G. E. OTIS.

CAM FOR SQUARE HOLE DRILLS.

APPLICATION FILED JAN. 17, 1917.

1,266,148.

Patented May 14, 1918.

2 SHEETS—SHEET 1.

Fig. 1.

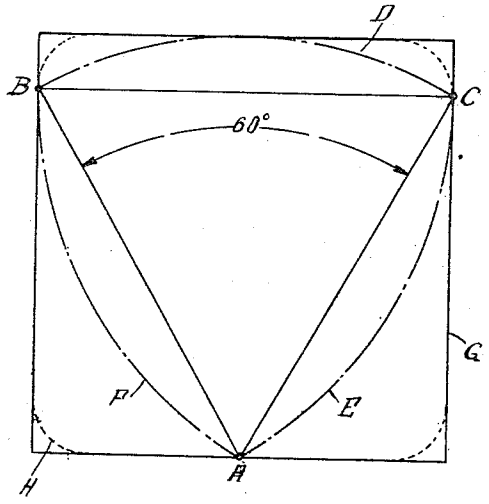


Fig. 2.

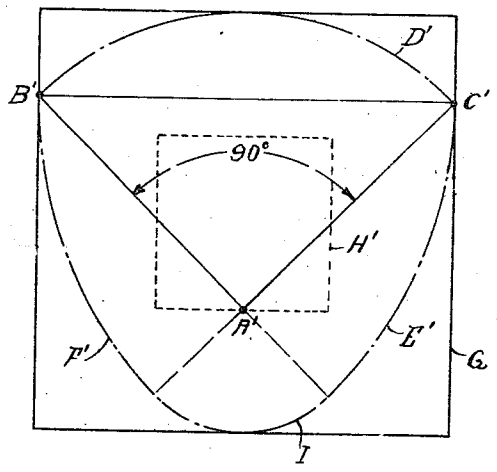
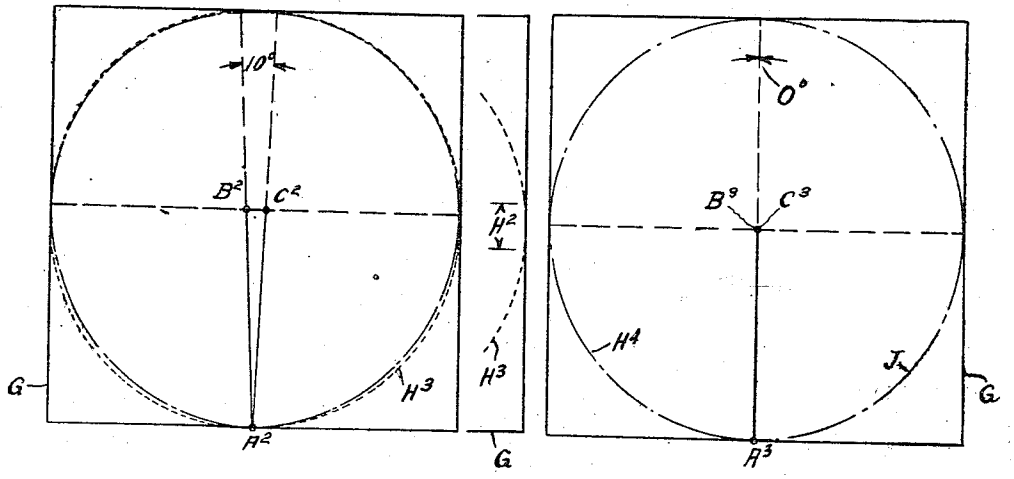


Fig. 3.

Fig. 4.

Fig. 5.



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2 SHEETS—SHEET 2.

Fig. 6.

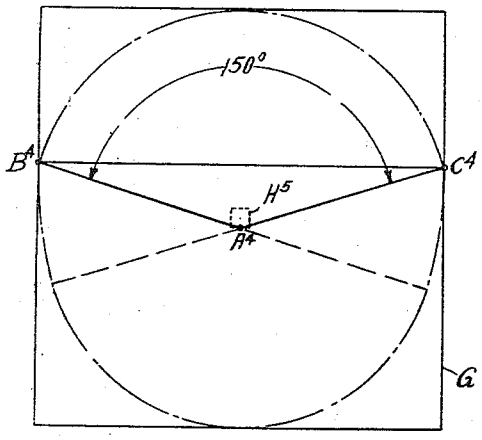


Fig. 7.

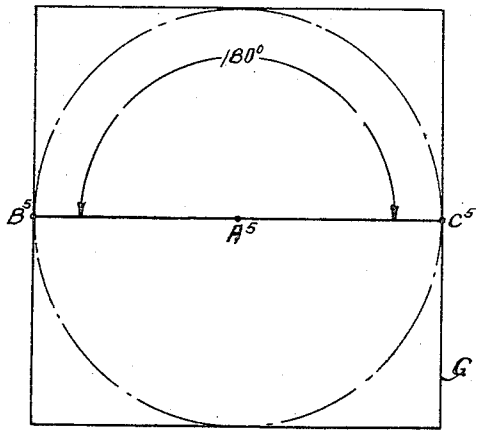
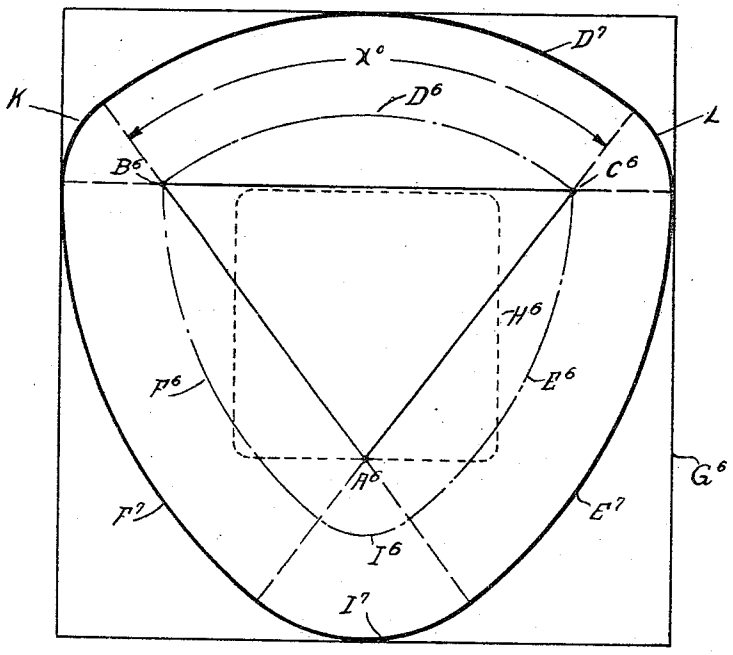


Fig. 8.



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UNITED STATES PATENT OFFICE.

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CAM FOR SQUARE-HOLE DRILLS.

1,266,148. Specification of Letters Patent. Patented May 14, 1918.

Application filed January 17, 1917. Serial No. 142,882.

To all whom it may concern:

Be it known that I, GERALD E. OTIS, a citizen of the United States of America, and a resident of Buffalo, Erie county, and State of New York, have invented certain new and useful Improvements in Cams for Square-Hole Drills, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

My invention relates to cams for square hole drills and its object is to improve the form of the drill shank cam and to provide a cam which shall be more efficient than those heretofore available.

In order that my invention may be thoroughly understood, I will now proceed to describe the same in the following specification, and then point out the novel features thereof in appended claims.

Referring to the drawings:

Figures 1 and 2 are diagrammatic plan views of square hole drill cams, such as have been known heretofore.

Fig. 3 is a similar representation of a hypothetical cam built up around a triangle having one of its angles less than 60°, and

Fig. 4 is a view of a part of the cut such a cam would produce.

Fig. 5 is a hypothetical cam built up around a similar triangle with its smallest angle theoretically reduced to 0°.

Fig. 6 is a similar view of a cam built up around a triangle having one of its angles greater than 90°.

Fig. 7 is a hypothetical cam built up around a similar triangle with its greatest angle theoretically increased to 180°.

Fig. 8 is a diagrammatic plan view of a cam made according to and embodying my present invention.

Like characters of reference designate corresponding parts in all the figures.

It has been known for many years that a drill shank constructed to have a cam shape built up around an equilateral triangle, when rotated without lost motion within a guide hole of square cross-section, would cause the bit of such drill to cut an approximately square hole. The sides of the shank cam have been made convex, usually on curves struck from each of the apexes of the triangle and intersecting at the other apexes. Such a cam is shown in Fig. 1.

In all of the figures the triangle around which the cams are constructed is shown by light solid lines, and in Fig. 1 its angles or apexes are designated by the reference letters A, B and C. The cam perimeters in all of the figures of the drawings, are shown by dash and dot lines which in Fig. 1 are designated by the reference letters D, E and F. A square is circumscribed around the cams by light solid lines and designated in Figs. 1–7 by the reference letter G. This represents the square sectioned guide for the drill cam. The hole drilled by the various cams shown is illustrated by dotted lines. With the cam shown in Fig. 1 the drilled hole will correspond with the square G, except at the corners where a curved fillet will be formed designated H. It is assumed that the end of the cutting edge of the tool is in every case in the vertex of the angle opposite the base of the triangle, which base in Fig. 1 is assumed to be the side B, C, so that the end of the cutting edge is at the point A. This angle may be termed the governing angle of the cam because the path taken by the point A in a revolution determines the shape of the hole to be drilled.

The fillets H of Fig. 1 are formed because of the fact that there is a time during the revolution of the cam in its square guide when no part of the arc D remains tangent to one side of the square G.

The fillet left by such a device makes its use objectionable.

It has been discovered that a square hole without fillets may be drilled by so constructing a cam that the arc having the governing angle as a center will at all parts of a revolution, remain tangent to one or another of the sides of a square guide. Such a cam can be built up only around a 90° isosceles triangle, and such a cam is illustrated in Fig. 2.

In this Fig. 2, A′ is the 90° governing angle of the triangle and its other apexes are designated by B′ and C′. D′ is an arc drawn from A′ as a center and with a radius equal to the side A′ B′ of the triangle.

E′ is an arc drawn from B′ as a center and with a radius equal to the side B′ C′ of the triangle, and F′ is a similar arc described from C′ as a center. In this case a fourth arc, described from A′ as a center and of a radius equal to the difference be-

tween the side A′ B′ of the triangle, and one side of the square G joins the arcs E′ and F′ to complete the perimeter of the cam.

When such a cam is rotated without lost motion within a square guide G, its governing angle A′ will describe a square path H′ considerably smaller than the guide, but without the objectionable fillets of Fig. 1. But such a cam is objectionable from a practical mechanical standpoint because of the fact that the tool must come to an actual point of rest for an instant at each corner of the hole, or four times during each revolution of the drill.

As a matter of fact any triangle may be used as a base for a cam of this general character. For the sake of symmetry and ease of demonstration, I will limit this description to cams built up around isosceles triangles. It has been shown that when the governing angle is reduced from 90° to 60° (Figs. 2 and 1), the drilled hole changes from a square to a square-sided figure with curved fillets in its corners. When the governing angle is made less than 60° the flat sides decrease and the fillets increase proportionately. Fig. 3 is an example of a cam built up around an isosceles triangle having a governing angle of 10°. In this case the flat sides of the drilled hole will be of the length shown at H^2 in Fig. 4, and the fillets of the size shown at H^3 in Fig. 3.

If the governing angle is theoretically reduced to 0, as at A^3 in Fig. 4, the other apexes B^3 and C^3 of the triangle will coincide and the cam outline, shown as in the other figures by a dash and dot line and designated by J, is a circle. With such a cam the point A^3 obviously rotates in a circular path H^4 which coincides with the circle J and the hole it would cut would have no flat sides.

Fig. 6 shows that if the governing angle at A^4 is made greater than 90°, the cam built up around it would cause the point A^4 to travel in a square path H^5 much smaller than the guide.

Fig. 7 is a continuation of this idea and shows what would happen if the governing angle A^5 is enlarged to 180° in which case the cam would be a circle with the point A^5 in its center so that this point would not move when the cam was rotated.

In the two examples of the former art, Figs. 1 and 2, and in the hypothetical cases illustrated in Figs. 3, 4, 5, 6 and 7, the perimeter of the cam consists of three or more connected arcs, described from the vertices of the triangle as centers, and inclosing the respective interior angles of the triangle together with such exterior arcs as may be necessary to complete the perimeter. Any perimeter will contain a total of six arcs and centers. The perimeter of a cam will contain at least one center but since there are only three centers, it must also contain three arcs or more. The perimeter of a 60° cam will contain three arcs and three centers; for more than 60° and less than 180°, four arcs and two centers; for less than 60° and more than 0°, five arcs and one center. In outlines larger than the critical outline, all of the elements will be arcs, while the three centers will lie within the cam.

From a practical standpoint, in drilling square holes, cams of 60° and less are unsatisfactory for general use because they leave too large a fillet in the corners of the hole. Cams with the governing angle 90° or more, are unsatisfactory because they produce an unsteady movement of the tool because of the period of rest. I have found that the best results are obtained by the use of a cam based upon a critical outline built up around an isosceles triangle having a governing angle of more than 60° and less than 90°. Such a cam is shown in Fig. 8. In this figure the triangle is designated by A^6, B^6, C^6 of which the angle at the vertex A^6 is the governing angle and is of X° more than 60° and less than 90°. The arc D^6 is described from A^6 as a center on a radius A^6, B^6. The arc E^6 described from B^6 as a center on a radius B^6, C^6 and F^6 is a similar arc described from C^6 as a center. A fourth arc I^6 from A^6 as a center joins the arcs E^6 and F^6. The perimeter thus formed and shown by a dash and dot line is what I call the critical outline of the cam and a cam of this form will cause the governing angle A^6 to travel on the path H_6 shown by a dotted line. This is approximately a perfect square with very small fillets in its corners. The fillets are not large enough to be objectionable and the tool will not stop intermittently during its rotation.

A cam made to correspond with this critical outline will wear at its sharp corners, the vertices B^6 and C^6 and these sharp corners will scrape and wear the surface of the square guide. This objectionable feature may be overcome by making the cam larger than the critical outline and providing for it a larger square guide.

This is done by describing arcs D^7, E^7, F^7 and I^7 concentric with and equi-distant from corresponding parts of the critical outline and joining the ends of arc D^7 with adjacent ends of arcs E^7 and F^7 by arcs K and L drawn from the apexes B^6 and C^6. The shape of the cam will then be that shown by the heavy black line of Fig. 8 and will cause a hole to be cut of the form shown by the dotted line H^6.

This same means of so constructing a cam that it will have no sharp corners, may of course, be applied as well to cams built up around other than such triangles as that shown in Fig. 8, and therefore I do not limit

this part of my invention to a cam which is constructed around an isosceles triangle having its governing angle greater than 60° and less than 90°.

What I claim is:

1. A cam for square hole drills having arcs described from the vertices of an isosceles triangle having an angle between the equal sides thereof greater than 60° and less than 90°.

2. A cam for square hole drills having major arcs described from the vertices of an isosceles triangle having an angle between the equal sides thereof greater than 60° and less than 90° and with minor arcs drawn from the vertices of said triangle and joining the ends of said major arcs.

3. A cam for square hole drills having major arcs described from the vertices of a triangle with greater radii than the length of the sides of said triangle and with minor arcs drawn from the vertices of said triangle and joining the ends of said major arcs.

In witness whereof, I have hereunto set my hand this 23rd day of November, 1916.

GERALD E. OTIS.