May 27, 1924. 1,495,494

H. LUTZ

BALL GAUGING MACHINE

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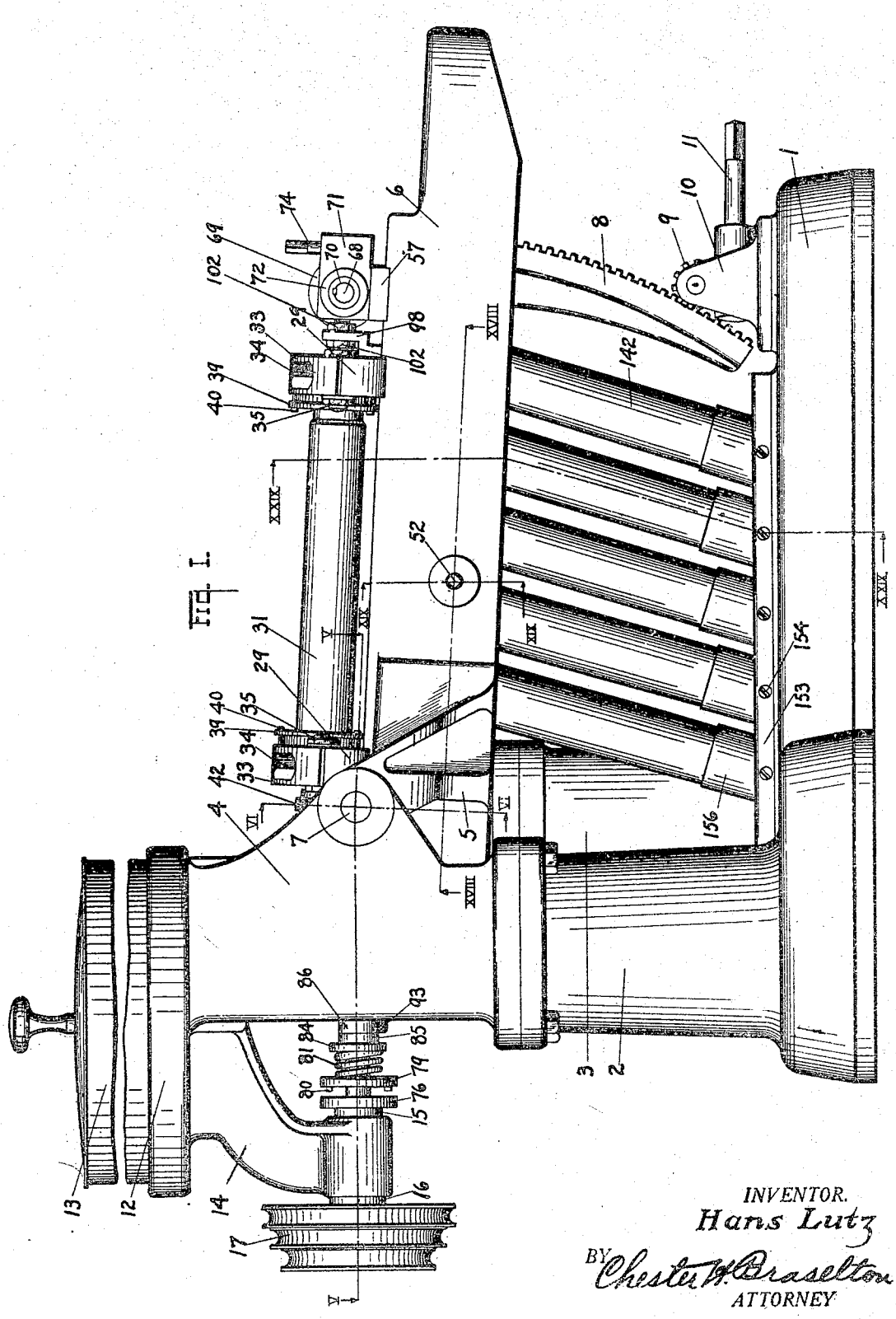


FIG. I.

INVENTOR.
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May 27, 1924.

1,495,494

H. LUTZ

BALL GAUGING MACHINE

Filed Feb. 6, 1919

13 Sheets-Sheet 2

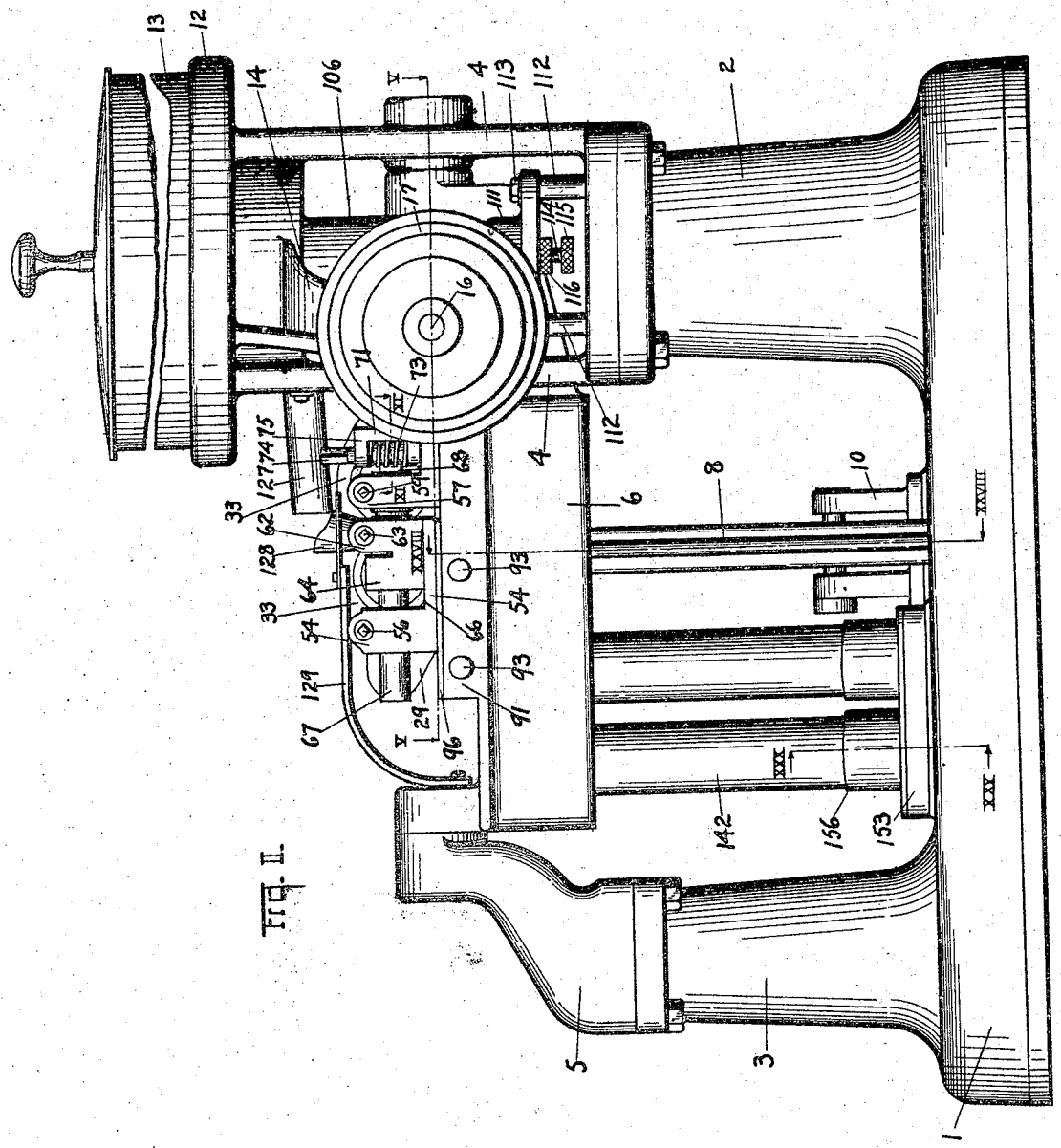


FIG. II.

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1,495,494

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BALL GAUGING MACHINE

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13 Sheets-Sheet 3

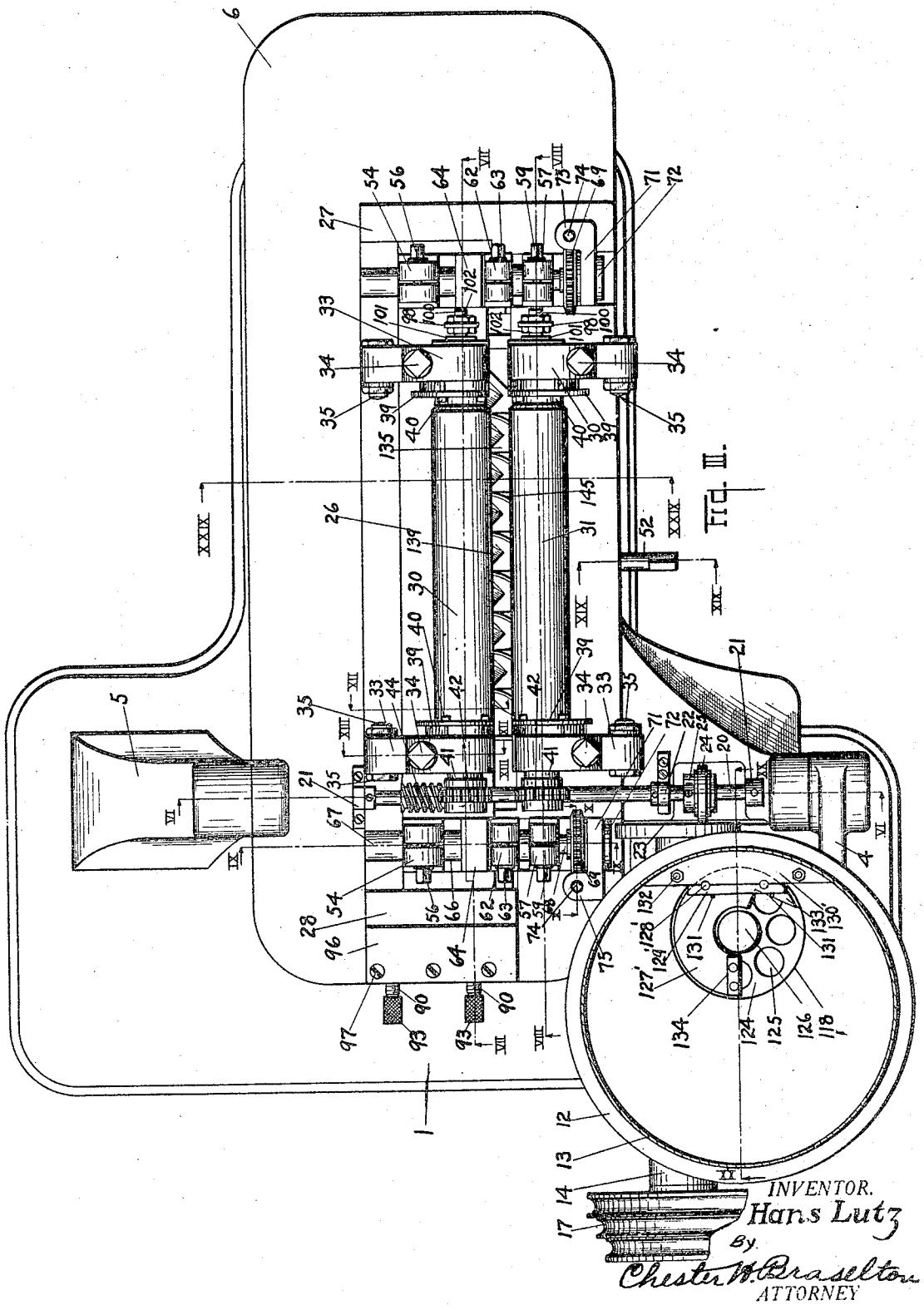


FIG. III.

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BALL GAUGING MACHINE

Filed Feb. 6, 1919

13 Sheets-Sheet 4

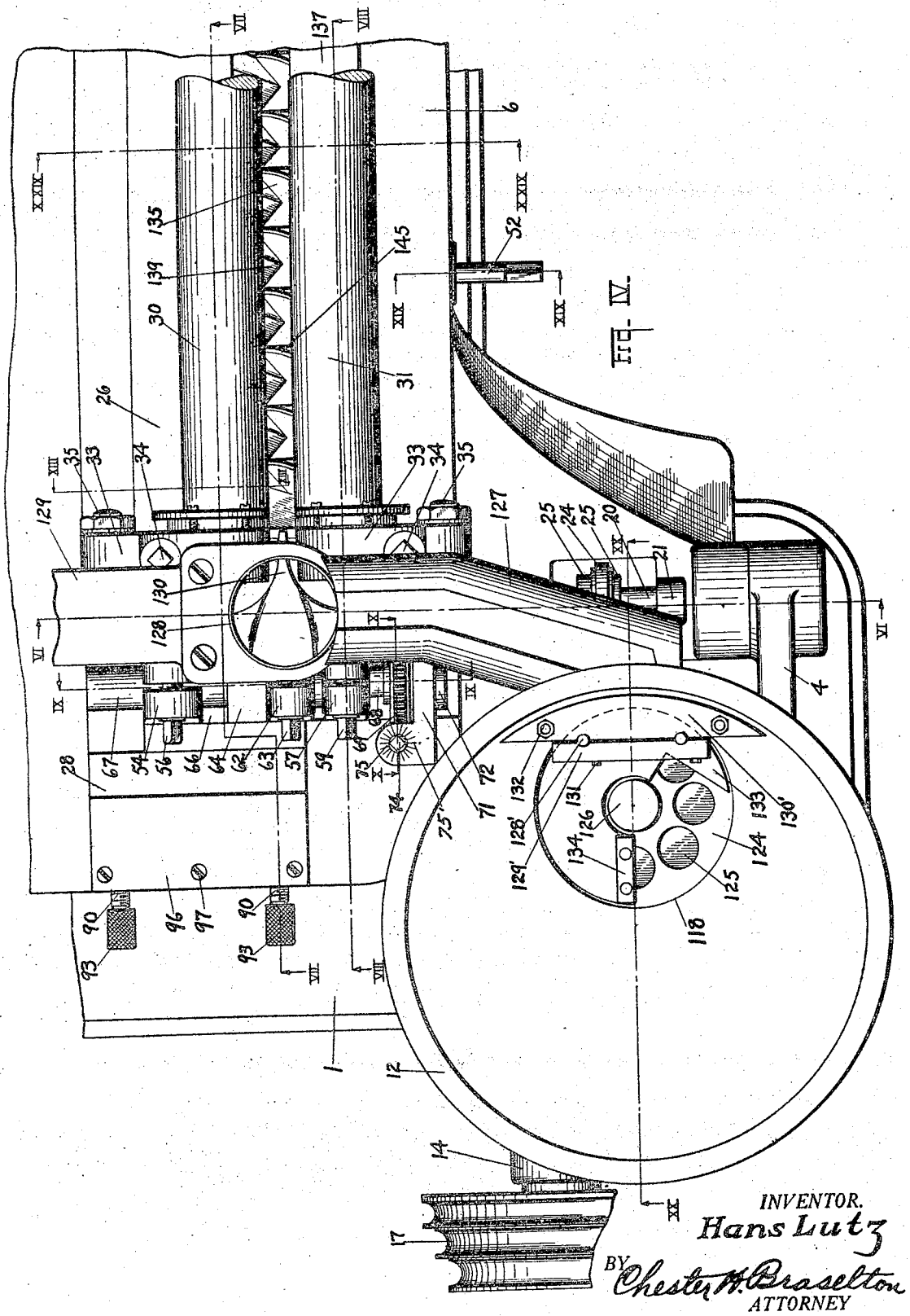


FIG. IV.

INVENTOR.
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1,495,494

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BALL GAUGING MACHINE

Filed Feb. 6, 1919

13 Sheets-Sheet 5

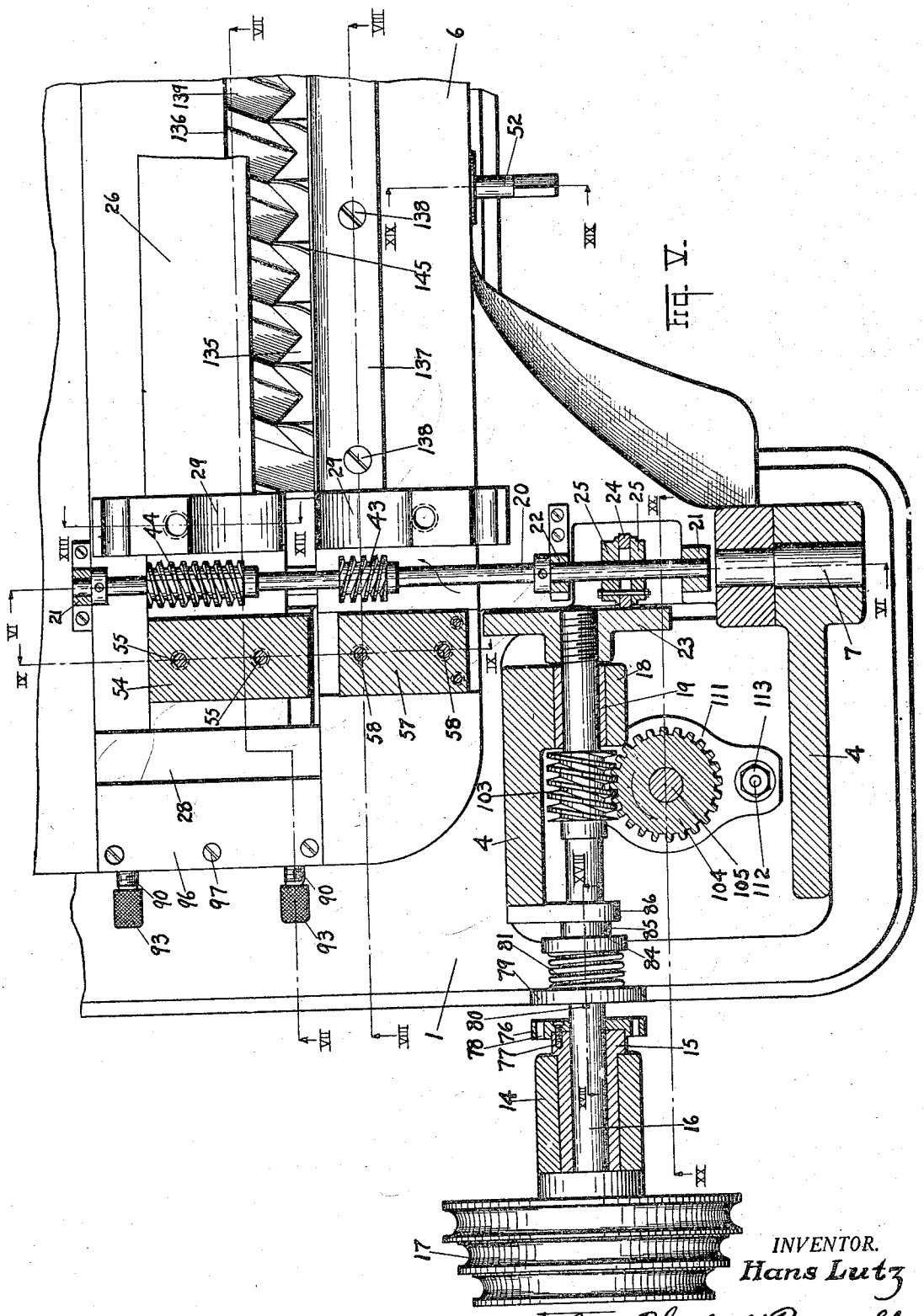


Fig. V.

INVENTOR.
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H. LUTZ

BALL GAUGING MACHINE

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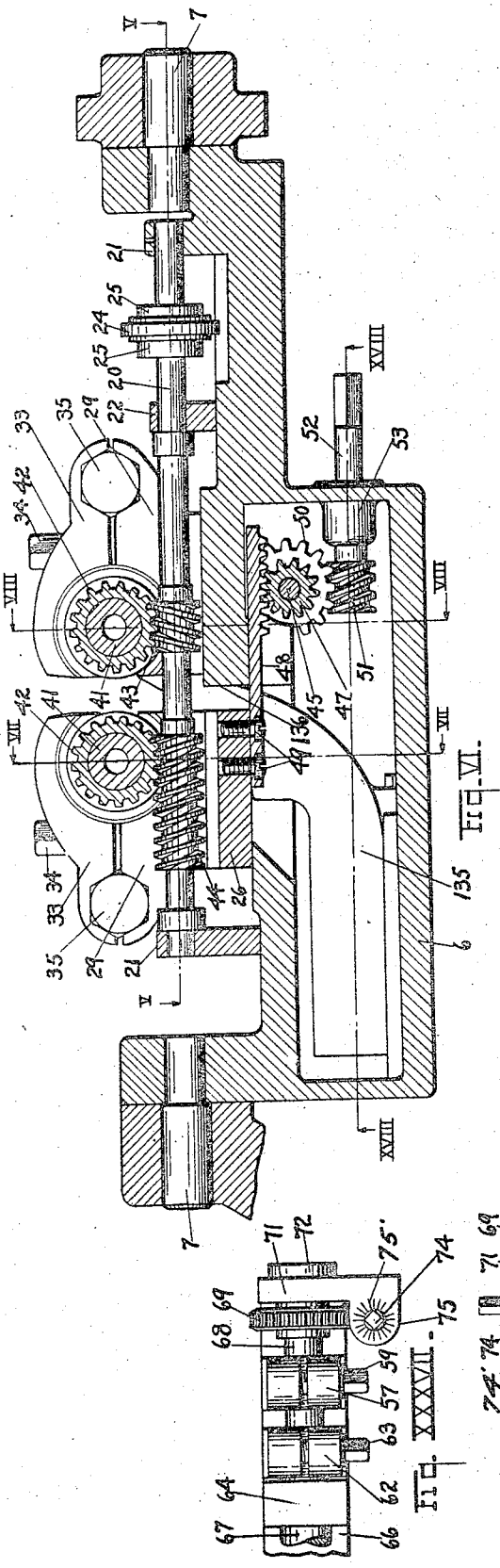


FIG. VI.

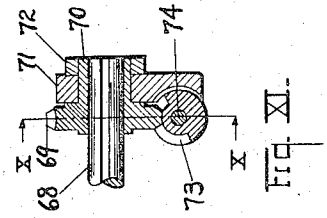


FIG. XI.

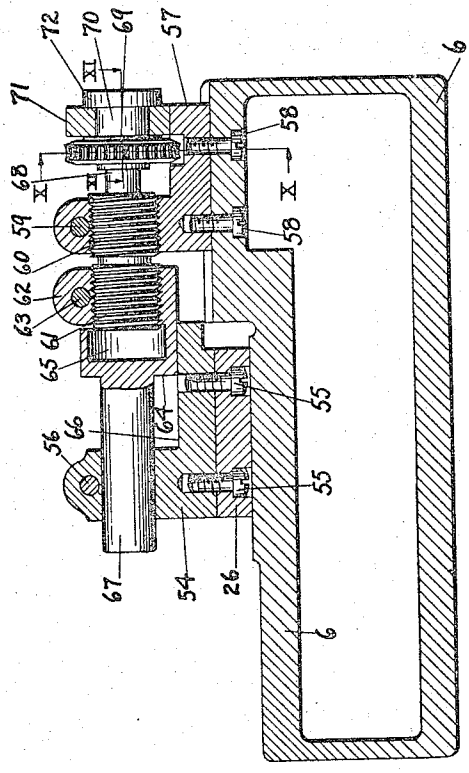


FIG. IX.

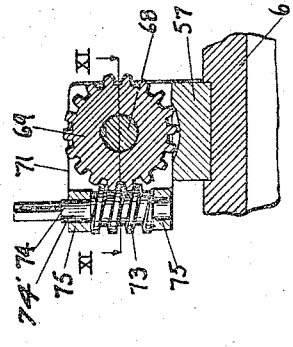


FIG. X.

FIG. XXXVII.

INVENTOR.
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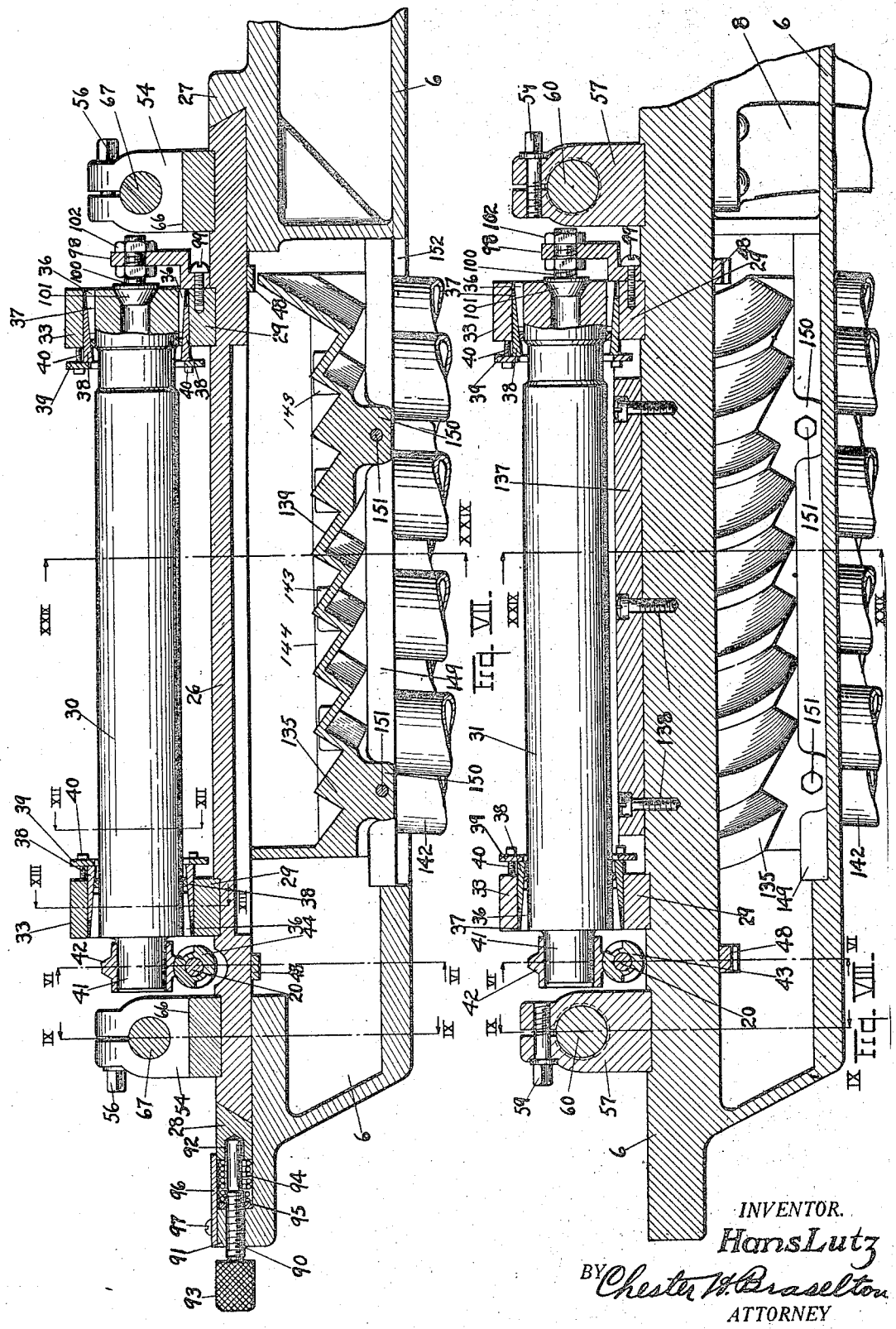
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H. LUTZ

BALL GAUGING MACHINE

Filed Feb. 6, 1919

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INVENTOR.
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1,495,494

H. LUTZ

BALL GAUGING MACHINE

Filed Feb. 6, 1919

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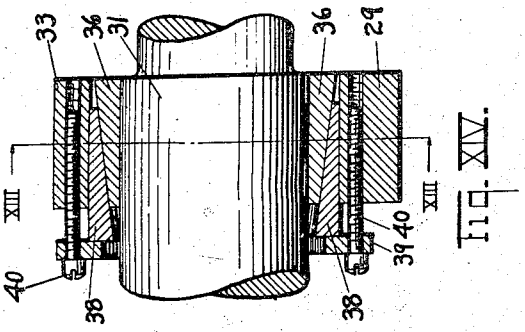


Fig. XIV.

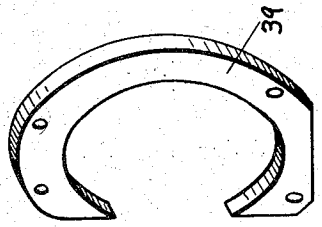


Fig. XVII.

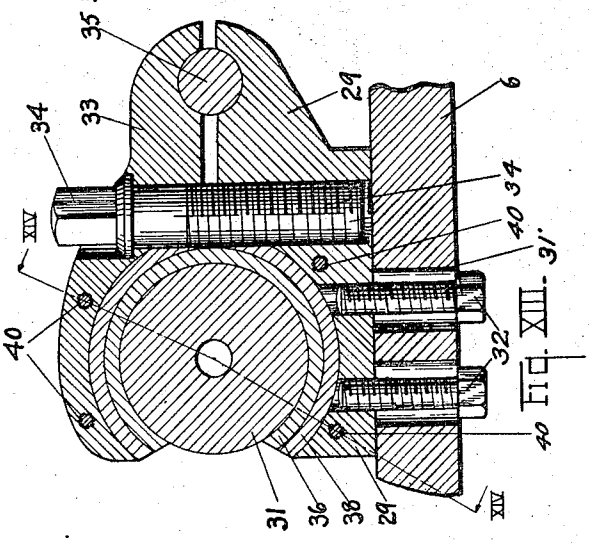


Fig. XIII.

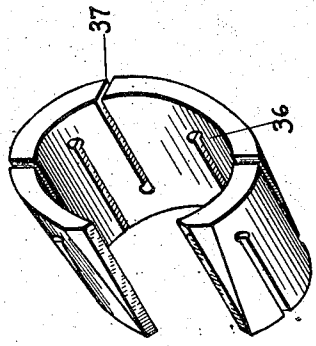


Fig. XVI.

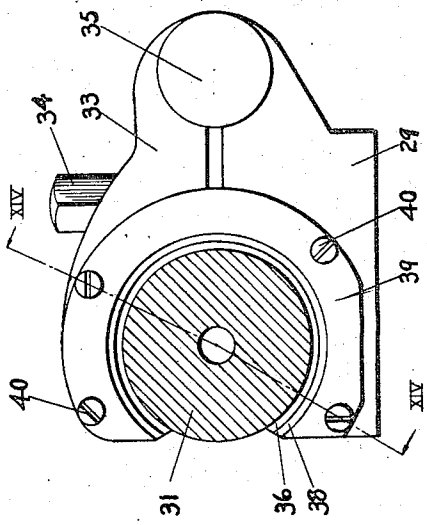


Fig. XII.

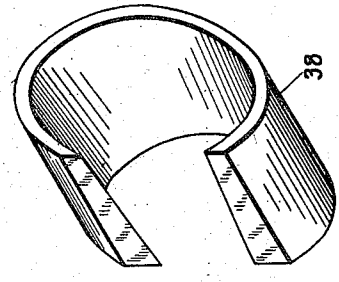


Fig. XV.

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May 27, 1924.

1,495,494

H. LUTZ

BALL GAUGING MACHINE

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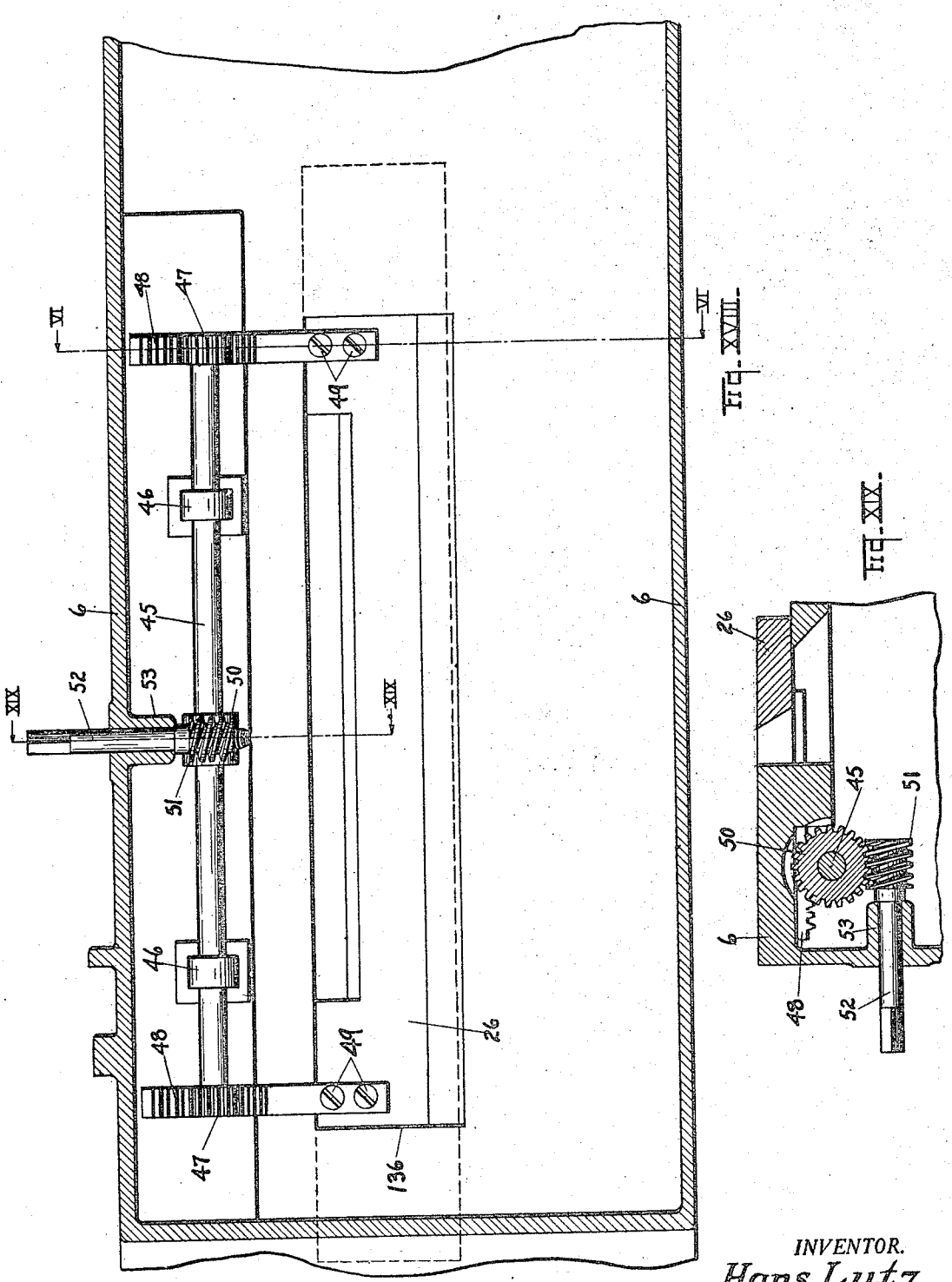


FIG. XVIII.

FIG. XIX.

INVENTOR.
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1,495,494

H. LUTZ

BALL GAUGING MACHINE

Filed Feb. 6, 1919

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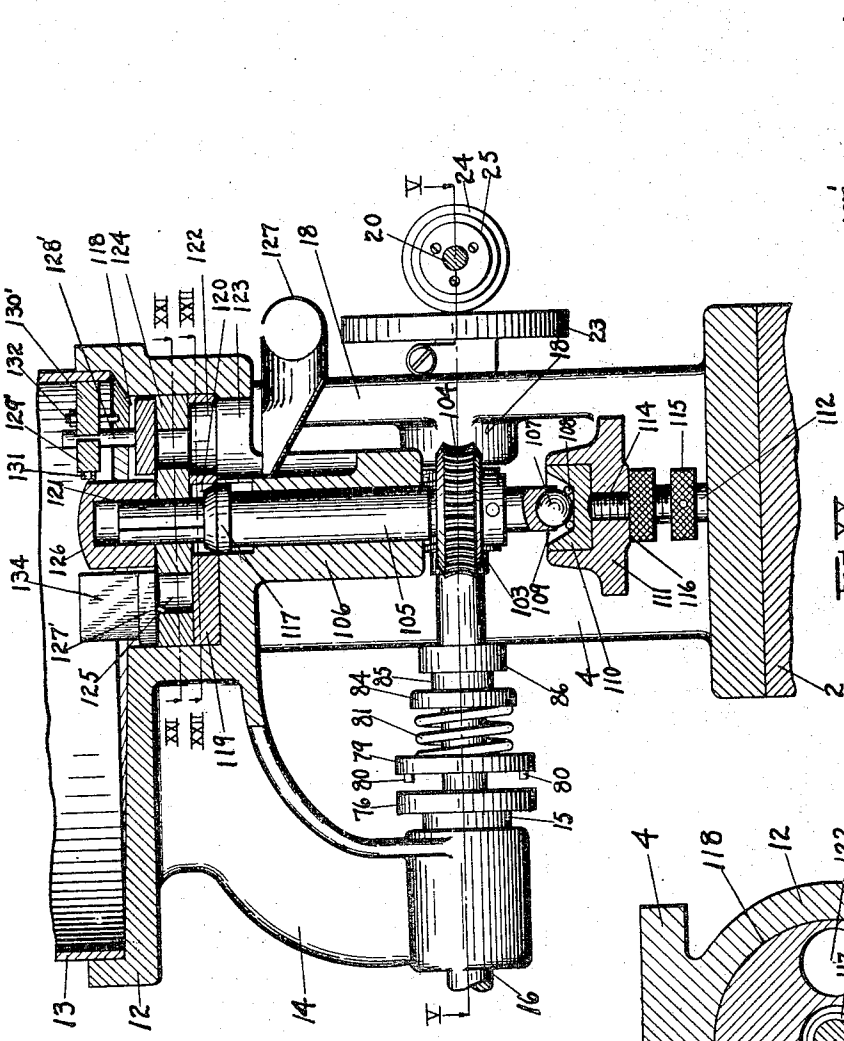


FIG. XX.

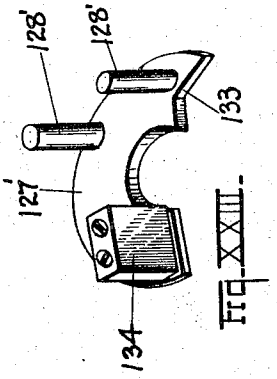


FIG. XXIII.

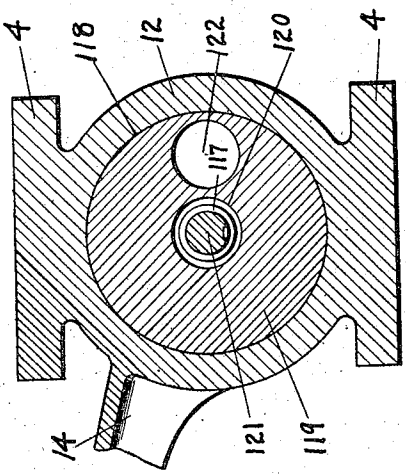


FIG. XXII.

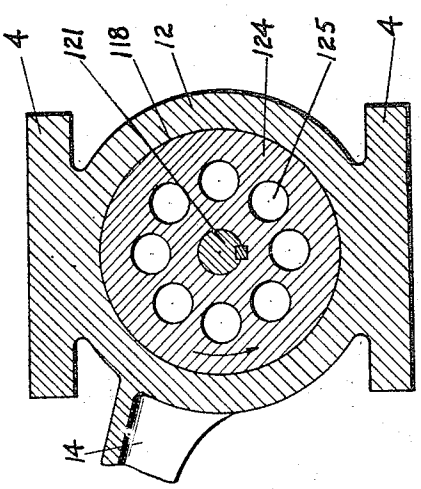


FIG. XXI.

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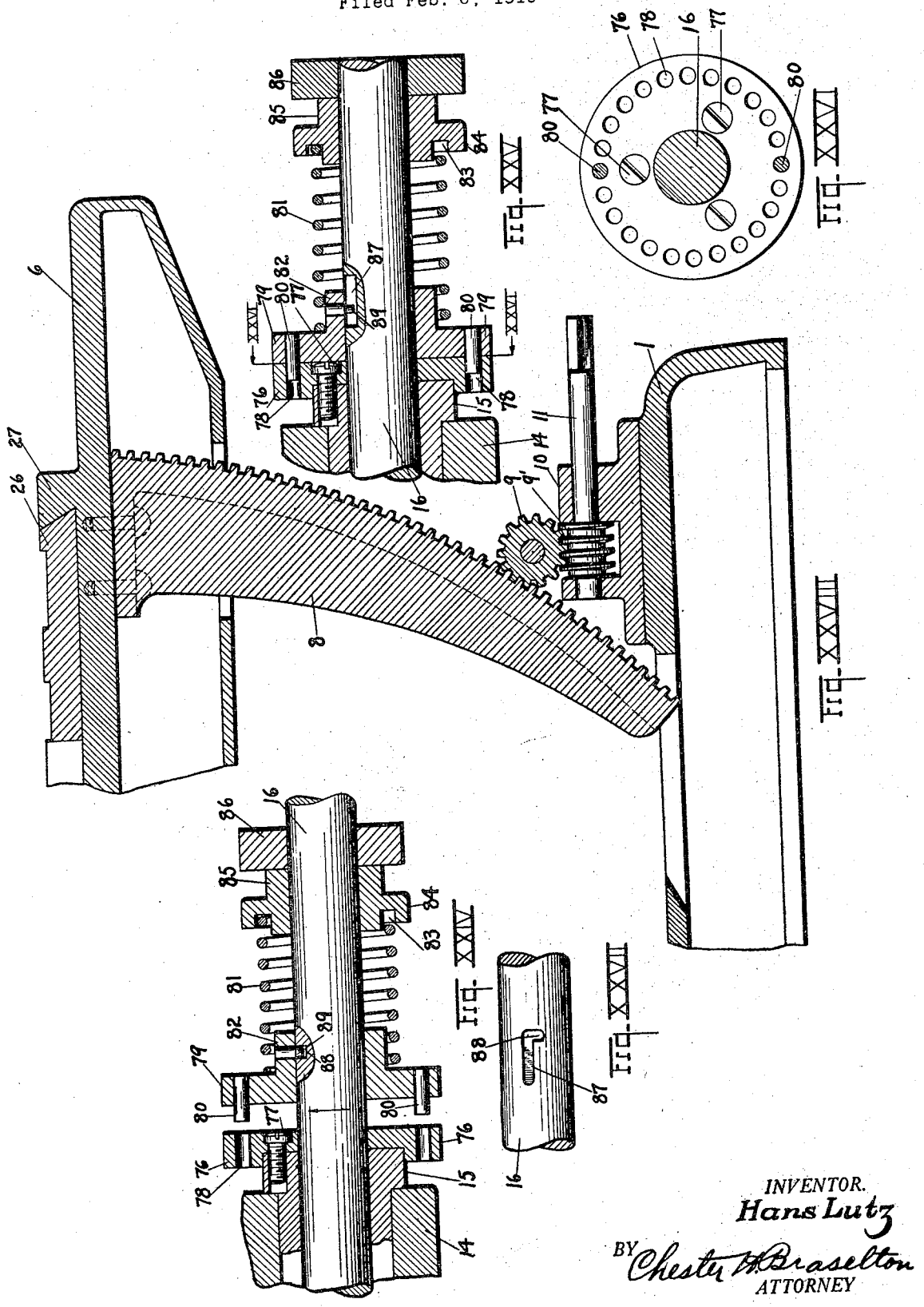
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H. LUTZ

BALL GAUGING MACHINE

Filed Feb. 6, 1919

13 Sheets-Sheet 11



INVENTOR.
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BY Chester H. Braselton
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May 27, 1924.

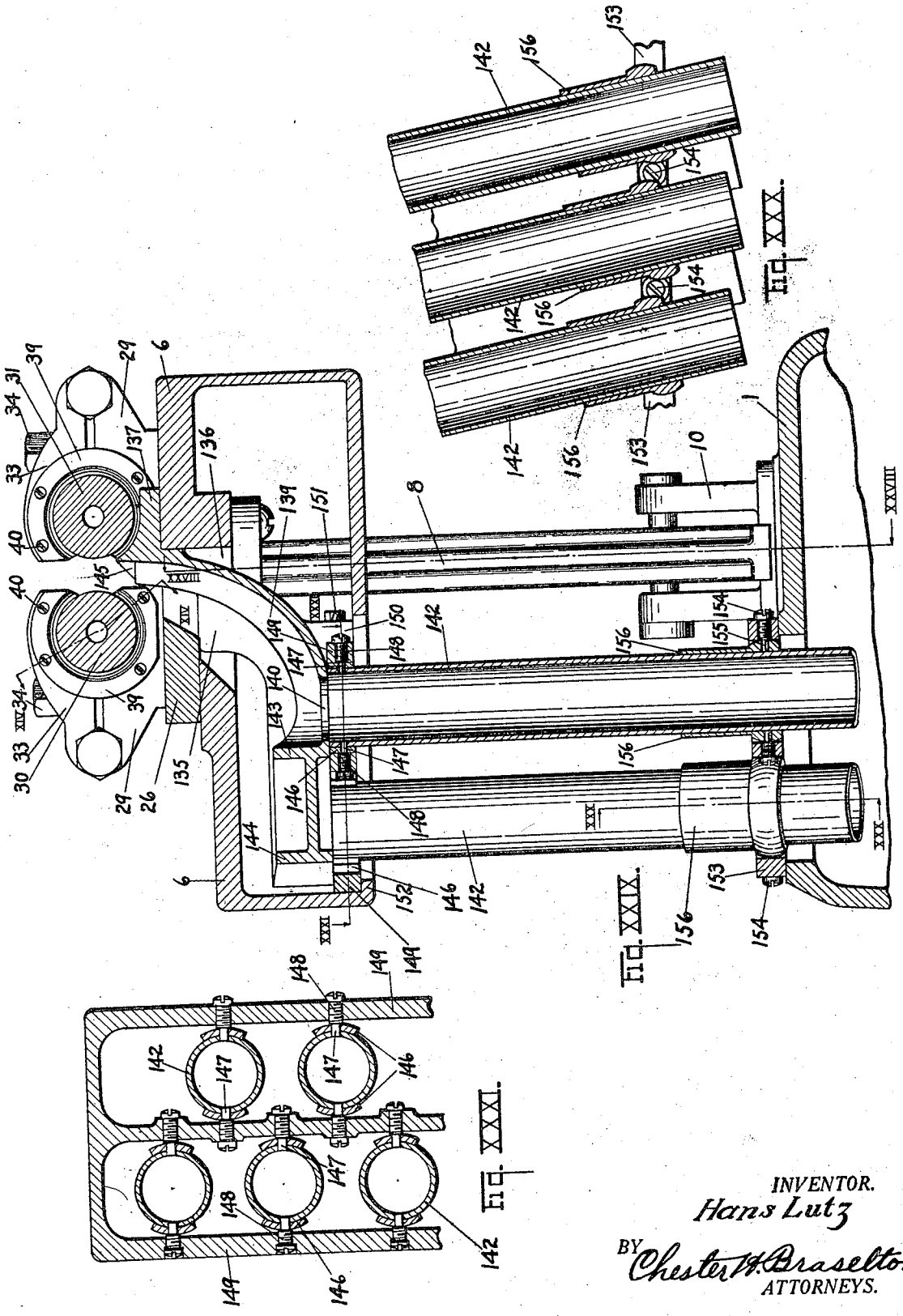
1,495,494

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BALL GAUGING MACHINE

Filed Feb. 6, 1919

13 Sheets-Sheet 12



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May 27, 1924.

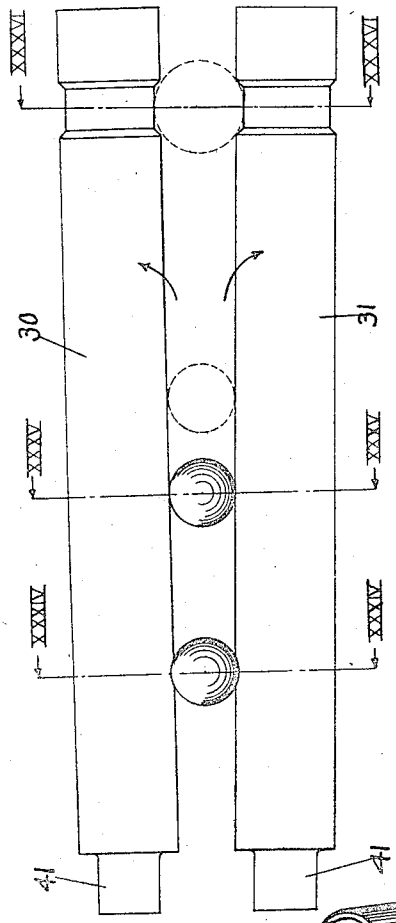
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H. LUTZ

BALL GAUGING MACHINE

Filed Feb. 6, 1919

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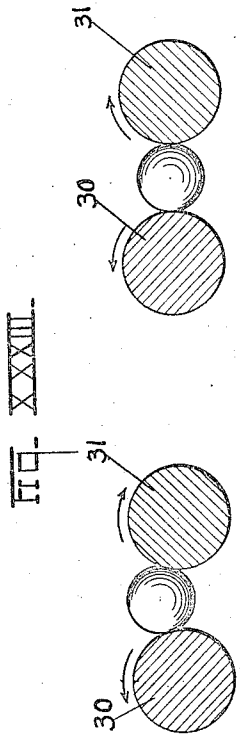


FIG. XXXIII.

FIG. XXXV.

FIG. XXXIV.

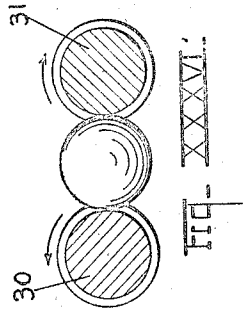
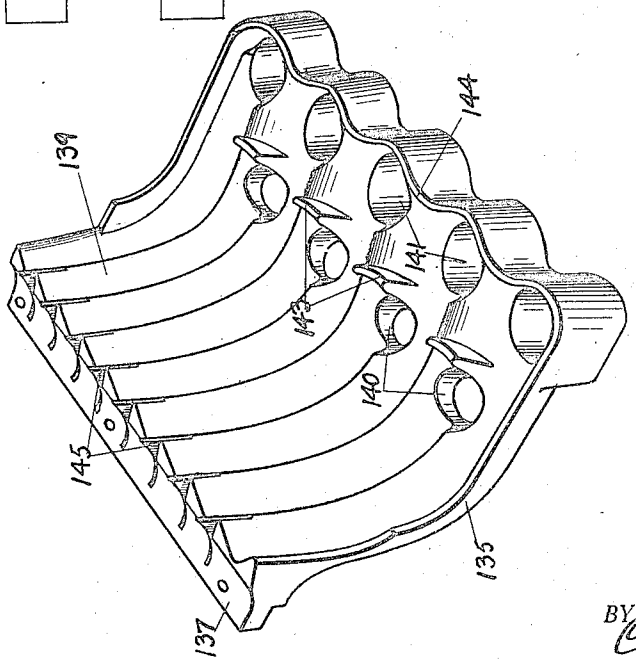


FIG. XXXVI.



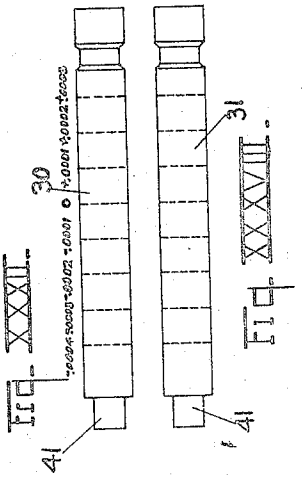


FIG. XXXII.

FIG. XXXVIII.

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ATTORNEY

Patented May 27, 1924. 1,495,494

UNITED STATES PATENT OFFICE.

HANS LUTZ, OF ELMIRA, NEW YORK, ASSIGNOR TO THE WILLYS-MORROW COMPANY, OF ELMIRA, NEW YORK, A CORPORATION OF OHIO.

BALL-GAUGING MACHINE.

Application filed February 6, 1919. Serial No. 275,418.

To all whom it may concern:

Be it known that I, HANS LUTZ, residing at Elmira, county of Chemung, State of New York, have invented certain new and useful Improvements in Ball-Gauging Machines, of which I declare the following to be a full, clear, and exact description.

My invention relates to ball gauging machines, and is particularly adapted for gauging the balls used in the manufacture of ball bearings.

One of the objects of the invention is to provide a ball gauging machine designed in such a way that a maximum number of balls may be gauged with the greatest possible precision in a minimum amount of time.

Another object of the invention is to construct a ball gauging machine which will require overhauling and readjustment only at the end of relatively long periods of time.

Another object of the invention is to provide a ball gauging machine having constantly moving members upon which the balls are carried and by which they are gauged, in contra-distinction to employing fixed or nonmovable gauging members.

Still another object of the invention is to provide a machine having rotatable oppositely driven members upon which the balls are adapted to travel, and between which they pass at points varying in spaced relation, whereby a number of balls of slightly different diameters may be separated and discharged into suitable receptacles in order that the balls used for a particular bearing or particular sets of bearings may be of an exact or equal size.

Aonther object of the invention is to provide a plurality of ball carrying cylinders or rollers, between which balls of different sizes are permitted to pass at predetermined points, means being provided by which the cylinders may be inclined one relatively to the other.

Still another object of the invention is to provide a plurality of ball gauging cylinders with means for driving the same, and improved means by which a fine or very accurate adjustment of the cylinders may be had, as well as independent means for effecting approximate adjustment of said cylinders, one relatively to another.

Another object of the invention is to provide a plurality of ball gauging cylinders or rollers having adjustable bearings for receiving said cylinders so that when the latter are reground from time to time the bearings may be suitably adjusted or reduced in size to fit the cylinders after each grinding.

Another object of the invention is to provide a plurality of ball gauging cylinders having improved adjusting means for effecting both lateral and longitudinal adjustment of the cylinders, one relatively to the other.

Another object of the invention is to provide a plurality of ball gauging cylinders having means by which longitudinal adjustment of the cylinders is effected, comprising adjustable end thrust members against which the cylinders are held by the action of the driving mechanism therefor.

A still further object of the invention is to provide improved means by which rotation of the cylinders in a direction towards each other is prevented.

Still another object of the invention is to provide improved means by which the balls to be gauged are fed to the cylinders.

Another object of the invention is to provide means for vertically inclining the cylinders supporting frame in order that any desired inclination of the cylinders may be had, whereby the speed of the balls upon the cylinders may be increased or decreased at will.

Another object of the invention is to provide means for varying the speed at which the cylinders are driven from time to time.

Another object of the invention is to provide means by which either of the ball gauging cylinders may be adjusted relatively to the other.

Another object of the invention is to provide an improved adjusting mechanism for inclining one of the cylinders with respect to another, together with means for indicating the amount of adjustment of the cylinders for a predetermined movement of the adjusting mechanism.

Another object of the invention is to provide an improved double screw adjusting mechanism for effecting angular adjustment of one of the cylinders with respect to another.

Still another object of the invention is to provide an improved chute construction by which the balls of different sizes are separately conveyed from the cylinders to the several receptacles provided for receiving the same.

To these and other ends the invention comprises certain novel features of construction and arrangements of parts which will hereinafter be more fully pointed out and claimed, it being understood that the present embodiment is merely illustrative of one form which the invention may take, and that other forms may be developed embodying the broad principles set forth herein without departing from the spirit of the invention when considered from its broadest aspect.

A structure constituting one embodiment of my invention is illustrated in the accompanying drawings, forming a part of this specification, in which:

Figure I is a side elevation of a machine embodying the invention.

Figure II is an end elevation thereof.

Figure III is a plan view of the machine shown in Figure I with certain parts removed.

Figure IV is an enlarged fragmentary plan showing the trough in position for conveying the balls from the container to the gauging cylinders or rollers.

Figure V is a sectional plan taken on lines V—V of Figures I, II, VI and XX.

Figure VI is a transverse sectional view taken on line VI—VI of Figures I, III, IV, V, VII, VIII and XIII.

Figure VII is a longitudinal sectional elevation, through the cylinder carrying frame, taken on lines VII—VII of Figures III, IV, V and VI.

Figure VIII is a similar longitudinal section taken on lines VIII—VIII of Figures III, IV, V and VI.

Figure IX is a transverse sectional elevation taken on lines IX—IX of Figures III, IV, V, VII and VIII.

Figure X is a detailed sectional elevation taken on lines X—X of Figures III, IV, IX and XI.

Figure XI is a detailed sectional plan taken on lines XI—XI of Figures II, IX and X.

Figure XII is an enlarged sectional elevation through one of the cylinders taken on lines XII—XII of Figures III, IV and VII.

Figure XIII is an enlarged sectional elevation through one of the cylinder bearings taken on lines XIII—XIII of Figures III, V, VII and XIV.

Figure XIV is a longitudinal sectional elevation through one of the cylinder bearings taken on lines XIV—XIV of Figures XII, XIII and XXIX.

Figure XV is a perspective view of one of the bearing supporting sleeves.

Figure XVI is a perspective view of one of the bearings.

Figure XVII is a perspective view of a ring for holding the bearing sleeve in supporting engagement with the bearing.

Figure XVIII is an enlarged sectional plan through the frame for supporting the cylinders, taken on lines XVIII—XVIII of Figures I and VI.

Figure XIX is a detailed sectional elevation taken on lines XIX—XIX of Figures I, III, IV, V and XVIII.

Figure XX is a fragmentary sectional elevation illustrating the ball feed drive mechanism, taken on lines XX—XX of Figures III, IV and V.

Figure XXI is a detailed sectional plan taken on line XXI—XXI of Figure XX.

Figure XXII is a detailed sectional plan taken on line XXII—XXII of Figure XX.

Figure XXIII is a perspective view of a guard for controlling the discharge of the balls from the container.

Figure XXIV is a fragmentary sectional elevation of a clutch for controlling the main drive shaft taken on line XXIV—XXIV of Figure V.

Figure XXV is a similar view showing the clutch in closed position.

Figure XXVI is a detail sectional elevation taken on line XXVI—XXVI of Figure XXV.

Figure XXVII is a fragmentary plan of the main drive shaft showing the groove in which the clutch locking pin is adapted to travel.

Figure XXVIII is a fragmentary sectional elevation taken on lines XXVIII—XXVIII of Figures II and XXIX.

Figure XXIX is a transverse sectional elevation taken on line XXIX—XXIX of Figures I, II, III, IV, VII and VIII.

Figure XXX is a fragmentary sectional elevation taken on lines XXX—XXX of Figures II and XXIX.

Figure XXXI is fragmentary sectional plan taken on line XXXI—XXXI of Figure XXIX.

Figure XXXII is a perspective view of a chute for conveying the balls from the cylinders.

Figure XXXIII is a plan view of the ball gauging cylinders shown inclined at an exaggerated angle with balls of different sizes respectively indicated thereon by full and dotted lines.

Figure XXXIV is a transverse sectional view taken on the line XXXIV—XXXIV of Figure XXXIII.

Figure XXXV is a transverse sectional view taken on line XXXV—XXXV of Figure XXXIII.

Figure XXXVI is a transverse sectional view taken on line XXXVI—XXXVI of Figure XXXIII.

Figure XXXVII is a plan view of a portion of one of the double screw cylinder adjusting mechanisms having shown thereon a scale for indicating the amount of adjustment of the cylinder for a predetermined movement of the worm shaft by which the double screw is actuated, and

Figure XXXVIII is a diagrammatic view of the cylinders showing by dotted lines the position at which balls of predetermined sizes are adapted to pass between said cylinders.

Similar reference numerals refer to similar parts throughout the several views of the drawings.

In the construction of ball bearings, it is essential that the balls of the individual bearings be of uniform diameter to insure quiet running, maximum load carrying capacity, and long life of the bearing. Since in the making of balls for use in ball bearings it is impossible to manufacture them in large quantities to an exact size, it becomes necessary to provide means for gauging and separating the balls of different sizes, although they may vary only a few thousandths of an inch in diameter. At the present time it is the general practice, in constructing ball gauging machines, to employ a pair of straight edges slightly inclined with respect to each other, and upon which the balls are adapted to travel until they reach a point at which they will fall through or between the straight edges. The objection to the use of these knife-edged members is that they are effective for the purpose provided only for a very short period of time, usually not exceeding a few hours, as the knife edges upon which the balls travel soon become worn, making it necessary for the user to be constantly regrinding and relapping the edges. This class of work is extremely difficult and requires the services of an expert continually, and by reason of the time required to keep machines of this type in proper condition for service, their capacity is very greatly reduced.

It is for this reason, as I understand, that there is a general complaint among ball bearing manufacturers of the present type of ball gauging machines, which are considered most unsatisfactory from a commercial standpoint for the reasons pointed out above.

It is the object of this invention to overcome the objections to the present types of machines and to greatly prolong the effective life and use of machines used for the purpose of gauging balls, such as are employed in various types of ball bearings.

By employing an entirely new principle, I am enabled to produce a ball gauging machine, the gauging members of which when in constant use need not be reground for relatively long periods of time.

In carrying out the present invention, I employ a plurality of cylinders or rollers of any suitable hardened material ground to a perfect cylindrical form. As the wearing surfaces of these cylinders is infinitely greater than the wearing surfaces of the straight edges, and as the cylinders are constantly in motion, the life and accuracy of the present machine is far greater and far more satisfactory than that of the machines now in use.

In order to make it impossible for the cylinders to have an eccentric action while rotating they are supported upon their outer cylindrical surfaces by plain surface bearings, rather than by supporting them upon reduced ends which might not be accurately centered upon the cylinders.

Adjustment of the distance between the cylinders to within one twenty-thousandth of an inch is obtained by the use of a very satisfactory adjusting mechanism at the ends, preferably of only one of the cylinders, while the other cylinder, although adjustably mounted, is preferably held fixed in a permanent position. Each adjusting mechanism for effecting angular adjustment of one of the cylinders relatively to the other consists of a double screw turned by a worm gearing, a scale being preferably provided for indicating the amount of movement of the adjusted cylinder for a fraction of a revolution of the worm carrying shaft. The threads of one portion of the double screw may have one-eighth of an inch pitch, while the other portion may have one-tenth of an inch pitch. Thus one turn of the double screw causes a movement equal to the difference in pitches of the screws, or one-fortieth of an inch. If the ratio of the worm gearing is 25 to 1, an adjustment of one/one-thousandth of an inch may be obtained by one turn of the worm gear, and if the worm is only turned one-twentieth of a revolution then the cylinder will be moved only one/one-twentythousandth of an inch. While the present machine is constructed according to these proportions, it will be understood that they may be varied or changed as desired. On these double screws I prefer to use relatively coarse threads, rather than fine short-lived ones, which would decrease the efficiency of the machine.

Machines of this character are not unduly affected by the action of the temperature,

since the influence of the temperature upon the cylinders and upon the balls is equalized by the influence of the temperature upon the double screws.

The ball gauging cylinders are of course adapted to rotate in opposite directions, or away from each other, the inner surfaces moving upward to prevent the balls from wedging between the cylinders, means being provided to automatically stop the machine should the main drive shaft be driven in a direction opposite to that intended.

The speed of the balls downwardly upon the inclined cylinders is controlled by a suitable adjusting means provided for changing the angle at which said frame is inclined, while the interval of time between the dropping of the balls upon the cylinders is also regulated by suitable means provided for that purpose.

While in the present case I have shown only one pair of the ball gauging cylinders, it will be understood that the number may be multiplied if it is desired to increase the capacity of the machine, and that all of the cylinders may be actuated by a common driving mechanism such as that shown in the drawings.

Considering the numbered parts of the drawings, 1 represents the bed or base of the machine, which is provided with the uprights 2 and 3 at one end thereof. Mounted upon the upright 2 is an extension consisting of a base bolted to the upright and carrying two spaced upstanding plate members 4 upon which the ball container is supported and upon the upright 3 is mounted an extension 5 as clearly shown in Figure II. The cylinder supporting frame 6 is pivoted at one end between the outer extension plate 4 and the extension 5 by means of the pivot pins 7, as shown in Figure VI.

As a means for adjustably inclining the frame 6 to any desired angle, I employ at the free or outer end of the frame a segment 8, the teeth of which mesh with the teeth of a gear 9 journaled in a bracket 10 on the bed 1, said gear being actuated by a worm 9′ provided with an operating rod or shaft 11, also journaled in said bracket, and which may be actuated in either direction by a suitable handle (not shown).

The spaced extension plates 4 carry, at their upper ends, a flanged base 12 for the ball receiving container 13, as shown in section in Figure XX.

Extending downwardly from the container base 12 at one side thereof and between the plate members 4 is an arm 14, provided with a horizontally disposed bearing 15, in which is journaled the main drive shaft 16 carrying a grooved driving pulley 17, as shown in Figures I, V and XX. The inner plate member 4 at one side thereof is provided with a right angle portion 18 upon which is mounted a bearing 19 in which is journaled the inner end of the main drive shaft 16, as shown in Figure V.

A transverse shaft 20 for driving the ball gauging cylinders is provided with suitable end bearings 21 and an intermediate bearing 22 supported by the frame, as shown in Figure V. The inner end of the main drive shaft 16 is provided with a friction driving disc 23 which is in driving engagement with a ring 24 carried between two clamping members 25 adjustably mounted on the transverse drive shaft 20, it being understood that adjustment of the ring 24 toward or from the center of the disc 23 will serve to increase or decrease the speed of the shaft 20 the desired amount.

Mounted upon the frame 6 is a transverse slide 26 having at one end a fixed guide 27 and at the other an adjustable guide 28, as shown in Figure VII. The slide 26 is widened at its ends and slotted to receive the lower halves 29 of the bearing boxes for the adjustable cylinder 30, as shown in Figure VII. As the bearings for the adjustable cylinder 30 and the relatively fixed cylinder 31 are the same, a description of one will suffice for the other, it being seen that the bearings of the relatively fixed cylinder 31 are adjustably mounted upon the frame 6 by providing slots 31′ in the frame to receive the clamping bolts 32, as shown in Figure XIII, whereby said cylinder is adjustable laterally of the cylinder 30. The lower half 29 of each of said bearing boxes is held in fixed position by said bolts 32, while the upper halves 33 of said boxes are held upon the lower halves by means of the screws 34, as shown in Figure XIII. A pin 35 is loosely positioned between the upper and lower halves of the boxes at their outer ends and this pin serves as a pivot upon which the upper half of the box may rotate when the same is being clamped in position upon the bearing sleeves by means of the screw 34. That portion of the bearing which comes in direct contact with the cylinder or roller comprises a split sleeve 36, said sleeve being provided with a number of longitudinally disposed slots 37, which are alternately cut from the opposite ends of the sleeve, as shown in Figure XVI. The bearing sleeve 36 is tapered to receive a correspondingly tapered split sleeve 38, shown in Figure XV, this latter sleeve forming a tapered seat or support for the sleeve bearing 36. As the rollers or cylinders have to be reground from time to time, it is necessary to adjust the slotted bearings 36 to fit the cylinders when ground, and this is done by means of a split ring 39 mounted upon the outer face of the sleeve 38, and which is adjustably connected with the two halves 29 and 33 of the bearing box by means of the screws 40, as shown in Figure XIV,

it being understood that tightening of the screws 40 will effect a reduction in the size of the sleeve bearings 36 to agree with the size of the reground cylinders when mounted therein by reason of the wedging action of the outer sleeve 38 upon the split sleeve 36.

The cylinders 30 and 31 are each reduced at one end as indicated at 41 in Figures VII and VIII, these reduced ends being provided with the gears 42 which are adapted to mesh with the worms 43 and 44 on the transverse shaft 20, as shown in Figure VI, the worm 44 being made longer than the worm 43 for the reason that the cylinder 30 is the one which is carried by the slide, the gear thereof being adapted to travel upon said worm 44 back and forth, as the slide is adjusted from time to time.

The means for adjusting the slide 26 is best shown in Figures VI and XVIII. This means comprises a shaft 45 mounted in bearings 46 upon the frame 6, said shaft being provided at each end with a pinion 47, meshing with a rack 48, which is connected with the slide 26 by means of the screws 49. Fixed upon the shaft 45 is a gear 50 adapted to mesh with a worm 51 on the inner end of an operating rod 52 which is journaled in the boss 53 of the frame member 6, said rod extending outwardly from the frame and being adapted to be rotated in either direction by a suitable handle (not shown). The mechanism just described comprises the operating mechanism for effecting the relatively coarse adjustment of the cylinder 30 with respect to the cylinder 31.

The means for effecting a fine or more accurate adjustment of the cylinder 30 with respect to the cylinder 31 is best shown in Figures III, IX, X and XI. In carrying out this feature of the invention, I secure in transverse grooves formed near the ends of the slide 26 a bracket 54 having the split jaws or bearing portions which are adjustable toward each other by means of the screws 56 as shown in Figure IX. A somewhat similar bracket 57 having upstanding split jaws is mounted directly opposite the bracket 54 in a slot formed in the frame 6 and said member is held upon the frame by means of the screws 58. The two jaws of said bracket 57 are adjustable towards each other by means of the adjusting screws 59. These jaws are provided on their inner faces with relatively coarse threads, which are adapted to receive the threaded portion 60 of the double screw for effecting adjustment of the cylinder 30 in a manner presently to be described. The threaded portion 61 of the double screw is preferably integral with the threaded portion 60, and is threaded into the split jaws of a clamping member 62, said jaws being adjustable toward each other by means of the adjusting screws 63. The jaws at their base are preferably formed integral with a slide 64 which is recessed at 65 to permit longitudinal movement of the screw portion 61 therein. The slide 64 is adapted to travel upon the base 66 of the bracket 54 as shown in Figure IX, said slide being provided with a cylindrical extension or plunger 67, which is slidably mounted between the jaws of the bracket 54, and which is free to move therein when the screw 56 is loosened. The double screw portions 61 and 60 are preferably provided with 8 and 10 threads per inch respectively, and said portions are carried by a shaft 68 which is provided with a gear 69 having a sleeve 70 journaled in the bearing 71 upon the bracket 57, said sleeve being held upon the bearing by means of a nut 72, as shown in Figure XI, it being understood that the gear 69 is keyed upon the shaft 68, which is slidably mounted in the sleeve 70 to permit longitudinal movement of the shaft and the screw portions 60 and 61 thereon. The bearing 71 is connected with the bracket 57 by any suitable means. A vertically disposed worm 73 for turning the double screw is adapted to mesh with the gear 69, as shown in Figure X, said worm being mounted upon a shaft 74, the opposite ends of which are journaled in the spaced lugs 75 carried by the bearing member 71, said shaft being adapted to be rotated in either direction by a suitable handle (not shown).

The mechanism just described for effecting the relatively fine adjustment of the cylinder 30 is duplicated in order that each end of the cylinder may be adjusted independently of the other, it being understood that the outer end of the cylinder, or that opposite the driving end thereof, will be spaced farther from the relatively fixed cylinder than the inner end by a few thousandths of an inch, or whatever is necessary to insure the desired inclination of one cylinder with respect to the other to accommodate the different size balls to be gauged. In order that the exact amount of adjustment of each end of the cylinder 30 may be known for a given turn of the worm shaft 74 I have provided upon this shaft a mark 74′ and upon the lug 75 a circular scale comprising a plurality of marks or lines 75′, as shown in Figure XXXVII. In the present instance the graduations 75′ are twenty in number and for one-twentieth of a turn of the worm shaft 74 the double screw will effect a movement of the cylinder 30 one one twenty-thousandth of an inch, as previously stated. The manner in which the cylinder 30 is adjusted by means of the double screw arrangement is a very simple one. Assuming by way of illustration that the screw portion 60 is provided with 8 threads per inch or

one-eighth inch pitch and the screw portion 61 with 10 threads per inch or one-tenth inch pitch, then it will be seen that one turn of the double screw will effect a movement of the cylinder equal to the difference in the pitches of the screws, or one-fortieth of an inch. Assuming further that the ratio of the worm gearing is that of 25 to 1, it will be seen that one turn of the worm 73 will effect rotation of the double screw to the extent of one-twentyfifth of a revolution, and one-twentyfifth times one-fortieth equals one-one-thousandth of an inch, which is the amount the cylinder 30 will be moved by one turn of the worm 73. If the worm were given only one-twentieth of a turn then the cylinder would be moved only one one-twenty-thousandth of an inch. By this mechanism it will be seen that a very fine adjustment of the cylinder 30 at either end may be effected with respect to the cylinder 31. Referring to the diagram shown in Figure XXXVIII, and assuming that the cylinders have been adjusted so that a quarter of an inch ball will pass between them at the zero point, then a ball one one-ten-thousandth of an inch larger will pass between the cylinders at the point indicated by the next succeeding dotted line on the right. From this diagram it will be seen that balls of eight different sizes may be gauged by the cylinders, and that a ball too large to pass between the cylinders along the main gauging portion thereof is adapted to be discharged at the point where the cylinders are grooved near their outer ends, as indicated in Figures XXXIII and XXXVI. The shaded balls shown in Figure XXXIII are assumed to be of a perfect size, that is of a size to pass between the cylinders at the zero point, as indicated by dotted line in Figure XXXVIII, and the point at which this size ball will pass between the cylinders in Figure XXXIII is indicated by the section line XXXV—XXXV which corresponds in this figure to the zero point shown in Figure XXXVIII, and which is also the point at which the same size ball will pass between the cylinders, as indicated in Figure XXXV. The larger ball shown by dotted lines in Figure XXXIII is one which is adapted to pass between the cylinders a little to the right of the zero point, and it is assumed that this ball will be one one-thousandth of an inch larger than the perfect ball. The large ball shown by dotted lines in Figure XXXIII, which is in position to pass between the rollers at the points where they are grooved, is one which it is assumed may inadverdently find its way to the container from time to time, but such cases will, of course, not occur very frequently. This ball is shown also in full lines in Figure XXXVI in position to pass between the rollers at the points where they are grooved.

In order to prevent the turning of the cylinders in a direction toward each other, in case the main drive shaft should be rotated in a direction opposite to that intended, I have provided an automatic clutch mechanism which is best shown in Figures V, XX, and XXIV to XXVII inclusive. In carrying out this feature of the invention, I have provided upon the bearing 15 of the main shaft 16 a disc 76 preferably held upon the bearing by means of the screws 77, as shown in Figure XXIV. The disc 76 is provided with a series of circumferentially arranged apertures 78 as shown in Figure XXVI, and a co-acting disc 79 is slidably mounted upon the shaft 16, and is provided with two or more pins 80 which are adapted to engage the disc 76 in the apertures 78 thereof, as shown in Figure XXV. Whenever the shaft 16 is inadverdently rotated in the wrong direction, the sliding disc 79 is adapted to be actuated at such times by means of a spring 81, having one end seated against said disc and surrounding the sleeve 82 thereof, the opposite end of said spring being seated in the groove 83 of the collar 84, the reduced portion 85 of which frictionally engages the stop 86 carried by one of the upright plate members 4, as shown in Figure V, and through which the main drive shaft extends as shown in Figures XXIV and XXV. The shaft 16 is provided with a longitudinally extending groove 87 having an offset portion 88 in which a pin 89 on the sleeve 82 normally rests as shown in Figure XXIV. With the pin in this position and the shaft 16 rotating in a direction indicated by the arrow in Figure XXIV the disc 79, spring 81, and sleeve 84 will rotate with the shaft, the reduced portion 85 of the sleeve rotating at the same time upon the stop 86. However, if the shaft 16 is accidentally rotated in the opposite direction, the pin 89 will move into alignment with the groove 87 and at such time the spring 81 will force the disc 79 to slide upon the shaft in the direction of the disc 76, and the pins 80 will be extended into the apertures 78 of the disc 76, as shown in Figure XXV, and since said disc 76 is rigidly fixed upon the bearing 15, rotation of the shaft 16 will thereby be prevented. At any time that the clutch may be thrown into locking position by rotation of the shaft 16 in the wrong direction, it can be readily reset to normal position as shown in Figure XXIV.

In the adjustment of the slide 26 from time to time, it is necessary to provide means for clamping the same in whatever position it may be desired to secure it, and by referring to Figure VII at the left hand

end thereof, it will be seen that the adjustable guide 28 may be clamped upon the end of the slide 26 by means of the screws 90 threaded into the boss 91 on the end of the pivoted frame 6, the inner end of said screws extending into the recesses 92 in the guide 28 as shown, said screws being provided with the heads 93 by which they are rotated in either direction. Springs 94 are seated between the guide 28 and the washers 95 carried by the boss 91, said springs being protected by a cover plate 96 secured to the boss by means of the screws 97. When the screws 90 are loosened, only the springs 94 hold the guide 28 in engagement with the slide 26 and therefore adjustment of the slide is permitted either by the turning of the worm 73 shown in Figure X or by the turning of the worm 51 shown in Figure VI, it being understood that turning of the last mentioned worm will effect a relatively coarse adjustment of the cylinder 30 and that turning of the worm 73 will effect a very fine adjustment thereof at either end of the cylinder.

In providing means for taking care of the end thrust or longitudinal adjustment of the cylinders, I have shown at one end of each cylinder a bracket 98 connected preferably with the lower bearing member 29 by means of the screws 99 as shown in Figures VII and VIII. The upper end of the bracket is threaded to receive the screw 100 carrying the cone shaped bearing or thrust member 101, which engages the end of the cylinder in a correspondingly shaped recess formed therein. Nuts 102 are provided upon the screw on opposite sides of the bracket to lock said screw in adjusted position upon the bracket. The cone shaped thrust members 101 serve to prevent longitudinal movement of the cylinders within their bearings in an outward direction. The cylinders are preferably made hollow and both ends are provided with the cone shaped recesses which serve to effect a more convenient mounting for the cylinders when placed in a regrinding machine. The action of gravity upon the cylinders tends to keep them in contact with the cone shaped thrust bearings, since the frame upon which the cylinders are mounted is inclined downwardly at its outer end as shown in Figure I. However, the cylinders are additionally held in engagement with the thrust bearings by rotating the driving worms 43 and 44 in a direction toward the cylinders, as indicated by the arrow in Figure V.

In providing means for driving the ball feed mechanism I mount upon the main drive shaft 16 a worm 103 meshing with a gear 104 fixed upon a vertically disposed shaft 105, which is journaled in a bearing 106 extending downwardly from the container base 12 between the uprights 4 as shown in Figure XX. The lower end of the shaft 105 is recessed to receive a ball thrust bearing 107 which may rotate upon a series of smaller balls 108 mounted in the cone shaped recess 109 of the cup 110, carried by the recessed holder or bracket 111, the opposite ends of which are supported by the posts 112 extending upwardly from the base plate which carries the uprights 4, as shown in Figure II. The posts at their upper ends are threaded and provided with nuts 113 which serve to retain the holder 111 in proper position upon the posts. An adjusting screw 114 for the cup 110 is extended through the base of the holder 111 to effect adjustment of the cup with the ball 107 and shaft 105 carried thereon, said screw being provided with a nut 115 by which it is turned and a lock nut 116, as shown in Figure XX. The ball thrust bearing 107 for the shaft 105 may be adjusted from time to time by loosening the nut 116 and turning the nut 115 in the desired direction. The shaft 105 is provided near its upper end with a collar 117 adapted to prevent said shaft from dropping through its bearing when the thrust bearing at the bottom of the shaft is removed.

The base 12 of the ball container is provided at one side with a circular recess 118, in the bottom of which is a disc 119, having a centrally disposed opening 120 through which the upper reduced end 121 of the shaft 105 projects. At one side of the disc 119 is a ball discharging opening 122 registering with an opening 123 in the bottom wall of the container. A ball feed disc 124 is mounted upon the top of the disc 119 and is keyed upon the upper end 121 of the shaft 105 so that it will rotate with said shaft. The feed disc 124 is provided with a series of openings 125, which are of a size to accommodate the balls to be fed to the cylinders, it being understood that a number of these discs may be provided and used independently with holes varying in size, according to the size of the balls to be gauged. Secured upon the upper end of the reduced portion 121 of the shaft is a cylindrical cover or cap member 126 which serves to keep the balls from collecting at the center of the feed disc, thereby causing them to be more evenly distributed in the openings 125, each of which is adapted to register with the opening 122 in the stationary disc 119, through which the balls are discharged one by one, and conveyed to the cylinders by means of the trough 127 emptying into the small hopper 128, at the inner ends of the cylinders, said trough being supported by the plate 129, as shown in Figures II, IV and XX. The small hopper 128 is provided with a finger 130 in its bottom which extends between the cylinders to insure the delivery of the balls thereto.

As it is essential to prevent the balls from crowding upon the cylinders and as best results are obtained by keeping them a slight distance apart when they travel downwardly upon said cylinders, I have provided means for preventing more than one ball from being fed from the container 13 at a time, this means comprising a semi-circular plate 127′ shown in section in Figure XX and in perspective in Figure XXIII. This plate is positioned immediately above the feed disc 124, and always covers the aperture in the feed disc which registers with the opening 122 in the stationary disc 119. The plate 127′ is provided with the upstanding pins 128′ which are adjustably held between the clamping members 129′ and 130′, as shown in Figures III and X. The clamping bar 129′ is connected with the plate member 130′ by means of the screws 131, which may be loosened to permit vertical adjustment of the plate 127′ and pins 128′ above the feed disc 124, said plate 130 being supported within the container 13 by means of the bolts 132 extending upwardly from the inner face of the container base, as shown at the right of Figure XX. It will be seen that vertical adjustment of the plate 127′ to the desired amount is readily effected by loosening the screws 131, after which the bar 129′ is clamped in position upon the plate 130′ by tightetning said screws. The plate 127′ is provided with a finger 133 as shown in Figure XXIII, and this finger lies in the path of the openings 125 of the rotating disc as shown in Figures III and IV, and serves to prevent the retention of more than one ball at a time in the openings 125 when they are brought into registering relation with the opening 122 in the disc 119. It will be seen that the finger 133 will also serve to prevent any extremely small balls or other objects which may find their way into the container from remaining lodged in the apertures 125 as they pass beneath said finger at the time they are being moved into registering relation with the ball discharging opening 122 in the disc 119. The plate 127′ is preferably adapted to cover about half of the openings 125 in the feed disc, as shown in Figure IV, and is provided at one edge with an upstanding projection 134, which is of a height substantially equal to the diameter of the balls, said member serving to hold the lower layer of balls at rest which lie upon the plate 127′.

The upstanding projection 134 insures the feeding of the balls downwardly to the uncovered openings 125 from a point above rather than from below, and by this arrangement a very satisfactory feed is obtained.

Referring now to the means provided for conveying the balls from the cylinders, I have shown in perspective in Figure XXXII, a chute indicated generally by the numeral 135, the application of which is shown in Figures VII, VIII and XXIX. This chute is extended through the opening 136 in the upper wall of the frame 6 and is provided with a flange 137, which is secured to the frame 6 by means of the screws 138, as shown in Figure VIII. The chute is provided with a pre-determined number of ball guideways 139 which are preferably curved downwardly and outwardly, as shown in Figures XXIX and XXXII. Two sets of ball discharging openings for the guideways are provided at the bottom thereof as indicated at 140 and 141 in Figure XXXII. These openings are adapted to communicate with the downwardly extending tubes 142, shown in Figure I and in Figures XXIX to XXXI inclusive. Adjacent the opening 140 at the bottom of the guideway 139 are upstanding lugs 143 serving as guards for the descending balls to insure their passage through said openings and into the tubes extending therebeneath. Adjacent the ball discharging openings 141 is also provided a guard in the form of an upstanding wall or a flange 144 as shown in Figures XXIX and XXXII. At the top of the chute 135 an upstanding triangular plate 145 is provided at the outer edge of each of the guideways, as shown in Figure XXXII. These plates serve to prevent the balls of one size from rolling into the guideways for the balls of another size, after they have dropped between the cylinders.

The tubes 142 at their upper ends are provided with the curved plates 146 at their opposite sides as shown in Figures XXXI and XXIX. These plates are pivotally hung upon the reduced ends 147 of the screws 148 which extend through the side and intermediate walls of the tube carrying frame 149. The frame 149 is connected at its inner edge to the lugs 150 on the chute 135 by means of the bolts 151, as shown in Figure XXIX, said frame being supported at its opposite side by means of the ledge 152, comprising a part of the bottom wall of the cylinder carrying frame 6. A similar tube holding frame member 153 is positioned upon the base 1 of the machine, as shown in Figures I, II and XXIX. Extending transversely through the side walls of the frame member 153 are screws 154, provided with the reduced ends 155 upon which are pivotally mounted the sleeves 156 through which the tubes 142 extend. The tubes are adapted to slide in the sleeves when the cylinder carrying frame 6 is raised and lowered, at which time the sleeves are free to move upon their pivots to take care of the angular adjustment of the tubes when shifted by the raising and lowering of the frame 6. It will be seen from Figure XXIX that the tubes are adapted to extend through the upper

wall of the base 1 beneath which is placed a suitable receptacle (not shown) for the separate collection of the balls from each of the tubes. These receptacles are preferably labeled with the proper sizes of the balls discharged therein and in this way it is possible to tell from time to time what size balls are being used on the different lots of bearings being manufactured.

In the operation of my improved ball gauging machine, by rotating the main drive shaft 16 counter-clockwise, the drive shaft 105 for the feed disc 124 will also be driven counter-clockwise, and the balls fed from the container 13 to the trough 127 one by one. From the trough 127 the balls drop into the small hopper 128 and roll off the finger 130 between the cylinders 30 and 31, which are being rotated in opposite directions by the turning of the transverse cylinder drive shaft 20 in a direction toward the cylinders or clock-wise as indicated in Figure V. As the balls roll downwardly upon the inclined cylinders they drop through at whatever point the diameter of the ball agrees with the spacing between said cylinders, which, of course, increases at a pre-determined ratio, said cylinders having previously been adjusted so that a perfect size ball will pass between them at a point approximately half way between their ends, this ball being adapted to drop into the centrally disposed guideway of the chute 135 as shown in Figure XXXII. The cylinders are preferably adjusted so that a ball one one-thousandth of an inch smaller than the true size ball will pass between the cylinders at a point indicated by the dotted line immediately to the left of the zero point, in Figure XXXVIII, and a ball one one-thousandth of an inch larger than the true size ball will pass between the cylinders at the point indicated by the dotted line immediately to the right of the zero point shown in said figure. These two under and over size balls will drop into the guideways of the chute immediately to the left and right of the central guideway thereof, as shown by the diagram in Figure XXXVII. The largest ball which can pass between the cylinders of the present design is one which is four-thousandths of an inch larger than the true size ball, with the exception of the very large balls which may pass between the cylinders at the points at which they are grooved or reduced, as shown at the right of Figure XXXVIII. It will be understood, of course, that this diagram is merely illustrative of a pair of cylinders of a predetermined length and spacing designed for gauging balls of predetermined sizes within certain limits, the adjustment of the cylinders being previously made to permit of the passage therebetween of the balls at the points indicated by the graduations shown on the cylinders. It will be readily understood that the length and size of the cylinders may be increased or decreased as desired, and that their angular relation may be changed to vary the number of different size balls which will pass between them when said balls are rotating thereon by the action of gravity.

In adjusting the movable cylinder with respect to the relatively fixed cylinder, the screws 90 are first loosened to relieve the pressure on the guide 28. The rough adjustment of the cylinder 30 is then effected by shifting the slide 26 the desired amount, which is done by rotating the shaft 52 shown in Figure XVIII, whereby the turning of the worm 50 effects rotation of the shaft 45 and the pinions 47 which shift the racks 48 and thereby the slide 26 shown in Figures VII and VIII, it being understood that the bearings for the adjustable cylinder 30 are rigidly mounted upon the slide and are adapted to move therewith. When the slide has been adjusted in this manner, before the screws 90 are tightened to force the guide 28 into engagement with the end of the slide adjacent thereto, the relatively fine adjustment of the cylinder 30 may be effected in the following manner.

A gauge, not shown, is preferably provided comprising a wire or rod having a ball on each end thereof spaced apart a distance equal substantially to the distance between the centers of the ball guideways at the extreme ends of the chute 135. The balls at the opposite ends of the wire are of a predetermined size, accurately tested and are laid upon the cylinders with the center of the wire corresponding to the center of the central guideway of the chute. The cylinder 30 is then adjusted by the turning of the shaft 74 and the worm 73 until said cylinder 30 is disposed at such an angle to the cylinder 31 as to permit the balls on each end of the wire to slip between the cylinders at the desired points. The clamping screws 90 are then tightened to prevent accidental displacement of the slide 26. Also the clamping screws 59 and 63 which were previously loosened are then tightened in order to prevent accidental displacement of the double screw portions 60 and 61, whereby the cylinders are held in the desired adjusted position. If it is desired to shift the position of the double screw one way or another this may be done by loosening the clamping screws 56 which will permit movement of the slide 64 and shaft 67 between the jaws of the member 54 shown in Figure IX.

The inclination of the frame 6 and cylinders thereon may be varied according to the speed at which it is desired to have the balls

travel upon the cylinders, and this adjustment is effected by turning the shaft 11 to rotate the worm 9 to effect the raising or lowering of the segment 8 the desired amount. The inclination of the frame 6 and cylinders thereon is preferably equal to that shown in Figure I, but this may be either increased or decreased as found necessary. It will be understood, of course, that when the frame is shifted, the tubes extending therefrom will slide in the sleeves surrounding the bottom of the tubes, since the tubes are pivotally mounted at their upper ends and the tube holding sleeves pivotally mounted upon the frame 153 on the base of the machine as shown in Figures I and XXIX.

It will be understood as previously explained, that should the main driving shaft be rotated in a direction opposite to that intended, the clutch mounted upon the shaft will automatically move into engagement with the disc 76 on the shaft bearing 15, as shown in Figure XXV, thereby preventing backward rotation of said shaft and consequently of the shaft 20 for driving the cylinders. By this means it will be seen that it is impossible to rotate the cylinders in a direction toward each other, which of course might result disastrously to the machine if the balls were traveling upon said cylinders.

While I have shown and described one embodiment of my invention in the present application, it will be understood, of course, that I do not wish to be limited to the particular construction and arrangement of parts shown, since it will be evident that other forms of construction may be designed without departing from the spirit of the invention when considered in its broadest aspect, and as claimed herein.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a ball gauging machine, the combination of a plurality of ball gauging members, the gauging surfaces of which are cylindrical, means for actuating said members in opposite directions, and means for preventing reversal of said actuating means.

2. In a ball gauging machine, the combination of a pair of oppositely driven cylinders inclined with respect to each other and upon which the balls are adapted to travel to points at which they will pass between the cylinders, means for actuating said cylinders, means for feeding the balls to the cylinders, and means for effecting both lateral and longitudinal adjustment of said cylinders.

3. In a ball gauging machine, the combination of a plurality of spaced cylindrical ball gauging members for gauging balls of different sizes having oppositely arranged reduced portions, means for rotating said members in opposite directions, means for adjusting one of said members to incline it relatively to another, and means for feeding the balls thereto.

4. In a ball gauging machine, the combination of a plurality of ball gauging cylinders, adjusting means for inclining one of said cylinders with respect to another to cause said cylinders to continuously gauge balls of different sizes, means for actuating said cylinders to rotate them in opposite directions, means for effecting vertical adjustment of said cylinders, means for feeding the balls thereto, and means for effecting the separation of the different size balls gauged by said cylinders.

5. In a ball gauging machine, the combination of a plurality of ball gauging cylinders, means for adjusting one of said cylinders laterally with respect to another, means for rotating said cylinders in opposite directions, and means independent of said first mentioned adjusting means for effecting angular adjustment of one of said cylinders.

6. In a ball gauging machine, the combination of a plurality of ball gauging cylinders, means for effecting adjustment of one of said cylinders in parallel relationship to another, means for rotating said cylinders in opposite directions, means for effecting angular adjustment of one of said cylinders with respect to another, and means connected with said actuating means for feeding the balls to said cylinders.

7. In a ball gauging machine, the combination of a plurality of ball gauging cylinders, means for effecting adjustment of one of said cylinders laterally of another, means for rotating said cylinders, and means for effecting vertical adjustment of the cylinders to vary the inclination of the same.

8. In a ball gauging machine, the combination of a plurality of ball gauging cylinders, means for driving said cylinders in opposite directions, and means for preventing rotation of said cylinders in a direction toward each other.

9. In a ball gauging machine, the combination of a plurality of inclined ball gauging cylinders, means for driving said cylinders in opposite directions, means for preventing rotation of said cylinders in a direction toward each other, and adjusting means for shifting one of the cylinders laterally of the other, and at an angle thereto.

10. In a ball gauging machine, the combination of a plurality of inclined ball gauging cylinders, means for driving said cylinders in opposite directions, means for preventing rotation of the cylinders in a direction toward each other, adjusting means for shift-

ing one of said cylinders laterally of another and at an angle thereto, and adjustable means for changing the position of said members.

11. In a ball gauging machine, the combination of a plurality of inclined ball gauging cylinders, means for driving said cylinders in opposite directions, and means for automatically preventing the rotation of said driving means when reversed.

12. In a ball gauging machine, the combination of a plurality of ball gauging cylinders, means for driving said cylinders in opposite directions, means for automatically preventing the rotation of said driving means when reversed, and means for feeding the balls to said cylinders.

13. In a ball gauging machine, the combination of a plurality of ball gauging cylinders, mechanism for driving said cylinders in opposite directions, means connected with and operated by said driving means for feeding the balls to said cylinders, and means adapted to automatically discontinue the operation of the machine when said driving mechanism is reversed.

14. In a ball gauging machine, the combination of a plurality of ball gauging cylinders, means for effecting lateral adjustment of one of the cylinders with respect to another, means for effecting longitudinal adjustment of the said cylinders, and means for rotating said cylinders in opposite directions.

15. In a ball gauging machine, the combination of a plurality of ball gauging cylinders, means for driving said cylinders, and means for effecting longitudinal adjustment of the same.

16. In a ball gauging machine, the combination of a plurality of ball gauging cylinders, means for driving said cylinders, means for effecting lateral adjustment of one of the cylinders with respect to another, and means for effecting longitudinal adjustment of the cylinders.

17. In a ball gauging machine, the combination of a plurality of inclined ball gauging cylinders, means for driving said cylinders, means for effecting longitudinal adjustment of the cylinders, and adjusting mechanism for varying the inclination of said cylinders.

18. In a ball gauging machine, the combination of a plurality of inclined ball gauging cylinders, means for driving said cylinders, means for shifting one of said cylinders laterally of another, means for effecting longitudinal adjustment of the cylinders, and adjusting mechanism for varying the inclination of said cylinders.

19. In a ball gauging machine, the combination of a plurality of inclined ball gauging cylinders, means for driving said cylinders, means for shifting one of said cylinders laterally of another, means for effecting longitudinal adjustment of the cylinders, adjusting mechanism for varying the inclination of said cylinders, and means for effecting angular adjustment of one of the cylinders with respect to another.

20. In a ball gauging machine, the combination of a plurality of inclined ball gauging cylinders, means for driving said cylinders, means for shifting one of said cylinders laterally of another, means for effecting longitudinal adjustment of the cylinders, adjusting mechanism for varying the inclination of said cylinders, means for feeding the balls to the cylinders, and means for automatically preventing operation of the cylinders upon reversal of said driving means.

21. In a ball gauging machine, the combination of a plurality of inclined ball gauging cylinders, means for driving said cylinders, means for shifting one of the cylinders laterally of another in parallel relation thereto, means for effecting longitudinal adjustment of the cylinders, adjusting mechanism for varying the inclination of said cylinders, means for effecting angular adjustment of one of the cylinders with respect to another, means for feeding the balls to the cylinders, and means for automatically preventing operation of said driving means upon reversal of the same.

22. In a ball gauging machine, the combination of a pivoted frame, a plurality of ball gauging members rotatably mounted upon said frame, means for rotating said members in opposite directions, and a rack and pinion mechanism for raising and lowering said frame.

23. In a ball gauging machine, the combination of a frame, a cylinder rotatably mounted upon said frame, a slide carried by said frame, a cylinder rotatably mounted upon said slide, means for actuating said slide to move said cylinder bodily, means for rotating said cylinders in opposite directions, and means for effecting angular adjustment of one of said cylinders with respect to the other.

24. In a ball gauging machine, the combination of a pivoted frame, a cylinder rotatably mounted upon said frame, a slide carried by said frame and movable transversely of said cylinder, a cylinder rotatably mounted upon said slide, means for actuating said slide, means for effecting angular adjustment of one of said cylinders with respect to the other, means for rotating said cylinders in opposite directions, and mechanism for adjustably inclining said frame.

25. In a ball gauging machine, the combination of a frame, a slide adjustably

mounted upon said frame, a pair of ball gauging cylinders one of which is rotatably mounted upon said frame and the other upon said slide, means for actuating said cylinders, and a double screw adjusting mechanism for adjusting one of said cylinders laterally of the other.

26. In a ball gauging machine, the combination of a frame, a slide adjustably mounted upon said frame, a pair of ball gauging cylinders, one of which is rotatably mounted upon said slide and the other upon the frame, means for actuating said cylinders, threaded members upon said frame and slide, the threads of which are of a different pitch, and an adjusting member screwed into said threaded members for effecting a relatively fine adjustment of the cylinder carried by said slide with respect to the opposite cylinder.

27. In a ball gauging machine, the combination of a frame, a slide mounted thereon, oppositely arranged ball gauging cylinders, one of which is mounted upon said slide and the other upon said frame, means for rotating said cylinders, means for adjusting said slide to effect angular adjustment of one of said cylinders relatively to the other, and means for effecting longitudinal adjustment of the cylinders.

28. In a ball gauging machine, the combination of a frame, oppositely arranged cylinders rotatably mounted upon the frame, means for rotating said cylinders, means for adjusting each of the cylinders relatively to the other, and means for effecting longitudinal adjustment of said cylinders.

29. In a ball gauging machine, the combination of a frame, oppositely arranged ball gauging cylinders rotatably mounted thereon, each of which is adjustable relatively to the other, means for rotating said cylinders, a double screw having threads of a different pitch for effecting lateral adjustment of one of said cylinders, means by which lateral adjustment of the other cylinder is effected, and means for effecting longitudinal adjustment of said cylinders.

30. In a ball gauging machine, the combination of a frame, oppositely arranged ball gauging cylinders rotatably mounted thereon, means for rotating said cylinders, a double screw having threads of a different pitch operatively connected with one of said cylinders for effecting lateral adjustment of the same, and means adapted to render the turning of the screw ineffective for shifting said cylinder.

31. In a ball gauging machine, the combination of a frame, oppositely arranged ball gauging cylinders rotatably mounted thereon, means for rotating said cylinders, a plurality of double screws each having threads of a different pitch, said screws being adapted to effect lateral adjustment of one of said cylinders with respect to another, means adapted to render the turning of the screws ineffective for shifting said cylinder and means for conveying the balls to said cylinder.

32. In a ball gauging machine, the combination of a frame, oppositely arranged ball gauging cylinders rotatably mounted thereon, one of which is adjustable laterally of the other, means for rotating said cylinders, a double screw having threads of a different pitch, means for mounting said screw upon said frame to effect lateral movement of said adjustable cylinder with respect to the other cylinder, and means for locking and releasing the last mentioned means whereby the turning of the screw may be rendered effective or ineffective at will.

33. In a ball gauging machine, the combination of a frame, oppositely arranged ball gauging cylinders rotatably mounted thereon, one of which is adjustable laterally of the other, means for rotating said cylinders, a double screw having threads of a different pitch, means for mounting said screw upon said frame to effect lateral movement of said adjustable cylinder with respect to the other cylinder, means for locking and releasing the last mentioned means whereby the turning of the screw may be rendered effective or ineffective at will, and actuating means for turning said screw provided with graduations for indicating the amount of movement of said adjustable cylinder for a predetermined movement of said turning means.

34. In a ball gauging machine, the combination of a frame, oppositely arranged ball gauging cylinders rotatably mounted thereon, means for rotating said cylinders, an adjustable holder for one of said cylinders, a bearing member upon said holder, a plunger slidably mounted upon said bearing, means for locking said plunger upon said bearing, a screw holder upon said frame, and a double screw, one portion of which is in threaded engagement with said holder and the other with said plunger, said screw portions, being provided with threads of a different pitch.

35. In a ball gauging machine, the combination of a frame, oppositely arranged ball gauging cylinders rotatably mounted thereon, means for rotating said cylinders, an adjustable holder for one of said cylinders, a bearing member upon said holder, a plunger slidably mounted upon said bearing, means for locking said plunger upon said bearing, a screw holder upon said frame, a double screw, one portion of which is in threaded engagement with the last mentioned holder and the other in threaded engagement with said plunger, said screw por-

tions being provided with threads of a different pitch, and means for feeding the balls to said cylinders.

36. In a ball gauging machine, the combination of oppositely arranged ball gauging cylinders, bearings for said cylinders, supports for said bearings, one of which is adjustable relatively to the other, a bearing member upon said adjustable support, a plunger slidably mounted upon the last mentioned bearing member, means for locking said plunger upon its bearing member, a screw holder fixed relatively to said plunger, a double screw, one portion of which is in threaded engagement with said screw holder and the other with said plunger, said screw portions being provided with threads of a different pitch, and means for rotating said cylinders upon their bearings.

37. In a ball gauging machine, the combination of oppositely arranged ball gauging cylinders, bearings for said cylinders supports for said bearings, one of which is adjustable relatively to the other, means for shifting said adjustable support, a plunger adjustably connected with the last mentioned support, a screw holder fixed relatively to said plunger, a double screw, one portion of which is in threaded engagement with said screw holder and the other with said plunger, said screw portions being provided with threads of a different pitch, and means for rotating said cylinders upon their bearings.

38. In a ball gauging machine, the combination of oppositely arranged ball gauging cylinders, bearings for said cylinders, supports for said bearings, one of which is adjustable relatively to the other, means for shifting said adjustable support, a plunger adjustably connected with each end of said last mentioned support, a screw holder fixed relatively to each of said plungers, a double screw for each of said holders, one portion of which is in threaded engagement with said screw holder and the other with said plunger, said screw portions being provided with threads of a different pitch, a rotatable member operatively connected with each of said screws for turning the same, one revolution of said member serving to effect operation of the screw to shift one of said cylinders a predetermined amount with respect to the other, and means for rotating said cylinders.

39. In a ball gauging machine, the combination of oppositely arranged ball gauging cylinders, bearings for said cylinders, supports for said bearings, one of which is adjustable relatively to the other, a plunger releasably connected with one of said supports, a screw holder fixed relatively to said plunger, a double screw, one portion of which is in threaded engagement with said screw holder, and the other with said plunger, said screw portions being provided with threads of a different pitch, and means for rotating said cylinders.

40. In a ball gauging machine, the combination of oppositely arranged ball gauging cylinders, means for supporting said cylinders in adjustable relation, one with respect to the other, a screw provided with a plurality of threaded portions, the threads of which are of a different pitch, means for operatively connecting said screws with one of said cylinders to shift the same, and means for rotating said cylinders.

41. In a ball gauging machine, the combination of oppositely arranged ball gauging cylinders, means for supporting said cylinders in adjustable relation, one with respect to another, a screw provided with a plurality of threaded portions, the threads of which are of a different pitch, means for operatively connecting said screw with one of said cylinders to shift it laterally of another, means for locking said screw in adjusted position, means for rotating said cylinders, and means for feeding the balls thereto.

42. In a ball gauging machine, the combination of oppositely arranged ball gauging cylinders, means for supporting said cylinders in adjustable relation, one with respect to another, a split screw holder mounted adjacent the end of one of the cylinders, a double screw provided with threaded portions each having threads of a different pitch, one of said portions being in threaded engagement with said holder, means for clamping said split holder upon said screw, means adapted to operatively connect the other threaded portion of said screw with one end of said adjustable cylinder support, and means for rotating said cylinders.

43. In a ball gauging machine, the combination of a frame, bearings mounted upon said frame, a cylinder rotatably mounted upon said bearings, a slide upon said frame, bearings mounted upon said slide, a cylinder rotatably mounted upon said last mentioned bearings substantially parallel to said first mentioned cylinder, means for actuating said slide, locking means for holding said slide in fixed position upon said frame, means for driving said cylinders in opposite directions, and a double screw mounted upon said frame and operatively connected with said slide for effecting angular adjustment of the same, whereby one of said cylinders is inclined with respect to the other.

44. In a ball gauging machine, the combination of a base, a frame adjustably inclined thereon, bearings mounted upon said frame, a cylinder rotatably mounted upon said bearings, a slide upon said frame, bearings mounted upon said slide, a cylinder rotatably mounted upon said last mentioned bearings substantially parallel to said first

mentioned cylinder, means for actuating said slide, locking means for holding said slide in fixed position upon said frame, means for driving said cylinders in opposite directions, and a double screw mounted upon said frame, and operatively connected with said slide for effecting angular adjustment of the same whereby one of said cylinders is inclined with respect to the other.

45. In a ball gauging machine, the combination of a base, a plurality of ball gauging cylinders rotatably mounted upon said base, means for actuating said cylinders, means for effecting lateral adjustment of one of said cylinders with respect to another, said means being provided with a scale for indicating the amount of adjustment of said cylinder for a predetermined movement of said adjusting mechanism, and means for feeding the balls to said cylinder.

46. In a ball gauging machine, the combination of a frame, a plurality of ball gauging cylinders rotatably mounted upon said frame, a double screw adjusting mechanism for shifting one of said cylinders laterally of another, a rotatable operating member for actuating said double screw adjusting mechanism, a graduated member associated with said rotatable operating member for indicating the amount of movement of said adjustable cylinder for a predetermined movement of said rotatable member, means for rotating said cylinders, and means for feeding the balls thereto.

47. In a ball gauging machine, the combination of a base, a frame pivoted thereon, means for moving said frame vertically upon its pivots, a shiftable member upon said frame, a cylinder mounted thereon, a second cylinder mounted upon the frame opposite the first mentioned cylinder and substantially parallel thereto, means for rotating said cylinders in opposite directions, a plunger movable upon said shiftable member, means for locking said plunger against movement, a screw holder upon said frame, a double screw having threaded portions, the threads of which are of a different pitch, one of said portions being in threaded engagement with said screw holder and the other with said plunger, means for locking said screw to prevent it from being accidentally turned, means by which said screw may be turned to incline the cylinder upon said shiftable member a predetermined amount with respect to the opposite cylinder, and means for feeding the balls to said cylinders.

48. In a ball gauging machine, the combination of a base, a frame thereon, means for moving said frame vertically upon its pivots, a shiftable member upon said frame, a cylinder mounted thereon, a second cylinder mounted upon the frame opposite the first mentioned cylinder and substantially parallel thereto, means for rotating said cylinders in opposite directions, a plunger movable upon said shiftable member, means for locking said plunger against movement, a screw holder upon said frame, a double screw having threaded portions, the threads of which are of a different pitch, one of said portions being in threaded engagement with said screw holder and the other with said plunger, means for locking said screw to prevent it from being turned, means by which said screw may be turned to incline the cylinder upon said shiftable member a predetermined amount with respect to the opposite cylinder, means for effecting longitudinal adjustment of the cylinders, means for feeding the balls to the cylinders, means adapted to prevent mixing of the different size balls gauged by the cylinders, and means for preventing rotation of the cylinders in a direction toward each other.

49. In a ball gauging machine, the combination of a frame, a cylinder rotatably mounted upon said frame, guides upon said frame extending substantially at a right angle to the longitudinal axis of the cylinder, a slide loosely mounted between said guides to permit of a slight angular adjustment of the slide with respect to said cylinder, a second cylinder mounted upon said slide substantially parallel to the first mentioned cylinder, means for moving said slide bodily in said guides, adjusting mechanism for effecting angular movement of said slide between its guides, and means for rotating said cylinders in opposite directions.

50. In a ball gauging machine, the combination of a frame, a cylinder rotatably mounted upon said frame, guides upon said frame extending substantially at a right angle to the longitudinal axis of said cylinder, a slide loosely mounted between said guides to permit of a slight angular adjustment of the slide with respect to said cylinders, a second cylinder mounted upon said slide substantially parallel to the first mentioned cylinder, means for moving said slide bodily in said guides, adjusting mechanism for effecting angular movement of said slide between its guides, means for holding said slide in adjusted position, means for rotating said cylinders in opposite directions, and means for feeding the balls to said cylinders.

51. In a ball gauging machine, the combination of a frame, a cylinder rotatably mounted upon said frame, guides upon said frame extending substantially at a right angle to the said cylinder, one of said guides being movable upon the frame, a slide mounted between said guides, means for adjusting said movable guide into and out of holding engagement with said slide, a cylinder mounted upon said slide substantially parallel to said first mentioned cylinder, adjusting mecha-

nisms for effecting angular movement of said slide and cylinder carried thereby with respect to the first mentioned cylinder, and means for rotating said cylinders in opposite directions.

52. In a ball gauging machine, the combination of a frame, a cylinder rotatably mounted upon said frame, a guide adjacent one end of the frame, a spring pressed guide adjacent the other end of the frame, a slide mounted between said guides, a cylinder mounted upon said slide substantially parallel to the first mentioned cylinder, means for rotating said cylinders in opposite directions, adjusting mechanism for effecting angular adjustment of said slide and cylinder carried thereby with respect to the first mentioned cylinder, an adjusting screw for clamping said movable guide upon said slide when the latter has been adjusted to the proper position, and means for rotating said cylinders in opposite directions.

53. In a ball gauging machine, the combination of a frame, a cylinder rotatably mounted upon said frame, a guide adjacent one end of the frame, a spring pressed guide adjacent the other end of the frame, a slide mounted between said guides, a cylinder mounted upon said slide substantially parallel to the first mentioned cylinder, means for rotating said cylinders in opposite directions, adjusting mechanism for effecting angular adjustment of said slide and cylinder carried thereby with respect to the first mentioned cylinder, an adjusting screw for clamping said movable guide upon said slide when the latter has been adjusted to the proper position, and means for rotating said cylinders in opposite directions.

54. In a ball gauging machine, the combination of a frame, a cylinder rotatably mounted upon said frame, a guide adjacent one end of the frame, a spring pressed guide adjacent the other end of the frame, a slide mounted between said guides, a cylinder mounted upon said slide substantially parallel to the first mentioned cylinder, means for rotating said cylinders in opposite directions, adjusting mechanism for effecting angular adjustment of said slide and cylinder carried thereby with respect to the first mentioned cylinder, an adjusting screw for clamping said movable guide upon said slide when the latter has been adjusted to the proper position, means for moving said slide between its guides independently of the first mentioned slide adjusting mechanism, means for rotating said cylinders in opposite directions, and means for feeding the balls to said cylinders.

55. In a ball gauging machine, the combination of a frame, a cylinder rotatably mounted upon said frame, guides upon said frame extending substantially at a right angle to the longitudinal axis of said cylinder, a slide loosely mounted between said guides to permit of a slight angular adjustment of the slide with respect to said cylinder axis, a second cylinder rotatably mounted upon said slide substantially parallel to said first mentioned cylinder, a double screw operatively connected with each end of said slide for shifting either end independently of the other, means for locking said slide in adjusted position, means for rotating said cylinders in opposite directions, and means for feeding the balls to said cylinders.

56. In a ball gauging machine, the combination of a frame, a cylinder rotatably mounted upon said frame, guides upon said frame extending substantially at a right angle to the longitudinal axis of said cylinder, a slide loosely mounted between said guides to permit of a slight angular adjustment of the slide with respect to said cylinder axis, a second cylinder rotatably mounted upon said slide substantially parallel to said first mentioned cylinder, a double screw operatively connected with each end of said slide for shifting either end independently of the other, means for locking said slide in adjusted position, means for locking said screws in adjusted position, means adapted to render the turning of said screws ineffective for the purpose of shifting said slide, means for rotating said cylinders in opposite directions, and means for feeding the balls to the cylinders.

57. In a ball gauging machine, the combination of a frame, bearings upon said frame, a cylinder rotatably mounted upon said bearings, a slide upon said frame movable laterally of said cylinder, means for actuating the slide, bearings upon said slide, a cylinder rotatably mounted upon said bearings, oppositely arranged brackets adjacent each end of said slide and frame, a member slidably mounted upon each of the brackets carried by the slide, releasable means for locking said members upon said brackets, a double screw for each set of oppositely arranged brackets, one portion of said screw being threaded into said slidably mounted member, and the other into said frame bracket, the threads of said screw portions being of a different pitch, and means for rotating said cylinders.

58. In a ball gauging machine, the combination of a frame, bearings upon said frame, a cylinder rotatably mounted upon said bearings, guides upon said frame, one of which is adjustable toward and from the other, means for effecting adjustment of said movable guide, a slide mounted between said guides, means for adjusting said slide, bearings upon said slide, a cylinder rotatably mounted upon said last mentioned bearings substantially parallel to the first mentioned cylinder, means for effecting adjustment of each end of the slide independently of the

other and independently of said slide adjusting means, means for rotating said cylinders in opposite directions, and means for feeding the balls to said cylinders.

59. In a ball gauging machine, the combination of a frame, bearings mounted upon said frame, a cylinder rotatably mounted upon said bearings, a movable member adjustable upon said frame, bearings upon said movable member, a cylinder rotatably mounted upon said last mentioned bearings, a double screw operatively connected with said movable member adjacent each end thereof for moving either end independently of the other to incline the cylinder carried by said movable member relatively to the first mentioned cylinder, means for locking said movable member in adjusted position, means for locking said double screws in adjusted position, means for rotating said cylinders in opposite directions, and means for feeding the balls to the cylinders.

60. In a ball gauging machine, the combination of a frame, bearings mounted upon said frame, a cylinder rotatably mounted upon said bearings, a movable member adjustable upon said frame, bearings mounted upon said movable member, a cylinder rotatably mounted upon said last mentioned bearings, a split bearing upon said movable member, a plunger slidably mounted in said split bearing, a screw for tightening said split bearing to prevent movement of said plunger, a bracket mounted upon said frame in line with said plunger, said bracket being provided with spaced jaws, a screw shaft journaled upon said bracket having double threaded portions thereon provided with threads of a different pitch, one of said threaded portions being in threaded engagement with the spaced jaws of said bracket and the other with a recessed end of said plunger, a screw connecting said bracket jaws for the purpose of locking said double screw against accidental turning, a gear upon said screw shaft, a worm operatively connected with said gear, means for rotating said cylinders in opposite directions, and means for feeding the balls to said cylinders.

61. In a ball gauging machine, the combination of a frame, a cylinder rotatably mounted thereon, a movable memeber adjustable upon the frame, a second cylinder rotatably mounted upon said movable member, a plunger slidably mounted upon said movable member, means for locking said plunger upon said member, spaced uprights upon said frame opposite said plunger, a screw shaft journaled in one of said uprights, said screw shaft having double threaded portions thereon provided with threads of a different pitch, one of said threaded portions being in threaded engagement with the other of said uprights and the other threaded portion extending into a recessed end of said plunger, a gear upon said screw shaft, a worm meshing with said gear, means by which said worm may be turned, means for locking said double screw against turning when adjusted to proper position, means for rotating said cylinders in opposite directions, and means for feeding the balls to said cylinders.

62. In a ball gauging machine, the combination of a frame, a plurality of ball gauging cylinders rotatably mounted upon said frame, means for rotating said cylinders, adjustable end thrust bearings for said cylinders, means for locking said bearings in adjusted position, and means for feeding the balls to the cylinders.

63. In a ball gauging machine, the combination of a frame, spaced bearings upon said frame, a plurality of ball gauging cylinders rotatably mounted upon said bearings, means for rotating said cylinders, brackets adjacent one end of the cylinders, adjustable end thrust bearings for said cylinders carried by said brackets, and means for locking said end thrust bearings in adjusted position upon said brackets.

64. In a ball gauging machine, the combination of a frame, vertically inclined ball gauging cylinders rotatably mounted upon the frame, end thrust bearings for the lower ends of the cylinders, means for rotating the cylinders, said means serving to hold the cylinders in contact with said end thrust bearings, means for preventing the rotation of the cylinders in a direction toward each other, and means for feeding the balls to the cylinders.

65. In a ball gauging machine, the combination of a frame, spaced bearings upon the frame, oppositely arranged cylinders having their ends slidably and rotatably mounted in said bearings, end thrust bearings at one end of the cylinders, gears connected to the opposite ends of the cylinders, a worm shaft provided with worms meshing with said gears to rotate the cylinders in opposite directions and to hold them in contact with said thrust bearings, means for driving said worm shaft, and means for feeding the balls to the cylinders.

66. In a ball gauging machine, the combination of a frame, spaced bearings upon the frame, oppositely arranged cylinders slidably and rotatably mounted in said bearings, said cylinders being provided at one end with reduced portions, thrust bearings at the opposite ends of the cylinders, gears upon said reduced portions, a worm shaft provided with worms meshing with said gears to rotate the cylinders in opposite directions and to hold them in contact with said thrust bearings, driving means connected with said worm shaft, means for adjustably inclining said cylinders, means for adjusting one of the cylinders laterally of

the other, and means for feeding the balls to the cylinders.

67. In a ball gauging machine, the combination of a frame, spaced bearings upon said frame, oppositely arranged ball gauging cylinders mounted upon said bearings, gears connected with said cylinders, a shaft provided with gears oppositely connected with said first mentioned gears, a second shaft operatively connected with said first mentioned shaft, a third shaft driven by said second shaft, a ball feed mechanism actuated by said third shaft, means by which the balls are conveyed from said feed mechanism to the cylinders, and means for adjusting one of said cylinders laterally of another.

68. In a ball gauging machine, the combination of a frame, oppositely arranged ball gauging cylinders rotatably mounted upon said frame, gears connected with said cylinders, a shaft provided with worms meshing with said gears and adapted to rotate said cylinders in opposite directions, a driving shaft operatively connected with said first mentioned shaft, an automatic clutch for preventing rotation of the driving shaft in one direction, a ball feed mechanism, a shaft for actuating the same, gears operatively connecting said last mentioned shaft with said drive shaft, a chute for conveying the balls from said feed mechanism to said cylinders, and means for adjusting one of said cylinders laterally of the other.

69. In a ball gauging machine, the combination of a base, a frame pivoted for vertical movement upon said base, means for adjusting the frame upon its pivots, oppositely arranged ball gauging cylinders mounted upon the frame, means for adjusting said cylinders laterally of each other, a shaft operatively connected with said first mentioned shaft, a ball feed mechanism operatively connected with said drive shaft, a chute for conveying the balls from said feed mechanism to said cylinders, and means for preventing the mixing of the different size balls gauged by the cylinders.

70. In a ball gauging machine, the combination of a frame, oppositely arranged ball gauging cylinders rotatably mounted upon said frame, driving means for said cylinders, said driving means being capable of adjustment for varying the speed at which the cylinders are driven, means for feeding balls to the cylinders, and means for adjusting one of the cylinders laterally of the other.

71. In a ball gauging machine, the combination of a frame, oppositely arranged ball gauging cylinders rotatably mounted upon said frame, driving means for said cylinders, said driving means being capable of adjustment for varying the speed at which the cylinders are driven, a ball feed mechanism operatively connected with said driving mechanism, means by which the balls are conveyed from said feed mechanism to said cylinders, and means for adjusting one of said cylinders laterally of the other.

72. In a ball gauging machine, the combination of a base, a frame pivoted for vertical movement upon said base, means for adjusting said frame upon its pivots, oppositely arranged ball gauging cylinders rotatably mounted upon said frame, means for adjustably inclining one of said cylinders relatively to the other, a drive shaft, a friction disc driven thereby, a driven shaft operatively connected with said cylinders for rotating them in opposite directions, a friction wheel upon said last mentioned shaft in engagement with said disc and adjustable thereon for varying the speed of said driven shaft, a ball feed mechanism operatively connected with said drive shaft, means for conveying the balls from said feed mechanism to said cylinders, and means for preventing the mixing of the different size balls gauged by said cylinders.

73. In a ball gauging machine, the combination of a base having spaced standards thereon, a pair of spaced plate members extending upwardly from one of said standards, a frame pivoted for vertical movement between the other of said standards and one of said plate members, oppositely arranged ball gauging cylinders rotatably mounted upon said frame, a ball container mounted upon the upper ends of said plate members, an arm extending downwardly from said container, a drive shaft journaled in said arm, a bearing extending downwardly from said container, a vertically disposed shaft journaled in said bearing, means operatively connecting said vertical shaft with said drive shaft, a ball feed mechanism in the base of the container actuated by said vertical shaft, means by which the balls are conveyed from the feed mechanism to said cylinders, means for adjusting one of said cylinders laterally of the other, a shaft operatively connected with said cylinders for driving the same in opposite directions, and means operatively connecting said last mentioned shaft with said drive shaft.

74. In a ball gauging machine, the combination of a pair of standards, one of which is provided with spaced upright plate members, a frame pivoted for vertical movement upon the other of said standards and one of said plate members, means for raising and lowering the frame, oppositely arranged ball gauging cylinders rotatably mounted upon said frame, means for adjusting one of said cylinders laterally of the other, a ball container mounted upon said plate members, a laterally projecting arm connected with said plate members, a drive shaft journaled in

said arm, a bearing connected with said plate members, a shaft journaled in said bearing, a ball feed mechanism in the bottom of said container adapted to be actuated by said last mentioned shaft, means operatively connecting said shaft with said drive shaft, means by which the balls are conveyed from said feed mechanism to said cylinders, and means operatively connecting said drive shaft with said cylinders to rotate them in opposite directions.

75. In a ball gauging machine, the combination of a plurality of standards, one of which is provided with spaced upright plate members, a frame mounted upon said standards, a plurality of ball gauging members rotatably mounted upon said frame, a ball container mounted upon said upright plate members, an arm connected with said plate members, a drive shaft journaled in said arm, a bearing carried by said plate members, a shaft journaled in said bearing, a ball feed mechanism carried by said plate members and adapted to receive the balls from said container, said feed mechanism being actuated by said last mentioned shaft, means operatively connecting said shaft with said drive shaft, means by which the balls are conveyed from said feed mechanism to said gauging members, and means operatively connecting said drive shaft with said gauging mechanism.

76. In a ball gauging machine, the combination of a base, a plurality of rotatably mounted ball gauging members carried by said base, spaced upright plate members connected with said base, a ball container upon said upright members having a recess formed in its base, ball feed mechanism mounted in said recess, a bearing projecting from said container base, a shaft journaled in said bearing and operatively connecting with said feed mechanism, spaced bearings carried by said upright plate members, a drive shaft journaled in said bearings, means operatively connecting said drive shaft with said first mentioned shaft, means operatively connecting said drive shaft with said ball gauging members, and means by which the balls are conveyed from said feed mechanism to said gauging members.

77. In a ball gauging machine, the combination of a base, a plurality of movably mounted ball gauging members carried by said base, a ball container mounted upon the base, a ball feed mechanism adapted to receive the balls from said container, a vertically disposed shaft operatively connected with said feed mechanism, an adjustable end thrust bearing for one end of said shaft, a drive shaft operatively connected with said first mentioned shaft, means operatively connecting said drive shaft with said ball gauging members, and means by which the balls are conveyed from said feed mechanism to said gauging members.

78. In a ball gauging machine, the combination of a base, a plurality of movably mounted ball gauging members carried by said base, spaced upright plate members upon said base, a ball container carried by said plate members, a ball feed mechanism adapted to receive the balls from said container, a vertically disposed shaft rotatably mounted between said plate members and operatively connected with said feed mechanism, a holder between said plate members at the lower end of said shaft, means for effecting vertical adjustment of said holder, a thrust bearing carried by said holder in engagement with the lower end of said shaft, means for rotating said shaft, means connected with said rotating means for actuating said ball gauging members, and means by which the balls are conveyed from said feed mechanism to said gauging members.

79. In a ball gauging machine, the combination of a base, a plurality of movably mounted ball gauging members carried by said base, a recessed member carried by said base having a ball discharging opening leading therefrom, a ball feed plate movably mounted in said recessed member and provided with an aperture therethrough, a ball container for supplying balls to said feed plate, means for actuating said plate to cause said aperture to intermittently register with said opening, means for actuating said ball gauging members, and means by which the balls are conveyed from said opening to said gauging members.

80. In a ball gauging machine, the combination of a base, a plurality of movably mounted ball gauging members carried by said base, a recessed member carried by said base having a ball discharging opening leading therefrom, a ball feed plate movably mounted in said recessed member and provided with an aperture therethrough, a ball container for supplying balls to said feed plate, means for actuating said plate to cause said aperture to intermittently register with said opening, a guard for preventing the lodgment of more than one ball in said aperture when the later is brought into registering relation with said opening, means for actuating said ball gauging members, and means by which the balls are conveyed from said discharge opening to said ball gauging members.

81. In a ball gauging machine, the combination of a base, a plurality of movably mounted ball gauging members carried by said base, a recessed member carried by said base having a ball discharging opening leading therefrom, a ball feed plate movably mounted in said recessed member and pro-

vided with an aperture therethrough, a ball container for supplying balls to said feed plate, means for actuating said plate to cause said aperture to intermittently register with said opening, a guard for preventing the lodgment of more than one ball in said aperture when the latter is brought into registering relation with said opening, means for insuring the feeding of the balls downwardly to said aperture from a point about the plate in which the aperture is formed, means for actuating said ball gauging members, and means by which the balls are conveyed from said discharge opening to said ball gauging members.

82. In a ball gauging machine, the combination of a base, a plurality of ball gauging members movably mounted upon said base, a recessed member carried by said base having a ball discharging opening leading therefrom, a ball feed disc rotatably mounted in said recessed member provided with a plurality of apertures adapted to be moved into registering relation with said discharging opening, a drive shaft operatively connected with said feed disc, a ball container for supplying the balls to said feed disc, a vertically adjustable guard above said disc for preventing the lodgment of more than one ball in each of said apertures when brought into registering relation with said opening, an upstanding member carried by said guard adjacent one edge thereof adapted to insure the feeding of the balls downwardly to the exposed apertures in the feed disc from a point above said upstanding member, means operatively connected with said drive shaft for actuating said ball gauging members, and means by which the balls are conveyed from said discharge opening to said gauging members.

83. In a ball gauging machine, the combination of a base, a plurality of ball gauging members movably mounted upon said base, a recessed member carried by said base having a ball discharging opening leading therefrom, a ball feed disc rotatably mounted in said recessed member provided with a plurality of apertures adapted to be moved into registering relation with said ball discharging opening, a drive shaft operatively connected with said feed disc, a ball container for supplying the balls to said feed disc, a vertically adjustable guard overlying a portion of said feed disc and covering a plurality of said apertures, upstanding pins carried by said guard, a holder for said guard comprising a releasable clamping member adapted to be clamped upon said pins whereby the guard may be adjusted vertically above the feed disc, means operatively connected with said drive shaft for actuating said ball gauging members, and means by which the balls are conveyed from said discharge opening to said gauging members.

84. In a ball gauging machine, the combination of a base having spaced uprights thereon, a frame pivotally mounted upon said uprights, a rack connected with said frame, a pinion for actuating said rack whereby adjustment of the frame upon its pivots is effected, ball gauging mechanism carried by the frame, and means for actuating said mechanism.

85. In a ball gauging machine, the combination of a base, having spaced uprights thereon, a frame pivotally mounted for vertical movement upon said uprights, means for adjusting said frame upon its pivots, ball gauging mechanism carried by said frame, means for actuating the same, and a plurality of members pivotally connected to said frame and adapted to convey the balls from said gauging mechanism to a predetermined point beneath said frame.

86. In a ball gauging machine, the combination of a base, a frame pivotally mounted upon said base, means for shifting the position of the frame upon its pivots, ball gauging mechanism carried by the frame, means for actuating said mechanism and a plurality of tubes interposed between said frame and base into which the different size balls are discharged by said gauging mechanism.

87. In a ball gauging machine, the combination of a base, a frame adjustably mounted upon said base and adapted to be inclined relatively thereto, ball gauging mechanism carried by said frame, and a plurality of tubes between said frame and base into which the balls are discharged from said gauging mechanism.

88. In a ball gauging machine, the combination of a base, a frame adjustably mounted upon said base and adapted to be inclined relatively thereto, ball gauging mechanism carried by said frame, means for adjusting said gauging mechansm to vary the size of the balls to be gauged, and a plurality of tubes pivotally mounted upon said frame into which the different size balls are discharged from said gauging mechanism.

89. In a ball gauging machine, the combination of a base, a frame adjustably mounted upon said base and adapted to be inclined relatively thereto, ball gauging mechanism carried by said frame, a plurality of tubes pivotally mounted upon said frame into which the different size balls are discharged from said gauging mechanism, and guides upon said base in which said tubes are slidably mounted.

90. In a ball gauging machine, the combination of a base, a frame adjustably mounted thereon and adapted to be inclined relatively thereto, ball gauging cylinders

carried by said frame, means for actuating said cylinders, a plurality of tubes pivotally mounted upon said frame into which the different size balls are discharged from said gauging mechanism, and pivoted guides upon said base in which said tubes are slidably mounted.

91. In a ball gauging machine, the combination of a base, a frame adjustably mounted upon said base, ball gauging mechanism carried by said frame, means for actuating said mechanism, a plurality of tubes pivotally mounted upon said frame into which the various size balls are discharged from said gauging mechanism, and a pivoted sleeve upon said base for each of said tubes in which the latter are slidably mounted.

92. In a ball gauging machine, the combination of a base, a frame adjustable vertically upon said base, ball gauging mechanism carried by said frame, a plurality of tubes pivotally mounted between said frame and base into which the balls are discharged from the gauging mechanism, said tubes being adapted to project through openings formed in said base, and means for raising and lowering said frame.

93. In a ball gauging machine, the combination of a base, a frame adjustable vertically upon said base, ball gauging mechanism carried by said frame, means for actuating said mechanism, a plurality of tubes connected with said frame into which the balls are discharged from said gauging mechanism, guides upon the base for receiving the lower ends of said tubes, and means for raising and lowering said frame.

94. In a ball gauging machine, the combination of a base, a frame adjustably mounted upon said base, ball gauging mechanism connected with said frame, means for adjusting said mechanism to vary the size of the balls to be gauged thereby, a plurality of tubes connected with said frame into which the balls are discharged from said gauging mechanism, and pivotally mounted guides upon said base for receiving the lower ends of said tubes.

95. In a ball gauging machine, the combination of a base, a frame pivotally mounted upon said base, means for moving said frame upon its pivots, ball gauging mechanism connected with said frame, a plurality of tubes connected with said frame into which the balls are discharged from said gauging mechanism, a holder mounted upon said base and a plurality of removable guides pivotally mounted upon said holder in which the lower ends of said tubes are slidably mounted.

96. In a ball gauging mahine, the combination of a base, a frame pivotally mounted upon said base, means for moving said frame upon its pivots, ball gauging mechanism carried by said frame, a removable holder carried by said frame, a plurality of tubes pivotally connected with said holder into which the balls are discharged from said gauging mechanism, means for actuating said gauging mechanism, and a plurality of guides pivotally mounted upon said base in which the lower ends of said tubes are slidably mounted.

97. In a ball gauging machine, the combination of a base, a frame adjustably mounted upon said base, ball gauging mechanism connected with said frame, a plurality of tubes connected with said frame, into which the balls are discharged from said gauging mechanism, a detachable holder upon said base, screws carried by said holder having bearing portions thereon and guides pivotally mounted upon said bearing portions in which said tubes are slidably mounted.

98. In a ball gauging machine, the combination of an adjustably inclined frame, ball gauging cylinders connected with said frame, means for actuating said cylinders, a detachable holder upon said frame, screws carried by said holder, having bearing portions thereon, and tubes pivotally mounted upon said bearing portions into which the balls are discharged from said cylinders.

99. In a ball gauging machine, the combination of an adjustably mounted frame, a ball gauging mechanism carried by said frame, a chute mounted in said frame provided with a plurality of guideways, a tube depending from said chute for each of said guideways, and means for effecting adjustment of said frame.

100. In a ball gauging machine, the combination of an adjustably mounted frame, ball gauging mechanism connected with said frame, a chute connected with said frame, a removable holder connected with said chute, a plurality of tubes pivotally connected with said holder, and means for effecting adjustment of said frame.

101. In a ball gauging machine, the combination of an adjustably mounted frame, ball gauging mechanism mounted upon said frame, a plurality of tubes pivotally mounted upon the frame, and means for separately conveying the different size balls passing through said gauging means to said tubes.

102. In a ball gauging machine, the combination of a frame, ball gauging mechanism mounted upon said frame, means for adjusting said gauging mechanism to vary the size of the balls to be gauged, a detachable holder upon said frame, a plurality of tubes connected with said holder, and means for conveying the different size balls passing through said gauging mechanism to said tubes.

103. In a ball gauging machine, the com-

bination of a frame, ball gauging mechanism mounted upon said frame, a plurality of tubes connected with said frame, a chute interposed between said ball gauging members and said tubes having a guideway leading to each of said tubes, pivoted guides for the lower ends of said tubes, and a rack and pinion mechanism for raising and lowering said frame.

104. In a ball gauging machine, the combination of a frame, ball gauging mechanism mounted upon said frame, a detachable holder upon said frame, a chute connected with said frame and said holder, a plurality of tubes pivotally connected with said holder, and a plurality of pivoted guides for the lower ends of said tubes.

105. In a ball gauging machine, the combination of a frame, ball gauging mechanism mounted upon said frame, a chute positioned beneath said gauging mechanism and having a plurality of ball guideways for receiving the different size balls gauged by said mechanism, a detachable holder connected at one side with said chute and adapted at its opposite side to be supported by said frame, and tubes connected with said holder in communication with each of said guideways.

106. In a ball gauging machine, the combination of a frame, ball gauging mechanism mounted upon said frame, a chute upon said frame beneath said gauging mechanism having guideways for separately receiving the different size balls passing through said gauging mechanism, lugs carried by said chute, a detachable holder connected with said lugs, and tubes connected with said holder in communication with each of said guideways.

107. In a ball gauging machine, the combination of a frame, ball gauging mechanism mounted upon said frame, a plurality of tubes carried by said frame, and a detachable member having a plurality of guideways for separately conveying from said ball gauging mechanism to each of said tubes the different size balls gauged by said mechanism.

108. In a ball gauging machine, the combination of a frame, ball gauging mechanism mounted upon said frame, a plurality of tubes mounted upon said frame, a chute interposed between said gauging mechanism and said tubes having guideways leading to the tubes for separately conveying thereto the different size balls passing through said gauging mechanism, and means for directing the balls into the proper guideways upon the chute when they are leaving said gauging mechanism.

109. In a ball gauging machine, the combination of a frame, ball gauging mechanism mounted upon said frame, and a chute beneath said gauging mechanism having a plurality of inclined ribs forming guideways alternately varying in length, said guideways being adapted to receive the different size balls gauged by said mechanism.

110. In a ball gauging machine, the combination of a frame, ball gauging mechanism mounted upon said frame, a chute beneath said gauging mechanism having a plurality of inclined guideways for receiving the different size balls gauged by said mechanism, said guideways each having a ball discharging opening adjacent the bottom thereof, and a guard adjacent each of said openings adapted to insure the passage of the balls through the openings.

111. In a ball gauging machine, the combination of a frame, ball gauging mechanism mounted upon said frame, a chute beneath said gauging mechanism having a plurality of inclined guideways for receiving the different size balls gauged by said mechanism, said guideways each having a ball discharging opening adjacent the bottom thereof, a guard for insuring the discharge of the balls through each of said openings, and an upstanding plate member at the top of each of said guideways serving to prevent mixing of the predetermined sizes of balls gauged by said mechanism.

112. In a ball gauging machine, the combination of a frame, ball gauging mechanism mounted upon said frame, means for adjusting said mechanism to vary the size of the balls to be gauged, a chute beneath said gauging mechanism having a plurality of inclined guideways provided adjacent their lower ends with alternately arranged openings through which the balls are discharged, and a ball receiving member adapted to register with each of said openings.

113. In a ball gauging machine, the combination of a frame, ball gauging mechanism connected with said frame, means for feeding the balls to said mechanism, a chute beneath said gauging mechanism having a plurality of inclined guideways provided adjacent their lower ends with alternately arranged openings through which the balls are discharged, a holder secured to the bottom of said chute, a tube pivotally mounted upon said holder for each of said openings, a pivotal guide for the lower end of each of said tubes, and means for adjustably inclining said frame.

114. In a ball gauging machine, the combination of a hollow frame having openings through its upper and lower walls, ball gauging mechanism mounted upon said frame above the opening in said upper wall, an inclined chute mounted in said frame and adapted to project through said last mentioned opening, said chute having a plurality of guideways in position to receive the balls from said gauging mechanism, and a

tube connected with each of said guideways through the opening in the bottom of said frame.

115. In a ball gauging machine, the combination of a hollow frame having openings through its upper and lower walls, ball gauging mechanism mounted upon said frame above the opening in said upper wall, an inclined chute mounted in said frame having a plurality of ball guideways, the chute being adapted to project through said last mentioned opening and having a flange resting upon said upper frame wall, and means for supporting the bottom end of said chute upon said lower frame wall in line with the opening therethrough.

116. In a ball gauging machine, the combination of a hollow frame having openings through its upper and lower walls, ball gauging mechanism mounted upon said frame above the opening in said upper wall, an inclined chute mounted in said frame having a plurality of ball guideways, said chute being adapted to extend through said last mentioned opening and having a projection resting upon said upper frame wall, a tube holder interposed between the bottom end of said chute and said lower frame wall, and a plurality of tubes connected with said holder through the opening in said lower wall, and in registering relation with said guideways.

117. In a ball gauging machine, the combination of a frame, a plurality of ball gauging cylinders rotatably mounted upon said frame, bearings for said cylinders adjustable to conform to the size of the cylinders when ground from time to time, means for rotating said cylinders within said bearings, and means for feeding the balls to said cylinders.

118. In a ball gauging machine, the combination of a frame, a plurality of ball gauging cylinders mounted upon said frame, bearings for said cylinders adjustable to conform to the size of the cylinders when ground from time to time, an adjustable holder for supporting each of said bearings, means for rotating said cylinders within said bearings, and means for feeding the balls to said cylinders.

119. In a ball gauging machine, the combination of a frame, a plurality of ball gauging cylinders mounted upon said frame, bearings for said cylinders adjustable to conform to the size of the cylinders when ground from time to time, means for effecting the adjustment of said bearings, means for rotating said cylinders within said bearings, means for feeding the balls to said cylinders, and means for separately conveying from said cylinders the different size of balls gauged thereby.

120. In a ball gauging machine, the combination of a frame, a plurality of ball gauging cylinders mounted upon said frame, bearings for said cylinders adjustable to conform to the size of the cylinders when ground from time to time, an adjustable holder for each of said bearings, a screw for effecting adjustment of said holder, means for rotating said cylinders within said bearings, and means for feeding the balls to the cylinders.

121. In a ball gauging machine, the combination of a frame, a plurality of ball gauging cylinders mounted upon said frame, bearings for said cylinders adjustable to conform to the size of the cylinders when ground from time to time, a fixed holder carried by said frame for each of said bearings, a movable holder for each of said bearings pivoted upon said fixed holder, means for effecting movement of the pivoted holder upon the first mentioned holder, means for adjusting said bearings, means for rotating said cylinders within said bearings, and means for feeding the balls to said cylinders.

122. In a ball gauging machine, the combination of a frame, a plurality of ball gauging cylinders mounted upon said frame, yieldable bearings for said cylinders carried by said frame, means for adjusting said yieldable bearings to conform to the size of said cylinders, means for rotating said cylinders within said bearings, and means for feeding the balls to said cylinders.

123. In a ball gauging machine, the combination of a frame, a plurality of ball gauging cylinders mounted upon said frame, yieldable bearings for said cylinders carried by said frame, adjustable to conform to cylinders of different sizes, a fixed holder for each of said bearings, an adjustable holder upon each of said fixed holders adapted to be adjusted to effect a reduction in the size of said yieldable bearings, means for rotating said cylinders within said bearings, and means for feeding the balls to said cylinders.

124. In a ball gauging machine, the combination of a frame, a plurality of ball gauging cylinders mounted upon said frame, split sleeve bearings mounted upon said frame, adapted to receive said cylinders, means for adjusting said split sleeve bearings to fit cylinders of different sizes, means for rotating said cylinders within said bearings, and means for feeding the balls to said cylinders.

125. In a ball gauging machine, the combination of a frame, a plurality of ball gauging cylinders mounted upon said frame, tapered split sleeve bearings for said cylinders, adjustable wedge shaped members for varying the size of said bearings to fit cylinders of different diameters, means for rotating said cylinders within said bearings, and means for feeding the balls to said cylinders.

126. In a ball gauging machine, the combination of a frame, a plurality of ball gauging cylinders mounted upon said frame,

tapered split sleeve bearings for said cylinders, said sleeves having alternately arranged longitudinally extending cuts in the opposite ends thereof, movable wedge shaped members adjustable upon said sleeves to cause them to fit cylinders of different diameters, means for supporting said wedge shaped members, means for rotating said cylinders within said sleeve bearings, and means for feeding the balls to said cylinders.

127. In a ball gauging machine, the combination of a frame, a plurality of ball gauging cylinders mounted upon said frame, tapered split sleeve bearings for said cylinders, said sleeves having alternately arranged longitudinally extending cuts in the opposite ends thereof, movable wedge shaped members adjustable upon said sleeves to cause them to fit cylinders of different sizes, adjustable holders for said wedge shaped members, means for rotating said cylinders within said bearings, and means for feeding the balls to said cylinders.

128. In a ball gauging machine, the combination of a frame, a plurality of ball gauging cylinders mounted upon said frame, tapered split sleeve bearings for said cylinders, correspondingly tapered sleeve members engaging said sleeve bearings, adjustable holders carried by said frame substantially surrounding said last mentioned sleeve members, split rings seated upon the outer faces of said sleeve members, adjusting screws connected with said rings and extending into threaded engagement with said holder, means for rotating said cylinders in said sleeve bearings, and means for feeding the balls to said cylinders.

129. In a ball gauging machine, the combination of a frame, a plurality of ball gauging cylinders mounted upon said frame, tapered split sleeve bearings for said cylinders, correspondingly tapered sleeve members adjustably supporting said sleeve bearings, spaced adjustable holders for said last mentioned split members, means for adjusting said holders toward each other, means connected with said holders for adjusting said tapered sleeve members upon said sleeve bearings, means for rotating said cylinders within said bearings, and means for feeding the balls to the cylinders.

130. In a ball gauging machine, the combination of a frame, a plurality of ball gauging cylinders mounted upon said frame, split tapered sleeve bearings for said cylinders, correspondingly tapered sleeve members upon said sleeve bearings, a fixed holder for the lower half of said split sleeve member, a pin upon said holder projecting above the upper face thereof, a movable holder for the upper half of said split sleeve member pivoted upon said pin, an adjustable clamping screw connecting said holders between said pivot pin and sleeve member, a split ring seated upon the outer face of said tapered sleeve member, adjusting screws connected with said ring and extending into threaded engagement with each of said holders, means for rotating said cylinders within said sleeve bearings, and means for feeding the balls to said cylinders.

In testimony whereof I affix my signature.

HANS LUTZ.