July 15, 1924. 1,501,229

C. G. OLSON

METHOD OF PRODUCING ABRASIVE ELEMENTS

Filed Oct. 12, 1921 4 Sheets-Sheet 1

Fig. 1.

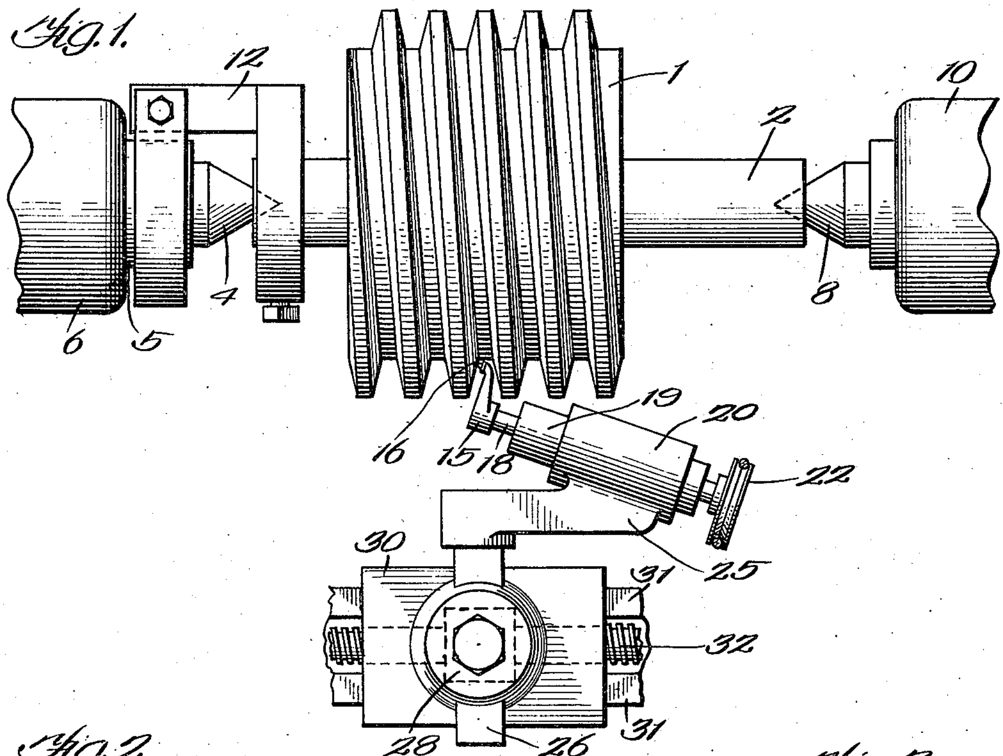


Fig. 2.

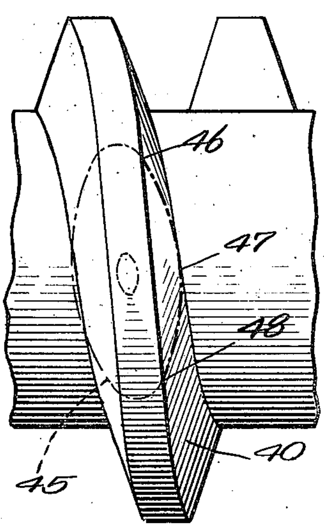
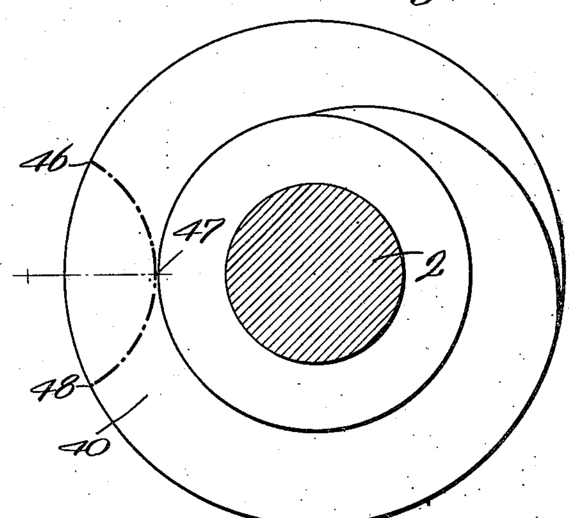


Fig. 3.



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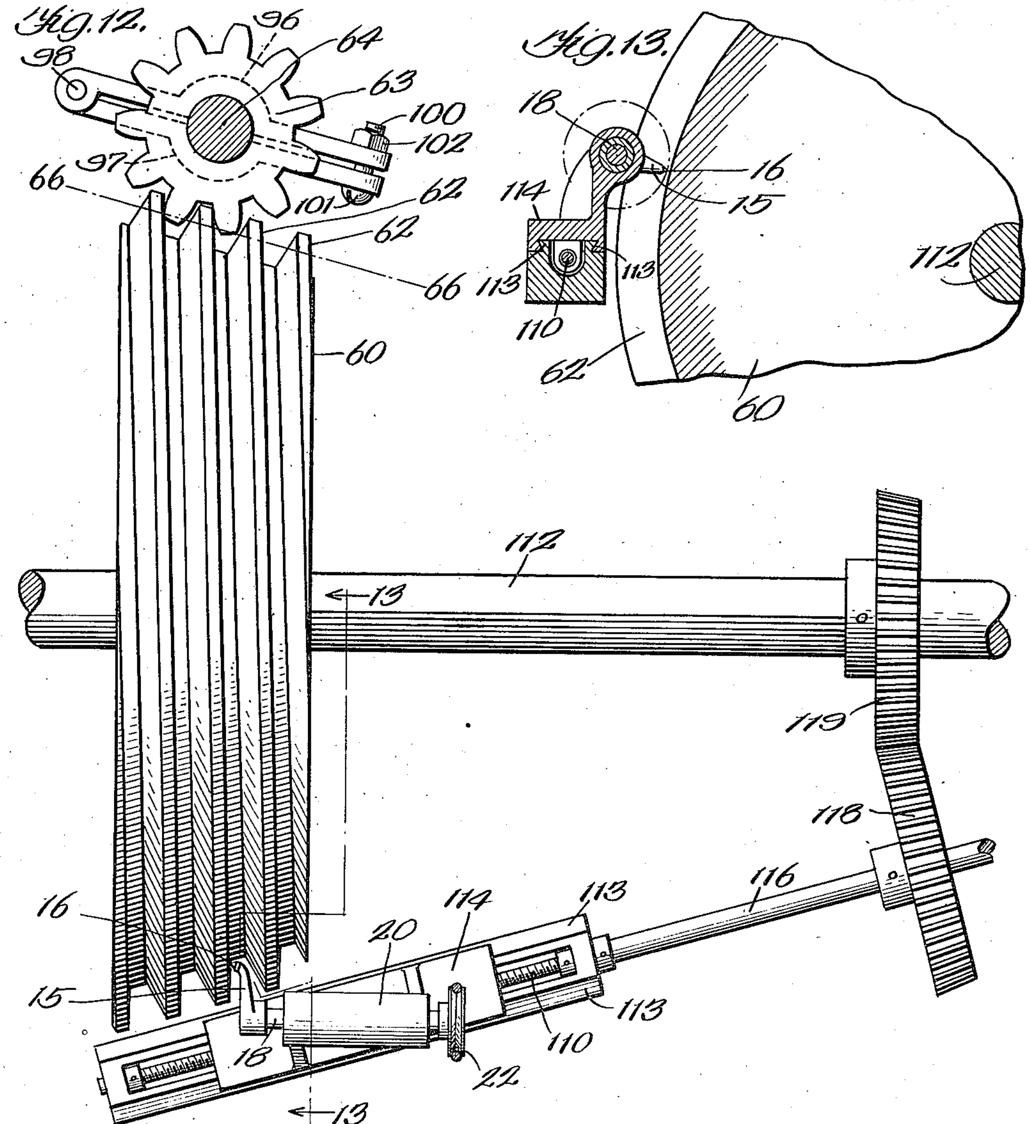

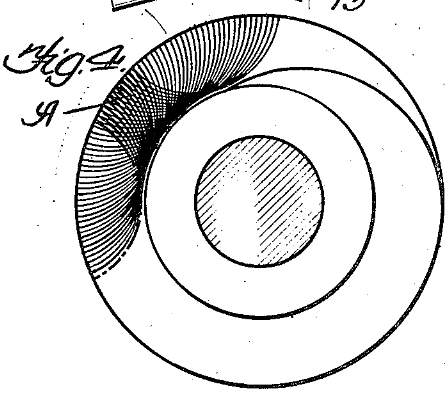

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METHOD OF PRODUCING ABRASIVE ELEMENTS

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Fig. 11.

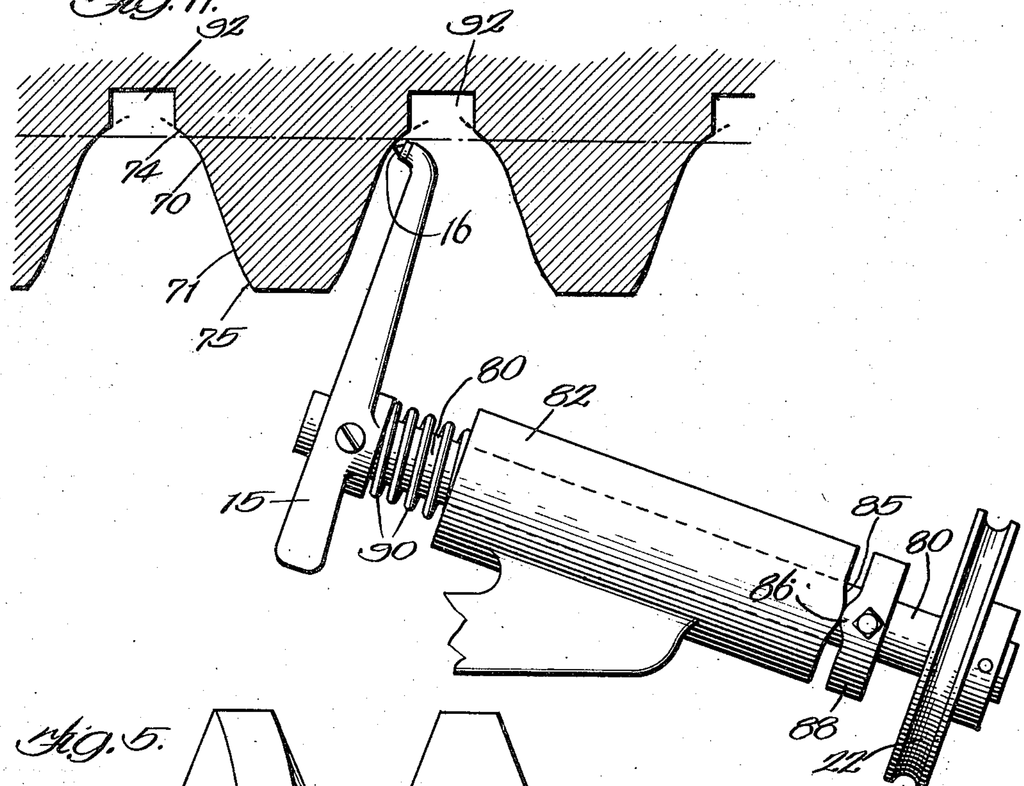


Fig. 5.

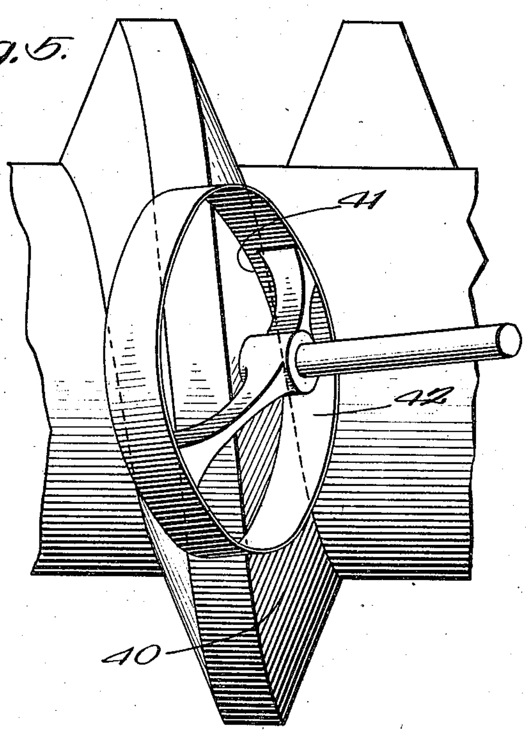
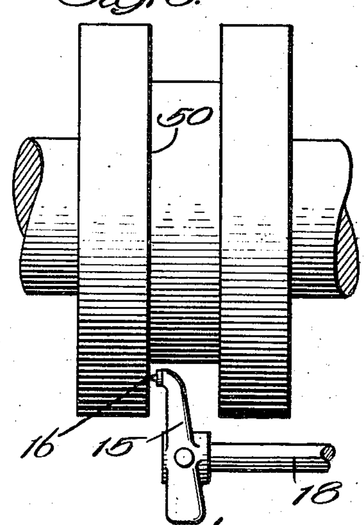


Fig. 6.



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METHOD OF PRODUCING ABRASIVE ELEMENTS

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Fig. 7.

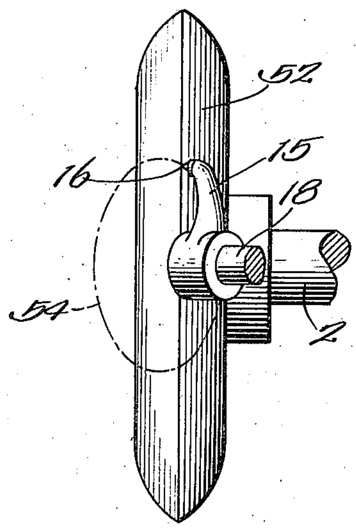


Fig. 9.

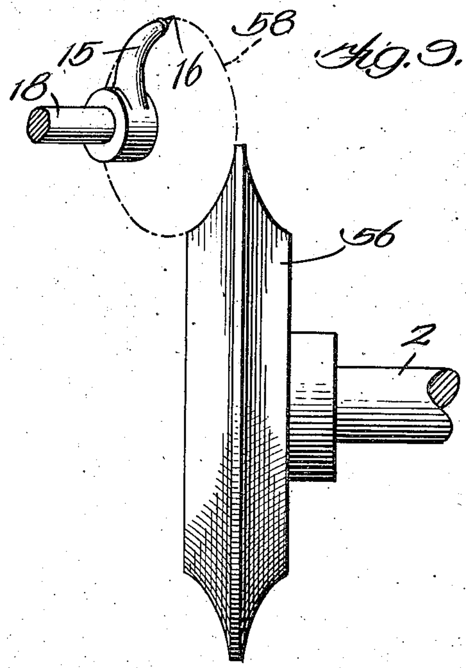


Fig. 8.

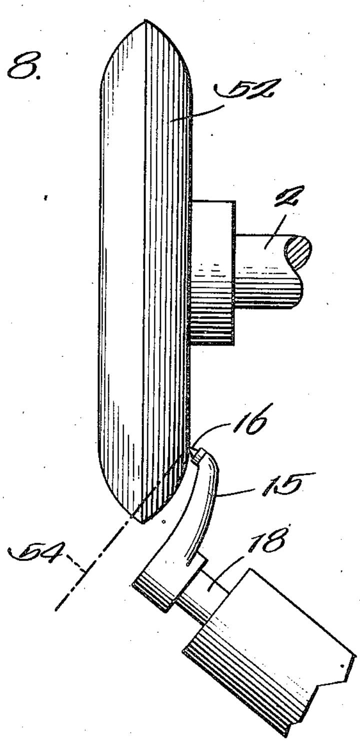
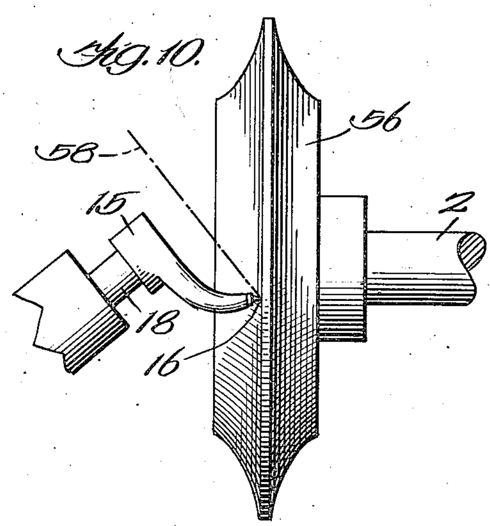


Fig. 10.



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Patented July 15, 1924. **1,501,229**

UNITED STATES PATENT OFFICE.

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METHOD OF PRODUCING ABRASIVE ELEMENTS.

Application filed October 12, 1921. Serial No. 507,219.

To all whom it may concern:

Be it known that I, Carl G. Olson, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Methods of Producing Abrasive Elements, of which the following is a specification.

My invention resides in a process for dressing or truing ring-like and helicoidal tools especially those made of abrasive material. My process is particularly adapted for the production of abrasive "hobs" so called, which operate somewhat after the manner of an ordinary toothed hob for producing gears and the like, but have no teeth and instead of cutting the metal, dress or true the surface by grinding it. The object is to provide a process capable of producing such articles and accomplishing the work accurately, simply and efficiently.

I obtain my object in the manner illustrated in the accompanying drawings in which—

Figure 1 is an assembly view, viewed from the top showing my process as applied to a helicoid or threaded abrasive tool.

Figure 2 is a diagrammatic view illustrating the theory of the invention and the manner in which the orbit of a diamond point may conform in part to the surface of the helicoid to dress it.

Figure 3 is an end view looking toward the left of Figure 2.

Figure 4 is a diagrammatic view illustrating the manner by which a plurality of cuts or scarfs may dress the entire surface.

Figure 5 is a side view of a ring type of tool where the sides of the ring are perpendicular to the axis.

Figure 6 is a diagrammatic view illustrating a practical method for adjusting the diamond point or other scarifying tool employed in connection with my present process.

Figure 7 is an edge view of an abrasive tool having a convex surface. This figure illustrates diagrammatically how such a surface can be produced by my process.

Figure 8 is a plan view of the parts shown in Figure 7.

Figure 9 is an edge view of an abrasive tool having a concave surface. This figure illustrates diagrammatically how such a surface can be produced by my process.

Figure 10 is a plan view of the parts shown in Figure 9.

Figure 11 is an assembly view illustrating a modification in the process, to produce special surfaces. In this case the diamond point has an axial movement in addition to its rotary movement.

Figure 12 is an assembly view showing my process applied to a threaded tool or abrasive hob which is of a conical or taper form.

Figure 13 is an end view of some of the parts shown in Figure 12.

Like numerals denote like parts throughout the several views.

As my process is of special utility in connection with the production of ring like and helicoidal abrasive tools I shall describe it primarily in that connection. I propose to preform the work to approximately the configuration desired, the preforming being accomplished by moulding or other suitable method. My present process is intended simply to finish the work and bring it accurately to form.

To impart a preliminary idea of the principle involved, it may be stated that in carrying out my process, I first determine the location of a circle having an arc which will lie in the desired surface, the axis of such circle to lie outside of the body of the work. I then mount a diamond point or other scarifying tool in such manner that it will revolve in an orbit which will include said arc. I then cause said tool to revolve at high speed and at the same time cause the work to rotate slowly about its own axis. The work and scarifying tool are caused to rotate at such relative speeds that the small grooves or scarfs produced by the tool, will, in the aggregate, cover the entire surface to be finished and leave it in the exact form desired.

The drawings are more or less diagrammatic and are intended to merely illustrate the principle of the invention.

Referring first to Figure 1, the work 1 is shown in the form of a helicoid mounted upon a work arbor 2. Said arbor is supported at one end by a center 4 located at the head of a lathe or similar machine tool. Said center rotates in unison with the drive shaft 5 journaled in the head stock 6. The opposite end of the arbor is supported upon a center 8 mounted in the tail stock 10. In practice the head stock shaft 5 rotates slowly and the rotary motion is imparted to the work arbor by a dog 12 in the usual manner.

An arm 15 carrying a diamond point or other scarifying tool 16 at its outer end is fastened to a tool spindle 18 journaled in a casing 19 rigidly fastened in a housing 20. In practice arm 15 is caused to revolve at high speed by means of a sheave 22 or other power device. The housing 20 is carried by a bracket 25 mounted upon a shank 26 secured to a tool post 28 in any suitable manner. Said tool post is mounted upon a carriage 30 adapted to slide on ways 31 which are arranged in the present case parallel to the axis of the work. The travel of the carriage is effected by a lead screw 32 which in practice is caused to rotate at a predetermined speed ratio with the speed of the work arbor. The tool carriage and its appurtenances may be greatly varied in design, the point being that means are provided for causing the arm 15 to revolve at high speed and to simultaneously travel in harmony with the lead of the helix of the work.

A practical method for adjusting the scarifying tool and its support is illustrated in Figure 5. Let 40 represent the side of one of the threads of the helicoid to be produced. Against this surface the operator lays the knife edge 41 of a ring 42. This ring may be termed the "test ring." The diameter of its knife edge is equal to the diameter of the orbit of the diamond point 16. In other words, said knife edge is of a diameter equal to twice the distance of the diamond point from its axis of revolution. When the ring thus comes to rest against the side of the helicoid it will contact the same thruout an arc 46, 47, 48, illustrated in dotted lines, Figures 2 and 3. The direction which the axis of the test ring now assumes will be the proper position for the axis of the tool spindle 18. If now, the tool spindle is adjusted to this position, and the tool is caused to revolve at high speed and the work is caused to rotate at slow speed and the tool carriage is moved along by the lead screw 32 at the proper rate determined by the lead or pitch of the helicoid, said tool will produce a series of arcuate scarifications indicated at A, Figure 4. In the drawing these small cuts, scarfs or grooves are shown far enough apart to be readily distinguishable, the purpose being to illustrate the principle; but in practice they are so close together as to be contiguous, and in the aggregate cover the entire surface, thus dressing it, or bringing it to true form.

In the form of work shown in Figure 1 the threads are helicoidal and their sides are flat after the manner of an ordinary gear-cutting hob. In such case the axis of the scarifying tool will lie obliquely to the axis of the work. In the case of rings or collars, where the sides 50 lie in plane perpendicular to the axis of rotation, the axis of the scarifying tool will lie parallel to the axis of rotation to the work, see Figure 6. The process is applicable, however, to other variations in the configuration of the work. In Figures 7 and 8 the work is in the form of a disc 52 having convex sides. In such case the tool spindle will lie obliquely, the orbit of the scarifying tool being represented by the dotted line 54. In the Figures 9 and 10 the work is in the form of a disc 56 having a concave side. In such case the tool spindle will lie obliquely, the orbit of the scarifying tool being represented by the dotted line 58. It will be understood that by causing the scarifying tool to travel parallel to the axis of the work, helicoidal surfaces similar in profile to those shown in Figures 6 to 10 may be produced.

In some cases it may be desirable to produce helicoids, the threads whereof have profiles showing compound curves, as for example in Figure 11. Here the line from the point 70 to the point 71, is of such configuration that it can be produced by a scarifying tool whose orbit lies in a plane as before, the remaining portions of the curve, as at 74 and 75, being sharper. To produce these special curvatures it is necessary to warp the orbit. This may be accomplished by mechanism illustrated in Figure 11, the scarifying tool 15 being mounted on a tool spindle 80 which is slideable as well as rotatable in a casing 82. At the rear end the casing has a cam 85 adapted to be engaged by the nose 86 formed on a collar 88 rigidly secured to spindle 80. A compression spring 90 constantly urges the spindle in a direction to keep the collar 88 in close contact with cam 85. This spindle is driven by a sheave 22 as before. It will be evident that by properly designing the cam, the diamond point will have a compound movement which will produce the profile desired. In order to permit the scarifying tool to completely finish the root of the curve it is desirable to form a channel 92 in the body of the work at the root of the threads.

The first type of abrasive hob shown in Figure 1 and elsewhere must be fed thru the work parallel to the axis thereof, after the manner of an ordinary hob so that as the grinding progresses it will produce straight and parallel gear teeth. Differently stated, as the lineal elements of the teeth of ordinary involute gears are straight lines, the grinding hob, as the work progresses, must be fed in a direction parallel to the axis of the gear wheel. I have conceived a second type of grinding hob, however, the same being illustrated in Figures 12 and 13. This second type has a conical body 60, and the helicoidal thread is formed upon the surface of the cone in such manner that one side 62 of the thread is nearly at right angles to the hob axis and therefore presents practically a flat surface to the teeth of the gear 63 to be dressed. In using this type of grinding wheel or hob, the grinding is done on one side of the thread only, in other words, the flat side only of the thread is utilized and if it becomes necessary to grind both sides of the teeth in the gear, it will be necessary to reverse the gear on the arbor or mandrel 64 on which it is mounted on the machine. It is not necessary to feed across the face of the gear with this type of abrasive hob because the surface that does the grinding is ideal for all practical purposes. The flat sides of the thread become analogous to the sides of a rack, the pitch line whereof is represented by the dotted line 66—66, Figure 12. In such case, it will be evident that the curvature of the periphery of the grinding hob will cut slightly deeper in the middle of the bottom of the spaces between the teeth to be dressed, but this can do no practical harm, as the diameter of the grinding hob is comparatively great in proportion to the width of the face of the gear to be ground.

In using the conical type of abrasive hob shown in Figures 12 and 13 ordinarily the gear to be dressed will be rotated in harmony with the lead of the helix by means of an interconnecting gear train in a manner analogous to the hobbing of spur gears. However, the gear to be dressed may be rotated simply by the action of the hob itself. In this event a friction device will be desirable so that the surface to be ground will be kept in close but in yielding contact with the grinding surface. In Figure 12, I have indicated a friction device, or a brake, consisting of two members 96 and 97 hinged on a pin 98 and adapted to and frictionally engage the arbor 64 on which the gear is fastened. The amount of friction may be regulated by a stud 100 having a head 101 and engaging one of the brake arms and a nut 102 engaging the other.

The mounting of the scarifying tool will be similar to the one previously described except that the lead screw 110 will be arranged at an oblique angle with the work arbor 112. The ways 113 on which the carriage 114 slides will, of course, be parallel to said lead screw. The work arbor and the shaft 116 by which the lead screw is driven will be geared together by bevel gears 118, 119.

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

1. The process of dressing preformed helicoidal and annular surfaces formed on bodies which are rotatable about on axis, said process consisting in causing the point of a pointed scarifying tool to rotate at high speed in an orbit an arc of which lies in the surface to be dressed, and simultaneously causing the work to rotate about its own axis, the tool thereby producing a series of scarfs which, in the aggregate, envelop the surface to be produced.

2. The process of dressing helicoidal and annular surfaces formed on bodies of abrasive material which are rotatable about an axis, and substantially symmetrical with respect to that axis, said process consisting in causing a scarifying tool to rotate at high speed in an orbit an arc of which lies in the surface to be dressed and simultaneously causing the work to rotate slowly about its own axis.

3. The process of dressing abrasive helicoids consisting in causing a scarifying tool to travel in an orbit a segment of which lies in the helicoidal surface, simultaneously causing the rotation of the helicoid about its axis, and simultaneously causing relative travel, bodily, between the grinding point and the helicoid in a direction parallel to the pitch line of the helicoid.

4. The process of dressing abrasive helicoids consisting in causing a scarifying tool to travel in an orbit a segment of which lies in the helicoidal surface, simultaneously causing the rotation of the helicoid about its axis, and simultaneously causing relative travel, bodily, between the grinding point and the helicoid in a direction parallel to the axis of the helicoid.

5. The process of dressing abrasive helicoids consisting in causing a scarifying tool to revolve about an axis in contact with the helicoidal surface of the work, simultaneously shifting the tool in an axial direction, simultaneously causing the work to revolve, and simultaneously causing relative travel, bodily, between the tool and the work in a direction parallel to the pitch line of the helicoid and at a rate in harmony with the lead of the helicoid.

6. The process of dressing abrasive helicoids formed on cylindrical bodies, said process consisting in determining the position of a circle an arc of which will lie in the helicoidal surface approximately from crown to root, causing a scarifying tool to travel in said circle, rotating the work, and causing bodily travel of the tool and work in a direction parallel to the axis of the work in harmony with the pitch or lead of the helicoid.

In witness whereof, I have hereunto subscribed my name.

CARL G. OLSON.