(No Model.)

2 Sheets—Sheet 1.

L. S. WRIGHT.

BORING CUTTER.

No. 454,585.

Patented June 23, 1891.

Fig 1

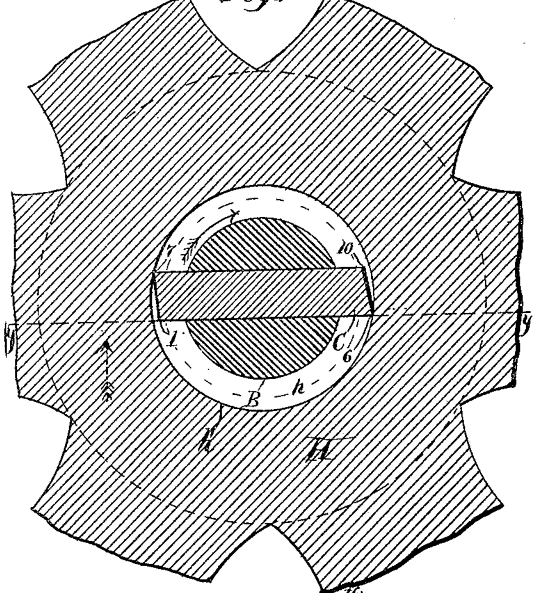


Fig 2.

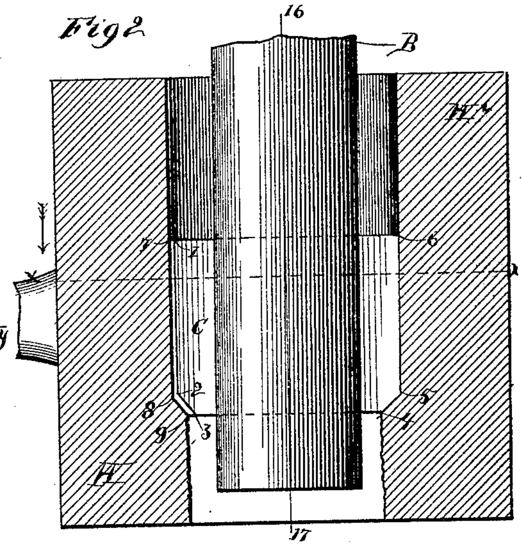


Fig. 3.

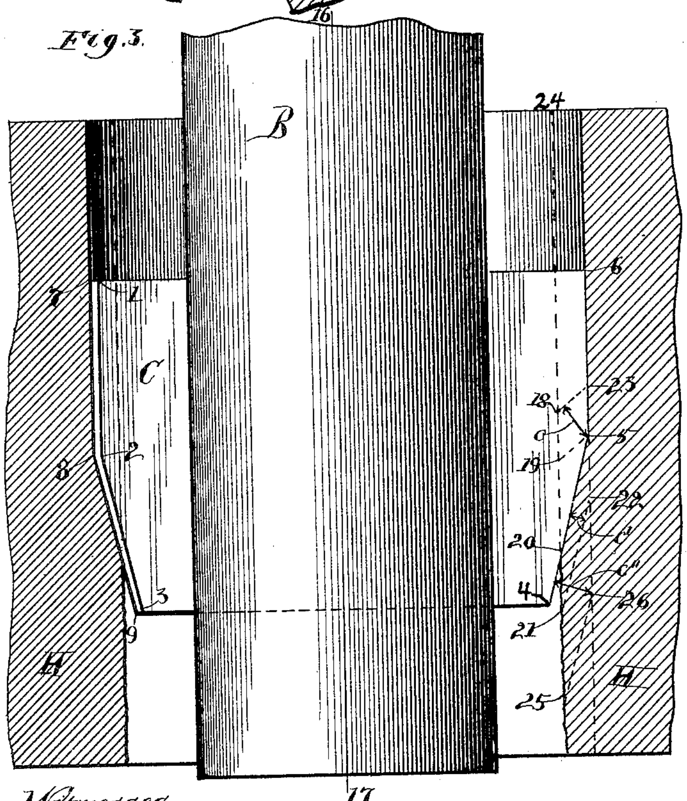
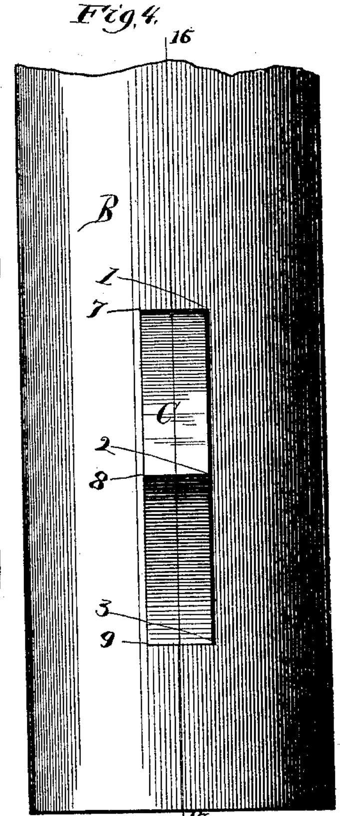


Fig. 4.



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(No Model.)

2 Sheets—Sheet 2.

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Fig 6

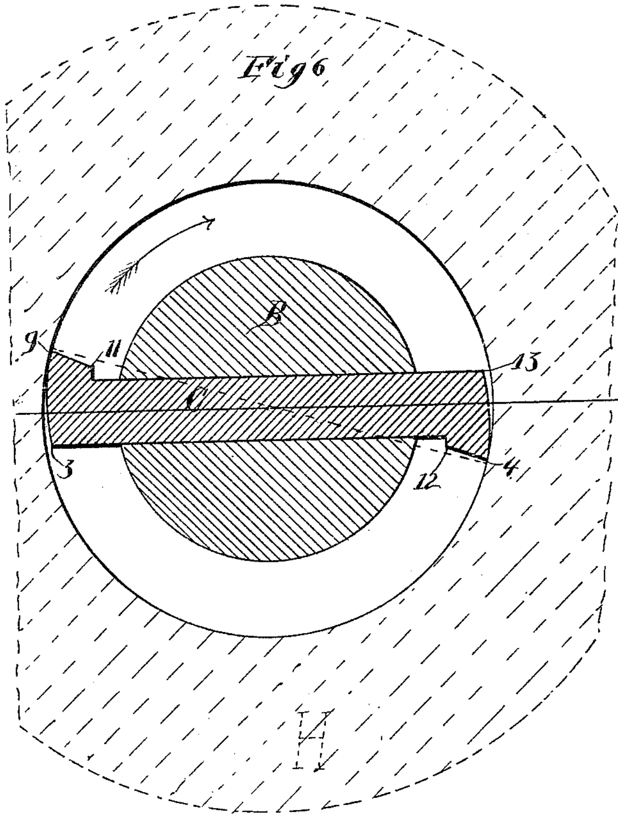


Fig. 5.

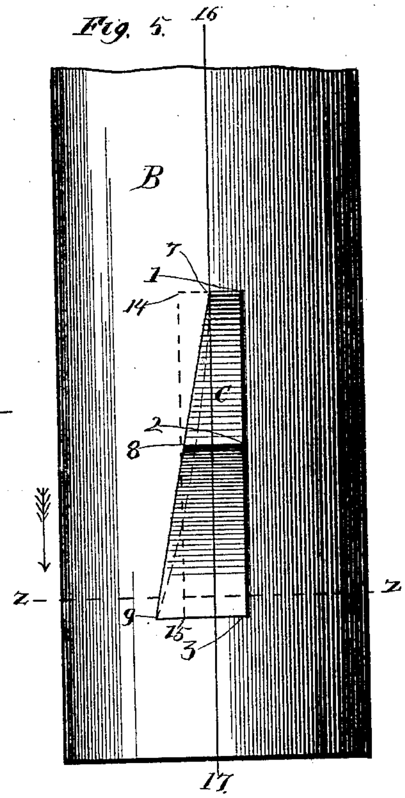
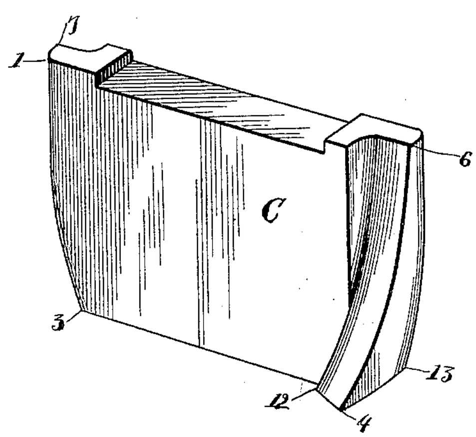


Fig. 7.



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UNITED STATES PATENT OFFICE.

LOUIS S. WRIGHT, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE LINK-BELT ENGINEERING COMPANY, OF SAME PLACE.

BORING-CUTTER.

SPECIFICATION forming part of Letters Patent No. 454,585, dated June 23, 1891.

Application filed March 21, 1891. Serial No. 385,898. (No model.)

To all whom it may concern:

Be it known that I, LOUIS S. WRIGHT, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Boring-Cutters, of which the following is a specification.

My invention relates particularly to the class of boring-cutters used for enlarging or finishing holes which are already provided (by coring or otherwise) in metal articles—such, for instance, as hubs of wheels, pulleys, &c., or cylinders, couplings, clutches, &c.; and its object is to increase their cutting efficiency.

The invention consists in certain changes of form, as more fully explained hereinafter, and more specifically defined in the claims.

In the operation of ordinary boring-cutters there are various methods of relative arrangement of parts. For instance, the cutter or boring-bar is revolved in some cases, while in others the wheel or other article to be bored is rotated around the cutter. Sometimes only one cutting-edge is used, and sometimes two opposite cutting-edges are applied simultaneously. Generally the cutter is fed forward into the hole of the wheel, but sometimes the wheel is fed toward the cutter instead. Often the relative movement is vertical, but at times it is horizontal or in any other convenient direction. To avoid prolixity therefore in my description and claims, I will assume that the article to be bored is a wheel-hub, that it is held in a stationary position in a horizontal plane, and that a cutter provided with two opposite cutting-edges applied simultaneously is carried by a vertical boring-bar and rotated forward against the resistance of the metal which is being cut and fed forward into the hole in a downward direction, these two uses of the word "forward" being understood to cover the movement of the cutter and wheel relative to each other, even in cases where the cutter is fixed in a stationary position, and the entire movement is made by the wheel and in directions different from those just assumed. The lower or forward portion of the cutting-edge in the direction of the feed I will also treat as the "front" portion, and the upper portion as the "rear."

With this understanding, therefore, I will now proceed to describe my cutter and the characteristics which distinguish it from those of ordinary construction, referring to the accompanying drawings, which form part of this specification, and in which similar numbers and letters of reference designate similar parts throughout the several views.

Figures 1 and 2 are respectively lateral and longitudinal cross-sections showing an ordinary cutter boring out a hole in a wheel-hub, Fig. 1 being a section on the line x x of Fig. 2, looking in the direction of the arrow, and Fig. 2 being a section on the line y y of Fig. 1, and looking in the direction of the dotted arrow. Fig. 3 is a view similar to Fig. 2, but drawn on a larger scale, and showing a change of form by which I increase the area of surface being cut and decrease the thickness of the chip. Fig. 4 is an end view of the cutter shown in Fig. 3, illustrating the relation of its cutting-edge to the axis of the boring or cutter bar. Fig. 5 is a view similar to Fig. 4, but illustrating a modification in form, whereby the relations of the cutting-edge and the axis are changed, for reasons more fully set forth hereinafter. Fig. 6 is a cross-section of the cutter and bar shown in Fig. 5, taken on the line z z and looking in the direction of the arrow. Fig. 7 is a perspective view of my cutter in its complete form.

C is the cutter in each figure, and B the boring-bar.

H is the hub to be bored out.

The dotted line h in Fig. 1 is a cross-section of the inside surface of the hub before boring, and full line h' is a cross-section of the inside surface after boring. The cutter is rotated in the direction indicated by the curved arrow in Fig. 1. The principal cutting-edges are therefore at lines 4 5 and 8 9, (in the other figures,) the finishing-edges being 5 6 and 7 8. The "clearance" customarily provided back of the cutting-edge is illustrated by the manner in which lines 7 1 and 6 10, Fig. 1, incline inward from the bored surface. This is further illustrated by the surfaces 1 2 3 9 8 7 in Figs. 2 and 3. The line 16 17 indicates the axis of the boring-bar.

The construction and operation of my cutter as distinguished from others are as follows:

In driving ordinary cutters much of the power is consumed in "feeding" the cutter forward into and through the hole. For instance, it is evident from the construction shown in Fig. 2 that there is a strong resistance to the downward movement of the cutter, and that this resistance is increased as the lines 4 5 and 8 9 become more nearly transverse to the axis, and decreased as they become more nearly parallel with the axis. The points at 5 and 8 are subject to great strain, wear, and damage from heating. The sharper these points are made the more quickly they give out. As a step in advance, therefore, I make the inclines 4 5 and 8 9 longer and more nearly parallel with the axis, about as shown in Fig. 3. This makes the angles at 5 and 8 more blunt and these portions of the cutter more durable. It also decreases the depth of the cut or chip, thus giving each portion of the cutting-edge less strain and consequent wear. In Fig. 3 I illustrate this last point as follows: The amount of feed at each revolution is assumed, for the sake of illustration, to be a distance equal to that between points 18 and 19, (in the dotted line 20 24, which represents a section of the inside surface before boring,) and the dotted lines 18 23 and 19 5 are assumed to indicate successive positions of the main cutting-edge of an ordinary cutter. The depth of the chip or cut is therefore the perpendicular distance between these lines, indicated by the short line c. The distance between points 20 and 21 is the same as between points 18 and 19, and the lines 20 5 and 21 22 indicate successive positions of the main cutting-edge 4 5 of the cutter shown in Fig. 3, and the short line c' (giving the perpendicular distance between them) shows the depth of the cut to be materially less than c. The area of surface to be cut is greater and the cut is thinner, so that the work is thus divided up among a larger number of particles in the cutting-edge, giving each less strain. If the feed were increased, however, until c' became as long as c, as shown at c'', the line 25 26 would represent the position of the cutting-edge corresponding to 21 22, and the line 20 25 would show the rate of feed necessary to bring this about.

The practical conclusion from the above is that the cutter shown in Fig. 3 should be more durable than the ordinary one if the feed is the same (20 21) and depth of chip decreased to c', or if the cutter will stand economically a depth of cut c'' equal to that ordinarily employed c, the feed can be materially increased to 20 25, and the work therefore finished more quickly. With a reasonable durability of cutter, the important item, practically, is the saving in time obtained by the increased efficiency. This change of shape, however, introduces a new element into the problem, for it transforms part of the resistance to downward movement into a laterally-compressive force, leading the cutter to act somewhat like a wedge, and while the relative power necessary to feed the tool downward is decreased, this is more than compensated for by the great increase in power required to rotate it. Furthermore the cut is characterized by a scraping, tearing, or ripping of the metal, causing excessive friction and heating, which rapidly destroys the temper and life of the cutter and nullifies the theoretical advantages mentioned above. My next step, therefore, is to transform this into a shearing or shaving cut, which will separate the fibers with less strain than where the motion is directly transverse to the cutting-edge. I accomplish this object by arranging the cutting-edge at an incline to a plane passing through the axis of the cutter and through any point in said edge. As long as the edge is in an axial plane, and thus at right angles to the direction of rotation, it is forced broadside against the metal, with the destructive frictional resistance just mentioned; but when the edge is inclined so that one portion precedes (in the direction of motion) its adjacent portion each advancing portion prepares the way for its neighbor and separates the fibers less violently, and with a sort of incision or shearing effect, which very materially reduces the strain on the parts, the danger of heating, and the power required to drive the machine. As to the general direction in which this incline should be made, it is evident that if the front (or downward) portion of the edge precedes in the direction of rotation the rear (or upper) portion the resultant of the opposing forces will have a tendency to draw the cutter forward, (or downward,) and thus overcome to a greater or less extent the resistance to the "feed," which I have mentioned before. In fact the degree of incline may be made so great that the cutter will have to be held back from a tendency to advance too rapidly. The shearing or shaving effect is heightened by the fact that the forward (or downward) feed assists in making a gradual incision.

Comparison of Figs. 4 and 5 will illustrate the relative arrangements of cutting-edge and axial plane. In Fig. 4 an axial plane in the line of sight is observed to pass through the middle of the cutter, and the cutting-edge 7 8 9 is parallel with it, while in Fig. 5 the edge 7 8 9 is seen to be inclined from its former position, (represented by dotted line 14 15,) and the portion toward 9 (or front end) enters the metal in advance (in the direction of rotation) of the portions toward 8 and 7 with the effect already described. It is not necessary that the same constant angle with the axial plane be preserved throughout the extent of the cutting-edge, and in practice I have often found it desirable to curve the edge somewhat, as shown by broken line running from 7 to 9 in Fig. 5, thus making the angle of the portion toward 9 sharper than that of the balance of the edge to assist the advancing portions in starting the cut. It will be noticed, however, that any portion of the main cutting-edge is inclined to an axial plane passing through it, for reasons before mentioned. In practice I have also found that the straight lines meeting at 5 and 8, Fig. 3, can be advantageously merged into curves, somewhat as illustrated in the perspective view, Fig. 7, the essential feature being that the front or forward portions of the principal cutting-edges (corresponding to the portions 4 5 and 8 9) should incline inward toward the axial line 16 17 in the forward direction, for reasons before given. The upper or rear portions (corresponding to 5 6 and 7 8) are made practically without incline toward the axis, as they are finishing-edges and must complete the bore to its full size.

The angle made by the two surfaces which form the cutting-edge must necessarily be a blunt one for work in metal; but my device makes it possible to employ under many circumstances a somewhat sharper edge than usual, thus increasing the cutting or shaving and decreasing the tearing or ripping effect. As I have thus far successfully practiced my invention in work with ordinary cast-iron, I have employed an angle of about eighty degrees, making practically a lip-cutter backed off about five degrees for clearance, and having the front surface about five degrees inside of a radial line to the edge. This is approximately indicated in Fig. 6 by the positions of lines 3 9 and 13 4 relative to the inside surface of the hole, and lines 9 11 and 4 12 relative to radii drawn to points 9 and 4; but I do not wish to be limited to any specific angles except that it is to be understood that the cutting-edge is formed by surfaces meeting at a blunt angle suitable for cutting metal.

The theoretical or apparent results of the above-described combination of elements are the decrease in power required to drive the boring-machine, and the decreased damage to cutting-edges or increased life of cutter; but practically the real gain is in the efficiency and rapidity with which the cutters will do more work for the same expenditure of power and durability of tools.

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

1. The combination of a boring-bar and a double cutter for enlarging holes in metal, said cutter being provided with opposite cutting-edges which are inclined to an axial plane passing through them, substantially as set forth.

2. In combination, a boring-bar and a cutter for enlarging holes in metal, said cutter having a cutting-edge which is inclined to an axial plane passed through it at any point, the front end of said edge being forward in the direction of rotation.

3. In a boring-cutter, a cutting-edge formed by two surfaces meeting at a blunt angle suitable for cutting metal, the front portion of said edge being inclined gradually inward toward the axis of rotation and forward from an axial plane passed through the rear portion of the edge, substantially as and for the purpose set forth.

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Witnesses:
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