March 11, 1924. 1,486,337

W. E. HOKE

METHOD OF AND MACHINE FOR MAKING GAUGES AND OTHER ARTICLES

Filed June 28, 1918

Fig. 1.

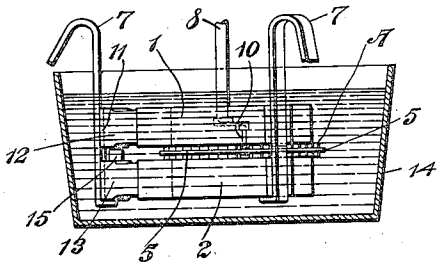


Fig. 2.

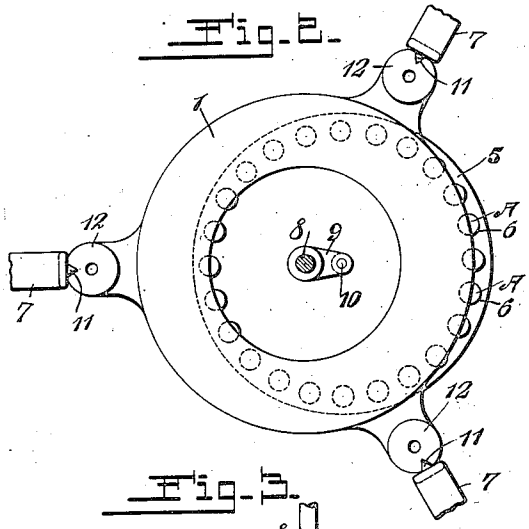


Fig. 3.

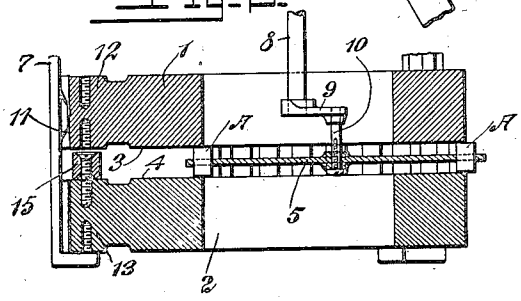


Fig. 4.

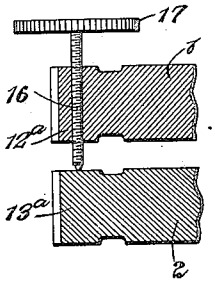


Fig. 5.

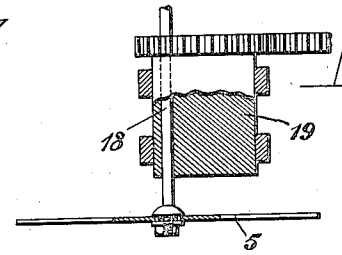
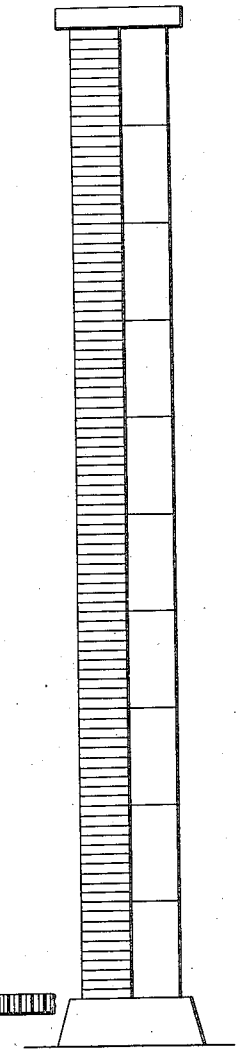


Fig. 6.



Attest.

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William E. Hoke,
By Rippey & Kingsland,
His Attorneys.

Patented Mar. 11, 1924.

1,486,337

UNITED STATES PATENT OFFICE.

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METHOD OF AND MACHINE FOR MAKING GAUGES AND OTHER ARTICLES.

Application filed June 28, 1918. Serial No. 242,482.

To all whom it may concern:

Be it known that I, WILLIAM E. HOKE, a citizen of the United States, residing at the city of St. Louis and State of Missouri, have invented a new and useful Method of and Machine for Making Gauges and other Articles, of which the following is a specification.

This invention relates to a method of and a machine for lapping gauge blocks or similar articles to produce identical sizes and particularly to produce plane parallel opposite faces separated from each other by an assigned dimension, the method and machine being in some respects similar respectively to the method and machine set forth in my copending application for method of and machine for making gauges and other articles, Serial No. 289,591, filed April 12th, 1919, which application, as to a part of its subject matter, is a continuation of this present application. The present invention relates particularly to a method and machine whereby the sizes or lengths of the blocks are automatically determined by positively limiting the reducing action.

In the accompanying drawing I have illustrated several embodiments of the mechanical features of my invention and the preferred way of practicing my improved method, but it will be understood that the drawing is for illustrative purposes only and is not to be construed as defining or limiting the invention, the claims appended to this specification being relied upon for that purpose.

Of the drawing:—

Fig. 1 is a view illustrating the method of and machine for lapping gauge blocks.

Fig. 2 is a plan view illustrating one of the laps, and a part of the disc or spider for moving the gauge blocks between the laps.

Fig. 3 is a side elevation to illustrate the relative positions of the laps and the disc or spider for performing the lapping operation by moving the blocks to be lapped between the lapping surfaces.

Fig. 4 is a view showing a form of adjustable limit stop which may be used when desired.

Fig. 5 is a view illustrating another form of device for actuating the disc or spider.

Fig. 6 is a view showing a number of the finished blocks in assembled relation in which they may be measured and compared to determine any error that may exist in the dimensions thereof.

As illustrated the machine includes two laps 1 and 2 of similar size having their adjacent faces 3 and 4 made as nearly flat as possible. A number of similar blocks are placed between the two laps 1 and 2, these blocks forming a group which may be varied as to arrangement but which is preferably a circular series as shown. While I do not so limit myself I have shown in the drawing blocks A—A having opposite flat faces. For holding the blocks in proper relationship and for other purposes, as will be presently explained, there is provided a flat plate or spider 5 preferably having suitable apertures 6 therein adapted to receive the respective blocks. Preferably the apertures 6 are larger than the blocks so as to permit turning or rolling movements between the blocks and the spider.

In order to effect lapping, relative movement is effected between the blocks and the laps, this movement preferably being effected by moving the blocks and holding the laps against any considerable movement. The laps are caused to contact with the blocks with a proper pressure and while I do not so limit myself this pressure is preferably secured by arranging the parts horizontally, as shown. The lower lap 2 is held by a suitable support, such as the legs 7, and the weight of the top lap is utilized to secure the desired pressure between the laps and the blocks. The top lap is preferably supported entirely by the blocks. If greater pressure is desired, additional weight can obviously be applied to the top lap. The top lap is entirely free as concerns vertical movement and it can adjust itself as to parallelism with the lower lap in accordance with the lengths of the blocks.

The movements of the blocks are preferably such that every part of the outer surface of each block engages every part of the working surface of the corresponding lap which is engaged by the surface of any other block. In this way all of the blocks are lapped equally. By preference the movement is such that each surface of each block engages the entire surface of the corresponding lap. As illustrated the movement is effected by bodily moving the spider

preferably in a circular path. I prefer to make the laps circular in outline and to provide them with circular central openings, as shown. Inasmuch as the spider is moved bodily in a circular path its center is eccentric of the laps. The degree of eccentricity is preferably such that the blocks at one side of the spider will project outward beyond the outer edges of the laps, whereas the blocks at the opposite side of the spider will project inward beyond the inner edges of the laps. Thus the laps are prevented from becoming unevenly worn. Simultaneously with the bodily circular movement the spider is preferably given a rotative movement, the blocks thus moving circumferentially around the laps. Preferably the blocks are also given a rotative movement about their own axes in addition to their bodily movements.

The combined bodily and rotative movement of the spider and blocks together with the supplemental rotative or rolling movement of the blocks themselves causes all parts of each block surface to move past all parts of the corresponding lap surface. At first the laps engage only the longer blocks but later, if the lapping proceeds long enough, the blocks are engaged equally and the combined movement affects all of them in the same way, as before stated, and does not tend to reduce some more than others.

For moving the spider there is preferably provided a central drive shaft 8 having a crank 9 with a crank pin 10 engaging a central aperture of the spider. When the crank 8 is rotated the spider is moved bodily in a circular path. Suitable means is provided for preventing the laps from partaking of the movements of the spider. As shown, the bottom lap 2 is held by the legs 7, and the top lap 1 is held by lugs or guides 11 formed on the legs 7 and engaging arms 12 on the lap. Preferably the bottom lap 2 is formed with arms 13 similar to the arms 12, there being three equally spaced arms on each lap. The supporting legs 7 are connected with the arms 13 of the lower lap 2 and the lugs 11 on the legs engage the arms 12 on the upper lap 1, the two laps thus being held against relative rotative movement but being free to move vertically and to adjust themselves as to parallelism within reasonable limits. A drill press may conveniently be utilized for supporting and operating the parts described. The legs 7 may be connected with the table of the drill press, and the shaft 8 may be the spindle of the drill press.

I preferably leave the spider 5 entirely free as concerns rotative movement, the aforesaid rotative or precessional movement taking place automatically. This rotative movement usually is in the same direction as the bodily movement, as for instance the clockwise direction. Several different factors may be involved in causing the rotation of the spider. The blocks that are entirely between the laps tend to turn about their axes in the counter-clockwise direction, rolling along the walls of their respective openings. When some of the blocks project beyond the edges of the laps as shown these blocks may be forced by the pressure of the spider to turn in the clockwise direction. These several turning movements of the individual blocks affect the spider in different ways and the result is that it is given a rotative movement about its axis, which movement as before stated is usually in the clockwise direction. Ordinarily the spider makes a complete revolution for every five or six revolutions, more or less, of the crank.

Approximately equal temperature throughout all parts of the laps and the blocks is desirable during the operation of lapping, although it is not necessary to maintain the temperature at any fixed point. In order to maintain all of the parts at equal temperature the mechanism may be submerged in some liquid such, for instance, as water, oil or coal oil. This is preferably accomplished by placing a tub such as 14 in position so that liquid therein will submerge the lapping mechanism.

For limiting the relative approaching movement of the two laps 1 and 2, I provide suitable stop devices between them. As shown in Fig. 3, each of the arms 12 and 13 has a bearing surface in the same plane as the main working surface of the corresponding lap. There are stops 15 positioned between the arms of each pair. Each stop is a block of predetermined length preferably secured to the lower arm 13.

If preferred, screws 16 as shown in Fig. 4, may be used in lieu of the blocks 15. As illustrated, each screw is threaded into an arm 12^a of the upper lap and abuts against the corresponding arm 13^a of the lower lap. Each screw is provided with a graduated wheel 17 for indicating the adjustment thereof.

Another form of device for actuating the disc or spider is illustrated in Fig. 5. This form of actuating device consists of a rotary shaft 18 journaled eccentrically in a revoluble bushing 19. A rotary motion is imparted to the shaft in any proper manner and at the same time a rotary motion is imparted to the bushing 19. The movement of the gauge blocks when actuated by this form of device is upon a sort of circular spiral curve, causing the spider or disc to move around between the laps.

The basic principle on which this invention rests and the discovery of which formed the preliminary steps leading thereto, reduced to its simplest form, is that if a start be made with two surface laps and

four pieces of metal, the pieces can be reduced to identical size by using three of them between the two surface laps to act as limit stops or supports while the fourth is passed between the two adjacent surfaces of the laps. By changing them about, lapping first one and then the other, using the other three as supporting stops all may be reduced to the greatest thickness of the thinnest one and at the same time produce plane parallel surfaces of identical dimension on them all except the thinnest one. This operation pre-supposes that the two surface laps are perfect planes, which is a condition never obtained in practice. If the imperfection of the surface lap consists of a depression the result will still be to produce identical size in all four pieces; but if the imperfection consists of a raised spot in the surface it will result in lapping the fourth piece thinner than the other three which are being used as supporting stops, and sets up a never-ending series of reductions which can never end in identical size of all four.

If, however, the same three pieces be used for support stops and any number of other pieces be passed between the same parts of the surface of the laps, these other pieces will be made of identical size and with plane parallel faces, even though the laps were not perfect planes nor the three support stops of equal size. Assuming that the stops are of equal size and the laps perfect planes, all the pieces constituting the work will be lapped to identical size and with plane parallel faces. The size, however, will be very slightly thinner than the stops on account of the fact that the work will continue to lap until no further pressure rests on the work from the upper lap, while the stops will continue to bear the entire weight of the upper lap without being reduced in size, since there is no movement between them and the laps.

The result therefore of imperfections in the lapping surfaces, stops, adjustments, etc., is to produce greater or less departure in size between the stops and the work without affecting the identical size or truth of the work. These are the conditions which exist in this machine and which enable it to produce plane parallel surfaces of identical dimension with high accuracy.

Similar results can be produced by placing three or more rectangular pieces previously lapped plane on one side in a row on a surface plate, side by side with their plane sides down, and lapping their upper surfaces into a perfect plane; and then turning each alternate one, end for end, and at the same time transferring them to a corresponding position at the other end of the row, and again lapping their upper surfaces to a perfect plane, and by repeating this operation several times they may finally be made of identical size and with plane parallel opposite faces, with high accuracy.

In accordance with the basic method as outlined, proper blocks 15 are selected or the screws 16 are properly set to positively limit the lapping operation when the blocks A—A have been reduced to the desired length. As already stated, any minor imperfections in the stops or in the adjustments thereof will not affect the identity of size of the blocks A or the accuracy of their surfaces. The length of the blocks may differ very slightly from the assigned length, but the method is nevertheless sufficiently accurate for most classes of work. When greater precision is desired, use can be made of the method as set forth in my aforesaid copending application Serial No. 289,591.

As shown in Fig. 6 a number of blocks made at one time may be placed in a series or stack and compared with a known standard of length. As the blocks are all of the same sizes their errors are added and the total error can be readily observed. This method of measurement is described in detail in my aforesaid copending application Serial No. 289,591.

What I claim and desire to secure by Letters Patent is:—

1. The method of reducing a series of similar blocks to identical sizes, the method consisting in arranging the several blocks in a group between two opposed flat laps, causing movement between the entire group of blocks and the laps, causing the blocks to simultaneously turn about individual axes, and positively limiting the relative approaching movement of the laps at a predetermined distance apart notwithstanding continued movement between the blocks and the laps.

2. The method as set forth in claim 1 characterized by the production of parallel flat end faces on the blocks.

3. The method as set forth in claim 1 characterized by the production of parallel flat end faces on the blocks and by the turning of the blocks about axes perpendicular to the surfaces of the laps.

4. The method as set forth in claim 1 characterized by the production of parallel flat end faces on the blocks and by the turning of the blocks about axes perpendicular to the surfaces of the laps and further characterized by a relative bodily movement between the entire group of blocks and the laps in a circular path.

5. The method of reducing a series of similar blocks to identical sizes, which consists in closely arranging the several blocks between two opposed flat laps in a group of which the several blocks are individually and freely movable with reference to the

laps, one of said laps being free to relatively adjust itself as to parallelism with the other laps in accordance with the sizes of the blocks, causing such movement between the blocks and the laps that every part of the surface of each block engages every part of the surface of the corresponding lap which is engaged by the surface of any other block, and positively limiting the relative approaching movement of the laps at a predetermined distance apart notwithstanding continued movement between the blocks and the laps.

6. The method of reducing a series of similar blocks to identical sizes, which consists in arranging the several blocks in a circular series between two opposed flat laps, permitting the said laps to automatically adjust themselves as to parallelism in accordance with the sizes of the blocks, causing rotative movement between the entire series of blocks and the laps parallelly with the working surfaces and about the center of the series, causing the entire series of blocks to move bodily in a circular path about a center eccentric of the center of the series, and positively limiting the relative approaching movement of the laps at a predetermined distance apart notwithstanding continued movement between the blocks and the laps.

7. The method as set forth in claim 6 characterized by the production of parallel flat end surfaces on the blocks.

8. The method of reducing a series of similar blocks to identical sizes, which consists in arranging the several blocks in a definite group between two opposed flat laps, permitting the laps to adjust themselves as to parallelism in accordance with the sizes of the blocks, causing movement between the blocks and the laps to effect lapping, positively limiting the relative approaching movement of the laps at a predetermined distance apart notwithstanding continued movement between the blocks and the laps, subsequently discontinuing the limiting of the approaching movement, transposing some of the blocks to distribute variations in size, and repeating the lapping and transposing operations alternately until identical sizes are obtained.

9. The method as set forth in claim 8 characterized by the production of parallel flat end surfaces on the blocks.

10. A lapping machine including in combination, two opposed laps having flat working surfaces, one of the laps being free to relatively adjust itself as to parallelism, with the other a spider positioned between the laps and having openings therein for blocks to be lapped, means for effecting relative bodily movement between the spider and the laps, and means supplemental to the blocks for positively limiting the relative approaching movement of the laps.

11. A lapping machine as set forth in claim 10 in which the limiting means comprises three triangular arranged stops.

12. A lapping machine as set forth in claim 10 in which the limiting means comprises three triangularly arranged stops and in which the stops are independently adjustable.

13. The method of reducing a number of similar blocks to produce parallel flat end faces and identical lengths, which consists in placing the several blocks with one end face of each in engagement with a flat surface plate, placing a flat lap in engagement with the opposite end faces of the blocks, simultaneously lapping the upper surfaces of all of the gauge blocks to a perfect plane, interchanging some of the blocks on the surface plate to symmetrically distribute variations in length, and repeating the lapping operation.

14. The method of reducing a number of similar blocks to produce parallel flat end faces and identical lengths, which consists in placing the several blocks with one end face of each in engagement with a flat surface plate, placing a flat lap in engagement with the opposite end faces of the blocks, simultaneously lapping the upper surfaces of all of the gauge blocks to a perfect plane, reversing the blocks end for end and again placing them in engagement with the surface plate, again placing the lap in engagement with the blocks and simultaneously lapping the upper surfaces of all of the gauge blocks to a perfect plane, interchanging some of the blocks on the surface plate to symmetrically distribute variations in length, and repeating the lapping operation.

WILLIAM E. HOKE.