

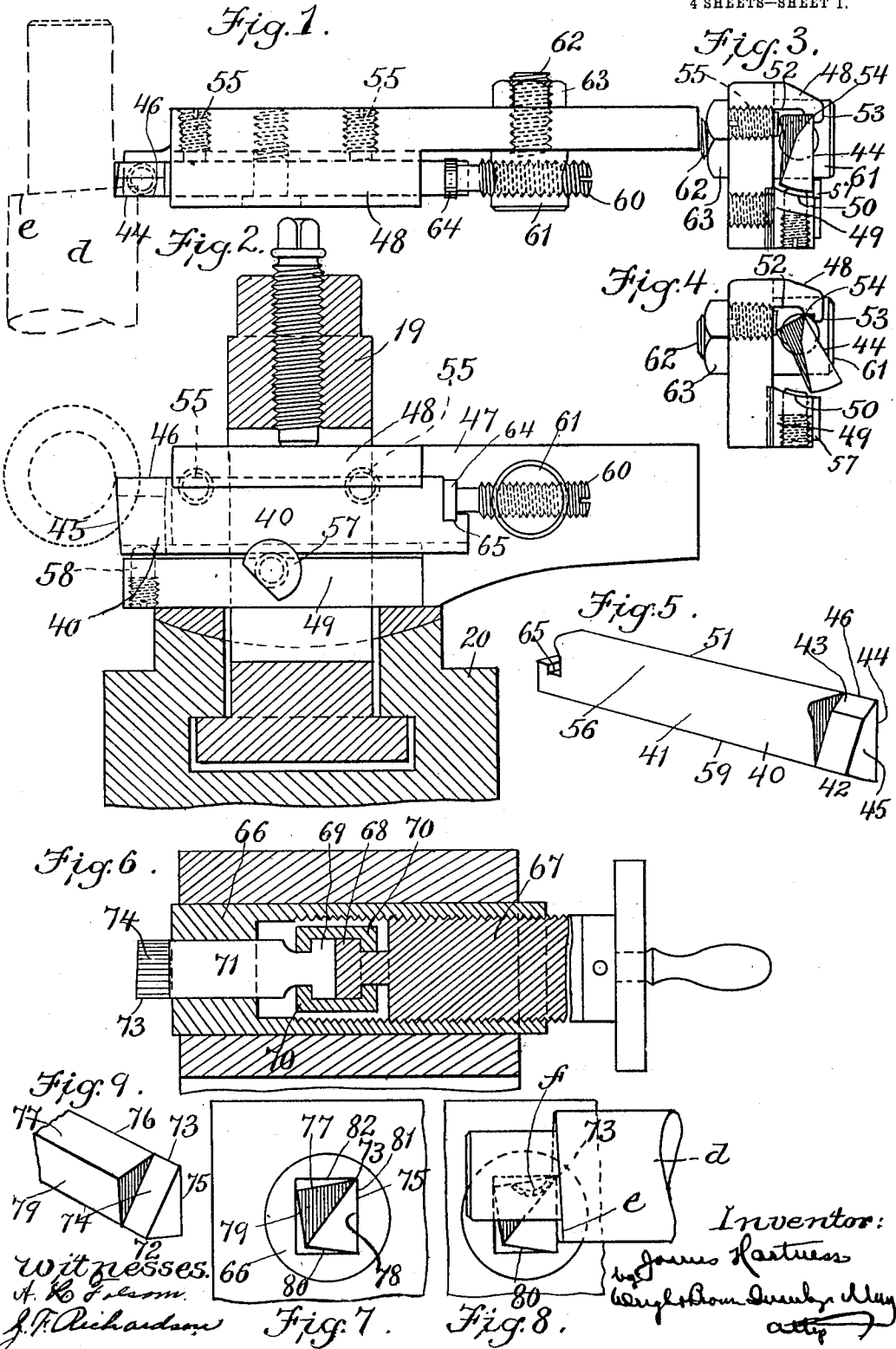
J. HARTNESS.
TURNING TOOL.

APPLICATION FILED DEC. 16, 1907.

Patented Mar. 19, 1912.

1,020,493.

4 SHEETS—SHEET 1.



Witnesses:
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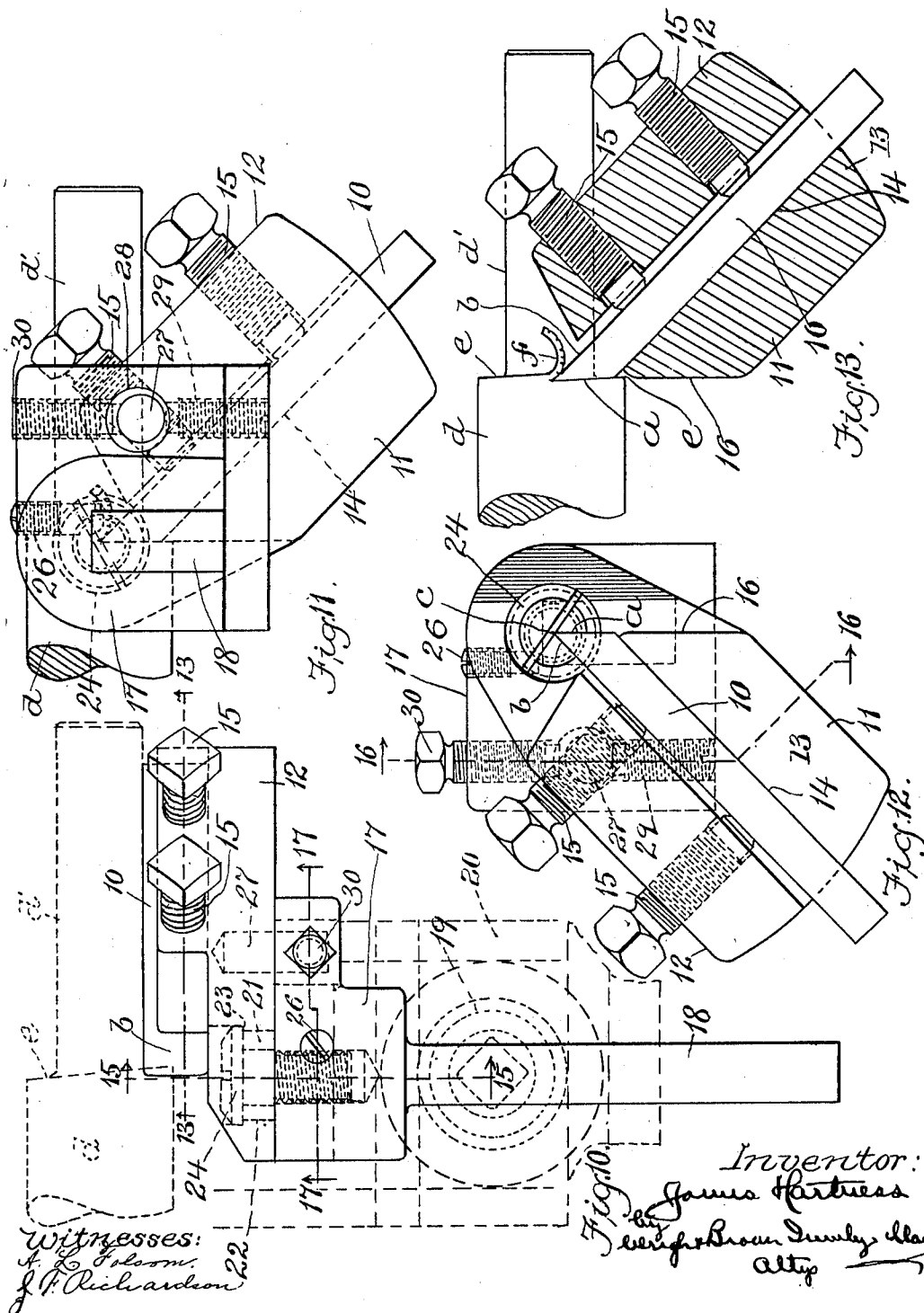
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TURNING TOOL.

Patented Mar. 19, 1912.

4 SHEETS—SHEET 2.

1,020,493.



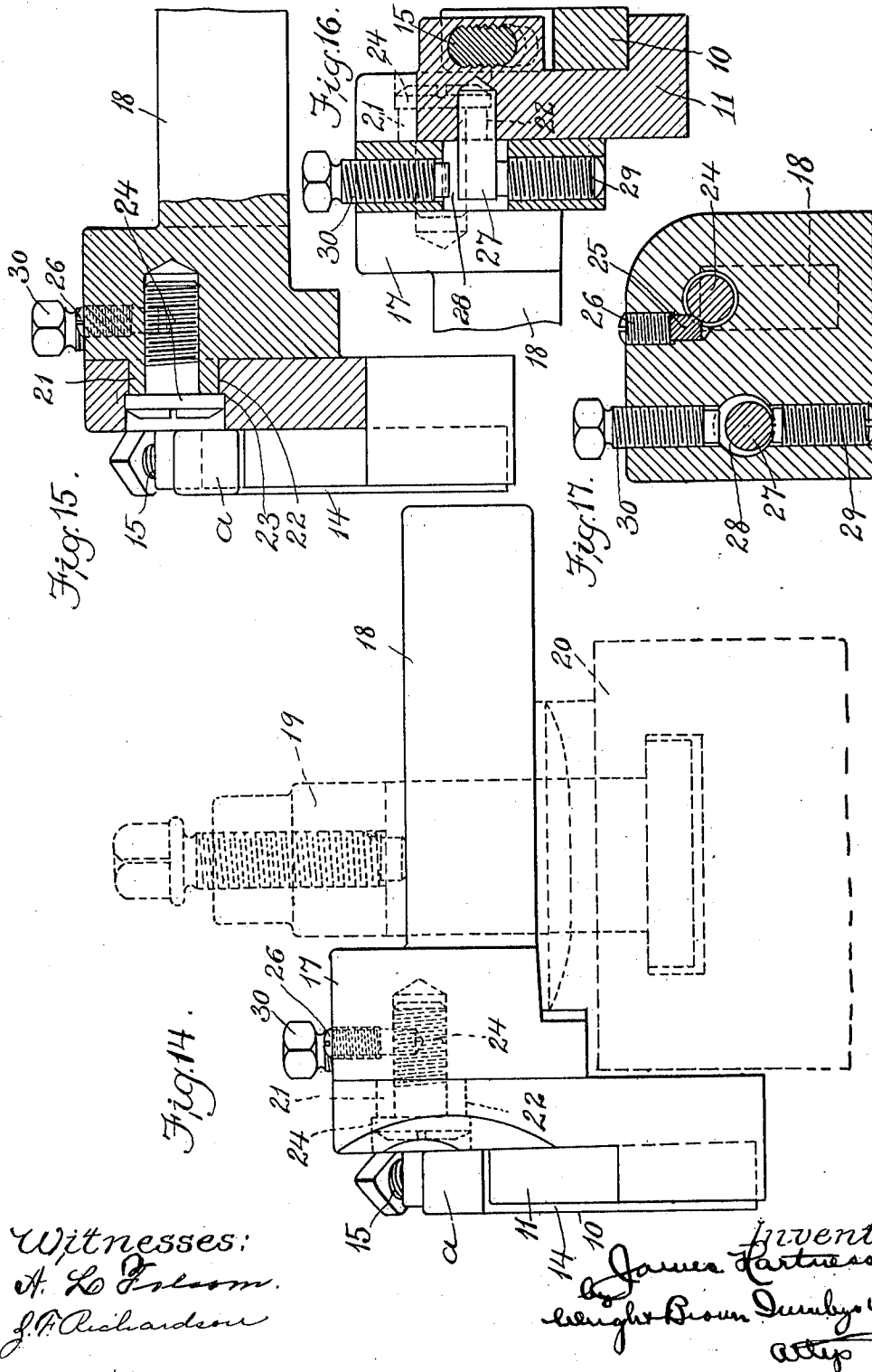
J. HARTNESS.
TURNING TOOL.

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4 SHEETS—SHEET 3.

1,020,493.



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J. HARTNESS.
TURNING TOOL.

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4 SHEETS—SHEET 4.

Fig. 18.

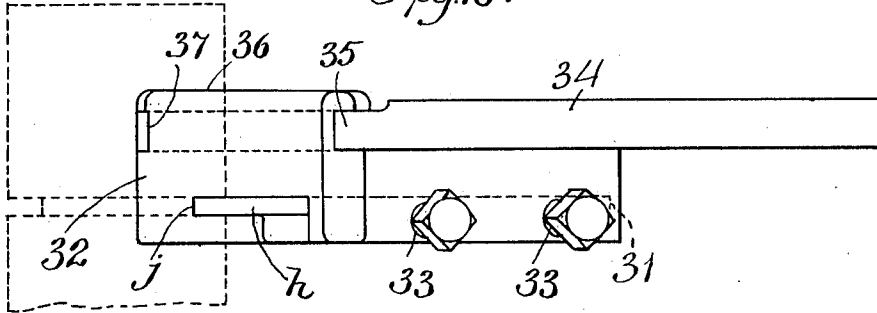
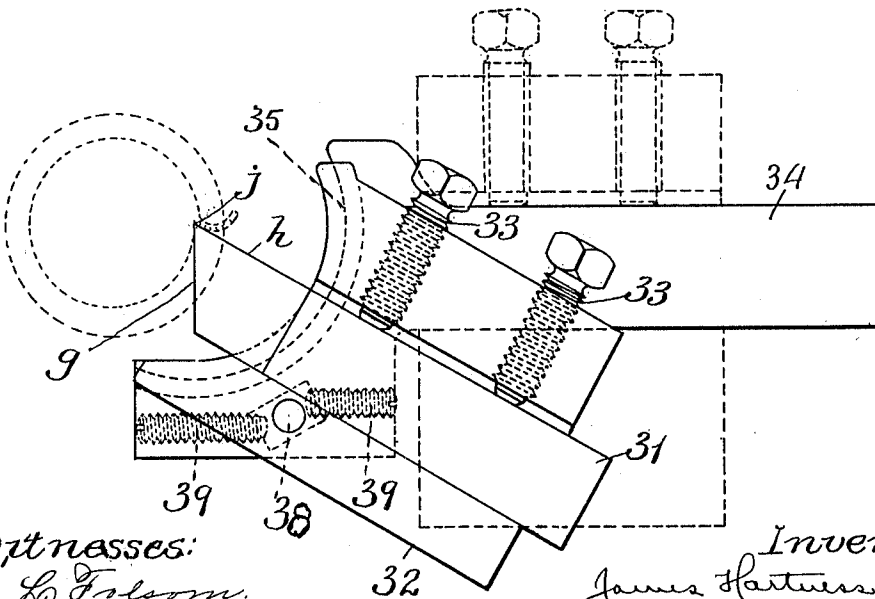


Fig. 19.



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UNITED STATES PATENT OFFICE.

JAMES HARTNESS, OF SPRINGFIELD, VERMONT.

TURNING-TOOL.

1,020,493.

Specification of Letters Patent.

Patented Mar. 19, 1912.

Application filed December 16, 1907. Serial No. 406,588.

To all whom it may concern:

Be it known that I, JAMES HARTNESS, of Springfield, in the county of Windsor and State of Vermont, have invented certain new and useful Improvements in Turning-Tools, of which the following is a specification.

This invention has relation to tools for cutting metal, as in turning, planing, and similar operations.

It consists of a cutter having a comparatively acute edge, mounted to swivel or move freely within certain defined limits so as to allow the pressure of the chip on the top slope of the tool to swing the tool around so as to bring its so-called clearance face flatly against the wall of the metal from which the chip is being taken, thus giving the cutting edge a pressure on both sides instead of the usual one-sided pressure.

It is the usual practice, in cutting metal, as in a lathe, to use a cutter having "clearance." This means that the cutter only touches the wall of metal from which the chip is being removed at the extreme edge of the cutter, the chip pressure being wholly on the top surface of the tool. The angle of the clearance face to the surface of the work, which it clears, varies according to the nature of the work, the machine, and the skill of the workman. The best practice aims at such a minimum clearance as can be used for a sufficient length of time, it being generally accepted that a tool having very slight clearance soon loses that clearance by slight wearing of the extreme edge, and that although the tool may for a time cut without clearance, yet, on account of the rigidity with which the tool is held, it is only a step from that condition to one in which there is what might be called a negative clearance (that is, in which the tool bears at a point below the cutting edge), when the process of abrasion continues rapidly to increase this negative clearance, which, of course, causes heat and rapid destruction of the tool.

Owing to the wearing of the tool and the imperfect control of the work and tool in the average machine, it has been accepted as best practice to give the tool from 4 to 8 degrees clearance, but on rougher work this is sometimes exceeded very much, especially in extreme cases or on account of careless workmanship. This practice of giving a tool clearance, throws all the labor of cut-

ting on the top edge, and converts it into a scraping action instead of a splitting action which would be ideal. Furthermore, on account of having this pressure wholly on one side, it has been found impracticable to use an acute edge, which would be a step toward securing a splitting action.

The angle of the top surface of the tool, against which the chip bears, is called the "rake" or "slope", and in the following description it is referred to as the "slope." The surface of this slope is usually flat, but inclined so as to make the edge of the tool most acute at that part of the chip which is the thickest. To make this statement clear, it should be remembered that, although the top slope is usually a plane surface, yet the clearance face may be round or rectangular. When rectangular, it presents two faces to the work; the face which is in the direction of the feed is the one that takes the heavy cut, the duty of the other face is comparatively slight.

The angle of the top slope to the travel of the metal should be as acute as possible, so that the tool becomes a wedge by which superfluous metal may be wedged or split off. It is well known that the efficiency of a wedge greatly increases with the reduction of the angle of its two faces, and that it is very inefficient and unmechanical to use a wedge of a greater angle than 40 or 45 degrees; and that the action of a greater angle, instead of working as a wedge, seems to push the material before it. For instance, the present tools have a top slope which, measured from the horizontal, varies all the way from horizontal to 20 degrees. This makes the face of the top slope stand at an angle of not less than 70 degrees to the vertical, the average being about 75 to 80 degrees; with the result that the chip removed from the metal, instead of being split off, is actually crushed off, as shown by the chip from cast iron which is broken up in small pieces. This is also found in working nearly all kinds of steels, although in working the softest and most ductile steels the metal flows sufficiently to produce a more or less continuous chip, but in the average work the chip is not continuous, and even an apparently continuous chip is one tied together on one surface, the other side being broken up, showing that it is a series of chunks not firmly united, and that the metal has been crushed in the process of scraping or crowd-

ing, which is the real action of the present cutting tools.

I have found that, by allowing the tool to ride on the wall of metal from which the chip is being removed, I bring sufficient pressure to bear on the under side of the edge of the tool to make it possible to use a more acute angle, and, although this angle for various kinds of work and machines may be varied within a fairly wide range, yet I have found that an angle of two faces which forms a wedge of 30 degrees to give excellent results. It is needless to say that the reduction of stress in removing the chip increases the capacity of the machine which is limited by its pulling power. It also increases the accuracy of any machine which is limited by the springing away, either of its parts or of the work away from the tool, due to the pressure.

For simplicity in illustrating the invention, I have chosen to show tools, the plan view of the top edge of which shows two so-called end and side faces at an angle of substantially 90 degrees, but it will be understood that the corner of the tool may be rounded or in any shape, and that I prefer to movably mount the tool so as to bring the center line of action along and in line with the top edge of the most acute part of the tool. It is apparent that, in certain kinds of work, this center of movement or oscillation may be put above, below, forward or back of the center line of this particular part of the tool.

Upon the accompanying drawings, I have illustrated a variety of different tools embodying the invention.

Figure 1 represents a plan view of one form of tool with its holder. Fig. 2 represents a side elevation of the same showing how it is mounted in the tool-post. Fig. 3 represents a front end elevation of the tool. Fig. 4 represents a similar view showing how the tool may be removed from its holder. Fig. 5 represents, in perspective view, the cutter. Fig. 6 illustrates a tool embodying the invention which may be employed in connection with a lathe such as shown in Letters Patent of the United States No. 876,305, dated January 7, 1908, this figure showing the tool holder in longitudinal horizontal section. Fig. 7 represents a rear end elevation of the tool. Fig. 8 illustrates a similar view but shows how the tool is automatically positioned so that its inner or under face is held against the work. Fig. 9 represents a perspective view of the operative end of the cutter. Fig. 10 represents in plan view another embodiment of the invention which is adapted for use upon any metal turning machine, such as an engine lathe. Fig. 11 represents a front end elevation. Fig. 12 represents a rear end elevation. Fig. 13 represents a section on

the line 13—13 of Fig. 10. Fig. 14 represents an elevation from the left side of the tool. Fig. 15 represents a section on the line 15—15 of Fig. 10. Fig. 16 represents a section on the line 16—16 of Fig. 12. Fig. 17 represents a section on the line 17—17 of Fig. 10. Fig. 18 represents in plan view another form of tool embodying the invention. Fig. 19 represents a side elevation thereof.

Before explaining in detail the tools which are illustrated upon the drawings, I desire to have it understood that the invention may be embodied in a variety of forms adapted for use on lathes, planers or the like; that it is not limited to the details which shall be described; that as the terms "top" "front" and "back" are merely relative terms, referring to the use of the tool in an engine lathe, the description of the tool used in any other position will be understood from its description in connection with a lathe; and that the phraseology which I employ is for the purpose of description and not of limitation.

Referring first to Figs. 1 to 5 inclusive, I have there illustrated a simple embodiment of the invention in which the cutter is indicated at 40. It consists of a bar comprising a shank 41 and an operative end 42. At the end 42 there is an outer face or top slope 43, which is at an acute angle to what I may term the "inner face" 44. The face 44 corresponds, in a measure, to what has heretofore been called the "clearance face." At the end of the portion 42 there is a clearance face 45 which is at substantially an angle of 90 degrees to the face 44. The faces 43 and 44 form a wedge, the angle of which may be, according to the character of the metal being turned, approximately 30 degrees more or less, so that the action of the cutter will be approximately that of splitting off the chip instead of crowding or scraping it off as heretofore. As previously stated, it is not necessary that the cutting edge 46, formed at the intersection of the two faces 43 and 44, should be straight. On the contrary, it may be curved, in which event the face 44 will be convex. As I have previously indicated, I so mount a cutter that it is capable of oscillation substantially about the center or axis coincident with its cutting edge. This may be accomplished by swiveling the cutter holder, as hereinafter described, or by mounting the cutter itself in its holder so that it may have the proper movement relatively thereto. In the tool now under discussion, the cutter is capable of moving relatively to the holder. It will be seen that the holder, which is indicated at 47, consists of a flat bar or plate, having along one side two parallel flanges 48 49 which form a groove or guideway to receive the shank of the cutter. The flange 49 pro-

jects beyond the inner end of the holder so as to underlie the operative end of the cutter to support it. The upper wall of the flange 49 is concave, as indicated at 50, in cross-section the arc or curvature being substantially centered at the cutting edge 46 of the cutter, when said edge 46 is coincident with the corner 51 of the shank 41. The flange or guideway 48 is recessed in its under face as at 52, and it is provided with a downwardly projecting lip or edge 53 which forms approximately a right angle to its inner face 54. This re-entrant corner is in line with the axis of the concave face 50, and it serves as a fulcrum or pivot in which the corner 51 of the shank of the tool is placed and about which the cutter may be oscillated. The corner 51 of the shank is held against its fulcrum by round-end adjusting screws 55 passed into the side of the holder and engaging a curved lip 56 on the other upper corner of the shank 41. These screws serve to hold the upper edge or corner 51 against the lip 53. From this description, it will be apparent that the cutter is socketed in the holder so that it is capable of oscillation to a limited extent. To prevent the cutter from leaving its guideway, I employ a locking device consisting of a rotatable headed pin 57 inserted in the socket in the flange 49, the head being cut away, so that, by rotating the pin to a point shown in Fig. 4, the cutter may be laterally removed. Passing upwardly through the projecting end of the flange 49, there is a pin 58, the end of which is concave as shown in Figs. 3 and 4, said pin fitting the convex under side 59 of the cutter and holding the cutter upwardly with its corner 51 in the socket formed by the lip 53. In order that the cutter may be adjusted longitudinally of its holder, I provide an adjusting screw 60 which is passed transversely through a cylindrical head 61 of a bolt 62. The bolt is passed through the holder and is secured in place by a nut 63. The screw 60 has a head 64 which may be engaged with a socket 65 formed in the outer end of the shank of the cutter. The tool holder is illustrated as being mounted in the conventional tool-post 19 of the lathe slide 20. It will be apparent that, when the cutter holder is fed along the work shown in dotted lines in Figs. 1 and 2, the face 44 will automatically position itself with reference to the face or shoulder of the work so as to lie flatly thereagainst, the chip which bears upon the top slope 43 maintaining the cutter in this position.

In Figs. 6 to 9 inclusive, I have illustrated a tool which may be employed in connection with what is commercially known as the "Lo-swing lathe"; that is, a lathe substantially similar to that illustrated in Letters Patent No. 876,305, hereinbefore mentioned. The cutter itself and the cutter holder are

quite similar to those illustrated in said patent, except that the cutter is arranged so that its inner face may find and rest flat against the shoulder or face of the work. The holder consists of a cylindrical block 66, provided at its inner end with an oblong aperture, the walls of which are rectangular. The other end of the holder is internally threaded to receive an adjusting screw 67, having on its inner end a head 68 which is connected to the head 69 on the end of the cutter bar by couplings 70. The cutter bar, which is indicated as a whole at 71, has an operative end 72, with a cutting edge 73 formed by the outer face or top slope 74 and the inner face 75. These faces form an acute angle, which, as shown, is approximately 36 degrees. The cutting edge 73 is substantially a continuation of the corner 76 of the shank of the tool. The top side 77 of the shank is at an angle less than 90 degrees to its side 78 which is in a plane with its face 75. Its other side 79 is at substantially a right angle to the top side 77, but is at an obtuse angle to its under side 80, which latter is at an angle less than 90 degrees to its side 78. In cross-section, the shank of the cutter is in the shape of a trapezium with its longest side upright. The height of the side wall 78 is substantially equal to the height of the socket in the holder 66, so that the corner 76 of the cutter shank is socketed in the angle formed by the side and top walls 81 82 of the aperture. By reason of this construction, it will be seen that the cutter is capable of oscillating about the corner 76 and cutting edge 73 to a greater or less extent, so as to permit the face 75 of the operative end of the cutter to be pressed against the face *e* of the work *d* by the chip *f* which is wedged or split off from the work and which engages the top slope 74 of the cutter.

In both of these embodiments of the invention, thus described, the cutter itself is capable of oscillation about a center coincident with its cutting edge, this oscillation being relatively to its holder.

In the embodiments of the invention now to be described, the cutter holder oscillates with the cutter.

Referring to Figs. 10 to 17 inclusive, the cutter 10 is conventionally illustrated as being a bar of tool steel, which is rectangular in cross-section, with its operative and beveled off at an angle of substantially 45 degrees (more or less) to one of its side faces. *a* represents the under face corresponding to the so-called clearance face, and *b* the outer face or top slope, these two faces terminating in a cutting edge *c*. The cutter is thus chisel-shaped at its operative end. The cutter is mounted so that its face *a* may bear against the face of the work, as shown in Fig. 13. The work is here shown

as a cylindrical bar *d*, a portion of which has been reduced or removed by the cutter as at *d'*. The work has a shoulder face or surface *e*, against which the face *a* of the cutter rests or bears with its surface in parallelism thereto, and with the surface *b* at an angle of 45 degrees to the face *e* so that a chip may be split off, as indicated at *f*. In turning a cylindrical bar as shown, the face *e* will be substantially spiral, and of a pitch which is determined by the feed of the tool. The cutter is mounted in a holder which is indicated at 11. This holder consists of a plate provided on its face with two flanges 12 13 which are separated to form a groove 14, in which the cutter is placed and in which it is clamped by set-screws 15 15 passed through the flange 12. The flange 13 is cut away or beveled at its end as at 16, so that it will clear the work. It will be observed that the inner wall of the flange 13 supports the cutter practically its entire length so that the end face 16 is substantially in alinement with the end face *a* of the cutter. This provides a solid backing for the tool so that it is impossible for the tool to yield or spring. Where work of a relatively large area is being faced, the end wall or face 16 of the flange 13 may rest against it, and, in that event, the faces *a* and 16 are located as accurately as possible in the same place.

In order that the tool may automatically adjust itself to the work, so that the under face *a* of the cutter will find the face *e* of the work, the cutter holder in this case is swiveled or pivotally mounted upon an axis which is preferably substantially identical with the cutting edge *c*. To this end, I provide a support 17, having a shank 18 which may be adjustably clamped and supported in the tool-post 19 of the slide 20 of a standard engine lathe, as shown in dotted lines in Fig. 14, which slide is moved, by any suitable feed mechanism, longitudinally of the axis of the work. The shank 18 of the support is mounted transversely of the axis of the work. The end face of the support 17 is adapted to receive the outer face of the cutter holder against it, as shown in Figs. 10 and 14, and it is provided with an annular pivot or boss 21 (see Fig. 15) adapted to project into an aperture 22 formed in the cutter holder. The cutter holder has a shoulder 23 against which bears the head of a screw 24 which is passed into the support 17. Thus the cutter holder is adapted to move about a pivot, the axis of which is so located that the cutting edge *c* of the cutter is coincident therewith, as shown in Figs. 12 and 13. As shown in Fig. 11, the cutter carrier or holder is supported by said pivot and depends therefrom. Since the cutter is arranged longitudinally of the cutter holder, with its face

b radial of the axis of the pivot, the cutter holder would tend to swing downward until it hung freely, but its downward movement beyond a certain position is prevented by the engagement of the face *a* of the cutter with the face of the work, as shown in Fig. 13. The screw 24 is secured against being accidentally loosened by any convenient means, as, for instance, by a pin 25 which is inserted in the support 17 substantially tangentially to the shank of the screw 24. The pin is threaded or grooved so as not to injure the threads of the screw, and it is wedged into place by a screw 26 as shown in Fig. 17.

From the foregoing description, it will be apparent that the thrust of the work against the cutter will tend to swing it downward about its pivot so as to maintain the face of the cutter against the face of the work, and that the face of the cutter will automatically find and accommodate itself to the face of the work, the tool being supported on an axis coincident with the line of its cutting edge, just as explained in connection with the other tools herein described.

It is desirable to limit the free movement or oscillation of the cutter, and I provide a suitable device for this purpose. This may with convenience comprise a pin or stop 27 projecting outwardly from the face of the tool-carrier or holder into a large aperture 28 in the support 17, as shown in Fig. 17. Said support is provided with oppositely arranged adjustable stops or abutments 29 and 30 extending into the aperture 28. These adjustments take the form of set-screws threaded into apertures in the support 17 with their ends in alinement and separated far enough apart to permit of a predetermined amount of play of the pin 27 between them.

It is apparent that, as the cutter is swiveled on a line with its cutting edge, the cutter may be fed into the work without yielding, and yet it is free to assume any position than the angle of the feed determines, the chip holding the beveled face of the tool squarely against the face of the work. It will be seen that the inner face *a* of the cutter should be approximately radial of the axis of movement of the holder, but that the outer face or top slope need not be radial, as shown. In other words, the axis of the pivot may be in advance or beyond the cutting edge, in which event the face *a* would be radial but the face *b* would not. The point of support of the cutter may be described as "at or beyond the line of the cutting edge" for this point may be varied. The face *a* would ordinarily be located in a plane to which a perpendicular to the face of the work is at an angle of 90 degrees (as when a surface is being planed), or in a plane which intersects said perpendicular

at an angle other than 90 degrees (as where work is being turned according to the accompanying illustration). This angle would be determined by the character of the work being performed, or, in the case of metal turning, by the feed of the cutter.

In Figs. 18 and 19, I have illustrated another embodiment of which the invention is capable, and which may be employed as a grooving, shaping or cutting-off tool. As in the case of the tool previously described, the cutter is capable of oscillation about an axis or center approximately coincident with the edge of the cutter, but instead of supporting its holder or carrier upon a pivot, it is mounted in a curved guide, the curve of which is substantially centered at a line coincident with the edge of the tool, so that the same results are secured. The cutter 31 has an under face *g*, an outer face *h* and a cutting edge *j*. The cutter is supported in a holder or carrier 32 which has a groove to receive it, the cutter being clamped by screws 33. The support is indicated at 34, and may be clamped or otherwise secured in a tool post, movable transversely of the work. The said support has at its end a curved socket or guide 35 which is the arc of a circle, and the cutter-holder has a laterally projecting flange 36 similarly curved with a groove 37 to receive the guide 35. The holder and the support thus have complementary curved guides or guideways, which enables the holder to be oscillated about an axis concentric to the said guides. The cutter is so placed in said holder that its edge is substantially coincident with the axis referred to, and the support and holder are arranged so that the cutter is substantially transverse to the work, which, in this case, consists of a bar to be cut off, grooved or shaped, according to the edge of the cutter. The under face *g* of the cutter bears upon the surface of the work, and is tangential to that portion of the work engaged by the edge, and it automatically feeds and follows said surface. To limit the play of the cutter and its holder, the latter has a stop 38 which plays between two adjustable stops or abutments 39 39 similar to those hereinbefore described.

It may be stated that one feature of the invention comprises a cutter and means for mounting it, so that the cutting edge is under the control of the feed and yet is free to adapt itself to the angle or surface of the metal under the chip in order to get a support for the under side or face of the cutter. Both faces of the cutter, which terminate in the cutting edge, bear against the metal of the work, one face bearing against the chip and the other face bearing against the surface or face of the work.

I should not regard it as a departure from my invention to either grind or adjust the

face of the tool for the desired feed, and then feed the tool with a pressure sufficiently great to hold the so-called clearance surface firmly against the wall of metal from which the chip is being removed. In this way, the feed or advance of the tool would be determined by the angle of the face of the tool and it could be accomplished either by hydraulic pressure or by any driving mechanism which would give the desired push without exceeding it. For instance, in the tool illustrated in Figs. 10 to 17, the cutter and its holder could be adjusted by the stops or abutments 29 and 30 which rigidly clamp the holder in the desired position with the face of the tool flat against the face of the work.

It should be remembered that the drawings, illustrating the various embodiments of the invention, are more or less conventional. This is also true of the illustration of the chip shown as taken off by the cutter in Figs. 11, 13 and 19. In these figures, the chip is shown as of the form ordinarily taken off by the cutters which scrape and crush the metal instead of splitting it off, the chip being shown as broken on the under side and curled up on a small radius just as it would be if taken off by a standard tool. I have not attempted to illustrate the chip as it would be removed by a cutter embodying the present invention. The ideal chip of course would be one that is practically a continuous helix, not curled sidewise, but one taking a diameter exactly the same as the same metal had on the bar before it was removed. The chip produced by a cutter embodying the present invention generally approaches the ideal, depending of course on the character of the stock and feed, and the relation of the top edge of the cutter to a radial line from the center of the bar.

I do not herein claim specifically a construction such as illustrated in Figs. 1 to 9 inclusive, in which the cutter is movable relatively to its support, as this forms the subject-matter of an application Serial No. 452,308, filed September 9, 1908, though said construction is intended to be generically claimed herein.

Having thus explained the nature of my said invention, and described a way of constructing and using the same, although without attempting to set forth all of the forms in which it may be made or all of the modes of its use, what I claim is:—

1. In a metal-cutting tool, a cutter having an inner face and a top slope at an acute angle to each other and terminating in a cutting edge, and a support for said cutter, the cutter being held in said support to oscillate about an axis lying in the plane of the inner face.

2. In a metal-cutting tool, a cutter having at its operative end two faces at an acute

angle to each other terminating in a cutting edge, and means for supporting said cutter so as to permit it to move about a line substantially coincident with said edge.

5 3. In a metal-cutting tool, a cutter having at its operative end two faces at an acute angle to each other terminating in a cutting edge, and means for movably mounting said cutter to move about an axis to which the
10 inner face of the cutter is substantially radial.

4. In a metal-cutting tool, a cutter having an inner face and a top slope at an angle and terminating in a cutting edge, and
15 means for mounting said cutter so that it is free to move more or less about an axis longitudinal of said cutting edge, and in a plane of the said inner face.

5. In a tool for metal-working machines,
20 a cutter, a support for the cutter, and a pivot for said support substantially coincident with the cutting edge about which said cutter may laterally swing.

6. In a tool for metal-working machines,
25 a cutter having faces at an acute angle to each other and terminating in a cutting edge, a support adapted to be secured in a tool post, a cutter holder mounted on said support and movable about an axis substantially
30 coincident with said cutting edge.

7. In a metal-turning tool; a support, a cutter holder loosely mounted on the inner end of said support to move about an axis longitudinal of the cutting edge, and a cutter
35 secured upon said holder and having a

flat face adapted to rest against the face of the work.

8. In a metal-turning tool, a support, a cutter holder pivoted to said support to swing about an axis, and a cutter on said
40 holder having a face substantially radial to said axis and terminating in a cutting edge.

9. In a metal-turning tool, a cutter having at its operative end faces at an acute angle to each other and terminating in a cutting
45 edge, means for mounting said cutter to move about an axis to which the inner or under face of the cutter is substantially radial, and stops for limiting the movement of said cutter about its pivot. 50

10. A tool for turning a rotating piece of metal, comprising a cutter having an inner face and a top slope terminating in a cutting edge transverse to the axis of the work to be operated on, so as to form a transverse
55 shoulder or face on the work, and a holder on which said cutter is mounted to move about an axis in the plane of the inner face so that, while the cutter is operating, its inner face is free to lie flat against and follow the said shoulder or face of the work
60 and be pressed thereagainst by the pressure of the chip or cutting against the top slope.

In testimony whereof I have affixed my signature, in presence of two witnesses.

JAMES HARTNESS.

Witnesses:

J. W. WALKER,
A. H. HUDSON.