July 26, 1966 M. V. SAMMONS ET AL 3,262,340

BOWLING BALL DRILL JIG

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FIG. 1

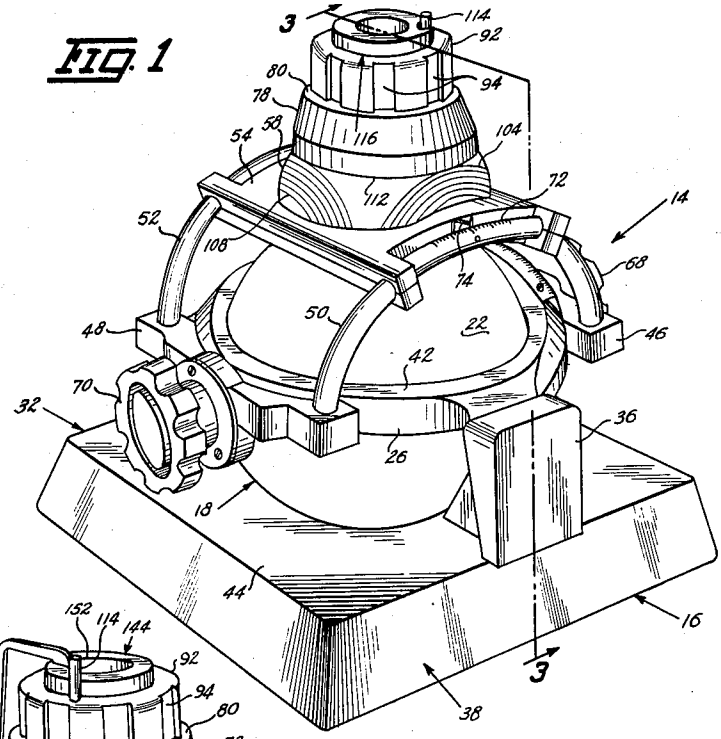
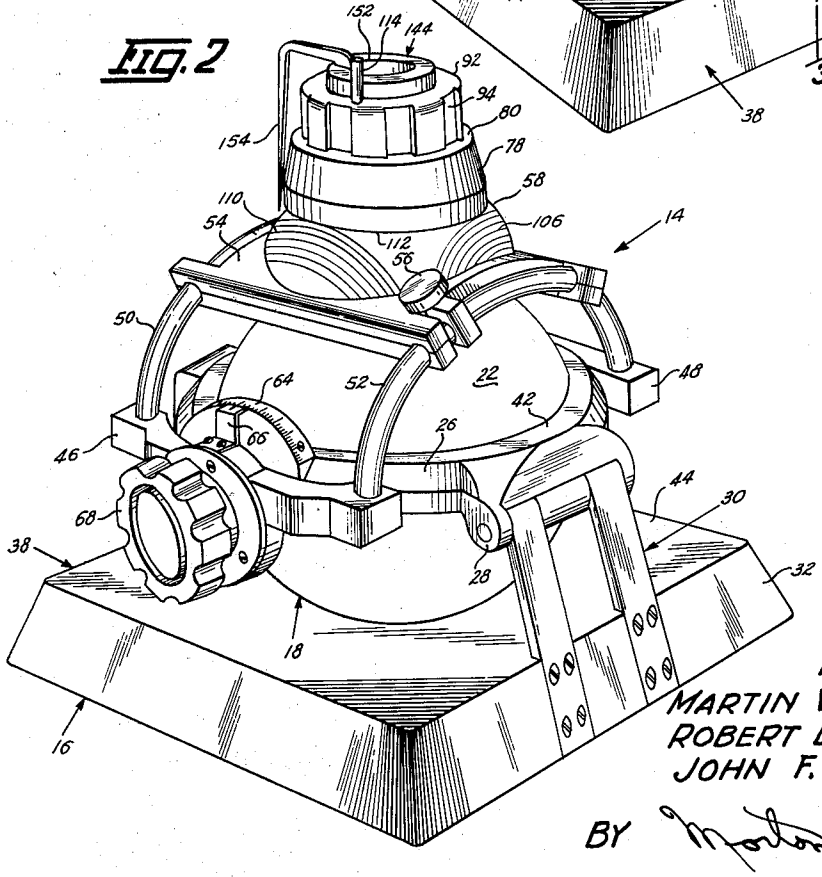


FIG. 2



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Fig. 12

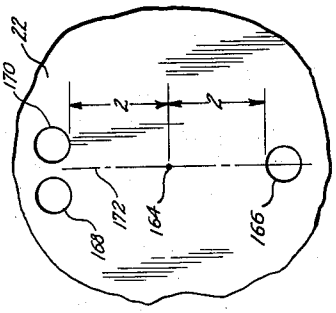


Fig. 13

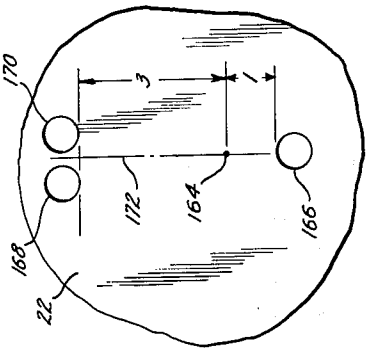


Fig. 11

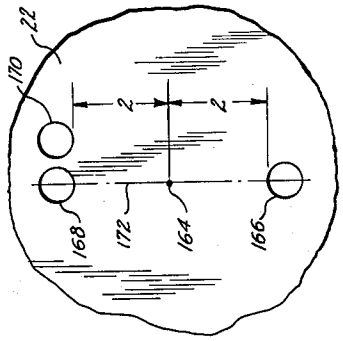


Fig. 3

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FIG. 4

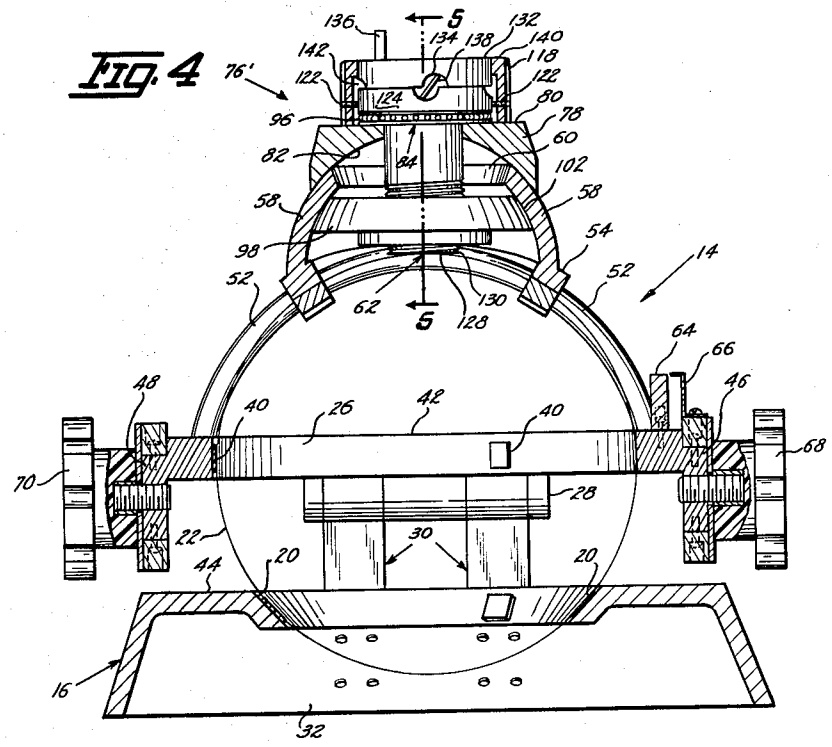


FIG. 6

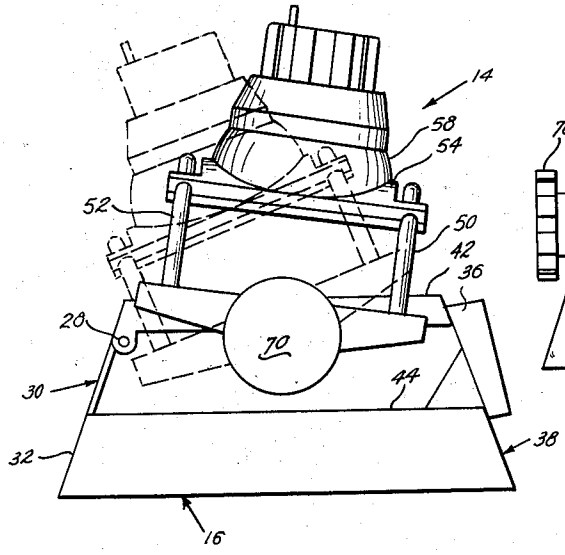
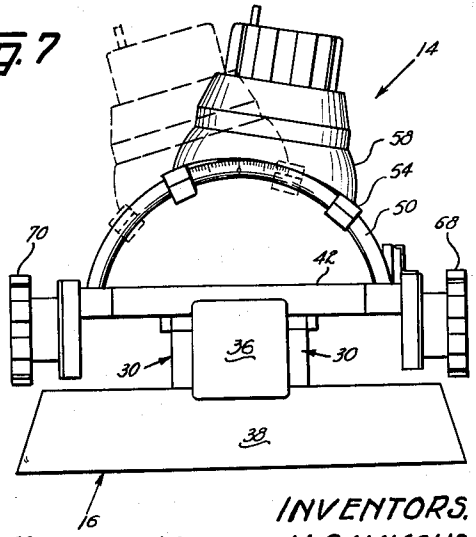


FIG. 7



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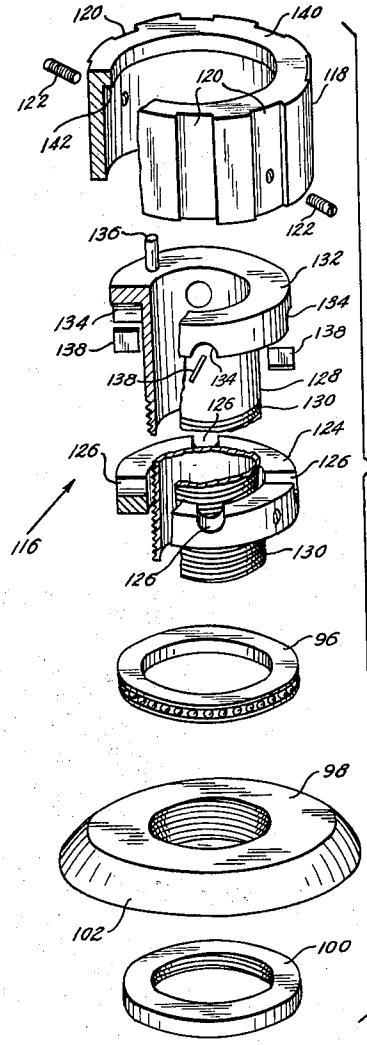


FIG. 5

FIG. 8

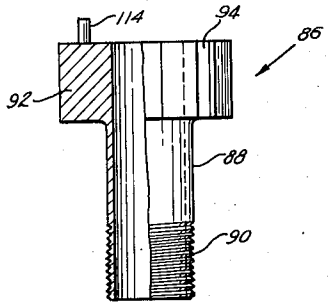


FIG. 9

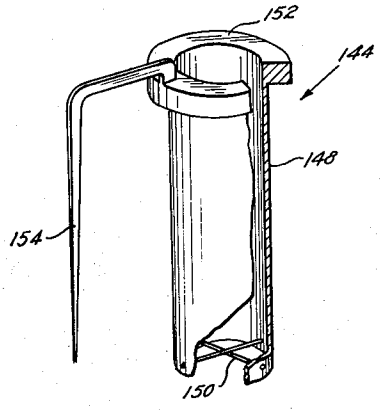
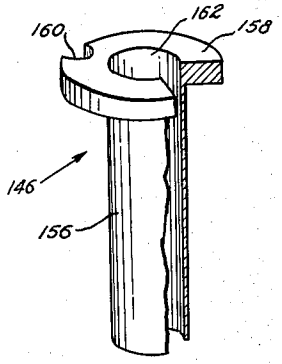


FIG. 10



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United States Patent Office

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3,262,340

BOWLING BALL DRILL JIG

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Filed Jan. 27, 1964, Ser. No. 340,375

15 Claims. (Cl. 77—62)

This invention relates to improvements in a jig apparatus for drilling the thumb and finger holes in bowling balls.

With the tremendous increase in popularity of bowling in recent years, many bowlers have acquired their own personal bowling ball in which the finger holes are drilled according to their particular specifications, and such holes are often filled and redrilled to satisfy the whims and idiosyncrasies of the individual users. There are, of course, a variety of more or less standard finger holes patterns that are provided on rental balls and according to present practices, the substantial portion of drilling the finger holes is done in professional supply shops as distinguished from the actual bowling lane establishments. This can no doubt be accounted for by the fact that the present drill jigs available weigh several hundred pounds, may cost from several hundred to several thousand dollars and require a fixed drill press so that it is economically unfeasible for each bowling lane to own such equipment.

In addition to the cost of drill equipment, the requirement for accuracy in drilling finger holes in bowling balls and the requirement for experienced personnel for operating the jigs makes it impractical for bowling lane proprietors to provide this service as mistakes can be very costly and a few mistakes can render the entire operation unprofitable. However, even with the so-called professional drilling jigs, there are certain problems and disadvantages which we have overcome with our new drill jig as will become apparent.

As is well known, all manufacturers of bowling balls mark on the ball what is known as the center point which is associated with their respective label or name and the drilling of the thumb and finger holes is in reference to such center point since the undrilled ball is heavier at this area so that the ball will be properly balanced after the holes are drilled. The axis of such holes in relation to a direct radius from the contact point of the drill on the surface of the ball is generally inclined forwardly or rearwardly and usually laterally and the exact degree of such inclination, unless of a standard pattern, will depend upon the desired thumb and finger hole positions of the particular user. It will thus be appreciated that the drill point will contact the curved surface of the ball at a tangent relative to the inclination of the hole desired and in present type jigs, experience has shown that this initial contact almost invariably results in a slight drift of the bit along the ball surface before it makes an actual penetration. Such drift, even though small, can and does affect the feel of the ball when considered in relation to all of the holes and is easily detected by experienced bowlers. Since the exact amount of such drift is not always the same on each ball or even on each hole, it cannot be accurately compensated for by varying the initial contact point and consequently extreme accuracy in the drilling of such holes by present apparatus is not generally obtained.

With these observations in mind, one of the important objects contemplated by this invention is the provision of an improved apparatus for drilling thumb and finger holes in bowling balls and more particularly such an apparatus or jig that will result in such holes being drilled with extreme accuracy because of the elimination of any drift of the drill bit relative to the surface of the ball at the initial contact therewith.

A further important object herein is the provision of a drill jig as indicated and by means of which the holes in the bowling ball may be drilled by any conventional electric hand drill preferably with a chuck of one-half inch capacity.

Other objects inherent in this invention are to provide a drill jig of the above class that is durable in construction, economical to manufacture, highly efficient for its intended use and sufficiently light in weight (approximately forty pounds more or less) so that it is easily portable and economically feasible for acquisition and use by individual bowling lanes as well as by professional bowling supply establishments.

Another object of this invention is to provide, with a drill jig as characterized, a novel turret assembly for aligning and guiding a drill bit at any selected angle of inclination and without permitting the drill point to drift relative to the predetermined point on the ball for penetration of such bit.

Still a further object herein is to provide a novel locking assembly for immovably fixing the turret assembly in any selected position.

An added feature of this invention resides in its adaptability for use with a finishing tool for the purpose of smoothing the surface of a filler plug placed in a previously drilled thumb or finger hole.

To attain these objects and such further objects as may appear herein, or be hereinafter pointed out, reference is made to the accompanying drawings forming a part hereof, in which:

FIG. 1 is a perspective front view of a preferred embodiment of this new drill jig shown with a drill bit bushing in the top thereof and with a bowling ball in place to be drilled,

FIG. 2 is a perspective rear view of the jig shown in FIG. 1 but shown with the line-up or zero setting bushing in the top thereof,

FIG. 3 is a cross-sectional view taken on the line 3—3 of FIG. 1 but with the jig in opened position,

FIG. 4 is a sectional view of the jig shown in FIG. 1 but illustrating a modified locking assembly for the turret,

FIG. 5 is an exploded view of the turret locking assembly taken on the line 5—5 of FIG. 4,

FIG. 6 is a schematic illustration of this jig showing its adjustment for the span between the thumb and finger holes in the bowling ball,

FIG. 7 is similar to FIG. 6 but showing the adjustment of this jig for lateral location of the holes relative to the center point on the bowling ball,

FIG. 8 is a sectional view, partially cut away, of the turret tightening cap shown in FIG. 1,

FIG. 9 is a perspective view, partially cut away, of the line-up or zero setting bushing shown in FIG. 2,

FIG. 10 is a perspective view, partially cut away of the drill bushing shown in FIG. 1, and

FIGS. 11–13 are schematic illustrations showing varied common locations of the thumb and finger holes in a bowling ball relative to the center point thereon.

Referring to the drawings, it should be first mentioned that for the most part, all of the substantial portions of this jig **14** are preferably made of aluminum so that its overall weight will be approximately forty pounds more or less. Such lightness in weight has certain commercial advantages and is preferable therefor, but it will be understood that other materials may also be used and the weight thereby increased without in any way departing from the principles hereinafter disclosed.

A generally square hollow base is designated by the numeral **16** (FIGS. 3 and 4) and is provided with a central annular opening **18** defined by the beveled edge **20** for receiving and supporting a bowling ball **22**. A plurality of friction tabs **24** of any suitable material such as vinyl or plastic, and preferably not more than one-sixteenth inch thick, are bonded to edge **20** in equally spaced relationship to provide a non-slip contact for ball **22** as will later appear. An annular frame **26** is adapted to overlie base **16** in spaced relationship thereto and for this purpose is hinged as at **28** to the upper end of a hinge support structure **30** secured to the rear side **32** of base **16** as best seen in FIG. 2. Frame **26** is movable as shown in FIG. 3 to permit the placing of ball **22** onto base **16** and is then movable into peripheral contact with the ball **22** for securely clamping it against any relative movement. For this purpose a hook **34** on frame **26** diametrically opposite to hinge **28** is engageable by an over center suitcase type locking means **36** mounted on the front side **38** of base **16**. The annular ball engaging surface of frame **26** is also provided with friction tabs **40** similar to tabs **24**. Thus far described, with a ball **22** in jig **14** as shown, the top surface **42** of frame **26** and the top surface **44** of base **16** are parallel and horizontal and for purposes of further description, frame **26** at its hinge point **28** will be referred to as the rear thereof and at the hook point **34**, as the front.

At oppositely disposed central points on frame **26** on the respective sides thereof intermediate the front and rear of such frame, there is pivotally and centrally mounted the respective elongated parallel support bars **46** and **48** as best seen in FIGS. 1 and 2. The respective corresponding ends of bars **46** and **48** are connected by the respective upwardly extending front and rear arcuate parallel rods **50** and **52** that provide a track means over the ball **22** parallel to the circumference thereof. A carriage **54** is slidably mounted on rods **50** and **52** for movement intermediate bars **46** and **48**, and a manually operable set screw means **56** is provided to lock carriage **54** against movement from any selected position. Mounted on the top of carriage **54** is the hollow housing **58** in the form of the upper portion of a sphere which is provided with the top opening **60**, and it is pointed out that with the continuation of a perimeter line on housing **58** to define a complete sphere, the exact center point of such sphere would coincide with point **62** on ball **22** (FIG. 4) as will be later referred to.

Thus far described it will be understood that housing **58** can be moved toward and away from the respective front and rear ends of frame **26** by pivoting or tilting bars **46** and **48** accordingly and such housing **58** is also movable laterally on tracks **50** and **52** between bars **46** and **48**. The movement of housing **58** relative to the front and rear of frame **26** by pivoting of bars **46** and **48** will be referred to as the span gauge and for this purpose a calibrated scale **64** (FIG. 2) is mounted to frame **26** and carries readings of 0 1 2 3 on each side of center. There are sixteen calibrations between each number representing one-sixteenth inch on the ball **22** and one thirty-one-thousandth of an inch on the scale. A pointer **66** on bar **46** is oriented relative to scale **64** and tightening knobs **68** and **70** on the respective bars **46** and **48** are manually operable to lock bars **46** and **48** in any selected position.

The movement of housing **58** laterally between bars **46** and **48** on tracks **50** and **52** will be referred to as the offset gauge and for this purpose the center portion of the front track **50** (FIG. 1) is calibrated with a scale **72** which carries a reading of 0–1 on each side of center. There are eight calibrations between zero and one at each side and each calibration represents one-eighth inch on the ball **22** and one forty-six-thousandth of an inch on the scale. A point **74** on carriage **54** is oriented relative to scale **72** and with pointers **66** and **74** at zero settings, the top surfaces of bars **46** and **48** are horizontal and parallel to surfaces **42** and **44** of frame **26** and base **16** respectively and the axis of opening **60** in housing **58** is in an absolute vertical plane.

Housing **58** is designed to carry a turret assembly which is one of the important features of this invention and is indicated generally by the numeral **76** in FIG. 3, and which is shown in a modified form in FIG. 4 where it is designated generally by the numeral **76'**. With reference first to assembly **76**, an annular collar **78** with a flat rim-like top **80** has its underside **82** tapered or dished to be complementary with the outside curvature of housing **58** so that it can nest thereon and be universally movable relative thereto to change the inclination of the axis of its central opening **84**.

A tightening cap **86** (FIG. 8) for securing collar **78** to housing **58** in relative positions of adjustment comprises an elongated hollow cylindrical shank **88** which is externally threaded at its lower end **90** and terminates at its upper end in a concentrically enlarged shoulder **92** which serves as a manually grippable knob. The spaced peripheral grooves **94** on knob **92** are to facilitate the manual gripping thereof. In mounting cap **86** to housing **58**, the washer members **96**, **98** and **100** in FIG. 5 are the same as for turret assembly **76'** and are accordingly given the same number. With collar **78** on housing **58** as described, washer **96** is placed on the top **80** thereof and the shank **88** of cap **86** is inserted downwardly into housing **58** and into threadable engagement with washer **98** which it will be noted is provided with a radius on its perimeter **102** corresponding to the radius of the inner surface of housing **58** so that it will tightly engage such housing as shank **88** is rotated clockwise in an obvious manner. Shank **88** is long enough to pass through washer **98** and the locknut **100** is threadably attached to the lower end thereof. Only a slight loosening of cap **86** is required to permit movement of collar **78** and this may be done by grasping knob **92**.

For measuring the distance of movement of the turret assembly **76** (and also for assembly **76'** to be later described), there are four sets of like calibrations or scales **104**, **106**, **108** and **110** in the form of respective groups of spaced arcuate lines (FIGS. 1 and 2) in which the spacing is progressively smaller from top to bottom. Scales **104** and **106** are oriented respectively relative to the front and rear of frame **26**, and scales **108** and **110** are similarly arranged relative to the respective opposite sides. The distance between each line on such scales represents a distance of one inch on the ball **22**. With the bottom edge **112** of collar **78** coplanar with the highest point on the top line on all four scales **104**, **106**, **108** and **110** and with all other settings at zero as previously described, the axis of shank **88** on cap **86** will be on an absolute vertical plane and the bottom of shank **88** will be in closely spaced relationship above the ball **22**. A stud or boss **114** extends upwardly from the top rim-like surface of knob **92** for purposes which will be later referred to in more detail.

The turret assembly **76'** (FIG. 4) differs from assembly **76** (FIG. 3) only as relates to a modified tightening cap structure designated generally by the numeral **116** and illustrated by the upper three drawings in the exploded view of FIG. 5. These three units, as will appear, may be used in place of cap **86** shown in FIG. 8 and in the following description of assembly **76'**, all like parts

with assembly **76** will be given like numerals. Cap structure **116** comprises a collar-like cap on knob **118** having spaced peripheral grooves **120** so as to be substantially similar to knob portion **92** of cap **86** and within the lower portion of cap **118** there is secured as by screws **122**, the annular collar **124** which is recessed from the lower end of cap **118** sufficiently to accommodate washer **96**. The upper surface of collar **124** is provided with a plurality (preferably four) of equally spaced semicircular recesses **126**. An elongated hollow shank **128**, externally threaded on its lower end **130** (corresponding to elements **88** and **90** of cap **86**), terminates at its upper end in the concentrically enlarged collar **132** which is similar in size and shape to collar **124** and is provided on its bottom surface with spaced semicircular recesses **134** corresponding in number and spacing to recesses **126**. The top surface of collar **134** carries an upstanding boss or stud **136** similar to stud **114** in FIG. 8.

Shank **128** is inserted through collar **124** into housing **58** and cooperates with nuts **98** and **100** as previously described for cap **86**. In this arrangement, however, recesses **126** and **134** are offset relative to defining a complete circle as best seen in FIG. 4 and a rigid shim-like insert **138**, preferably of steel, is inserted in each complementary set of recesses so as to be diagonally disposed and in abutment with the respective inner surfaces of such recesses. The top of collar **132** will be within and flush with the top edge of collar **118** which defines the rim **140** that provides the shoulder **142**. In this position, shank **128** can be substantially tightened against collar **124** by tightening nut **100** to correspondingly tighten collar **78** on housing **58** and to further secure collar **78** against any movement relative to a pre-fixed position, cap **118** is manually twisted clockwise. This will produce only a slight movement of cap **118** since collar **124** will move with cap **118** tending to urge recesses **126** and **134** in full circle alignment and as this occurs and inserts **138** are urged toward a vertical position, they will bind in such recesses and exert an upward wedging force against collar **132** to further tighten shank **128** relative to nuts **98** and **100**. This effect is possible since the length of the inserts **138** accommodated on a diagonal plane when recesses **126** and **134** are offset as described is longer than the diameter of said recesses in full circle alignment. Normally only a slight twist of cap **118** is required as indicated above but if the force applied to cap **118** should be excessive, it is possible, but not likely, that inserts **138** might pass over center, and should this occur, the direction of twist of cap **118** can be reversed since such cap and collar **134**, except for inserts **138**, are not otherwise attached to collar **132**.

For use in the operation of jig **14**, which will be described in detail, reference is made to FIGS. 9 and 10 showing respectively the line-up or zero setting bushing **144** and a representative drill bit bushing **146**. Bushing **144** includes the cylindrical hollow shank **148** with the cross hairs or wires **150** across the bottom end. The top of shank **148** terminates in the flange collar **152** and secured to collar **152** is the downwardly disposed pointer **154** that is parallel with the axis of shank **148**. Bushing **146** includes the hollow cylindrical shank **156** topped by the flange collar **158** in the perimeter of which is an arcuate notch **160**. Bushing **146** is a guide bushing for drill bits (not shown) and it will be understood that a plurality of such bushings may be provided in which the diameter of the bore **162** will vary according to the size bit being used. The outside diameters of the shank **156** on all such bushings **146** will, of course, be the same and of like diameter as shank **148** on bushing **144**. All such bushings are used in association with the turret assemblies **76** and **76'** where the diameter of shank **88** on cap **86** and the diameter of shank **128** depending from collar **132** are the same and designed to receive such bushings as shown in FIG. 3.

Operation

With jig **14** constructed as described, it is used and operated as follows. Frame **26** is opened (FIG. 3) to permit the bowling ball **22** to be placed on base **16** with the center point **164** (FIGS. 11–13) of the ball substantially at point **62** as seen in FIG. 4. Point **164** is easily recognized by those familiar with drilling bowling balls since it will always be found associated with the manufacturer's label or trademark on the ball and each manufacturer has his own characteristic form of marking the center point. Frame **26** is then returned to closed position (FIGS. 1 and 2) but not yet secured by lock or clamp means **36**. Pointers **66** and **74** are placed at zero settings and the lower edge **112** of collar **78** is oriented relative to the highest point on the top scale line of calibrations **104**, **106**, **108** and **110**. The line-up bushing **144** is then placed into the turret assembly **76** (or **76'**) as seen in FIG. 2 where the diameter of collar **152** is such that this collar rests on the top surface of cap **86** (or of knob **118**) and at the inner side of the studs **114** or **136** so that such studs do not interfere with rotation of the bushing. Pointer **154** on bushing **144** is then oriented directly over the zero reading on scale **72** (FIG. 1) so that the cross wires **150** are oriented relative the respective front, rear and sides of frame **26**. Ball **22** is then manually maneuvered until point **164** is vertically aligned with the center of the cross wires, which can be determined by sighting down bushing **144**, and when this has been accomplished, lock **36** is secured and ball **22** is then immovable being secured between base **16** and frame **26** in which the friction tabs **24** and **40** are placed as previously described. Bushing **144** is then removed and the axis of the turret assembly is on an absolute vertical plane through the center point **164** of the ball **22**.

Ball **22** at this point is ready to be drilled and it is pointed out that at no time during the drilling of either the thumb hole **166** or finger holes **168** and **170** is it necessary to move or remove the ball from its locked-in position in jig **14** and consequently, the accuracy obtainable by this jig is materially greater than in other type jigs where the ball is removed or moved after each hole is drilled to permit proper measurements for the succeeding holes.

In describing the drilling operation with this jig **14**, reference will be made to FIGS. 11–13 which illustrate different common hole patterns for two finger holes and the thumb hole, and it will be understood that other patterns and a larger number of finger holes may be desired in particular cases. It will also be understood that the size of and relative position of the several holes will have been predetermined either by reference to a standard arrangement or from specifications furnished by the contemplated user of the ball according to his special preferences and that the function of jig **14** is to accurately drill the holes in compliance with such measurements.

The thumb hole **166** is first located and drilled and then the finger holes **168** and **170**, and in describing the relative adjustments on jig **14**, the thumb hole **166** is toward the front end **38** of base **16** at one side of point **164** and the finger holes **168** and **170** are on the opposite side of point **164** toward the rear **32** of base **16**. Any inclination of any of the holes toward the center point **164** will be referred to as forward, and away from point **164** as rearward. Likewise, lateral inclination of any hole will be referred to as a right or left lateral from a reference point at the front **38** of base **16** and as viewed in FIGS. 11–13. The measurement generally between the thumb hole **166** and the finger holes **168** and **170** across the center point **164** is referred to as the span and the measurement between the finger holes is referred to as the bridge. The span may be measured from edge to edge of the holes as shown in FIGS. 11–13 or may be measured from center to center with, of course, proper allowance relative to the reference point used. The span may of course vary with different users and the four inch span

shown is merely illustrative. As seen in FIGS. 11 and 12 the thumb hole and finger holes are equidistant from point **164** which is known as splitting the label and in FIG. 13 most of the span is shown above point **164** which is a preferred arrangement. The relative position of the finger holes **168** and **170** as seen in FIGS. 11 and 12 are a matter of choice.

With jig **14** at all zero settings as described and with reference to the preferred hole pattern in FIG. 13, the span gauge is moved toward the front one-fourth the distance of the span plus one-half the diameter of the proposed thumb hole **166** whereby the axis of the turret assembly will be on center with the axis of the hole to be drilled, and on a direct radial line to the actual center or axis of the ball since the lower shank end of the turret assembly moves in a parallel plane to the circumference of the ball. Calibrations **64** will be used for this purpose and the span gauge then tightened in place by knobs **68** and **70**. The inclination of the proposed hole either forward or rearward or lateral, or a combination of either a forward or rearward and a lateral inclination is provided by adjustment of the turret assembly **76** (or **76'**). For a forward inclination only, collar **78** is moved so that edge **112** registers with the desired line on scale **104** and maintains zero registration with scales **108** and **110**. For a rear inclination only, the registrations with the scales **108** and **110** are maintained at zero and edge **112** is adjusted relative to scale **106**. It will be understood, of course, that the turret cap is loosened to permit movement of collar **78** and tightened once the proper setting is made. In such movement of collar **78**, as well as in other adjustments to be described, it is pointed out that because of the spherical plane of the contour of housing **58** having an axial point corresponding to point **62** on ball **22** and the conformation of collar **78** to such contour, that the axial point at the lower end of the shank **90** (or **128**) always remains at the same point over designated axial point on the proposed hole at the perimeter of the ball and that any movement of collar **78** relative to scales **104**, **106**, **108** and **110** merely changes the inclination of the turret axis without changing the contact point of the drill bit on the ball as will later appear. For a right lateral inclination only, collar **78** is oriented relative to scale **108** with edge **112** at zero readings on scales **104** and **106** and for a left lateral only, scale **110** is used and zero readings maintained on scales **104** and **106**. It will become apparent from these possible adjustments that both a forward or rear and a lateral inclination can be calibrated simultaneously by orienting edge **112** of collar **78** with scale **108** and either **104** or **106**, for example, or simultaneously using scale **110** with **104** or **106** according to the specific measurements for each scale. Having thus set the span gauge and provided for the inclination desired, if any, the thumb hole is ready to be drilled.

An appropriate guide bushing **146** having a bore **162** relative to accommodating a drill bit for the size hole desired is placed in the turret assembly and the diameter of collar **158** (FIG. 10) is such that notch **160** can embrace stud **114** (or **136**) to prevent any rotary movement of the bushing. Such bushing and its cooperating turret structure permit the use of any ordinary one-half inch electric drill which is a substantial difference over other jigs of this type that require the use of a heavy drill press. The turret assembly and guide bushing will hold the drill bit directly on line and eliminate any drift of the bit on the circumference of the ball before penetration is accomplished. The weight of the drill with perhaps only a slight manual pressure is adequate to accomplish the desired drilling. The depth of such holes vary from what is known as standard, semi-finger tip and finger tip depths and it will be understood that any suitable calibrated depth gauge will be applied to the drill in a well-known manner.

Having completed the thumb hole, the span gauge with reference to FIG. 13 is moved over the center point **164** three-fourths of the distance of the span plus one-half the diameter of the ball. Since both finger holes (FIG. 13) **168** and **170** are offset relative from the front and rear vertical line **172** through point **164**, the offset gauge must be adjusted. This requires loosening the set screw **56** and moving carriage **54** left or right for the respective holes **168** and **170** and aligning pointer **74** on scale **72**. Forward, rear and lateral inclinations are then provided by adjustment of the turret assembly as described for the thumb hole and the holes drilled with the electric hand drill as indicated.

The turret assembly of this jig has particular value in drilling the finger holes since the bridge between such holes is normally only one-quarter inch and if two such closely adjacent holes are drilled on a perpendicular axis to the perimeter of the ball at the point of contact, it will be appreciated that the lower extremities of such holes would converge and break through. This is a frequent occurrence in present drilling apparatus and can be eliminated entirely by jig **14** since once the axial point of the finger holes **168** and **170** has been determined by the offset gauge, the axis of the turret assembly is inclined to left for hole **168** and to the right for hole **170** so that the axes of such holes can be parallel to each other or otherwise oriented so they will not break through at the bottom. This will, of course, necessitate the drill bit entering the ball at a tangent relative to the perimeter where the drift of the bit, as described, generally occurs but which has been eliminated by the jig herein disclosed.

This jig **14** when constructed as described may also be used with conventional plug cutter tools. In this regard, as is well known, holes in bowling balls are frequently plugged so new holes can be drilled in perhaps a different pattern or in different degrees of inclination. Such plugging is accomplished by providing a parapet around the hole at the surface and filling the hole with a fluid mixture that will harden according to well-known methods. The resulting plug thus projects slightly from the hole and must be cut or smoothed to be coplanar with the outer ball surface. A rotating cutter wheel is generally used and care must be taken to cut the plug accurately so as not to gouge or indent the ball as the tool is moved back and forth across the plug. Accordingly, by tightening the turret assembly at all zero readings, forward, rear and lateral, and by loosening the tightening members for both the span and offset gauges, the cutter tool, with an appropriate depth gauge, may be inserted into the turret assembly through an appropriate bushing **146** and then rocked forwardly, rearwardly and laterally in its grinding or cutting action against the plug. In this respect, it will be appreciated that such tool will always move parallel to the perimeter of the ball for a uniform cutting action and the depth gauge will prevent further cutting at the required point when the plug is flush with the surface of the ball.

It will be appreciated from the foregoing that jig **14** affords many advantages over the heavy, cumbersome and relatively expensive jigs now available for drilling bowling balls. This jig, because of its relatively light weight and economical cost, may be profitably acquired by individual bowling lane establishments and its adaptability to the use of an ordinary electric hand drill instead of a heavy expensive drill press is a marked departure from and improvement over present methods of bowling ball drilling. Likewise, the fact that the ball is not moved once frame **26** is tightened and the relative simplicity of setting the span and offset gauges and inclination of the hole axes makes the requirement for trained personnel unnecessary.

It is thus submitted that the invention shown and described is aptly suited to achieve the purposes intended and is characterized by a combination of highly useful and mutually cooperating elements that combine their

respective and proportionate functions in accomplishing the objects sought to be obtained.

It will be understood that the phraseology employed herein is for the purpose of description and not for limitation and that modifications and changes in the construction and arrangement of this invention can be made within the scope of what is claimed, without departing from the spirit and purpose thereof. It is thus intended to cover by the claims, any modified forms of structure or mechanical equivalents which may be reasonably included within their scope.

We claim:

1. A bowling ball drill jig comprising:
a base having a front and rear and designed for supporting a bowling ball,
a hinged lockable annular frame carried by said base so as to embraceably engage a bowling ball to hold it against movement relative to said base,
first and second elongated parallel bars pivotally secured at their respective centers at respective diametrically opposed points on said frame,
the longitudinal axes of said bars extending between the front and rear of said base,
a first releasable lock means to hold said bars immovable at times,
arched track means connecting said bars and having a curvature designed to be parallel to the perimeter of a bowling ball when such a ball is supported on said base,
carriage means movable on said base intermediate said bars,
a second releasable lock means to hold said carriage immovable at times,
a hollow semispherical housing mounted on said carriage,
a collar having a flat annular top edge and an underside formed for nesting arrangement on said housing so as to be universally movable relative thereto,
a cap for holding said collar immovable at times relative to said housing means,
said cap including a depending cylindrical hollow shank terminating within said housing so as to be in closely spaced relationship from the perimeter of a bowling ball on said base, and
a drill bit guide bushing of a selected size removably journalled in said shank.

2. A bowling ball drill jig comprising:
a base having a front and rear and designed for supporting a bowling ball,
a hinged lockable annular frame carried by said base so as to embraceably engage a bowling ball to hold it against movement relative to said base,
first and second elongated parallel bars pivotally secured at their respective centers at respective diameterically opposed points on said frame,
the longitudinal axes of said bars extending between the front and rear of said base,
a first releasable lock means to hold said bars immovable at times,
arched track means connecting said bars and having a curvature designed to be parallel to the perimeter of a bowling ball when such a ball is supported on said base,
carriage means movable on said base intermediate said bars,
a second releasable lock means to hold said carriage immovable at times,
a turret assembly having a vertical bore and mounted on said carriage,
means to locate and fix the axial point at the lower end of said bore at any selected point relative to the perimeter of a bowling ball in which a hole is to be drilled,
said turret assembly being universally movable to vary the inclination of the axis of said bore but maintaining the fixed position of the axial point at the lower end thereof, and
a drill bit guide bushing removably journalled in said bore for maintaining such bit exactly on the axis of said bore during penetration of said ball.

3. A device as defined in claim 2 wherein said turret assembly comprises:
a hollow semispherical housing mounted on said carriage,
a collar having a flat annular top edge and an underside formed for nesting arrangement on said housing so as to be universally movable relative thereto,
an annular cap,
an annular shoulder secured to the inner surface of said cap near one end thereof,
said shoulder provided with a plurality of spaced recesses,
a cylindrical hollow shank extending through said collar into said housing,
a concentrically enlarged shoulder at the top of said shank,
said shoulder having similarly arranged recesses as said annular shoulders so that each recess on each shoulder is in semiregistering position with a recess on the other shoulder,
a rigid shim-like insert diagonally disposed in each pair of semiregistering recesses,
means for tightening said shank against said collar and said housing, and
with said shank tightened, rotation of said cap urging said recesses into full registration where said inserts are urged toward a vertical position and exert a leverage action between said shoulders to further increase the tightening means between said shank and said collar and housing.

4. A jig for drilling thumb and finger holes in a bowling ball having a fixed marking indicating its center point, said jig comprising:
a base for supporting said ball,
a lockable annular frame carried by said base to embraceably engage said ball and hold it against movement relative to said base,
a calibrated span gauge movably mounted to said frame for selectively measuring distances on the perimeter of said ball in two diametrically opposite directions from said center point,
a calibrated offset gauge carried by said span gauge for selectively measuring distances on the perimeter of said ball in two diametrically opposite directions from said center point and perpendicular to the line of measurement of said span gauge,
a calibrated turret assembly having a vertical bore and mounted on said offset gauge,
means to locate and fix the axial point at the lower end of said bore at any selected point relative to the perimeter of said ball in which a hole is to be drilled,
said turret assembly being universally movable to vary the inclination of the axis of said bore but maintaining the fixed position of the axial point at the lower end thereof, and
a drill bit guide bushing removably journalled in said bore for maintaining such bit exactly on the axis of said bore during penetration of said ball.

5. Apparatus as defined in claim 4 wherein the position of the axial point at the lower end of said bore relative to the perimeter of said ball is the common reference point for the respective calibrations on the span and offset gauges and on said turret assembly.

6. Apparatus as defined in claim 4 wherein at the zero position of the calibrations for said span and offset gauges and for said turret assembly, the axis of said bore is on an absolute vertical plane through the axis of said ball.

7. A jig for drilling thumb and finger holes in a bowling

ball having a fixed marking indicating its center point, said jig comprising:
a base for supporting said ball,
a lockable annular frame carried by said base to embraceably engage said ball and hold it against movement relative to said base,
a turret assembly having a vertical bore and operatively mounted on said frame,
means to locate and fix the axial point at the lower end of said bore at any selected point relative to the perimeter of said ball in which a hole is to be drilled,
said turret assembly being universally movable to vary the inclination of the axis of said bore but maintaining the fixed position of the axial point at the lower end thereof, and
a drill bit guide bushing removably journalled in said bore for maintaining such bit exactly on the axis of said bore during penetration of said ball.

8. A device as defined in claim **7** wherein said turret assembly comprises:
a hollow semispherical housing mounted on said carriage,
a collar having a flat annular top edge and an underside formed for nesting arrangement on said housing so as to be universally movable relative thereto,
an annular cap,
an annular shoulder secured to the inner surface of said cap near one end thereof,
a cylindrical hollow shank extending through said collar into said housing,
a concentrically enlarged shoulder at the top of said shank,
said shoulders being in juxtaposition,
a first means for tightening said shank against said housing and said collar, and
a second means for urging said shoulders away from each other to increase the tightening effect of said first means.

9. A jig for drilling thumb and finger holes in a bowling ball having a fixed marking indicating its center point, said jig comprising:
a base for supporting said ball,
a lockable annular frame carried by said base to embraceably engage said ball and hold it against movement relative to said base,
a turret assembly operatively mounted on said frame and having a vertical bore terminating at its lower end in closely spaced relation above the center point on said ball,
means to fix the position of the axial point at the lower end of said bore relative to any selected point on the perimeter of said ball determined as the axial point of a hole to be drilled therein,
means to selectively incline the axis of said bore but maintaining the fixed position of the axial point at the lower end of said bore, and
a drill bit guide bushing removably journalled in said bore and designed for guiding the bit on a manually held electric drill.

10. A jig for drilling thumb and finger holes in a bowling ball having a fixed marking indicating its center point, said jig comprising:
a base for supporting said ball,
a lockable annular frame carried by said base to embraceably engage said ball and hold it against movement relative to said base,
a turret assembly having a vertical bore,
means for supporting said turret assembly so that the lower end of said bore is in closely spaced relation above the center point of a bowling ball secured by said frame,
a first calibrated means for selectively moving said turret assembly in diametrically opposite directions relative to said center point,
a second calibrated means for selectively moving said turret assembly in diametrically opposite directions from said center point and perpendicular to the line of movement with said first calibrated means, and
means to selectively incline the axis of said bore away from a vertical plane in any selected direction but maintaining any prefixed position of the axial point at the lower end of said bore relative to a prefixed point on the perimeter of said ball which has been designated as the axial point for a hole to be drilled.

11. A device as defined in claim **10** including:
a drill bit guide bushing removably journalled in said bore, and
said guide bushing adapted to receive a drill bit on an electric hand drill and to hold said bit against any drift on the perimeter of said ball at the initial contact therewith.

12. A device as defined in claim **10** including means for orienting the axis of said bore on an exact vertical plane through said center point and the axis of said ball.

13. A jig for drilling thumb and finger holes in a bowling ball having a fixed marking indicating its center point, said jig comprising:
a base for supporting said ball,
a lockable annular frame carried by said base to embraceably engage said ball and hold it against movement relative to said base,
a hollow semispherical housing operatively supported by said frame,
a collar having a flat annular top edge and an annular underside adapted for nesting arrangement on said housing so as to be universally movable relative thereto,
a cap assembly for holding said collar immovable relative to said housing in any predetermined position,
said cap assembly including a depending cylindrical shank terminating within said housing so as to be in closely spaced relationship at its lower end from the perimeter of a bowling ball on said base,
means for orienting the axis of the bore of said shank on a vertical plane through said center point and the axis of said bowling ball,
the axial point at the lower end of the bore of said shank defining the center point of a circle represented by a line completing a full circle of the curvature of said housing,
movement of said collar relative to said housing effecting an inclination of the axis of the bore in said shank away from a vertical plane but maintaining a prefixed position of said axial point at the lower end of said bore relative to the perimeter of said bowling ball, and
bushing means associated with said cap assembly for guiding the drill bit on an electric hand drill into said bowling ball.

14. A device as defined in claim **13** including means to orient the axis of the bore in said shank over any selected point on the perimeter of said bowling ball offset from the center point thereof.

15. A means for tightening a first and second apertured member in juxtaposition, said means comprising:
an annular cap,
an annular shoulder secured to the inner surface of said cap near one end thereof,
a cylindrical hollow shank extending through such apertured members,
a concentrically enlarged shoulder at the top of said shank,
said shoulders having similarly arranged recesses so that each recess on each shoulder is in semiregistering position with a recess on the other shoulder,
a rigid shim-like insert diagonally disposed in each pair of semiregistering recesses,
means for tightening said shank against such apertured members, and

with said shank tightened, rotation of said cap urging said recesses into full registration where said inserts are urged toward a vertical position and exert a leverage action between said shoulders to further increase the tightening means between said shank and such apertured members.

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