May 7, 1940. J. ARMAND 2,199,773

MACHINE FOR SHARPENING THE POINTS OF TWIST DRILLS OR THE LIKE

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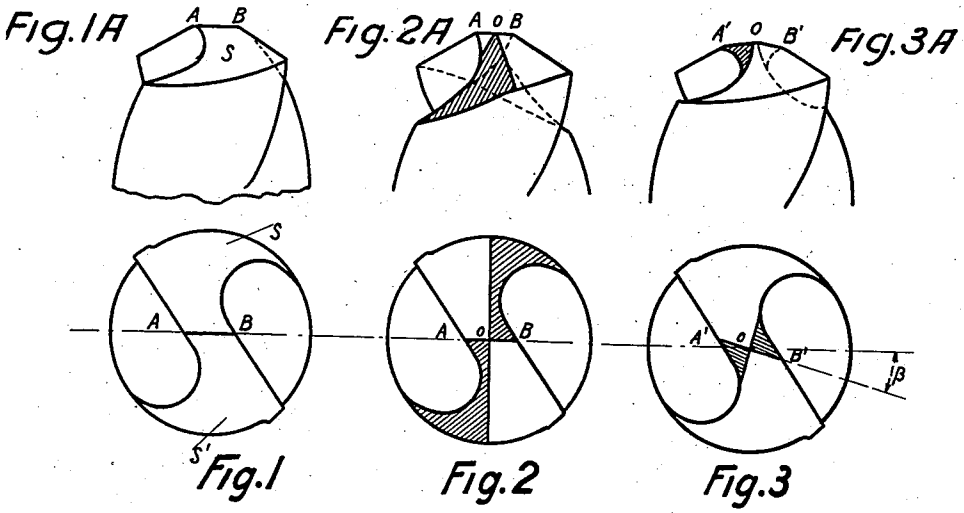


Fig.1 Fig.2 Fig.3

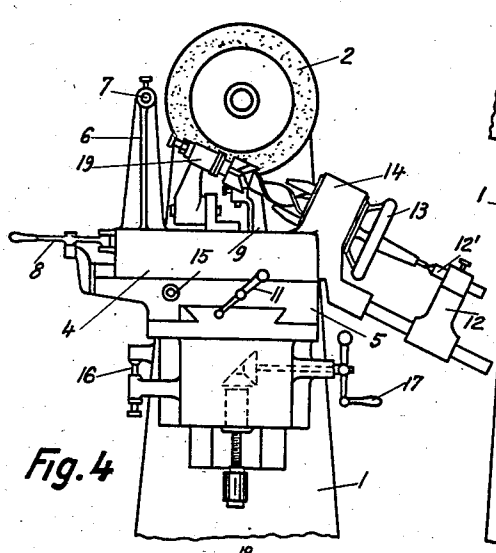


Fig.4

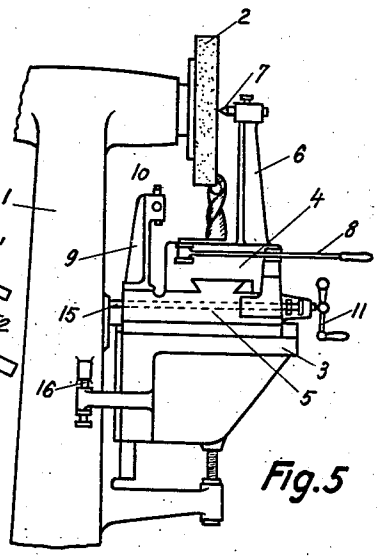


Fig.5

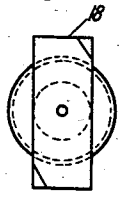


Fig.8

Fig.6

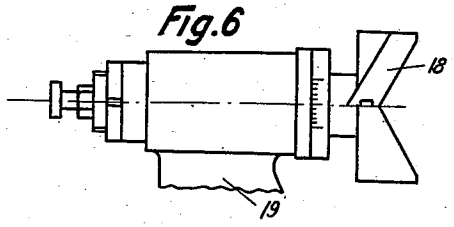
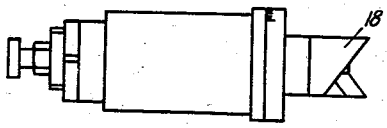


Fig.7



Inventor:
Joseph Armand
per
Fred T. Barton
Attorney

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MACHINE FOR SHARPENING THE POINTS OF TWIST DRILLS OR THE LIKE

Joseph Armand, Paris, France

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9 Claims. (Cl. 51—219)

The present invention relates to a new or improved machine for sharpening the points of twist drills or the like.

In order that a drill may work under the best conditions for resisting the violent strains due to the pressure and torsion to which it is subjected, it is necessary that it cut the metal with a leading edge which is shaped and sharpened with extreme precision and it is necessary that the machine destined for shaping and sharpening the essential part of the drill, that is to say its point, ensure the performance of these operations without the attendant having to take special precautions and being, to this extent, a sharpening specialist.

It is known, on the other hand, that the intersection of the tapered surfaces of the two cutting edges and which is situated at the apex of a twist drill or the like, is not only inoperative but, on the contrary, constitutes an obstacle to the penetration of the tool.

In fact, said intersection between the tapered surfaces of the two cutting edges forms the blunt edge of an obtuse dihedral angle which, instead of assisting the penetration of the drill into the metal, exerts a drag on the surface thereof attaining, in the case of drills of large diameter, almost prohibitive values.

An object of the invention is to convert this intersecting edge into two leading and cutting edges by grinding away the two apices to leave two inclined surfaces meeting in a single apex.

That is to say, in order to obviate the difficulties previously met with the usual tapered surfaces obtained by present grinding methods, said tapered surfaces are each reduced by grinding the trailing edge thereof to a slope materially steeper than that of the original surfaces, and in a radial direction forming a substantial angle with the initial blunt intersection.

Said finishing operation is effected in two stages, first on one tapered surface, continuing until said steeper sloping surface reaches the geometric center of the drill tip, thus removing in one operation one half of said blunt edge. The drill is then revolved 180° around its axis, and a similar grinding operation is effected on the trailing edge of the opposite tapered surface, until the geometric center of the drill tip is reached from the other side, thus removing in a second operation the second half of said initial blunt edge, and leaving four tapered surfaces meeting in one point at the geometric center of the drill tip. The drag on the metal due to the initial blunt edge is thereby eliminated and, moreover, this operation produces two auxiliary cutting edges, the action of which is added to that of the original main cutting edges. This greatly facilitates the penetration of the drill into the metal to be drilled, together with the centering of the drill, which has no further tendency to be deflected along the metallic surface.

This second or finishing grinding operation, which ensures a substantial increase in the efficiency of the tool, may at present be effected by hand, and is an operation requiring substantial skill.

The machine forming the subject of the present invention is of the type comprising a grinding wheel, means for truing such wheel and a chuck for carrying the drill adapted to have a cutting feed imparted to it by hand operated carriage means and has for its object to finish or complete the sharpening of the points of twist drills by making it possible to eliminate, in a second or finishing grinding operation, the above-mentioned blunt edge from the tip of said drill with a mathematically exact precision without the skill of the attendant being considered.

One of the characteristics of the invention resides in the fact that the twist drill, when in the grinding position, is held in such manner in the drill holder that its axis or center-line lies in the plane of the radial working face of the grinding wheel, and at a substantial angle with the direction in which it is fed towards said grinding wheel; and, moreover, in that the geometric center of the drill tip moves on a line tangent to the peripheral working face of the grinding wheel. In this manner, the sharp edge produced by the intersection of the radial and peripheral working faces of the grinding wheel cuts into the previously formed tapered surface which backs one of the cutting edges of the drill along the axis of said drill; and, in so doing, the radial working face forms an auxiliary cutting edge, while the peripheral working face of said grinding wheel cuts a bevel or inclined surface into the trailing edge of said initial tapered surface to a materially steeper slope than that of said initial tapered surface.

Another essential characteristic of said machine lies in that truing means are provided for trimming the radial and peripheral working faces of said grinding wheel, said radial truing means being adapted to trim the radial working face exactly in a plane passing through the axis of the drill when the latter is set in its drill holder in the grinding position; and said peripheral truing means being adapted to trim the peripheral working face of said grinding wheel in such manner

as to keep the cutting edge of the grinding wheel tangent to the line of travel of the geometric center of the drill tip. To these ends, said radial truing means are mounted in fixed space relation with respect to said drill holder, and provided with a trimming tool, such as a diamond, the cutting edge of which lies in a plane containing the axis of said drill when in its holder, said plane being parallel at all times to that of the radial working face of said grinding wheel and coinciding therewith when the drill is in the grinding position. Furthermore, said peripheral truing means are so disposed that they can be fed in a line parallel to the axis of rotation of said grinding wheel, and in such manner as to adapt it to trim the peripheral grinding face to make the latter exactly tangent to the line of travel of the geometric center of the drill tip.

Another characteristic of this invention lies in that, when the grinding wheel has been trimmed radially and peripherally, the working positions of the two diamond cutting edges of said radial and peripheral truing means are functions of two limiting and previously adjusted stops or abutments, one of which stops defines simultaneously the plane of the trimmed radial working face of said grinding wheel and of the axis of the drill in its drill holder; while the other stop defines the cylindrical working surface of the grinding wheel in such manner that it must be tangent to the line of travel of the geometric center of the drill tip.

Thus said drill is made to follow automatically the wear of the grinding wheel in such manner that its axis or centerline remains in a fixed position relative to the radial and peripheral working faces of said grinding wheel, without depending upon the skill of the operator.

A further characteristic of this invention lies in that means may be associated with said drill holder, for the purpose of automatically positioning said drill axially in said holder in such manner that the geometric center of the drill tip will lie in a plane parallel to the axis of the grinding wheel and passing through the cutting edge of the peripheral truing tool, in order to cause said drill to move with its center always on a line tangent to the periphery of the grinding wheel, said positioning means being removable, once the drill has been clamped in its holder, in order not to be in the way of the grinding operations.

A still further characteristic lies in that said drill positioning means may also be made to position said drill both axially and radially, in such manner that the geometric center of the drill tip will travel in a line tangent to the periphery of the wheel, and, furthermore, that the original blunt edge at the drill tip which it is desired to eliminate will form a given predetermined angle with the radial working face of the grinding wheel.

The attached drawing shows, by way of example only, one embodiment of a machine for sharpening the points of twist drills or the like according to the characteristics specified above, as well as showing diagrams of the drill sharpened according to known machines and by the machines according to the present invention.

Fig. 1 and Fig. 1^A are views in elevation and in plan of the point of a twist drill sharpened in the ordinary way and having a blunt and substantially straight edge A—B formed at the apex of the tool, by the intersection of the tapered surfaces S and S. This intersection edge A—B, as is known and commonly agreed, constitutes an obstacle to the penetration of the tool, as stated above.

Fig. 2 and Fig. 2^A show also views in elevation and in plan of the same drill point, but after sharpening on the machine forming the subject of the application with the blunt edge to be eliminated lying in the plane of the radial working face of the grinding wheel. This operation produces two cutting counter edges AO and OB, O representing the neutral point, said cutting counter edges AO and OB lying substantially in a straight line.

Fig. 3 and Fig. 3^A represent two views of the same drill of which the sharpening operation has been performed after turning the drill in such a way that the edge AB (Fig. 1) forms an angle β with the radial working face of the grinding wheel, which in elevation gives a noticeable inclination to the cutting edges A'O and OB' relatively to the perpendicular to the axis of the drill, thus constituting an angle of which the apex is exactly at the axis of the drill in order to facilitate its centering and its correct penetration on a simple punch mark.

Fig. 4 is a view in elevation of the face of the machine.

Fig. 5 is a lateral elevation and

Figs. 6, 7 and 8 are three different views of the device for axially and radially positioning the twist drill in its mandrel or chuck.

In its preferred embodiment, the sharpening machine comprises a frame 1 at the upper part of which there is mounted a grinding wheel 2 driven at a suitable peripheral speed. On this frame there can be displaced vertically a bracket member 3 mounted in suitable guides and supporting two movable tables 4 and 5, one provided with a support 6 destined to receive the radial truing tool and the table 5 being provided with a support 9 for the peripheral truing tool.

The table 4 is operated by means of the lever 8 while the table 5 is controlled by the hand wheel 11. As shown clearly by Figs. 4 and 5, the diamond tool 7 is destined to trim the radial face of the grinding wheel 2 while the diamond tool 10 trims its peripheral face. The two tables 4 and 5 are thus displaceable in perpendicular planes.

The diamond tool 7 is fixed on the movable upper table 4 in such a way that its point is situated exactly in the plane passing through the axis of the drill and parallel to the radial face of the grinding wheel. The point of the diamond tool 10 fixed on the carriage 5 is situated exactly in the line of intersection of the plane parallel to the plane of motion of the lower table 5 and passing through the point of the drill with the perpendicular plane passing through the axis of the grinding wheel.

The upper table 4 supports the drill-carrying mandrel or chuck 14 inclined relatively to the plane of motion of the upper table 4 and provided with a positioning abutment 12 with a counter point 12'. The drill to be sharpened is fixed between the jaws of the mandrel or chuck and may be operated through the desired angles of rotation by means of an operating wheel 13.

The table 5 is provided with an abutment 15 of which the position may be regulated by means of a micrometer screw. This abutment stops the movement of the table at the exact point where the diamond 7 is tangential to the front face of the grinding wheel. A second abutment 16, mounted on the bracket member 3, limits the

vertical displacement of the whole of the system and permits an exact truing of the periphery of the grinding wheel under the same conditions as at present for the front face by means of the diamond 7. This second abutment 16 comes into action during the operation of the handle 17 destined for the vertical regulation and it stops the vertical movement of the system at the exact point where the diamond is tangential to the periphery of the grinding wheel.

From the above description, it will be seen that the respective positions of the abutments 15 and 16 determine with great precision the positions in space of the radial and peripheral working faces of the grinding wheel 2, hence the position of their intersecting edge; furthermore, the twist drill, when clamped in its chuck 14, is so positioned, first, that its axis lies in the plane of the radial working face of said grinding wheel; and secondly, that the geometric center or apex of its tip automatically follows any changes produced by radial and peripheral truing operations in the location of said intersecting edge of the radial and peripheral grinding faces, in such manner that the motion of the upper table 4 causes said geometric center of the drill tip to follow a line lying in the plane of the radial grinding face and tangent to the peripheral grinding face.

In order to ensure the drill being held in the axially and radially correct position, as defined hereinbefore, with respect to said radial and peripheral working faces of the grinding wheel 2, this invention provides positioning means which may be removed after the drill has been correctly positioned and clamped in its holder, so that said positioning means shall not interfere with the grinding operations.

One embodiment of such positioning means is illustrated in Figs. 6, 7 and 8. In this embodiment, said positioning means comprise a hollow V-shaped block 18 adapted to fit exactly over the tip of the drill as the latter is shaped when ground by present methods, the vertex of said V being adapted to coincide with the geometric center of the drill tip. Said V-block is mounted rotatably in a swinging bracket support 19 pivoted to the upper table 4, the purpose of which support is to fix invariably the relative position of the center of the drill tip, with respect to table 4, and indirectly with respect to the peripheral truing tool 10. Said V-block is mounted in its support 19 in such manner that it may be revolved therein around an axis coinciding with that of the twist drill in its chuck. A graduated scale enables the operator to determine accurately the angular position of the drill in its chuck, for the purpose of setting the afore-mentioned initial blunt edge A—B at the required angle β with respect to the radial working face of the grinding wheel; and a locking device clamps said V-block 18 in said position.

When it is desired to position the drill, said support 19 is swung into its operative position, wherein the vertex of the V-block is at the same height above the plane of the table 4 as the cutting edge of the peripheral truing tool 10, and in the plane containing the axis of the drill and parallel to that of the radial working face of said grinding wheel 2. The drill is then moved axially and radially in the chuck 14 until its tip fits perfectly into the V-block; it is then clamped in the chuck, and the support 19 is swung back until it lies on table 4 out of the way of the grinding operations.

This arrangement, as already described, permits the edge A—B to be ground with two edges inclined to one another and relatively to a plane perpendicular to the axis of the drill and thus producing a valuable point for centering the tool (Fig. 3).

In utilising the machine assume the grindstone 2 to have been dressed by the cutting tools 7 and 10. Then with the table 4 moved to the right from the position shown in Fig. 4 and the table 5 to the right from the position shown in Fig. 5, the drill is mounted in the chuck 14 and is positioned by the V block 18. This is turned up by the bracket 18 and gives definite positions to the edge A—B (Fig. 1). The angle is given by the index shown in Fig. 6. When thus set the tool is clamped in the chuck.

Now by moving the table 5 to the left until its stop 15 is in the position shown in Fig. 5 the table 4 can be moved back (from the right to the left) to the position shown in Fig. 4 and even beyond this position. This has the effect of grinding off what has been termed one apex, say A.

The table 4 is again moved to the right from the position shown in Fig. 4, and the drill turned on its axis through 180° by the hand wheel 13. The table 4 is again moved to the left and the other apex B removed.

The resulting shape of the point of the drill is as shown in Fig. 3.

As the invention has only been described by way of example, it is obvious that modifications can be made in the construction of the machine shown, the essential characteristic of the invention residing in the combination of a grinding wheel with radial and peripheral working faces, the radii of the former forming sharply defined right angles with the generatrices of the latter and being moreover perpendicular to the axis of rotation of said grinding wheel, a drill holder or support adapted to hold said drill so that its axis lies in a plane parallel to said radial working face of said grinding wheel at all times except during the grinding periods, when said plane containing said drill axis coincides with that of the radial grinding face, and so that the geometric center of the drill tip moves along a line tangent to the peripheral working face of said grinding wheel, radial truing means adapted to trim said radial grinding face in said plane passing through the drill axis, and peripheral truing means adapted to trim the peripheral working face in such manner as to make the same tangent to the line of motion of the geometric center of the drill tip.

The invention is not limited to the precise forms or details of construction described, as these may be varied to suit particular cases.

What I claim and desire to secure by Letters Patent of the United States of America is:

1. A grinding machine for finishing the sharpening of twist drills by eliminating, in two operations, the blunt edge from the tip of such drills previously ground by known methods and replacing said blunt edge by two supplementary cutting edges, said machine comprising, in combination, a frame, a cylindrical grinding wheel rotatably mounted on said frame, said grinding wheel having radial and peripheral working faces, the radii of the former forming sharply defined right angles with the generatrices of the latter, a drill holder adapted to hold said drill with its axis lying in a movable plane at least parallel to that of the radial working face of

said grinding wheel and coinciding therewith during the grinding operations, means for movably supporting the said drill holder and also adapted to receive truing means for trimming the radial working face of said grinding wheel in said plane containing the axis of said drill when the latter is set in its holder, and only in said plane, and the said supporting means being further adapted to receive truing means for trimming the peripheral working face of said grinding wheel perpendicularly to said plane containing the axis of the drill in its holder and in such manner as to make said peripheral face tangent to the line of motion of the geometric center of the drill tip during the grinding operations, and the said supporting means including means for movably supporting said peripheral truing means from said machine frame in fixed space relation with respect to the plane of motion of the geometric center of the drill tip.

2. A finishing twist drill grinding machine as hereinbefore defined comprising, in combination, a frame, a cylindrical grinding wheel rotatably mounted on said frame, said grinding wheel having radial and peripheral working faces, the radii of the former forming sharply defined right angles with the generatrices of the latter, a drill holder adapted to hold said drill with its axis lying in a movable plane at least parallel to that of the radial grinding face and coinciding therewith during the grinding operations, means for movably supporting and guiding said drill holder and also adapted to receive truing means for trimming the radial grinding face in said plane containing the axis of the drill in its holder, and only in said plane, and adapted to receive truing means for trimming the peripheral grinding face perpendicularly to said plane containing the axis of the drill in its holder and in such manner as to make said peripheral grinding face tangent to the line of motion of the geometric center of the drill tip during the grinding operations, the said supporting and guiding means being further adapted to allow simultaneous parallel translation of said drill holder and said radial grinding face truing means in two directions parallel to said radial grinding face and in one direction perpendicular to the same, and the aforementioned supporting and guiding means including means for movably supporting and guiding said peripheral truing means from said machine frame in fixed space relation with respect to the plane of motion of the geometric center of the drill tip, the said latter supporting and guiding means being adapted to allow simultaneous parallel translation of said peripheral truing means, of said radial truing means and of said drill holder in one direction parallel to said radial working face of said grinding wheel and in one direction perpendicular to said radial grinding face.

3. A finishing twist drill grinding machine as hereinbefore defined comprising, in combination, a frame, a cylindrical grinding wheel rotatably mounted on said frame, said grinding wheel having radial and peripheral working faces, the radii of the former forming sharply defined right angles with the generatrices of the latter, stationary guideways integral with said frame, parallel to said radial grinding face and perpendicular to the line of motion of the drill during the grinding operations, a bracket member adapted to slide up and down on said guideways, lower guideways supported by said bracket member and perpendicular to said radial grinding face, a lower sliding table adapted to translate on said lower guideways, upper guideways supported on said lower sliding table and parallel to said radial grinding face and perpendicular to said stationary guideways, an upper sliding table adapted to translate on said upper guideways, a drill holder mounted on the said upper sliding table and adapted to hold said drill with its axis in a movable plane at least parallel to that of the said radial grinding face and coinciding therewith during the grinding operations, the said upper sliding table being also adapted to receive truing means for trimming the said radial grinding face in said plane containing the axis of the drill in its holder, and only in said plane, and the said lower sliding table being also adapted to receive truing means for trimming the peripheral working face of said grinding wheel perpendicularly to said plane containing the axis of the drill in its holder and in such manner as to make said peripheral working face tangent to the line of motion of the geometric center of the drill tip during the grinding operations, means for adjusting the position of said bracket member on said stationary guideways, means for moving said lower sliding table on its guideways into the grinding position and, when necessary, for trimming the peripheral face of the grinding wheel, and means for moving said upper sliding table on its guideways for the grinding operations and, when necessary, for trimming the radial working face of said grinding wheel.

4. A finishing twist drill grinding machine according to claim 3 comprising, in addition, removable abutment means for positioning the drill axially in its holder in such manner as to locate the geometric center of the drill tip at a given predetermined distance above said upper sliding table.

5. A finishing twist drill grinding machine according to claim 3 comprising, in addition, removable abutment means for positioning the drill axially and radially in its holder in such manner as to locate the geometric center of the drill tip at a given predetermined distance above said upper sliding table and to set the blunt edge of the drill tip at a given predetermined angle with the radial working face of the grinding wheel.

6. A finishing twist drill grinding machine according to claim 3 comprising, in addition, removable abutment means for positioning the drill axially and radially in its holder in such manner as to locate the geometric center of the drill tip at a given predetermined distance above said upper sliding table and to set the blunt edge of the drill tip at a given predetermined angle with the radial working face of the grinding wheel, and means associated with said drill positioning means adapted to ensure the locking of said positioning means in a given position, in order to allow a number of drills to be sharpened under identical conditions.

7. A finishing twist drill grinding machine according to claim 3 in which said drill holder comprises means for revolving said drill around its own axis between grinding operations, without it being necessary to loosen the drill gripping means, or to displace the drill axially, or to move its axis with respect to the grinding wheel.

8. A finishing twist drill grinding machine according to claim 3 comprising micrometrically-adjustable stop means associated with said lower sliding table in such manner as to limit the travel of said lower table in the direction of the grinding wheel to that position in which the plane con-

taining the axis of the twist drill in its holder coincides with that of the radial working face of the grinding wheel, and micrometrically-adjustable stop means associated with said bracket member in such manner as to limit the travel of said bracket member in the direction of the grinding wheel to that position in which the geometric center of the drill tip and the cutting edge of the peripheral truing means lie in a plane tangent to the periphery of the grinding wheel, the said bracket member and lower table stop means thus coacting to define the respective positions of said bracket member and of said lower sliding table for the twist drill grinding and grinding wheel truing operations.

9. In a machine for grinding twist drills and the like, having a rotatable grinding wheel and means for supporting a drill in position for sharpening the end thereof and to provide a pointed tip on the said end; a grinding wheel truing means, a support for the said truing means adapted to position and move the truing means adjacent the peripheral working face of the grinding wheel to trim the said face perpendicularly to the plane parallel with the radial face of the grinding wheel and containing the axis of the drill in its support and in such manner as to make the said peripheral face tangent to the line of motion of the geometric center of the drill tip during the grinding operations, a second grinding wheel truing means, and a support for the said second truing means adapted to position and move the latter truing means adjacent the radial working face of the said grinding wheel to trim the latter face in a plane coinciding with the axis of a drill held in the drill supporting means and the said drill supporting means being associated with the support for at least one of the said truing means.

JOSEPH ARMAND.