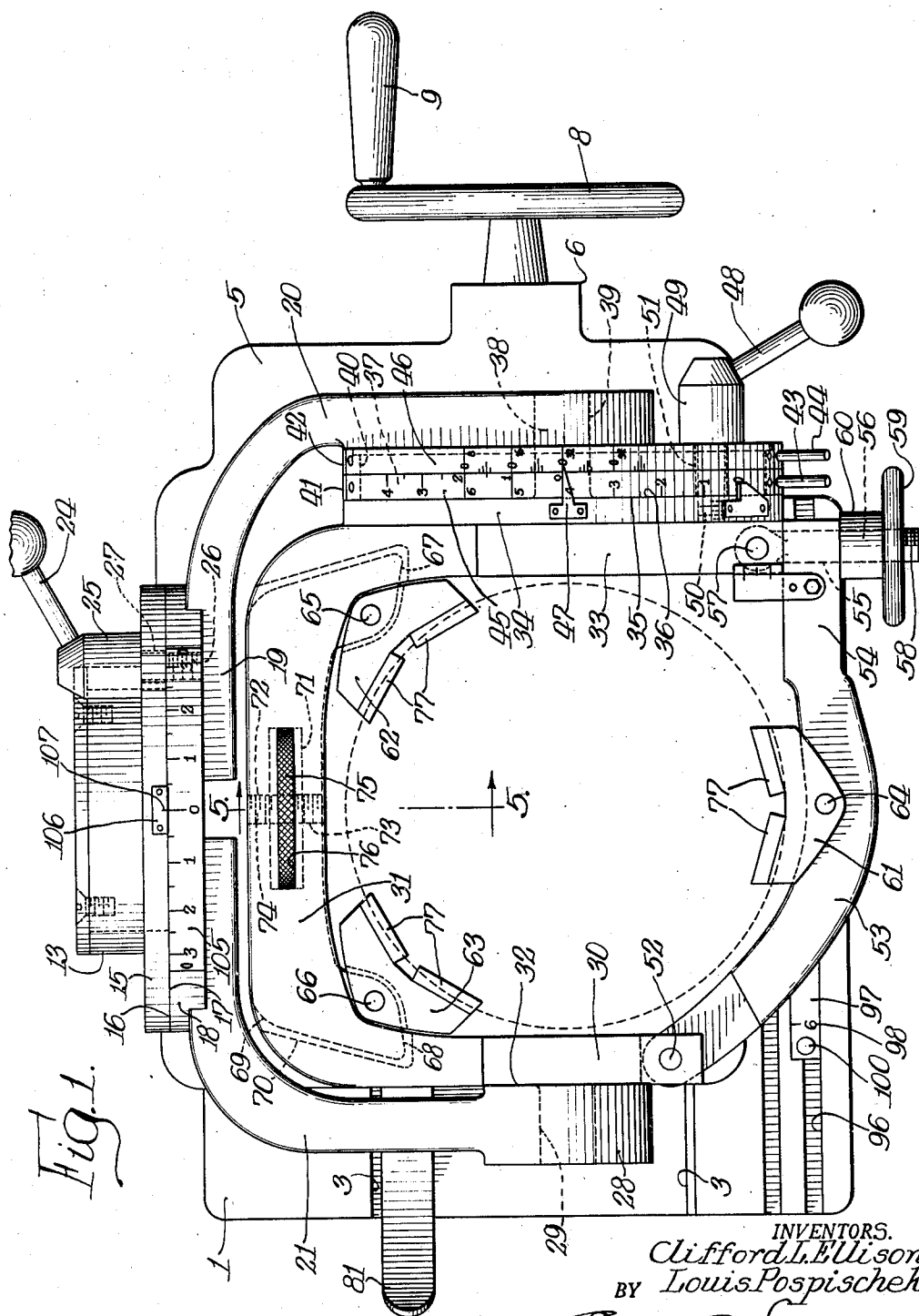


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5 Sheets-Sheet 1



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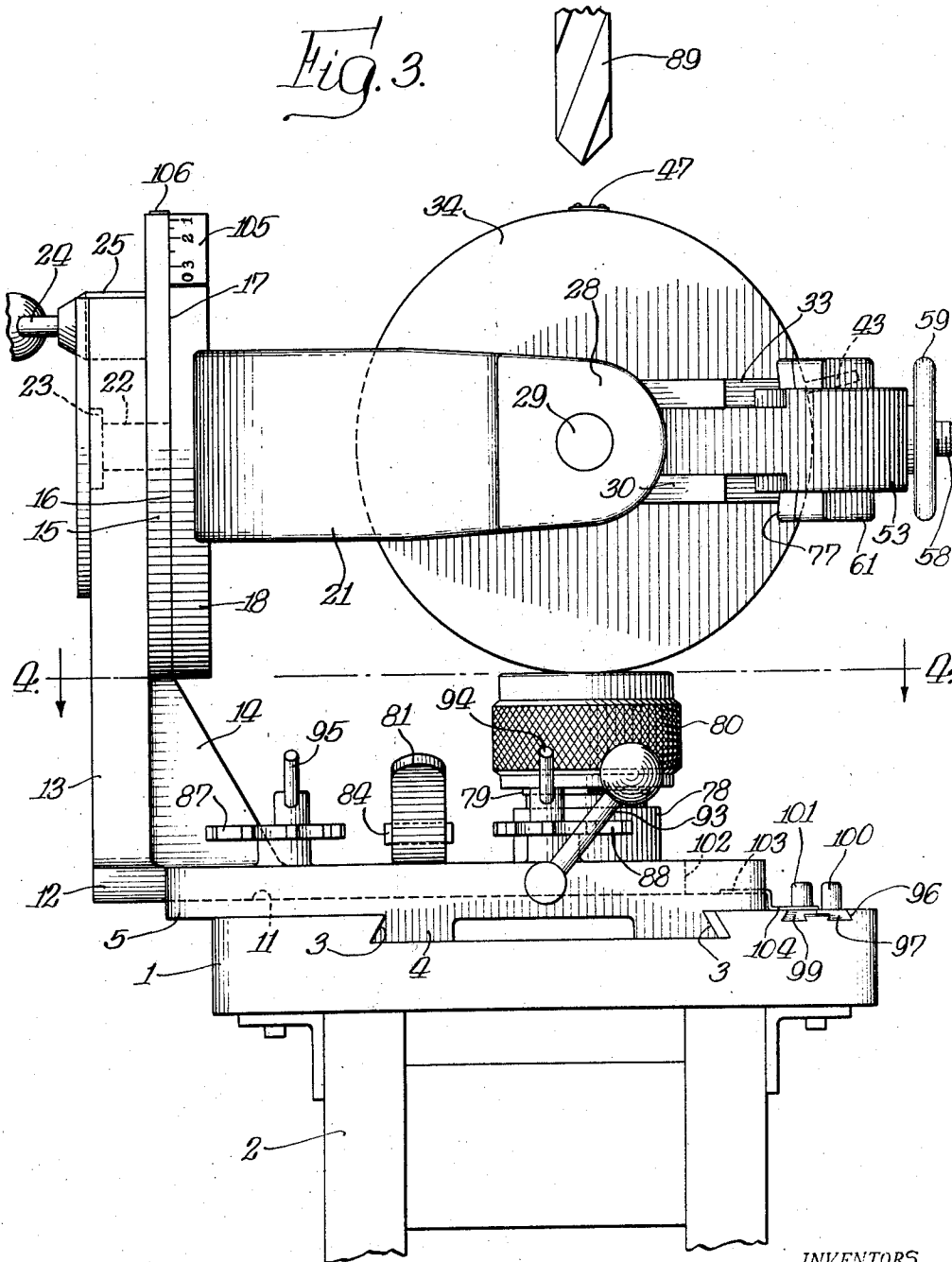
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DRILLING FIXTURE

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5 Sheets-Sheet 3



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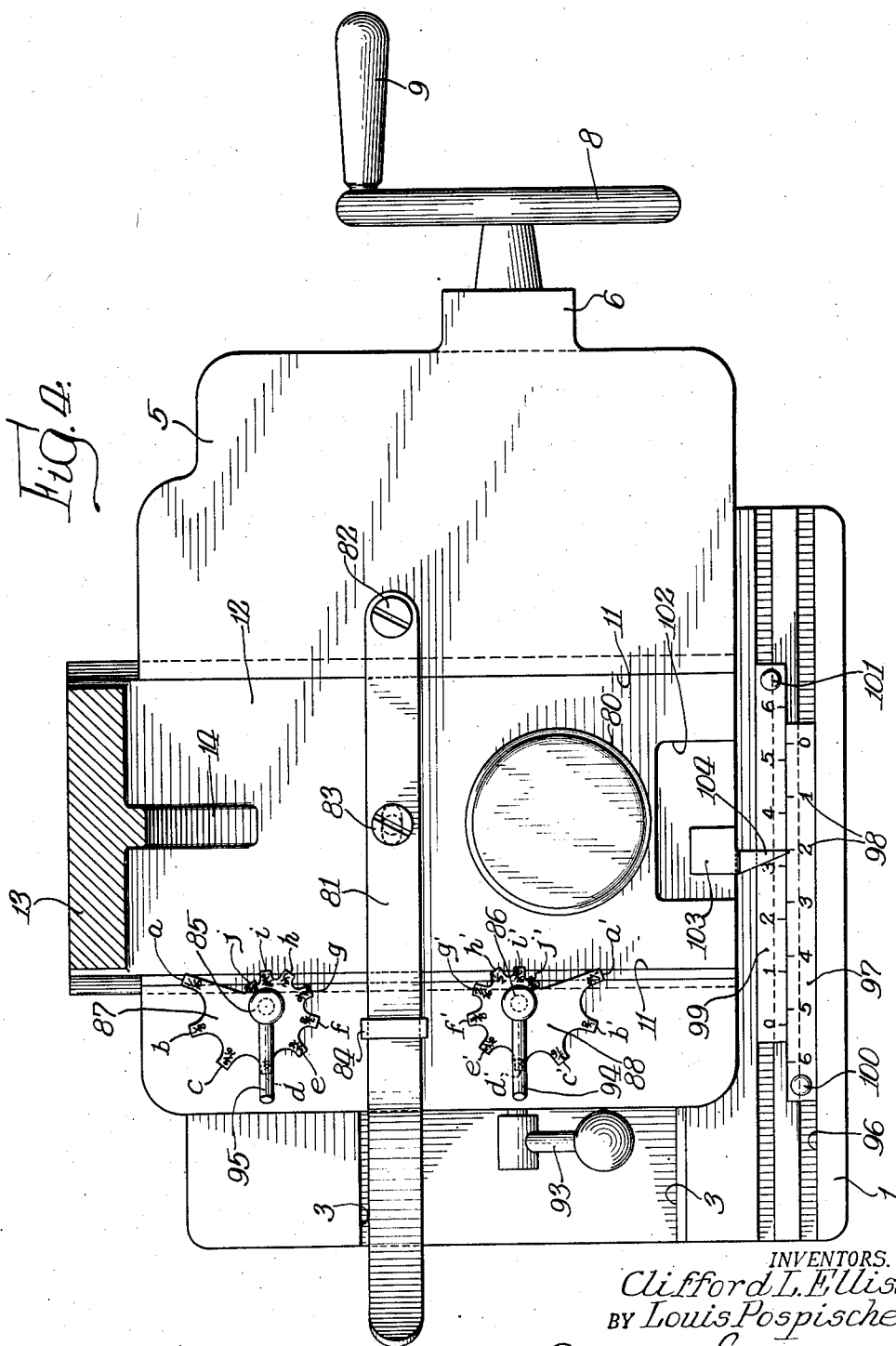
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DRILLING FIXTURE

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5 Sheets-Sheet 4



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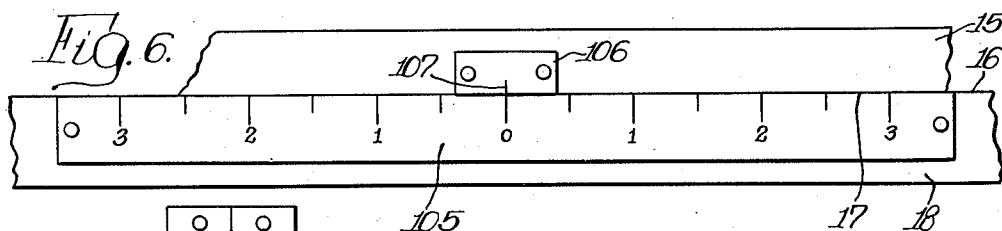
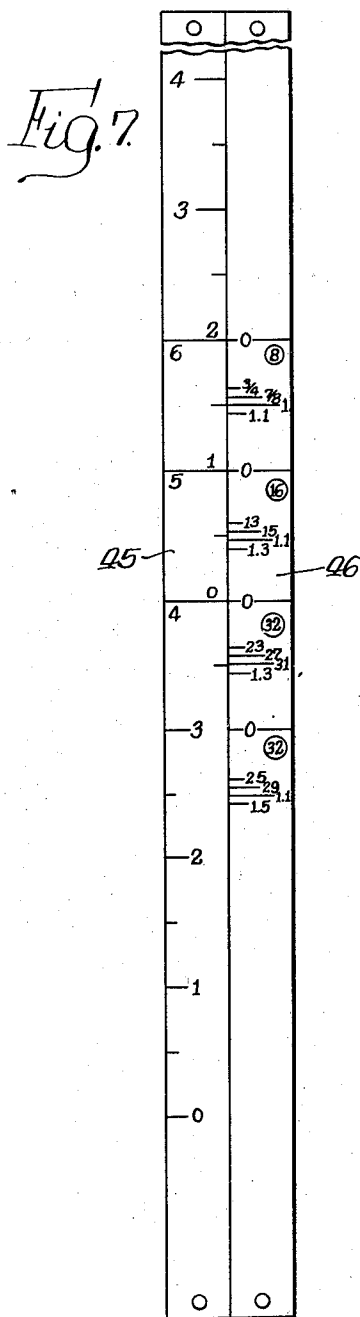
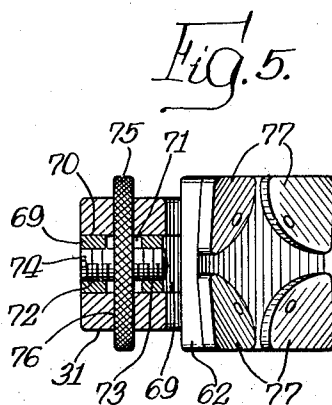
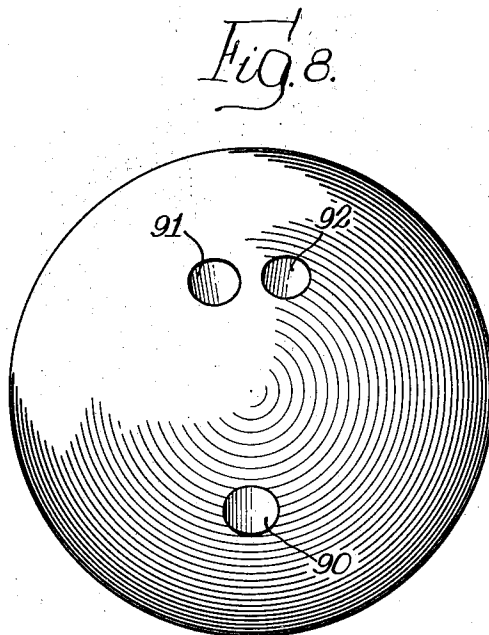
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DRILLING FIXTURE

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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

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DRILLING FIXTURE

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24 Claims. (Cl. 77-63)

1

This invention relates to apparatus for drilling thumb and finger holes in a bowling ball, and more particularly to such apparatus having quick and accurate means for so positioning the ball as to enable drilling any desired number of holes in a bowling ball with any type of grip desired. A major advantage of the present apparatus is its extreme adaptability and ease with which all adjustments may be made. Its sturdy construction, ease and rapidity of adjustment, and novel and accurate arrangement of scales, reduce the possibility of error and provide a rapid means of correctly securing the desired setting.

Among the objects of our invention are: to provide a novel and improved bowling ball drilling apparatus; to provide apparatus of the type referred to in which the bowling ball may be quickly and easily moved to its various positions to enable drilling thumb and finger holes in desired and accurate position therein; to provide a bowling ball drilling apparatus having extreme adaptability and ease with which all adjustments may be quickly and accurately made; to provide a bowling ball drilling apparatus in which all of the adjustments may be easily and quickly made without the need of applying a separate scale or measuring strip to the surface of the ball; to provide a bowling ball drilling apparatus having a ball supporting cradle capable of universal swinging movement, and a pair of carriages each slidable at right-angles with relation to the other; to provide apparatus of the type referred to having a universally swinging cradle and a vertically adjustable support for the bottom of the ball; to provide a bowling ball drilling apparatus having novel adjustable means for controlling the pitch of holes to be drilled in the ball; to provide a pair of spaced-apart rotatable pitch stops and a carriage-moving lever adapted to contact said stops; to provide a rotatable pitch stop having a plurality of projections of different lengths for selectively determining and controlling the pitch desired; to provide a universally swingable ball-receiving cradle having chuck jaws and novel means for adjusting said jaws in the cradle; to provide novel means for swingably mounting a ball cradle about two axes at right angles to each other; to provide means for swinging a ball cradle about an axis passing through the center of the ball, and a pair of independently rotatable annular rings concentric with said axis and each ring having a scale member so that said rings and scales can be manipulated with relation to each other for adding and subtracting any cradle swinging measurements about said axis as de-

2

sired; to provide novel means for supporting a bowling ball to be drilled, in any desired position longitudinally, laterally and angularly; and to provide novel means for controlling the span, the pitch, and the web thickness between finger holes.

Other objects and advantages will become readily apparent from the following detailed description taken in connection with the accompanying drawings wherein:

Fig. 1 is a top plan view of a bowling ball drilling apparatus embodying our invention.

Fig. 2 is a front elevation of the apparatus shown in Fig. 1, with a portion of the base member and a portion of the adjusting wheel for the bottom carriage broken away for convenience.

Fig. 3 is a side elevation looking toward the left hand side of Fig. 1 with a portion of the base member broken away for convenience.

Fig. 4 is a section on the line 4-4 of Fig. 3.

Fig. 5 is a section on the line 5-5 of Fig. 1.

Fig. 6 is a development of the scale and pointer, and fragmentarily showing portions of the adjacent relatively movable parts, for measuring the angular swinging of the cradle about its axis through the supporting pedestal.

Fig. 7 is a development of the two independent adjacent scales on rotatable annular rings to be manipulated for adding and subtracting swinging movement of the cradle about an axis at right angles to the axis passing through the cradle supporting pedestal.

Fig. 8 is a plan view of a bowling ball having a thumb and two finger holes drilled therein.

While our invention further resides in the combination, construction and arrangement of parts illustrated in the accompanying drawings, we have shown therein for illustrative purposes, a preferred embodiment, and wish it understood that the same is susceptible of modification and change without departing from the spirit and scope of the appended claims.

In the form shown for illustrative purposes in the drawing our apparatus comprises a base member 1 supported upon and fixed to four supporting legs 2 adapted to rest upon the floor or other supporting surface. This supporting or base member 1 is formed with a transversely extending slot having undercut sides 3 which serve as a trackway for an extension 4 of a carriage 5 longitudinally slidable on the base member (see Fig. 3).

Carriage 5 is provided, at its right hand end as viewed in Fig. 2, with a depending flange 6 in which is rotatably mounted a shaft 7 having fixed at its outer end a hand wheel 8 having a

handle 9 for rotating the same. Shaft 7 inside of flange 6 is formed with screw threads 10 threadably engaging complementary threads in a stationary portion within the base member 1, so that rotation of handle 9 in the desired direction will cause longitudinal movement of the carriage 5 in a corresponding direction with relation to the base member. Formed in the upper surface of carriage 5 to extend at right angles to the axis of shaft 7 is a slot having undercut sides 11 to form a guideway for a second carriage 12 slidable therein. Carriage 12 at its rear end (its left hand end as viewed in Fig. 3) is provided with an upstanding pedestal 13 which, at its lower portion, is formed with an inwardly inclined strengthening flange 14 integrally, or otherwise as desired, connected to the carriage 12 at its rear middle portion. Pedestal 13 just above the inclined flange 14 is formed with a circular portion 15 having a flat circular front face 16.

Rotatably contacting circular face 16 is a similar circular face 17 of the circular plate 18, to which is fixed to extend horizontally on both sides of the center of circular plate 18 a rear member 19 of a U-shaped member having the outwardly extending side arms 20 and 21. Circular plate 18 has fixed thereto a rearwardly extending stub shaft 22 rotatably mounted in a similar opening in the circular plate 15 and pedestal 13. Stub shaft 22 may be held against longitudinal movement by any suitable means such as a head 23 rotatably mounted in a similar depression formed in pedestal 13. This mounting enables circular plate 18 with the U-shaped member 19-21 to be snugly but freely rotated against face 16 of the circular plate 15 and when desired locked against such rotatable movement by rotation of the tightening handle 24. This locks these parts together in a conventional manner by abutting the end of hub 25 against the rear face of circular plate 15 through the action of screw threads 26 threaded into circular plate 18. There is provided an arcuate slot 27 in circular plate 15 through which the neck of the screw threaded extension 26 passes to permit relative rotation between circular plate 15 and circular plate 18 when handle 24 is turned to loosening position.

Arm 21 of the U-shaped member is formed at its outer end with a hub portion 28 having an opening therein to rotatably receive the stub shaft 29 of arm 30 of the cradle member 31. The adjacent faces of hub 28 and arm 30 are flat as shown at 32 to facilitate snug but free rotation of arm 30 with relation to hub 28. Arm 33 of the cradle at its outer end portion is formed with an outwardly extending hub portion 34 having a flat face 35 which rotatably rests against and contacts a similar circular flat face 36 on the hub extension 37 of arm 20 of the U-shaped member. The hub 34 of arm 33 is provided with an outwardly extending stub shaft 38 rotatably mounted in a cylindrical opening 39 in the arm 20 of the U-shaped member and its hub 37.

As seen at the right hand side of Fig. 1, the hub extension 37 is reduced in diameter at 40 to rotatably receive a pair of circumferentially slidable annular rings 41 and 42. Ring 41 is provided with a handle 43 and ring 42 is provided with a handle 44 so that these two annular rings may be selectively and circumferentially slid as desired around the cylindrical hub extension 40. Annular ring 41 has fixed to its upper surface a graduated scale 45 and annular ring 42 has fixed at its upper surface a graduated scale 46. The outwardly extending hub 34 of the cradle arm 33 is provided

at its extreme upper middle portion with a pointer member 47 fixed thereto. From this it will be understood that the scale members on annular rings 41 and 42 may be selectively manipulated in one direction or the other by handles 43 and 44 to add or subtract measurements of holes to be drilled in a ball held in the cradle. After such addition or subtraction manipulations have been completed, the straight edge of the pointer 47 on the cradle may be moved in the appropriate direction to the appropriate reading on one of the scale members 45 and 46. This swings the ball held in the cradle to proper position for drilling.

Cradle 31 may be locked against rotation in the U-shaped member by rotating in the desired direction the lock handle 48 fixed to the locking hub 49, the construction of which is similar to that described earlier herein in connection with locking arm 24 and locking hub 25 of the rotatable circular disk 18 of the U-shaped member. To effect this locking or loosening operation the lock hub 49 is formed with a thread end 50 threaded in a threaded opening in the hub 34 of cradle arm 33 and having an unthreaded portion slidable in an arcuate slot 51 in the hub extension 37 of arm 20 of the U-shaped member.

Pivoted at 52 to the outer end of arm 30 of the cradle is a lever 53 outwardly bowed at its intermediate portion and having at its opposite end a straight portion 54 having near its outer end a slot 55 for receiving the rod 56 pivoted at 57 and formed at its outer end with threads 58 threadably receiving the locking wheel 59 which is provided with an integral hub portion 60 adapted to bear against the outer face of portion 54 of lever 53. By this construction it is seen that lever 53 may be locked in position or if desired may be unlocked and swung outwardly a desired distance to permit the deposit in the cradle of a bowling ball.

When the bowling ball is deposited in the cradle it is there locked in position by three chuck jaws 61, 62 and 63. Jaw 61 is pivoted at 64 to a mid point on lever 53 and jaws 62 and 63 are respectively pivoted at 65 and 66 to the extensions 67 and 68 of plate 69. Plate 69 is mounted for lateral sliding movement in an elongated slot 70 in the cradle and sufficiently greater in size to permit lateral movement of plate 69 therein.

As seen in Fig. 5, plate 69, at the axis of rotation of the U-shaped member, is provided with an upwardly extending slot 71 on both sides of which the plate 69 has threaded openings 72 and 73 in which are tightly screwed a screw 74 upon which is threaded the adjusting wheel 75 rotatably mounted in the slot 75 formed in arm 31. As will be understood in Fig. 5, rotation of adjusting wheel 75 will move threaded screw 74 in one direction or the other to swing the plate 69 inwardly or outwardly (depending upon the direction of rotation) in slot 70 to advance or retard the chuck jaws 62 and 63 with relation to the cradle. Each of the chuck jaws 61-63 is preferably formed on its inner side with rubber cushioning pads 77 to prevent marring or scratching of the polished surface of a ball clamped in the cradle.

Referring to Fig. 3 there is provided on carriage 12 an upstanding block 78 having threads 79 upon which are threadably mounted the adjustable supporting block 80, which by rotation may be adjusted at any desired height upwardly or downwardly so that its upper face forms a supporting surface for the bottom face of the bowling ball clamped in the cradle. This adjustment is

5

such as to support the ball in the cradle so that the center of the ball will at all times coincide with the intersection of the two rectangular axes of the cradle and the U-shaped member.

By coincidence the diameter of the ball illustrated in the drawing happens to be the same as the diameter of the circular hub 34 of the cradle, and the same as the diameter of the circular plate 18 of the U-shaped member, hence the circles representing these circular hubs or plates in Figs. 2 and 3 may also be assumed to represent a bowling ball clamped in the cradle. Figs. 2 and 3 also illustrate how the bowling ball is supported in this position by the adjustable block 80 referred to above. Should, for any reason, it be desired that the ball be supported at any other height, such adjustment may be made by rotating the supporting block 80 in one direction or the other to increase or decrease the height of its upper face. It is to be here noted that the supporting block 80 and the U-shaped member and the cradle are all movable together as a unit whenever any movement is effected in either of the carriages 12 and 5.

Referring to Fig. 4 a pitch lever 81 is fulcrumed at 82 to the upper surface of carriage 5 to one side of the carriage 12. Lever 81 is articulated with carriage 12 by a pin or screw member 83 which may be fixed to either the carriage 12 or lever 81 and have rotational movement in a complementary opening in the other one of these parts. This enables sliding of carriage 12 in its guideway by swinging the lever 81 in the desired direction.

Lever 81 at a slight distance from the left hand side of carriage 12, as viewed in Fig. 4, has fixed thereto a stop member 84 projecting a predetermined distance on each of the side edges of this lever. Pivotaly mounted for horizontal rotation upon pins 85 and 86 are a pair of spaced apart pitch stops 87 and 88. Pins 85 and 86 are mounted in the upper surface of carriage 5. As pitch stops 87 and 88 are of similar construction, except for being inverted one with relation to the other, only one of these need be described in detail. Referring in detail to pitch stop 87 it will be seen in Fig. 3 that the same comprises a body portion of medium thickness having a plurality of outwardly extending projections, *a, b, c, d, e, f, g, h, i, and j* (Fig. 4). Progressing from projection *a* to projection *j* it will be seen that these projections are each slightly shorter than the one preceding it. While any desired difference in length between the successive stops may be used as desired, for illustrative purposes in the drawings these stops are shown in Fig. 4 as decreasing in length by $\frac{1}{8}$ of an inch from *a* to *j*.

When the pitch lever 81 stands at right angles to the longitudinal axis of movement of carriage 12 the pitch of the hole to be drilled in the ball will be zero. This means that a hole drilled into the ball by drill 89 (Fig. 3) if extended far enough would have its axis passing through the center of the ball, which would mean a hole with no pitch. Assuming that the hole to be drilled in the ball is to have a $\frac{1}{8}$ pitch one or the other of the pitch stops 87 and 88 (depending upon which side of the center line of the ball the hole is being drilled) will be rotated to bring its longest projection *a* to extend toward the stop member 84 on the lever 81. Assuming that the thumb hole 90 of the ball shown in Fig. 8 is to be positioned on the right side of the vertical center line through the ball (when the cradle is posi-

6

tioned in a horizontal plane) and one or two finger holes 91 and 92 are to be positioned on the left hand side when the cradle is horizontal as viewed in Fig. 3, the operation of the pitch stops will now be explained.

In drilling a thumb hole to have $\frac{1}{8}$ " pitch the pitch stop 88 (Fig. 4) will be rotated to swing the projection *a'* to be directly opposite the adjacent edge of stop member 84 of lever 81, it being assumed that the lever at this time stands in its neutral position, to wit: at right angles to the longitudinal axis of movement of the carriage 12. This means that the space between the adjacent edge of stop member 84 of lever 81 as viewed in Fig. 4, will be $\frac{1}{8}$ of an inch away from the outermost end of projection *a'*. Lock lever 93 will now be rotated a slight distance to release carriage 12 for movement with relation to carriage 5 after which the lever 81 will be swung forwardly as viewed in Fig. 4 until stop member 84 contacts the outermost end of projection *a'*. This moves the ball forwardly as viewed in Fig. 4 to bring its center $\frac{1}{8}$ inch forward (downward as viewed in Fig. 4 and to the right as viewed in Fig. 3), beyond the position shown in Fig. 3. This will result in the axis of the drill entering the ball to the rear (left as viewed in Fig. 3) of the center of the ball. As will be later more fully understood, the cradle will be swung in a counter-clockwise direction as viewed in Fig. 3 so as to rotate the ball for properly positioning the point of the ball where the drill will enter for drilling the thumb hole. As also later more fully explained, the cradle will be further swung a slight distance in counter-clockwise direction as viewed in Fig. 3 in compensation for the $\frac{1}{8}$ offset in the forward direction of the ball center for determining the pitch. In other words, the cradle as viewed in Fig. 3 will be swung in a counter-clockwise direction such an amount as necessary to bring the axis of the drill directly above the center of the place where the thumb hole is to be drilled with the desired pitch.

If the amount of pitch for the thumb hole is to be greater than $\frac{1}{8}$ of an inch, the pitch stop 88 will be rotated by its handle 94 to bring whichever projection corresponds to the desired amount of pitch, opposite the adjacent side of the stop member 84 of pitch lever 81. Pitch stop 87 is also provided with a handle 95 for rotating it to bring any desired one of the plurality of projections *a-j* in alignment with the point of travel of the stop member 84 of the lever 81. When pitch stop 87 is in the desired position the lever 81 is swung in the opposite direction to move the carriage 12 rearwardly when drilling one or more finger holes. This will move the center of the ball bodily rearwardly (to the left as viewed in Fig. 3) which will place the pitch angle into the front half of the ball. It will be understood that before causing the drill to enter the ball for drilling the finger holes the ball will have been swung in a clockwise direction as viewed in Fig. 3 to move the last drilled thumb hole a distance equal to the space between the thumb hole and finger hole plus one half of the diameter of the finger hole plus the distance the ball was bodily moved rearwardly to set up the desired pitch. If the ball is to have only a single finger hole drilled therein, the drill will now be forced the desired distance into the ball.

When it is desired to drill two finger holes in the ball, the bottom carriage 5 will be moved longitudinally by rotation of handle 9, and hand wheel 8 a distance from its neutral position equal to one half of the width of the bridge or web

between the finger holes plus one half of the diameter of the finger hole to be drilled. When this finger hole is drilled the handle 9 and handle wheel 8 will be rotated in the opposite direction to move the center of the ball and carriage in the opposite direction a distance equal to one half of the finger hole already drilled plus the thickness of the bridge or web between the finger holes plus one half of the finger hole yet to be drilled. While the finger holes are generally drilled in a direction parallel to each other, it might sometimes be desirable for special balls to have the finger holes drilled at various angles with relation to each other. This may be effected by either or both swinging the U-shaped member (which carries with it the cradle) in either a clockwise or a counterclockwise direction depending upon which of the two finger holes is being drilled, and moving the carriage 5 in the desired direction.

In order to measure the amount of movement of the bottom carriage 5 in either direction, the base member 1 has longitudinally slidably mounted in a dovetail recess 96 a scale member 97 having upon its upper face indicia 98 in desired graduations, and also slidable in a parallel direction closely adjacent scale 97 is a similar scale 99 mounted in a similar groove in the base member as seen in Fig. 3. Scale 97 has an upstanding handle 100 to be grasped by the operator's fingers for sliding the scale a desired amount in its dovetailed groove. Scale 99 is provided at its opposite end with an upstanding handle 101 which enables sliding of this scale in the desired direction and to the desired amount. Fixed to carriage 5, and within a slot 102 formed in carriage 12, is a plate 103 carrying a pointer 104 movable longitudinally of both of scales 97 and 99 upon movement of carriage 5. Slot 102 is large enough to permit all necessary movements of pointer 104 with relation to carriage 12 upon movement of carriage 5.

Scale means is provided for indicating the amount of swinging movement of the U-shaped member 19 about its axis perpendicularly to the circular disc 18, and comprises a scale 105 fixed to the upper edge of disc 18 and a plate 106 fixed to the upper edge of circular disc 15 and having an indicating mark 107 which should register with the zero of scale 105 when the U-shaped member 19 stands in a horizontal position. The amount of rotation or swinging movement of the U-shaped member with relation to the circular disc 15 may be read on scale 105 with the pointer mark 107.

From the above the operation of our bowling ball drilling apparatus will be understood to comprise first setting all of the scales described earlier herein at zero, so as to have the carriages 5 and 12 positioned with the center of the ball, clamped in the cradle, into registry with both axes of rotation of the U-shaped member and the cradle and in registry with the axis of the drill, with the shift lever standing in neutral position and both the U-shaped member and the cradle being level in a horizontal plane. These various parts will be held in such neutral position until movement of any one of them is desired at which time the clamping means for that part will be loosened.

Assuming a bowling ball to be clamped in the cradle with its bottommost surface resting upon the top face of the adjusting block 89, and the ball in the relative position referred to above, the ball is now ready for adjustment to its var-

ious positions for drilling of the thumb and finger holes by the drill 89.

To drill the thumb hole, the cradle is first swung in a counterclockwise direction as viewed in Fig. 3 one half of the span between the thumb and finger holes plus one half the diameter of the thumb hole plus the amount of pitch desired to be formed in the thumb hole. The pitch stop 88 is next rotated to bring the desired projection, corresponding to the desired pitch, into the path of movement of the stop member 84 of lever 81, after which locking lever 93 will be released and lever 81 swung forwardly until stop member 84 contacts the projection corresponding to the pitch to be formed in the thumb hole. The thumb hole is then drilled to the desired depth.

Assuming the ball is to have only one finger hole the cradle is then rotated in a clockwise direction as viewed in Fig. 3 a distance equal to the span between the thumb and finger hole plus one half the diameter of the finger hole plus the amount of pitch to be given the finger hole, after which the cradle is locked against further swinging movement. The pitch stop 87 is then rotated to bring opposite the stop member 84 of lever 81 the projection corresponding to the desired pitch, after which the pitch lever 81 is swung rearwardly until member 84 strikes the selected pitch stop projection. The finger hole will then be drilled to the desired depth. Should it be desired to drill two parallel finger holes, the carriage 5 will be moved a desired distance to one side or the other (depending upon which finger hole is to be drilled first) which will bodily carry the ball in that direction with relation to the point of the drill 89. The amount of such movement may be read on scales 97-99 with pointer 104. This finger hole is then drilled a desired depth and the carriage 5 is then moved in the opposite direction a distance equalling one half the diameter of the finger hole already drilled plus the thickness of the bridge or web between the finger holes plus one half of the diameter of the finger hole yet to be drilled. The second finger hole is then drilled to the desired depth. Should it be desired to have the axes of the finger holes at an angle to each other, this may be effected by swinging the U-shaped member or circular disk 15 a desired amount and then readjusting by movement of the carriage 5 to bring the point of the drill to the desired point for starting the hole. The same operations may be carried into effect for producing an angularly inclined axis to the other finger hole before actually drilling the same.

Precise control of the amount of swinging of the cradle with relation to the U-shaped member may be accomplished by setting the scale members 45-46 into the proper position for the measurement desired, and adding or subtracting such distances as required by manipulating handles 43 and 44 to move scales 45 and 46 in an additive or subtractive direction as required. By so manipulating scales 45 and 46 and finally setting the pointer 47 in the proper position with relation to these scales, the ball will be in position to have the desired hole accurately drilled. Should the ball have two finger holes the carriage 5 will be moved longitudinally to accommodate for the web or bridge thickness between the finger holes, and should it be desired to have angularly arranged axes to the finger holes this may be accomplished by swinging the U-shaped member 19 in the desired direction and compensating for the same by appropriate sliding of carriage 5.

We claim:

1. In apparatus for drilling bowling balls, a supporting member, a first carriage slidable transversely across said supporting member, a second carriage slidable transversely across the first carriage at substantially right angles to the direction of travel of the first carriage, an upstanding arm fixed to the second carriage, a universally swingable cradle mounted on said arm to extend over the second carriage and move therewith, and means mounting said cradle on said arm for adjustment about a first axis parallel to the direction of movement of said second carriage and about a second axis perpendicular to the first axis.

2. Bowling ball drilling apparatus as claimed in claim 1, having fixed on said second carriage an upstanding vertically adjustable ball support adapted to have its upper surface in contact with the bottom of the ball with the center of the ball at all times in alignment with the axes of rotation of the universally swingable cradle.

3. Bowling ball drilling apparatus comprising, a supporting member, a carriage slidable with relation to said member, a swingable cradle on said carriage for positioning and holding a bowling ball, a swingable lever having adjacent one end a fulcrum beyond one edge of the carriage and articulated with relation to the carriage to move the same when the lever is swung, and adjustable stops beyond the opposite edge of the carriage to selectively contact a side edge of the lever to control the pitch of a hole to be drilled in the ball.

4. In a bowling ball drilling apparatus, a stationary supporting member, a first carriage slidable on said member, a second carriage slidable transversely on and across the first carriage, ball supporting means on said second carriage, a lever for sliding the second carriage having one end pivotally connected to said carriage, a pitch stop rotatably mounted on the same carriage and having projections of different lengths adapted to selectively contact the lever when the lever is swung thereagainst, and means connecting another part of said lever to the other carriage.

5. Bowling ball drilling apparatus as claimed in claim 4, in which is provided a second pitch stop rotatably mounted on the first carriage and spaced from the first mentioned pitch stop in a direction longitudinally of the second carriage, each of said pitch stops having projections of progressively increasing radial lengths so that the pitch stops may be selectively rotated to present projections of desired lengths toward the lever to be selectively contacted by the lever to determine the pitch of thumb and finger holes to be drilled in the ball.

6. Bowling ball drilling apparatus as claimed in claim 4, having a universally swingable cradle mounted on the second carriage for bodily movement therewith and positioned thereabove.

7. Bowling ball drilling apparatus as claimed in claim 4, having a universally swingable cradle mounted on the second carriage for bodily movement therewith and positioned thereabove, and a vertically adjustable ball supporting block on the second carriage below the center of the cradle.

8. In bowling ball drilling apparatus, a stationary base member, a carriage slidable on and transversely with relation to said base member, an upstanding pedestal on said carriage, a cradle mounted on said pedestal for universal swinging movement with relation thereto, means mounting said cradle on said pedestal for adjustment about

a first axis parallel to the direction of movement of said carriage and about a second axis perpendicular to the first axis, a plurality of chuck jaws in said cradle, and means for simultaneously moving said jaws inwardly and outwardly with relation to the cradle.

9. In bowling ball drilling apparatus, a stationary base member, a first carriage slidable on and transversely of said base member, a second carriage on the first carriage and slidable at right angles thereto, an upstanding pedestal on the second carriage and having a flat face thereabove, a disk rotatably slidable on said flat face on a first axis parallel with the longitudinal center line of the second carriage, a U-shaped first cradle member fixed to said disk, a second cradle member rotatably mounted on the arms of the first cradle member, and about an axis at right angles to said first axis and scale members to indicate the amount of movement of said movable parts.

10. Bowling ball drilling apparatus as claimed in claim 9, having means for releasably fastening said movable parts in their various selectively adjusted positions for controlling the span and pitch of thumb and finger holes to be drilled in a bowling ball held in said second cradle member.

11. Bowling ball drilling apparatus comprising, a stationary base member, a carriage supported on and slidable with relation to said base member, a pedestal fixed to said carriage, a U-shaped member rotatably mounted on said pedestal for swinging movement on a horizontal axis, a cradle rotatably mounted on said U-shaped member for rotation thereon about an axis at right angles to the axis of rotation of the U-shaped member, one of the side members of the cradle having an elongated slot, a plate in said slot, a chuck jaw member mounted at each end of said plate, and means for adjustably sliding said plate to move said jaw members in the cradle.

12. Bowling ball drilling apparatus as claimed in claim 11, in which said jaw members are pivotally mounted adjacent the respective ends of the plate, said cradle having a swingably mounted side arm releasably secured on one side thereof.

13. Bowling ball drilling apparatus comprising, a stationary base member, a first carriage slidable mounted on the base member, a second carriage slidable mounted on the first carriage for movement at right angles to the line of movement of the first carriage, an upstanding pedestal fixed to the second carriage and having a flat face, a U-shaped yoke member having a flat face rotatable against the first mentioned flat face about an axis parallel with the line of movement of the second carriage with relation to the first carriage, a cradle rotatably mounted in said yoke member and having a flat face portion rotatably contacting a similar flat face portion on one of the outstanding arms of the U-shaped yoke member, the axis of rotation of the cradle with relation to the yoke member being at right angles to the axis of rotation of the yoke member with relation to the pedestal, and a lever pivoted to the first carriage and articulated with the second carriage for sliding the latter as the lever is swung.

14. Bowling ball drilling apparatus as claimed in claim 13, having scale means on the edges of the cradle flat face portion and the yoke member arm flat face portion for registering the span of thumb and finger holes to be drilled in a ball to be held in the cradle, pitch stops on the first carriage against which said lever is adapted to contact for determining the pitch of said holes, and scale means on the base member and the

first carriage for controlling the web thickness between finger holes.

15. Bowling ball drilling apparatus as claimed in claim 13, having scale means on the edges of the coacting flat face portions of the yoke member and the pedestal for registering the amount of rotation of the yoke member about its axis passing through the pedestal.

16. Bowling ball drilling apparatus comprising a base member, a first carriage slidable on the base member, a second carriage slidable on the first carriage at right angles to the direction of movement of the first carriage, an upstanding pedestal on the second carriage, a U-shaped yoke member rotatably mounted on the pedestal, a cradle rotatably mounted in the yoke member for rotation about an axis at right angles to the axis of rotation of the yoke member, one of the outstanding arms of the yoke member having on its inner side a hub provided with a contact face, the adjacent arm of the cradle having fixed on its outer side a circular boss extending to and in rotatable contact with the said contact face of the yoke member arm, a pair of independently slidable annular rings on said hub, a pointer on the inner edge of the circular boss, and a curved scale on the outer circumferential face of each of said annular rings for coaction with said pointer.

17. Bowling ball drilling apparatus as claimed in claim 16, having scale means for registering the amount of rotation of the yoke member with relation to the pedestal.

18. Bowling ball drilling apparatus as claimed in claim 16, including a pair of rotatable pitch stops on the first carriage spaced apart longitudinally of the second carriage, and a lever pivoted to the first carriage on the opposite side of the second carriage and articulated with the second carriage for sliding the same, said lever when it is swung contacting one of the pitch stops for controlling the pitch of a hole to be drilled in a ball held in the cradle.

19. In a bowling ball drilling apparatus, a ball holding cradle, a U-shaped yoke member having outstanding arms in which said cradle is swingably mounted, one of said arms having on its inner side a hub provided with a contact face, the adjacent cradle arm having on its outer side an outwardly extending cylindrical projection contacting said contact face for sliding rotation therebetween, a pair of independently slidable annular rings on said hub, a pointer on the cylindrical projection, and an independent scale on each of said annular rings for coacting with said pointer, to enable manipulation of said scales and pointer to set the cradle in proper position for enabling the drilling of a hole with predetermined characteristics in a ball to be held in the cradle.

20. In a bowling ball drilling apparatus, a base member, a pair of carriages movably mounted on said base member for movement in directions at right angles to each other, a universally swingable cradle mounted on one of said carriages for holding a bowling ball in various positions, means mounting said cradle on said one of said carriages for adjustment about a first axis parallel to the direction of movement of one of said carriages and for adjustment about a second axis parallel to the direction of movement of the other of said carriages, means mounted on said carriages for controlling the pitch of holes to be drilled in the ball, and means on the cradle for

controlling the span between the thumb and finger holes in the ball.

21. Bowling ball drilling apparatus as claimed in claim 20, including means on one of said carriages for controlling the web width between finger holes to be drilled in the ball.

22. Bowling ball drilling apparatus comprising, a supporting member, a carriage slidable horizontally on said supporting member, means on the carriage for supporting a ball, a lever for sliding said carriage and a stop indexable about an axis stationary with relation to said carriage and with which said lever contacts to control the pitch of the hole to be drilled in the ball, said stop being separate from and unconnected with said carriage and spaced laterally from said lever and being formed with a plurality of surfaces different distances from its axis, said stop further being rotatable in a plane substantially that of the plane of movement of the lever, to selectively present a desired surface for contact with the lever.

23. Bowling ball drilling apparatus comprising, a supporting member, a carriage slidable horizontally on said supporting member, means on the carriage for supporting a ball, a lever for sliding said carriage and a stop indexable about an axis stationary with relation to said carriage and with which said lever contacts to control the pitch of the hole to be drilled in the ball, said stop being separate from and unconnected with said carriage and spaced laterally from said lever and formed with a plurality of projections of different lengths, said stop being rotatable to selectively present a desired projection for contact with the lever, and a second similar stop spaced from the first mentioned stop in a direction lengthwise of the carriage, whereby to selectively control the pitch of a thumb hole and a finger hole to be drilled in the ball, said lever being swingable between said stops.

24. Bowling ball drilling apparatus comprising, a supporting member, a carriage slidable horizontally on said supporting member, means on the carriage for supporting a ball, a lever for sliding said carriage and a stop indexable about an axis stationary with relation to said carriage and with which said lever contacts to control the pitch of the hole to be drilled in the ball, said stop being separate from and unconnected with said carriage and spaced laterally from said lever formed with a plurality of projections of different lengths, said stop being rotatable to selectively present a desired projection for contact with the lever, and a second similar stop spaced from the first mentioned stop in a direction lengthwise of the carriage and on the opposite side of the lever, whereby to selectively control the pitch of a thumb hole and a finger hole to be drilled in the ball, each of said stops having a handle for selectively rotating the stops to the desired position of pitch adjustment.

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