in the lead of the screw cause movement of said screw engaging means, means whereby said machine may be set for any selected lead, and means whereby said machine is adapted for testing plural threaded screws.

9. A machine for testing the lead of screws comprising means for rotating a screw on its axis, means for moving said screw axially during each complete revolution thereof a distance corresponding to the lead desired for the screw being tested and in a direction opposite to that in which the thread of said screw advances, an indicating device having a yieldable contact arm adapted to engage the side of the thread of said screw during the rotation thereof, whereby inaccuracies in the lead of the screw will cause movement of said contact arm and thus cause the indicating mechanism to indicate the amount of such inaccuracies, and means for moving said arm into and out of engagement with the thread of said screw.

10. A machine for testing the lead of screws comprising means for rotating a screw on its axis, means for moving said screw axially during each complete revolution thereof a distance corresponding to the lead desired for the screw being tested and in a direction opposite to that in which the thread of said screw advances, an indicating device having a yieldable contact arm adapted to engage the side of the thread of said screw during the rotation thereof, whereby inaccuracies in the lead of the worm will cause movement of said contact arm and thus cause the indicating mechanism to indicate the amount of such inaccuracies, means for moving said arm longitudinally of said screw, and means for adjusting said arm for movement into and out of engagement with the thread of said screw in a plane parallel to the pressure angle of the thread and passing through the axis of said screw.

11. A machine for testing the lead of screws comprising means for rotating a screw on its axis, means for moving said screw axially during each complete revolution thereof a distance corresponding to the lead desired for the screw being tested and in a direction opposite to that in which the thread of said screw advances, an indicating device having a yieldable contact arm adapted to engage the side of the thread of said screw during the rotation thereof, whereby inaccuracies in the lead of the worm will cause movement of said contact arm and thus cause the indicating mechanism to indicate the amount of such inaccuracies, means for moving said arm into and out of engagement with the thread of said screw, and means for adjusting said indicating mechanism to cause the contact arm thereof to engage the thread of said screws at the pitch line thereof when said arm is moved into engagement with said screw.

12. A machine for testing the lead of screws comprising means for rotating a screw on its axis, means for moving said screw axially during each complete revolution thereof a distance corresponding to the lead desired for the screw being tested and in a direction opposite to that in which the thread of said screw advances, an indicating device having a yieldable contact arm adapted to engage the side of the thread of said screw during the rotation thereof, whereby inaccuracies in the lead of the worm will cause movement of said contact arm and thus cause the indicating mechanism to indicate the amount of such inaccuracies, means for moving said arm into and out of engagement with the thread of said screw, and means for adjusting said arm to cause the same to contact with the thread of said screw along a plane passing through the axis of the screw.

13. A machine for testing the lead of screws, said machine comprising a bed, a carriage on said bed provided with means for rotatably supporting a screw, means for

rotating said screw on its axis, means for shifting said carriage to move the screw axially during the rotation thereof in a direction opposite to that in which the thread of the rotating screw advances and at a rate corresponding to the advance of a screw having the lead desired for said screw, and an indicator mounted on said bed and having a movable contact arm adapted to engage the side of the thread of said screw during the rotation thereof, whereby inaccuracies in the lead of the screw cause movement of said contact arm and thus cause the indicating mechanism to indicate the amount of such inaccuracies.

14. A machine for testing the lead of screws, said machine comprising a bed, a carriage on said bed provided with means for rotatably supporting a screw, means for rotating said screw on its axis, means for shifting said carriage on said bed to move the screw axially during each complete revolution thereof a distance corresponding to the lead desired for the screw being tested and in a direction opposite to that in which the thread of the rotating screw advances, means for varying the movement of said carriage for screws with different leads and an indicating gage mounted on said bed and having a movable contact arm adapted to engage the side of the thread of said screw during the rotary and axial movement thereof, whereby inaccuracies in the lead of the screw cause movement of said contact arm and thus cause the indicating mechanism to indicate the amount of such inaccuracies.

15. A machine for testing the lead of screws, said machine comprising a bed, a carriage on said bed provided with means for rotatably supporting a screw, means for rotating said screw on its axis, means for shifting said carriage on said bed to move the screw axially during each complete revolution thereof a distance corresponding to the lead desired for the screw being tested and in a direction opposite to that in which the thread of the rotating screw advances and at a rate corresponding to the advance of a screw having the desired lead for the screw being tested, and an indicating gage mounted on said bed and having a movable contact arm adapted to engage the side of the thread of said screw during the rotary and axial movement thereof, whereby inaccuracies in the lead of the screw cause movement of said contact arm and thus cause the indicating mechanism to indicate the amount of such inaccuracies, said carriage shifting means being adjustable to accommodate screws with different leads.

16. A machine for testing the lead of screws, said machine comprising a bed, a carriage on said bed provided with means for rotatably supporting a screw, means for rotating said screw on its axis, means for shifting said carriage on said bed to move the screw axially during each complete revolution thereof a distance corresponding to the lead desired for the screw being tested and in a direction opposite to that in which the thread of the rotating screw advances and at a rate corresponding to the advance of a screw having the desired lead for the screw being tested, an indicating gage mounted on said bed and having a movable contact arm adapted to engage the side of the thread of said screw during the rotary and axial movement thereof, whereby inaccuracies in the lead of the screw cause movement of said contact arm and thus cause the indicating mechanism to indicate the amount of such inaccuracies, said carriage shifting means being adjustable to accommodate screws with different leads, and means for adjusting said indicating gage longitudinally of the screw axis, towards and away from said screw and in a plane parallel to the pressure angle of the thread of said screw and passing through the axis thereof.

17. A machine for testing the lead of screws, said machine comprising a bed, a carriage on said bed provided with means for rotatably supporting a screw, a spindle journaled on said carriage for rotating said screw on its axis, means on said carriage for rotating said spindle, means operated by the spindle rotating means for shifting said carriage on said bed to move the screw axially during the rotation thereof in a direction opposite to that in which the thread of the rotating screw advances and at a rate corresponding to the advance of a screw having the desired lead for the screw being tested, said carriage shifting means comprising a rack geared to said spindle and movable transversely of the axis thereof, a plate mounted on said bed for sliding movement at an angle corresponding to the lead angle of the screw being tested and a pivotal connection between said rack and said plate, and means mounted on said bed and adapted to engage the side of the thread of said screw during the rotation thereof, whereby inaccuracies in the lead of the screw cause movement of said screw engaging means.

18. A machine for testing the lead of screws, said machine comprising a bed, a carriage on said bed provided with means for rotatably supporting a screw, a spindle journaled on said carriage for rotating said screw on its axis, means on said carriage for rotating said spindle, and means for shifting said carriage on said bed to move the screw axially during the rotation thereof in a direction opposite to that in which the thread of the rotating screw advances and at a rate corresponding to the advance of a screw having the desired lead for the screw being tested, said carriage shifting means comprising a rack geared to said spindle and movable

transversely of the axis thereof, a plate mounted on said bed for sliding movement at an angle corresponding to the lead angle of the screw being tested, and a pivotal connection between said rack and said plate.

19. A machine for testing the lead of screws, said machine comprising a bed, a carriage on said bed provided with means for rotatably supporting a screw, a spindle journaled on said carriage for rotating said screw on its axis, means on said carriage for rotating said spindle, means for shifting said carriage on said bed to move the screw axially during each complete rotation of said spindle a distance corresponding to the lead desired for the screw being tested and in a direction opposite to that in which the thread of the rotating screw advances, said carriage shifting means comprising a rack geared to said spindle and movable transversely of the axis thereof, a plate mounted on said bed for sliding movement at an angle corresponding to the lead angle of the screw being tested, and a pivotal connection between said rack and said plate, and an indicator mounted on said bed and having an adjustable contact arm adapted to engage the side of the thread of said screw during the rotation thereof, whereby inaccuracies in the lead of the screw cause movement of said contact arm and thus cause said indicator to indicate the amount of said inaccuracies.

20. A machine for testing the lead of screws, said machine comprising a bed, a carriage on said bed provided with means for rotatably supporting a screw, a spindle journaled on said carriage for rotating said screw on its axis, means on said carriage for rotating said spindle, means for shifting said carriage on said bed to move the screw axially during each complete rotation of said spindle a distance corresponding to the lead desired for the screw being tested and in a direction opposite to that in which the thread of the rotating screw advances, said carriage shifting means comprising a rack geared to said spindle and movable transversely of the axis thereof, a plate mounted on said bed for sliding movement at an angle corresponding to the lead angle of the screw being tested, and a pivotal connection between said rack and said plate, means for adjusting said indicator longitudinally of the screw axis and toward and away therefrom, and means for varying the angular position of said plate to obtain the desired movement of said carriage.

21. A machine for testing the lead of screws, said machine comprising a bed, a carriage on said bed provided with means for rotatably supporting a screw, a spindle journaled on said carriage for rotating said screw on its axis, means on said carriage for rotating said spindle, means for shifting said carriage on said bed to move the screw axially during the rotation thereof in a direction opposite to that in which the thread of the rotating screw advances and at a rate corresponding to the advance of a screw having the desired lead for the screw being tested, said carriage shifting means comprising a rack geared to said spindle and movable transversely of the axis thereof, a plate mounted on said bed for sliding movement at an angle corresponding to the lead angle of the screw being tested and a pivotal connection between said rack and said plate, means for rotating said plate about the axis of said pivotal connection to vary the angular position thereof, and an indicator mounted on and having a contact arm adapted to engage the side of the thread of said screw during the rotation thereof, whereby inaccuracies in the lead of the screw cause movement of said screw engaging means and thus cause the indicator to indicate the amount of said inaccuracies.

22. A machine for testing the lead of screws, said machine comprising a bed, a carriage on said bed provided with means for rotatably supporting a screw, means on said carriage for rotating said screw on its axis, said screw rotating means comprising a rotatably supported spindle, gearing for driving said spindle, a driving plate journaled on said spindle and adapted to be coupled to said spindle and to said screw, means for shifting said carriage on said bed to move the screw axially during the rotation thereof in a direction opposite to that in which the thread of the rotating screw advances and at a rate corresponding to the advance of a screw having the desired lead for the screw being tested, said carriage shifting means comprising a rack geared to said spindle and movable transversely of the axis thereof, a plate mounted on said bed for sliding movement at an angle corresponding to the lead angle of the screw being tested and a pivotal connection between said rack and said plate, and an indicator mounted on said bed and having a contact arm adapted to engage the side of the thread of said screw during the rotary and axial movement thereof, whereby inaccuracies in the lead of the screw cause movement of said contact arm and thus cause said indicator to indicate the amount of said inaccuracies.

23. A machine for testing the lead of screws, said machine comprising a bed, a carriage on said bed provided with means for rotatably supporting a screw, means on said carriage for rotating said screw on its axis, means on said carriage for rotating said spindle, said screw rotating means comprising a rotatably supported spindle having an index plate rigid therewith, a drive plate journaled on said spindle and adapted to be coupled to said screw, said drive plate being provided with a series of circularly

arranged holes, a spring pressed index pin mounted on said drive plate and adapted to be engaged with any one of the holes in said index plate to cause the drive plate to rotate with said index plate, means for shifting said carriage on said bed to move the screw axially during the rotation thereof in a direction opposite to that in which the thread of the rotating screw advances and at a rate corresponding to the advance of a screw having the desired lead for the screw being tested, said carriage shifting means comprising a rack geared to said spindle and movable transversely of the axis thereof, a plate mounted on said bed for sliding movement at an angle corresponding to the lead angle of the screw being tested and a pivotal connection between said rack and said plate, and an indicator mounted on said bed and having a contact arm adapted to engage the side of the thread of said screw during the rotation thereof, whereby inaccuracies in the lead of the screw cause movement of said contact arm and thus cause said indicator to indicate the amount of said inaccuracies.

24. A machine for testing the lead of screws, said machine comprising a bed, a carriage on said bed provided with means for rotatably supporting a screw, means on said carriage for rotating said spindle, said screw rotating means comprising a rotatably supported spindle having an index plate rigid therewith, a drive plate journaled on said spindle and adapted to be coupled to said screw, said drive plate being provided with a series of circularly arranged holes, a spring pressed index plate mounted on said drive plate and adapted to be engaged with any one of the holes in said index plate to cause the drive plate to rotate with said index plate, means for shifting said carriage on said bed to move the screw axially during the rotation thereof in a direction opposite to that in which the thread of the rotating screw advances and at a rate corresponding to the advance of a screw having the desired lead for the screw being tested, said carriage shifting means comprising a rack geared to said spindle and movable transversely of the axis thereof, a plate mounted on said bed for sliding movement at an angle corresponding to the lead angle of the screw being tested, and a pivotal connection between said rack and said plate, an indicator mounted on said bed and having a contact arm adapted to engage the side of the thread of said screw during the rotation thereof, whereby inaccuracies in the lead of the screw cause movement of said contact arm and thus cause said indicator to indicate the amount of said inaccuracies, said indicator being slidably supported for movement towards and away from the work on a bracket pivotally supported on a carriage slidable on said bed in a direction parallel to the spindle axis, and a lead screw journaled on said bed and operatively engaging the indicator carriage for actuating the same.

Signed at Detroit, Michigan, this 2nd day of May, 1927.

PERCE E. GARLENT.