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W. E. HOKE

METHOD OF MAKING GAUGES AND OTHER ARTICLES

Filed July 8, 1919

Fig. 1.

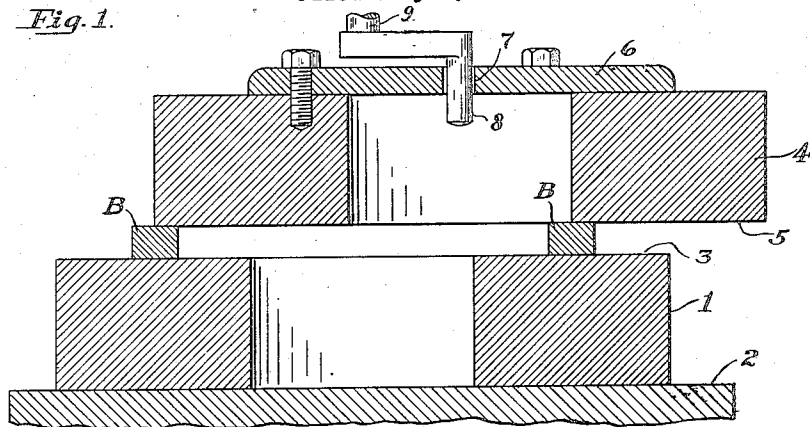


Fig. 2.

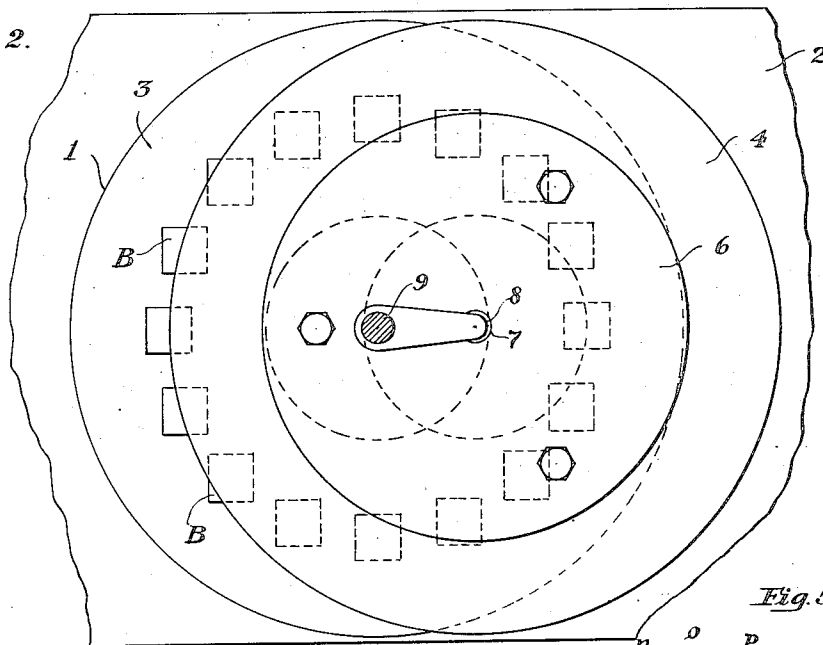


Fig. 3.

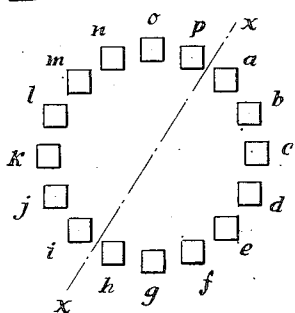


Fig. 4.

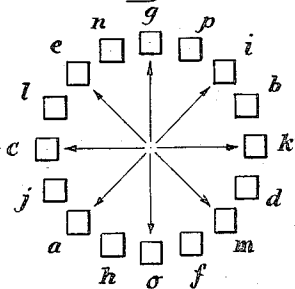
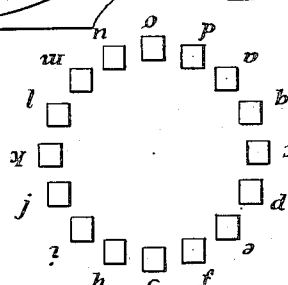


Fig. 5.



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UNITED STATES PATENT OFFICE.

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METHOD OF MAKING GAUGES AND OTHER ARTICLES.

Application filed July 8, 1919. Serial No. 309,450.

To all whom it may concern:

Be it known that I, WILLIAM E. HOKE, a citizen of the United States, residing at St. Louis, Missouri, have invented certain new and useful Improvements in Methods of Making Gauges and Other Articles, of which the following is a specification.

This invention relates to a method of lapping gauge blocks or similar articles to produce identical sizes and particularly to produce plane parallel opposite surfaces separated from each other by an assigned dimension with a high degree of accuracy. The method is in some respects similar to the method set forth in my copending applications for method of making identical articles, Serial No. 252,073, filed Aug. 30th, 1918, and for method of and machine for making gauges and other articles, Serial No. 289,591, filed April 12th, 1919.

In accordance with the present invention, I effect the lapping of the opposite end surfaces of the blocks successively instead of simultaneously as was set forth in my aforesaid application. Ordinarily the simultaneous lapping is preferable, as it is more rapid and is usually productive of more accurate results. However, for certain classes of work, particularly when the highest degree of accuracy is not required, it may be desirable to lap the surfaces successively.

In the accompanying drawing I have illustrated in diagrammatic form a machine for practicing the method. I have also presented further diagrams by which the method will be explained. It will be understood that the drawing is for illustrative purposes only and is not to be construed as defining or limiting the scope of the invention, the claims appended to this specification being relied upon for that purpose.

Of the drawing:

Fig. 1 is a vertical sectional view of a machine adapted for carrying out my improved method.

Fig. 2 is a plan view of the principal parts of the machine shown in Fig. 1.

Figs. 3 to 5 are diagrammatic views further illustrating the method.

The blocks to be lapped are first formed with the desired shape and with a little more than the desired length, by any usual or preferred means. When they are to be used as gauges the blocks are hardened and otherwise suitably treated, but these pre-

liminary steps constitute no part of the present invention. After the blocks have been thus formed and treated, they are then subjected to a lapping operation or a series of lapping operations and are otherwise acted upon, in the manner to be described.

Referring to Figs. 1 and 2 of the drawing, it will be seen that I provide a surface plate 1 which is suitably mounted on a table or other support 2. The surface plate 1 is provided with a surface 3 which is made as nearly plane as possible by any known method. The several blocks B—B to be lapped are placed upon the surface plate and are secured in position by cementing or otherwise. I do not limit myself as concerns the arrangement of the blocks, but preferably they are arranged in a circular series as illustrated. For reducing the upper surfaces of the blocks B—B I provide a lap 4 having a bottom surface 5 which is made as nearly plane as possible. This lower surface of the lap is suitably prepared and is charged with an abrasive such as fine emery. The character of the lap and of the abrasive may be varied as required.

The lap 4 rests directly on the blocks B and is entirely free to adjust itself as to parallelism with the surface plate in accordance with the lengths of the blocks. In order to effect lapping, the lap is moved with respect to the blocks, this movement preferably being in a circular path. As illustrated, a plate 6 is secured to the lap 4, this plate having a central aperture 7 in which is fitted a crank 8 on a rotating spindle 9. It will be seen that the entire lap is caused to partake of the rotative movement of the spindle. The lap is free to turn about the axis of the crank 8 and as the result of the resistance offered by the blocks, the lap is given a rotative movement in addition to its bodily circular movement. The movement of the lap 4 is continued until the lap engages all of the blocks equally. When this point is reached it may be assumed that the top surfaces of all the blocks are flat or approximately so, although the blocks may vary slightly in length.

After the blocks have been provided with plane surfaces at one end as described, they are then removed from the surface plate 1 and turned over end for end so that the flat surfaces of the blocks directly engage the flat surface of the surface plate. The

blocks are now held against movement with respect to the surface plate and this holding may be effected by wringing them into place, this wringing action being a well known phenomenon whereby two flat surfaces strongly adhere. When two flat surfaces are properly wrung together actual physical contact is very closely approximated, the actual separation frequently being as small as a millionth of an inch. Then the lapping operation is repeated as before described and continued, preferably until the lap again engages all of the blocks equally.

Then the lapping movement is stopped and the lap is removed, thus leaving the blocks exposed. Certain blocks are then transferred in such a way as to distribute any errors or variations in the respective lengths. It may be assumed that, with a group of blocks of slightly varying lengths, those at one part of the group will average longer than those at another part. Following this assumption it will be seen that the transferring must be such that the longer and shorter blocks will be commingled. In order that the longer and shorter blocks may be uniformly distributed, the transferring is preferably effected symmetrically. If the blocks are arranged in a circular series, it is to be expected that the lengths of those at one side will have a greater average than the lengths of those at the other side. Inasmuch as the surface plate 1 and the lap 4 are both flat, the result is that some one or two of the blocks at one side will have a maximum length and some one or two blocks diametrically opposite will have a minimum length. The blocks between will have lengths successively varying from the maximum to the minimum. The blocks at one side of the diametral line will have lengths greater than the average and those on the other side will have lengths less than the average. The transferring of the blocks to distribute the errors and equalize the lengths is preferably done by moving alternate blocks or alternate groups of blocks to positions diametrically opposite. This places the longer blocks between the shorter ones.

For practicing the method in the preferred manner, the number of blocks in any one circular series, such as a to p , as shown in Fig. 3, should be a multiple of four and should be at least eight. By way of example I have shown sixteen blocks, but it will be understood that any desired multiple of four may be used. If it be assumed for instance that the blocks at one side of a diametral line $x-x$, have lengths greater than the average and that the blocks at the other side of the line have lengths less than the average, then it will be seen that after the diametral transposition of alternate blocks the longer and shorter blocks will, in the main, be alternately arranged as shown in

Fig. 4. The operator has no means of determining the position of the diametral dividing line $x-x$ and no means of determining which is the side of maximum length and which the side of minimum length, but it is not necessary for him to do so. It will be observed that inasmuch as the alternate blocks throughout the entire series are transposed, the required alternate arrangement of longer and shorter blocks is secured irrespective of the position of the dividing line.

The blocks having been transferred as described, the top lap is restored to position and the lapping operation is repeated. Obviously the laps will at first engage only the longer blocks, thus reducing their lengths. The lapping operation is continued preferably until the laps again engage all of the blocks. Obviously the blocks are more nearly uniform in length than before but there may still be some variation. Therefore alternate blocks are again transferred, as before described, and the blocks are again lapped. These operations are repeated alternately in succession for a number of times, and the final result is that all of the blocks have the same length and have their end surfaces flat and parallel.

The manner of moving or transferring the blocks may be varied, particularly in the ways set forth in my aforesaid application. It may be also desirable to change the blocks by turning some of them through 180° as indicated in Fig. 5.

The blocks having been made with identical lengths and with plane parallel end surfaces, the lapping operation is then continued to reduce the lengths to the desired predetermined amount. If considerable additional lapping is required to secure the desired uniform length, it may be preferable to continue the transferring of the blocks from time to time to avoid possible variations. The blocks may be measured in any desired way to ascertain when the predetermined lengths have been reached. Use may be made of the method set forth in my aforesaid application, but this method constitutes no part of my present invention and need not be here described.

What I claim is:

1. 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, permitting the lap to adjust itself as to parallelism with the surface plate in accordance with the lengths of the blocks, moving the lap with respect to the blocks to effect lapping, interchanging some of the blocks on the surface plate to symmetrically

distribute variations in length, and repeating the lapping operation.

2. 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 wringing engagement with a flat surface plate, placing a flat lap in engagement with the opposite end faces of the blocks, permitting the lap to adjust itself as to parallelism with the surface plate in accordance with the lengths of the blocks, moving the lap with respect to the blocks to effect lapping, interchanging some of the blocks on the surface plate to symmetrically distribute variations in length, and repeating the lapping operation.

3. 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 in a circular series 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, permitting the lap to adjust itself as to parallelism with the surface plate in accordance with the lengths of the blocks, moving the lap with respect to the blocks to effect lapping, interchanging some of the blocks on the surface plate with those diametrically opposite to symmetrically distribute variations in length, and repeating the lapping operation.

4. 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, permitting the lap to adjust itself as to parallelism with the surface plate in accordance with the lengths of the blocks, moving the lap with respect to the blocks in a circular path and simultaneously rotating it to effect lapping, interchanging some of the blocks on the surface plate to symmetrically distribute variations in length, and repeating the lapping operation.

5. 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, permitting the lap to adjust itself as to parallelism with the surface plate in accordance with the lengths of the blocks, moving the lap with respect to the blocks to effect lapping, 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, permitting the lap to adjust itself as to parallelism with the surface plate in accordance with the lengths of the blocks, moving the lap with respect to the blocks to effect lapping, interchanging some of the blocks on the surface plate to symmetrically distribute variations in length, and repeating the lapping operation.

6. 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, moving the lap with respect to the blocks to effect lapping, interchanging some of the blocks on the surface plate to symmetrically distribute variations in length, and repeating the lapping operation.

7. 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, moving the lap with respect to the blocks to effect lapping, 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, moving the lap with respect to the blocks to effect lapping, interchanging some of the blocks on the surface plate to symmetrically distribute variations in length, and repeating the lapping operation.

In testimony whereof, I hereto affix my signature.

WILLIAM E. HOKE.