July 30, 1929. C. H. NORTON 1,722,388

METHOD OF GRINDING SMALL CYLINDRICAL OBJECTS

Original Filed Nov. 24, 1922

Fig. 4

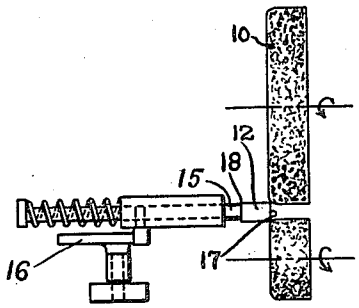


Fig. 2

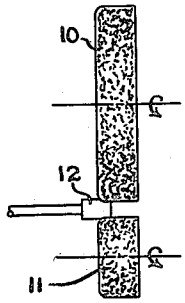
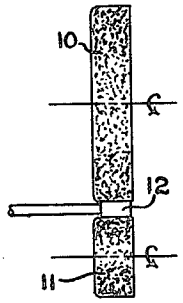


Fig. 3



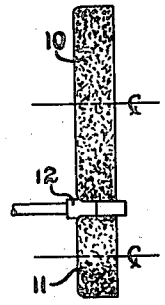


Fig. 5

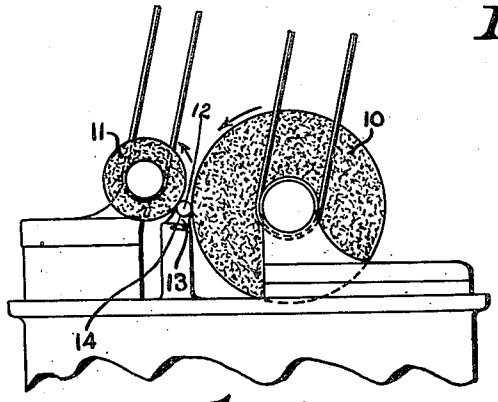


Fig. 1

Fig. 6

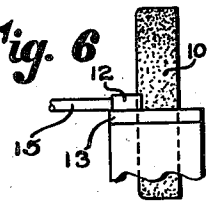
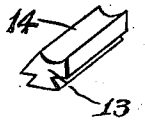


Fig. 7.



Witnesses
Harold W. Eaton
Anna Murphy

Inventor
Charles H. Norton
By Clayton R. Jenkins
Attorney

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UNITED STATES PATENT OFFICE.

CHARLES H. NORTON, OF PLAINVILLE, CONNECTICUT, ASSIGNOR, BY MESNE ASSIGNMENTS, TO CINCINNATI GRINDERS INCORPORATED, OF CINCINNATI, OHIO, A CORPORATION OF OHIO.

METHOD OF GRINDING SMALL CYLINDRICAL OBJECTS.

Application filed November 24, 1922, Serial No. 603,076. Renewed October 4, 1928.

My invention relates to the art of grinding and more particularly to a method of grinding small cylindrical objects progressively and in rapid succession.

It has heretofore been proposed to grind such objects in what is known as a centerless grinding machine, in which the work is supported peripherally on a plane or external cylindrical surface without the aid of centers and in contact with the adjacent oppositely moving operative surfaces of a grinding wheel and a regulating wheel; in such a machine, the cylindrical work pieces are rotated by the slowly moving surface of the regulating wheel, the latter being preferably of abrasive material, and the work pieces are fed axially past the grinding wheel by the regulating wheel, the latter and the work support being so related to each other that there exists a relative inclination between the path of travel of the operative surface of the regulating wheel and the path of travel of the work pieces along the work support. The work pieces may be passed continuously across the face of the grinding wheel at a uniform rate, their rotation being controlled by the regulating wheel. One of the objects of this invention is to provide a method of grinding work pieces of round section whereby certain great advantages of the above-mentioned type of grinding machine may be thoroughly realized and whereby certain further advantages may be achieved in a thoroughly practical way. For example, in apparatus of the above-mentioned character and in which the regulating wheel feeds the work pieces axially as well as rotates the work pieces, it is sometimes of certain disadvantage to have to true the wheels frequently, and particularly the regulating wheel, due to the fact that the latter, because of its peculiar relation to the work support, has to be given, where it is a wheel of the peripheral type, a slightly concaved operative surface. Such truing may be readily achieved by the use of diamonds but such truing, because of the above-mentioned peculiar interrelation of the parts, oftentimes requires the expenditure of considerable time and skill in truing the wheels for a given practical condition to be met. A dominant aim of this invention is to provide a method whereby the great accuracy of grinding, characteristic of the above-mentioned type of apparatus, may be effectively achieved while eliminating the disadvantages of having to true the regulating wheel into a concaved shape or form.

It is another object of my invention to achieve certain additional advantages by grinding small objects without the aid of centers continuously from one end to the other and at the same time correcting the shape of the rough article and making it ultimately round by progressively approaching the true curve of a supporting guide surface, and thereby to provide a method of grinding substantially duplicate objects successively, rapidly and economically, and produce satisfactorily finished and uniformly sized work. Other objects will be apparent from, or will be pointed out in, the following disclosure.

The invention accordingly consists in the several steps and relation and order of each of the same to one or more of the others all as will be illustratively described herein, and the scope of the application of which will be indicated in the following claims.

Referring to the drawings, in which I have illustrated diagrammatically the successive stages through which a cylindrical object passes in being ground, in accordance with a preferred embodiment of my method,

Figure 1 is a diagrammatic end view of a two wheel centerless grinding machine which may be utilized for carrying out my method;

Fig. 2 is similarly a diagrammatic view of a work pushing mechanism and abrasive wheels showing the position of the work at the start;

Figs. 3, 4 and 5 are similar views showing the successive stages through which the work passes in being ground;

Fig. 6 is a diagrammatic front view of a two wheel centerless grinding machine having the work rotating wheel and supporting slide removed; and

Fig. 7 is a perspective view of the work support.

In accordance with certain features of my discovery, I have found that it is feasible and desirable to pass the cylindrical work along its axial line into contact with the corner of a rapidly rotating grinding wheel and a work rotating wheel and then grind the work progressively from one end to the other while it is supported in contact therewith on a concave surface having the shape of the finished work, then grind the work simultaneously

throughout its entire length by means of a wheel whose active face is as wide as the length of the work, and when sufficient stock has been removed pass the work out of the grinding range, and preferably along its axial line in the same direction as it was moved before, until it is out of contact with the wheel.

Referring more particularly to the drawings, I have illustrated this method as being employed in a centerless grinding machine having two peripherally opposed wheels 10 and 11 which are rotated in the same direction, the larger wheel 10 at a rapid rate to grind the work and the smaller wheel 11 at a slower rate to rotate and control the speed of rotation of the work. The directions of rotation of the grinding wheel 10 and of the work rotating wheel 11 are shown by the arrows in the several views of the drawing, and it will be noted (see Fig. 1) that the adjacent operative surfaces of the two wheels are thus made to move in opposite directions; thus, the operative surface of the grinding wheel 10 moves downwardly toward the work support 13 and the operative surface of the slow moving or work rotating wheel 11 moves upwardly or away from the work support 13. The wheels are preferably as wide as and preferably wider than the length of the work. In order, in accordance with certain features of my invention, to support the work 12, I provide a rigid supporting member 13, which preferably has a concave partial cylindrical surface 14 located between the peripheral wheel faces and preferably below a line connecting the wheel centers. This surface 14 is made of the same radius as that desired for the finished work so that as the irregularly shaped piece of work is ground and rotates, it progressively assumes a shape which more and more approximates the perfect shape of the support. The work may be moved axially along its support by hand or by a suitable mechanism, such as shown in Fig. 2 as comprising a plunger 15 which may be moved forward by a power driven cam 16 and retracted by a spring. The specific construction of this apparatus is not a part of my invention, hence it is to be understood that various other types may be employed and that my method is not limited to use with any particular construction. Referring to Figs. 2 to 5 inclusive, I have there illustrated the successive stages through which the work piece 12 passes. Assuming that this member 12 is to be ground to the smaller finished size shown in Fig. 5, I move the piece longitudinally or axially along the support 13 until it is in grinding contact with the grinding wheel 10 and in rotative contact with the smaller or work rotating wheel 11. It will be understood that these wheels are properly mounted and positioned so as to contact as desired with the work, the frame work which supports these wheels having sufficient resiliency or spring to permit inserting therebetween a work piece which is initially larger in diameter than the normal distance between the abrasive wheels.

The first result of forcing this large piece into contact with the corners of the wheels, and along its axial line and parallel with the wheel axes, is to cause a deep cut to be ground progressively from its forward end 17 to the rear 18 of the work, this grinding being done largely by the near corner of the wheel 10 as illustrated in Fig. 3. It should be understood that the drawings are greatly exaggerated in order to illustrate the method, since in actual practice the amount of stock removed from the work is very small, being measured in thousandths of an inch. When the work has come into full linear contact with the peripheral surface of the grinding wheel 10, I cause the work to remain in that position for a period of time, as shown in Fig. 4, and be ground for such a length of time as may be necessary for the wheel 10 to grind its way out and relieve the tension in the machine parts and thus grind to approximately the correct size, which has the same radius as that of the cylindrical supporting surface 14. During this period the plunger 15 is being retracted to permit bringing up a second piece of work. Then upon pushing a new piece into the grinding zone, as shown in Fig. 5, the first piece is gradually forced out in the same direction as it originally traveled. During this final stage, any uneven size due to various causes and any grinding marks produced during the preceding stage or stages of grinding will be removed and the surface of the work polished or given a desired finish as the piece is traversed past successive portions of the wheel 10 until out of contact therewith. During this latter stage the work fits the concave partial cylindrical surface 14 and so is carefully steadied for the final finishing operation.

It will thus be seen that I have provided, by this invention, a method in which the several objects hereinbefore noted, together with many advantages, are successfully achieved. It will be seen that the wheel 11 may be and preferably is relieved of the function of feeding or moving the work pieces axially and that the wheel, being preferably of the peripheral type as shown in the drawing, need not have its axis tilted with respect to the path of travel of the work pieces along the work support and that there need not exist a relative inclination between the path of travel of the operative surfaces of the wheel 11 and the path of travel of the work piece along the work support 13. Hence, the wheel 11 need not be concave and thus it will be seen that the operation of truing of the wheel is greatly simplified.

As the art herein described might be varied

in various parts without departing from the scope of the invention, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawing is to be interpreted as illustrative and not in a limiting sense.

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

1. The herein described method of grinding work pieces of round section in a grinding throat having included therein a grinding wheel and a work rotating wheel, which method consists in moving a work piece axially into the grinding throat so that, while the work rotating wheel rotates the work, the grinding wheel takes a peripheral cut progressively along said work piece as the latter is moved relative to the grinding wheel; halting the axial movement of the work piece to permit the grinding wheel to grind itself out throughout the axial extent of the work piece engaged by the grinding wheel; placing a second work piece in back of the halted work piece; and moving the second work piece axially in a direction to cause it to move the first work piece in a direction out of the grinding throat and to effect entry of the second work piece into the grinding throat, the grinding wheel acting during the last-mentioned axial movement of the first work piece to substantially finish grind the surface of the latter.

2. The herein described method of grinding work pieces of round section in a grinding throat having included therein a grinding wheel and a work rotating wheel, which method consists in moving a work piece axially into the grinding throat so that, while the work rotating wheel rotates the work, the grinding wheel takes a peripheral cut progressively along said work piece as the latter is moved relative to the grinding wheel; halting the axial movement of the work piece to permit the grinding wheel to grind itself out throughout the axial extent of the work piece engaged by the grinding wheel; placing a second work piece in back of the halted work piece; and moving the second work piece axially in a direction to cause it to move the first work piece in a direction out of the grinding throat and to effect entry of the second work piece into the grinding throat, the grinding wheel acting during the last-mentioned axial movement of the first work piece to substantially finish grind the surface of the latter; and halting the movement of the second work piece to permit the grinding wheel to grind itself out throughout the axial extent of the second work piece engaged thereby.

3. The herein described method of grinding work pieces of round section in a grinding throat having included therein a grinding wheel and a work rotating wheel, which method consists in moving a work piece axially into the grinding throat so that, while the work rotating wheel rotates the work, the grinding wheel takes a peripheral cut progressively along said work piece as the latter is moved relative to the grinding wheel; halting the axial movement of the work piece to permit the grinding wheel to grind itself out throughout the axial extent of the work piece engaged by the grinding wheel; and then again moving the work piece axially past the grinding wheel to permit the grinding wheel, while the work rotating wheel continues to rotate the work piece, to substantially finish grind the surface of the work piece.

4. The herein described method of grinding work pieces of round section in a grinding throat having included therein a grinding wheel, a work rotating wheel, and means for holding work in operative relation to both wheels, which method consists in placing a work piece in advance of a movable member; effecting movement of said member in a direction to move the work piece in an axial direction into the grinding throat so that, while the work rotating wheel rotates the work, the grinding wheel takes a peripheral cut progressively along the work piece as the latter moves relative thereto; withdrawing the movable member from the work piece; interposing a second work piece between the withdrawn member and the first work piece which is engaged by the wheels; and effecting movement of the movable member to cause movement of the first-mentioned work piece in a direction out of the grinding throat and to cause movement of the second work piece into the grinding throat, whereby the grinding wheel acts to substantially finish grind the axis of the first-mentioned work piece and acts to take a peripheral cut progressively along the second-mentioned work piece as the latter is moved relative thereto.

Signed at Worcester, Massachusetts, this 16th day of Nov. 1922.

CHARLES H. NORTON.