May 16, 1933. F. MÜLLER 1,909,840

MACHINE FOR FORMING GEARS AND THE LIKE

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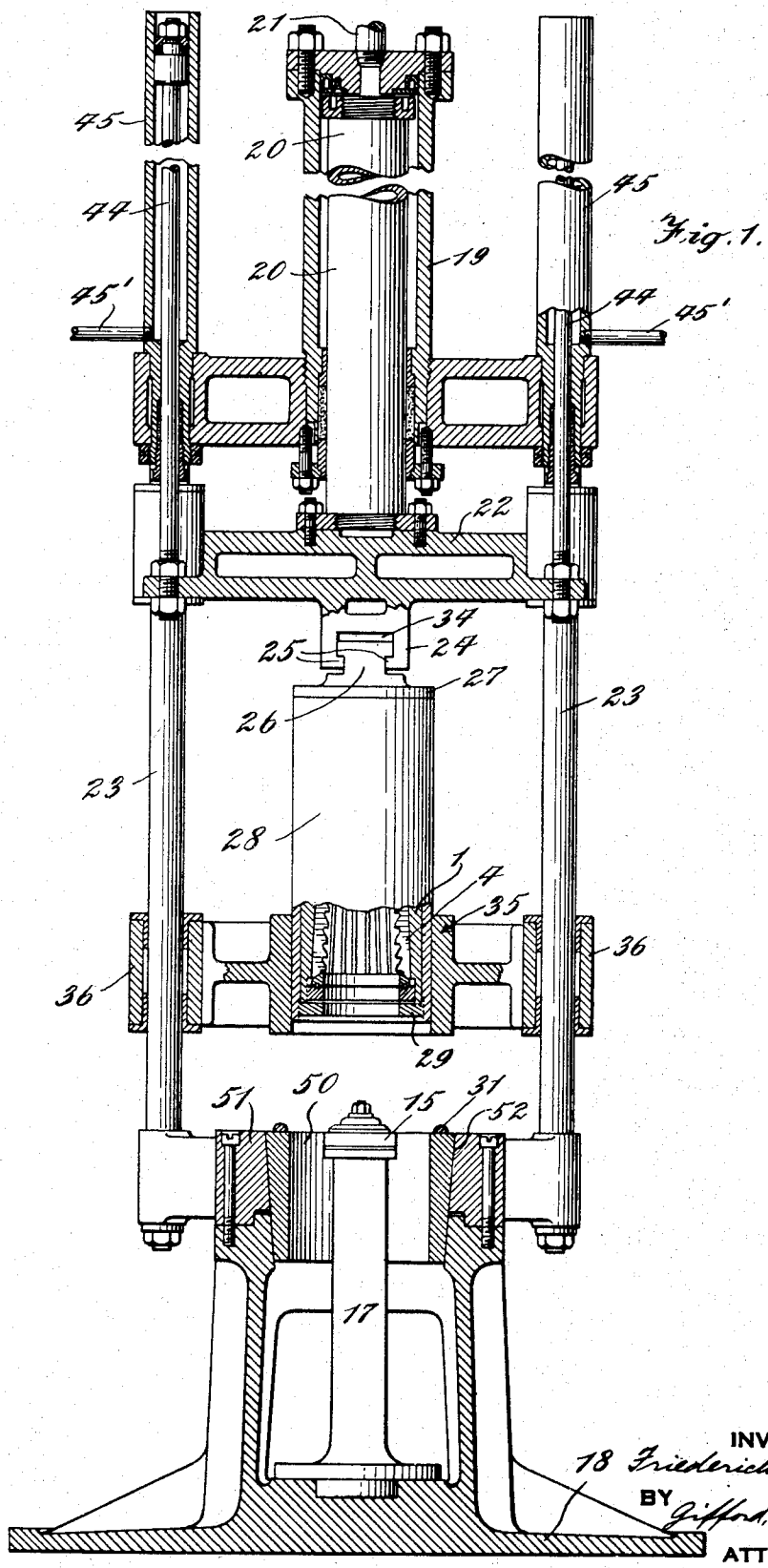


Fig. 1.

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Fig. 2.

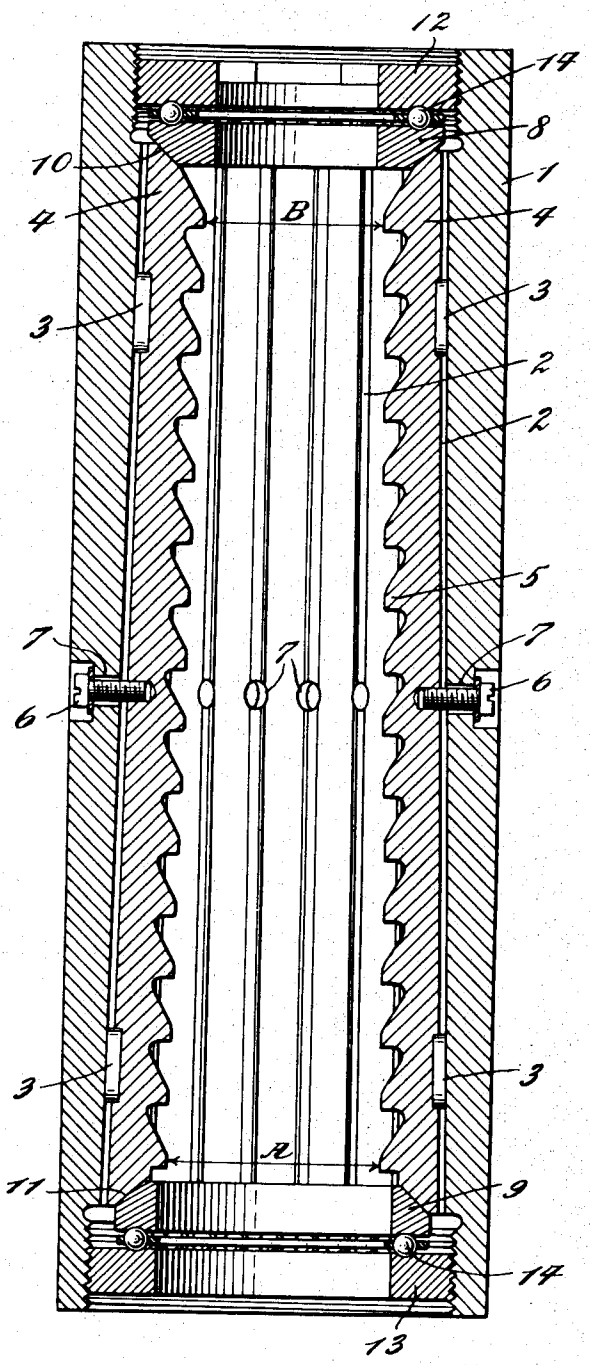
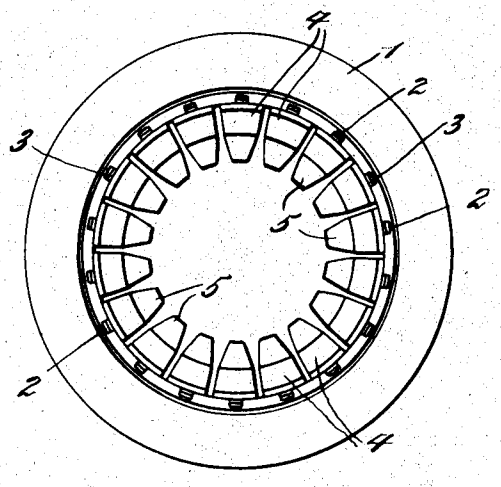


Fig. 3.



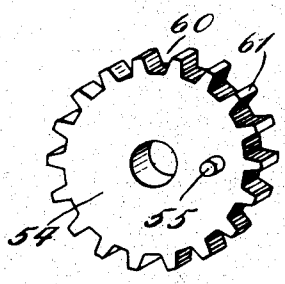


Fig. 6.

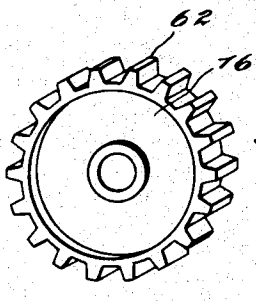


Fig. 5.

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Fig. 7.

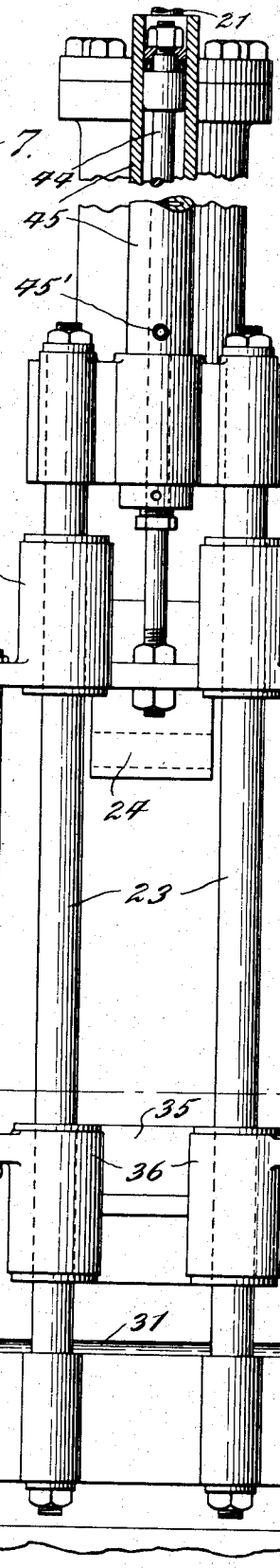


Fig. 9.

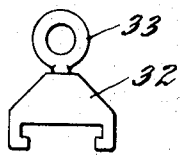


Fig. 10.

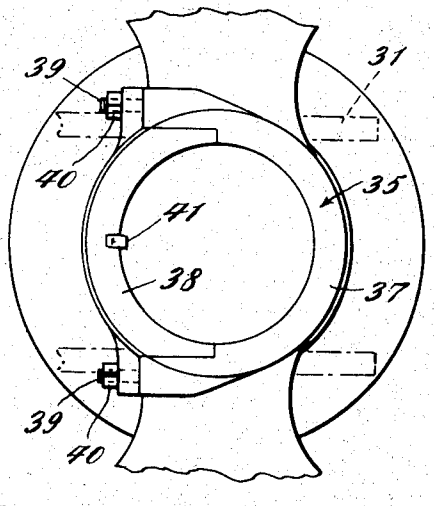
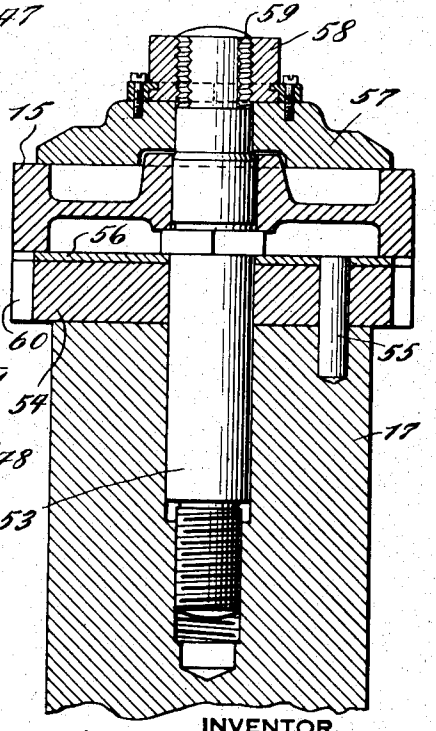


Fig. 4.



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Fig. 8.

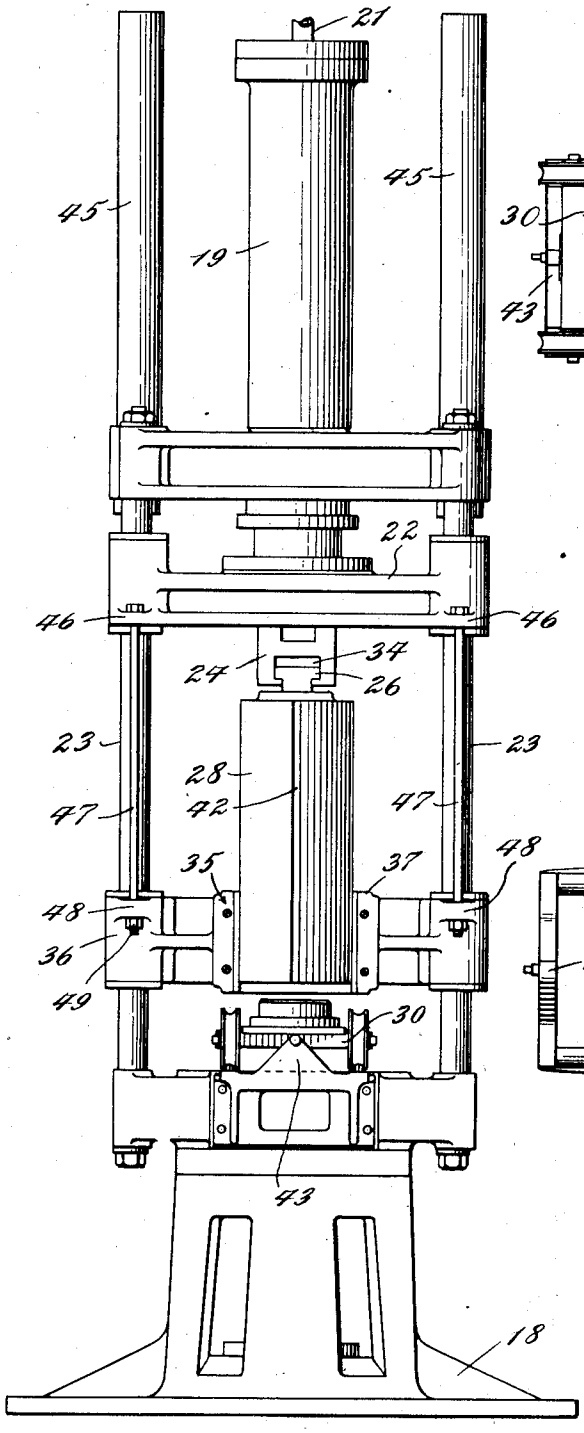


Fig. 11.

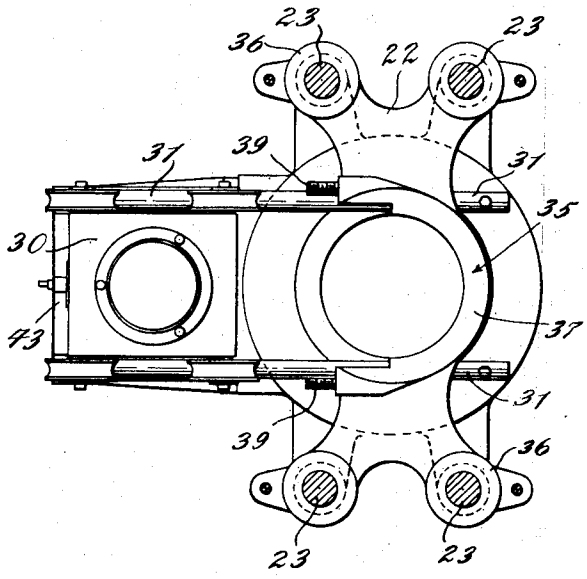
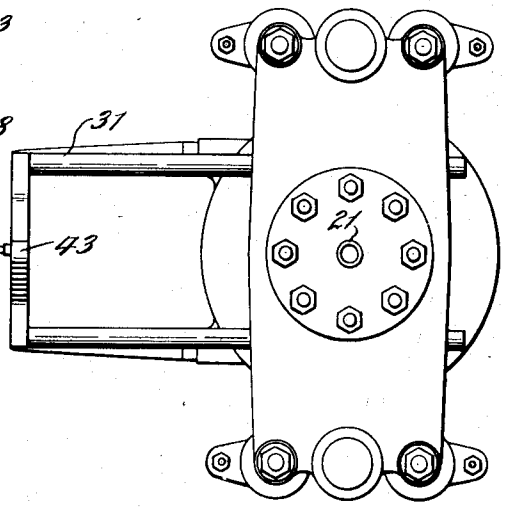


Fig. 12.



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UNITED STATES PATENT OFFICE

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MACHINE FOR FORMING GEARS AND THE LIKE

Application filed January 12, 1931. Serial No. 508,265.

This application is a continuation in part of my copending application, Serial No. 210,242.

The invention relates to a novel and improved machine for forming gears, sprockets, and the like. According to present practice, one way of forming gears is to cut the metal from between two adjoining teeth on a blank and then rotate the blank to a sufficient extent to bring into registry with the tool the portion of metal between the next pair of adjoining teeth, after which the first operation is repeated until the blank has been revolved through a complete circle.

According to my invention, I provide a machine whereby the metal between the teeth of a gear may be removed from the blank at a single operation, without the necessity of rotating or indexing the blank. Other and further objects and advantages will be apparent from the following description when read in connection with the accompanying drawings, in which I have shown a selected embodiment of the invention, and in which:—

Fig. 1 is a vertical view, partly in elevation and partly in section, showing a machine constructed according to my invention, and in which the operating power is supplied by a hydraulic press.

Fig. 2 is a vertical sectional view through the tool holder appearing in Fig. 1, certain of the tools being omitted.

Fig. 3 is a top plan view of the holder shown in Fig. 2.

Fig. 4 is a vertical sectional view through the top of the standard on which the work is supported, showing the work in place thereon.

Fig. 5 is a perspective view of the work shown in Fig. 4.

Fig. 6 is a perspective view of a device appearing in Fig. 4 beneath the work, and the function of which will be more fully described later.

Fig. 7 is a side elevation of the structure appearing in Figs. 1 and 8, and showing the manner in which the tool holder is put into place;

Fig. 8 a view taken from the right of Fig. 7, but showing the tool holder in place.

Fig. 9 is a view of the device by which the tool holder is handled.

Fig. 10 is a fragmentary plan view of the movable guide for the tool holder.

Fig. 11 is a horizontal sectional view approximately on the line 11—11 of Fig. 7, but with the tool holder removed.

Fig. 12 is a top plan view of the structure appearing in Fig. 7, after the tool holder is in place and the carriage removed.

According to my invention, I provide means for rigidly holding the work or blank from which the gear is to be cut, this means preferably being so arranged that the blank will occupy a horizontal position. I then operate on the blank with a tool which will remove from the blank all the metal between teeth. A tool which will perform this operation is illustrated in the drawings, and more particularly in Figs. 1, 2, and 3. Referring to these figures, the tool holder comprises a tubular sleeve 1 having on the inner face thereof a plurality of longitudinally extending grooves 2, these grooves forming guides for keys 3 on the tools 4. These tools are shown as elongated cutting elements, there being one element for each of the grooves 2.

As best shown in Fig. 2, the inside diameter of the holder 1 is greater at the bottom thereof than at the top, so that this wall is frustoconical and so that the cutting elements are inclined inwardly at their upper ends. On their inner faces or edges, each tool or cutting element is provided with a series of teeth 5.

It will be seen that the distance A between opposite teeth at the bottom of the tool holder is greater than the distance B between opposite teeth at the top of the tool holder, or, in other words, the top tooth of each element is nearer the center line of the sleeve than is the bottom tooth, so that each element forms a broach.

Preferably, each cutting element is held in position intermediate its length as by means of screws 6 which pass through openings 7 in the wall of the sleeve, and are threaded into holes in the backs of the elements. The holes 7 may be larger than the diameter of

the screw so as to permit adjustment particularly lengthwise of the groove in which the cutting element is keyed.

The cutting elements may also be held in place adjacent their ends by means of bearing members 8 and 9. Each of these elements has a frusto-conical surface 10 and 11 contacting with similar surfaces on the ends of the cutting elements so that, as the bearing members are moved longitudinally of the sleeve, they will serve to tighten the cutting elements in place.

One of the functions of the screws 7 is to prevent inward buckling of the cutting elements because of the pressure of the bearing members. Longitudinal movement of the bearing members may be caused in any suitable way, such, for example, as by providing nuts 12 and 13 threaded into the ends of the sleeve. In the form illustrated, I have shown anti-friction members 14 between each nut and its associated bearing member, so that when the nut is turned, there will be no tendency to twist the associated bearing member.

By manipulation of the nuts 12 and 13, the cutting elements may be adjusted longitudinally of their grooves and in unison, such adjustment resulting in varying the distance of each tooth of an element from the center line of the tool.

The work upon which the cutting operation is to be formed is usually a relatively thick blank, such as indicated at 15 in Fig. 4. The finished gear cut from this blank is shown in Fig. 5, and is designated 16. The blank is secured on top of a standard 17 mounted on a suitable base 18, and the tool holder is supported above the standard on a frame carried by said base, in such a way that its longitudinal axis is in exact alignment with the vertical axis of the standard so that, when the tool holder is reciprocated vertically, the cutting elements may simultaneously and accurately perform their cutting operations on the blank. The means for causing this reciprocating movement is illustrated herein as a hydraulic press, although other forms of operating mechanism may be used.

The press shown herein is supported on the base 18 and comprises a cylinder 19 containing a piston 20 operated by pressure supplied through a pipe 21. Connected to the lower end of the piston 20 is a cross head 22 vertically slidable on guides 23 forming part of the frame, the head being provided with a depending connecting means 24. In the form shown, this connecting means is formed of two facing hooks 25 adapted to receive a projection 26 on the top 27 of a sleeve 28 in which the tool holder 1 may be placed. It is to be understood that the tool holder accurately fits within the sleeve 28 and may be secured therein by any suitable means, such as a nut 29.

Referring to Figs. 7 and 8, it will be seen that the sleeve 28 and parts therein may be mounted on a carriage 30 which runs on the track formed of rails 31, and extends transversely from the base. A suitable hook 32 provided with an eye 33 may be used in conjunction with a suitable hoist (not shown), this hook engaging the projection 26 so that the sleeve 28 and parts therein may be lifted and placed upon the carriage. After that, the carriage may be rolled horizontally to a place where the sleeve is in position and where the projection 26 may engage the connecting means 24. The projection 26 and means 24 are then preferably tightly secured together by a wedge or wedges inserted in the space 34.

The position of the sleeve is accurately defined by means of a vertically slidable guide 35. This guide has bearings 36 which slide on the guides 23 and, as best shown in Figs. 10 and 11, the guide is made in two parts 37 and 38. The part 37 is provided with threaded bolts 39 which are received in corresponding holes in the part 38, after which the nuts 40 are threaded on the bolts to secure the parts together with the sleeve 28 therebetween.

In Fig. 11, I have shown the part 38 as being removed, and it is to be understood that the sleeve 28 is placed on the carriage 30 which is then wheeled to the right, as viewed in this figure, until the sleeve is received within the concave surface of the part 37, after which the part 38 is put into position, as shown in Fig. 10. One of the parts is provided with a key 41 which may be placed in a corresponding keyway 42 on the sleeve 28.

In Fig. 8, I have shown the sleeve in position within the part 37 and with the connecting means 24 in engagement with the projection 26, with the sleeve slightly raised so that the carriage 30 may be rolled out of the way. A stop 43 may be provided to limit outward movement of the carriage.

In the operation of the mechanism thus far described, after the sleeve is secured in position within the guide 35, within which it is to be understood that the sleeve has a sliding fit, the press is operated to raise the head 22, this being done by pistons 44 in cylinders 45, the lower ends of the pistons being connected to the head, as plainly shown in Fig. 1.

Mounted on the heads are ears 46, within which slide vertical rods 47, these rods also passing through ears 48 in the bearings 36. These rods are preferably threaded at both ends, as plainly shown in Fig. 7, and on these threaded ends are placed nuts 49. Therefore, when the head 22 is lifted, it will also raise the guide 35 to some such position as shown in Figs. 1 and 8. The work or blank is put

in place on the standard 17, and the press is now operated to lower the sleeve 28.

During the first part of this lowering movement, the guide 35 will drop with the movement of the sleeve, because the rods 47 have no provision for preventing such movement of the guide. The guide will then come to rest on the rails 31 or, if such rails are not used, on top of the base, and the sleeve 28 and associated parts will continue their downward movement, the teeth on the cutting elements acting on the blank. This action, it will be observed, is one in which the first tooth on an element will take out a chip from the space between adjacent teeth, and each succeeding tooth will take out another chip, each chip being nearer the center of the blank than the preceding one. The last tooth, or last few teeth, may be used as finishing teeth to give the final shape to the gear teeth.

During the above operation, it will be seen that the guide 35 is in position adjacent the work, so that it effectively guides the sleeve in its downward movement. It will also be seen that the guide 35 cooperates with a guide 50 inserted in the top 51 of the base, it being understood that this guide 50 has, like the guide 35, a bore of interior diameter, so that the sleeve 28 will have an accurate sliding fit therein. The guide 50 is preferably in the form of a sleeve having an outer frusto-conical surface 52 contacting with a corresponding surface on the top 51 so that it may be accurately centered.

After the cutting is completed, the head 22 is again lifted by means of the pistons 44, it being understood that fluid may be admitted to the cylinders 45 by suitable pipes 45′. During the first part of this movement, the rods 47 will slide upwardly in the ears 48, it being understood that by the time the lowermost position of the header 22 has been reached, the lower nuts 49 have passed to points some distance below the ears 48. In other words, the movement of the rods 47 has continued while the movement of the guide 35 and its associated ears 48 has been arrested. During the lifting movement of the head, however, the time comes when the nuts 49 will engage the ears 48 and lift the guide to some such position as shown in Fig. 1. The parts are now at their initial position. The operation of the press is momentarily discontinued while the workman removes the blank 15 and replaces it with another, after which the operation is repeated.

Referring now more particularly to Figs. 1, 4, and 6, I have shown the work or blank 15 supported on the standard 17, and centered by means of a centering pin 53. Surrounding the pin, and disposed between the blank and the standard is an anti-burr plate overhanging the standard 54. This plate may have one or more pins 55 received in corresponding holes in the top of the standard 17 to coact with the centering pin 53 and properly place the plate.

On top of the plate 54 is a thin plate 56, likewise centered by the pins 53 and 55. The blank may be held in position by a clamp 57, this clamping being secured to the pin 53 by a quick-turn nut 58 cooperating with a threaded portion 59 on the upper end of the pin 53. This nut and threaded end portion may conveniently be formed in the well-known manner, wherein opposite sides of the nut and of the threaded portion of the pin are formed as flat surfaces without threads, so that the nut may be placed on the pin, and by a half turn, the threads may be quickly and tightly engaged. Such an arrangement in this particular location is of great advantage as facilitating the work of changing the blanks between operating of the press.

In operation, and when cutting the first gear, the plates 54 and 56 are circular in cross section, without teeth. The blank is then placed on top of the plates, and the press operated as described above. The result would be to cut teeth on the blank and also on the plates 54 and 56. These plates are then left in position for succeeding operations, and it will be seen that, as the cutting teeth on the elements 4 leave the blank, they will be received in spaces 60 between teeth 61 which have been cut on the plates.

The teeth 61 form substantial continuations of the teeth 62 which are formed on the gear 16, and the surfaces of these teeth will consequently be substantially continuous. In performing a cutting operation wherein the cutting tool leaves the blank, it is difficult to avoid forming a burr at this place where the knife leaves the blank.

By providing an anti-burr plate as described above, the knife in effect does not leave the blank, or, in other words, there is no chance for a burr to form, because the blank has no free surface disposed transversely to the movement of the cutting element at the point where that element leaves the blank. Any burr formed at all, must be formed at the bottom of the anti-burr plate.

I preferably use two plates 54 and 56 so that the wear may be taken up by the relatively thin plate 56, and so that this plate may be taken off and replaced by another one without removing the entire plate 54. This is evidently economical of material, because the plate 54 must be of substantial thickness. In this way also the plate 54 may be retained and used indefinitely when cutting similar gears.

While I have shown the invention as being used where the finished gear is formed by one operation, it is of course to be understood that the same or similar arrangement may be used where it may be necessary to form the gear in several operations. For example, the size or weight of the gear may be such that only some of the metal between teeth may be re-

moved at one operation, after which the gear blank would have to be moved to a different broaching machine for removal of more of the metal. Therefore, in the claims, when I refer to the forming in one operation of the space between two adjacent teeth, it is to be understood that this language refers to the space formed by one operation of the machine, this space being completely formed so far as the practical working conditions will permit.

Moreover, while I have shown the invention as embodied in a specific form, it is to be understood that various changes in details may be made without departing from the scope of the invention, and I therefore do not intend to limit myself except by the appended claims.

I claim:

1. In a device for cutting gears and the like, stationary means to support a blank, a movable tool comprising a plurality of cutting elements disposed circumferentially of said blank and each adapted to operate on said blank to completely form in one operation the space between two adjoining teeth of the blank, means adjacent the work for guiding the tool, and means for actuating said tool.

2. In a device for cutting gears and the like, stationary means to support a blank, a movable tool comprising a plurality of cutting elements disposed circumferentially of said blank and each adapted to operate on said blank to completely form in one operation the space between two adjoining teeth, means adjacent the work for guiding the tool, and means to actuate said tool to move said elements simultaneously, each of said elements forming a broach.

3. In a device for cutting gears and the like, stationary means to support a blank, a movable tool comprising a plurality of cutting elements disposed circumferentially of said blank and each adapted to operate on said blank to form the space between two adjoining teeth, means adjacent the work for guiding the tool, and means to actuate said tool to cause a plurality of said elements to simultaneously operate on said blank, each of said elements forming a broach with a plurality of teeth spaced at different distances from the center of the tool whereby each of said broaches completes a tooth at each stroke.

4. In a device for cutting gears and the like, stationary means to support a blank, a movable tool holder having a plurality of cutting elements thereon disposed circumferentially of said blank, and each adapted to operate on said blank to completely form in one operation the space between two adjoining teeth of a gear, means adjacent the work for guiding the tool, means to actuate said holder to cause said elements to simultaneously operate on said blank, and means for detachably securing said elements to said holder.

5. In a device for cutting gears and the like from plain blanks, means to support a blank, a tool holder having a plurality of cutting elements thereon disposed circumferentially of said blank, and each adapted to operate on said blank to form the space between two adjoining teeth of a gear, means to actuate said holder to cause said elements to simultaneously operate on said blank, means for detachably securing said elements to said holder, and means for simultaneously adjusting all of said elements in relation to the center of the holder.

6. In a device for cutting gears and the like, means to support a blank, a tool holder having a plurality of cutting elements thereon disposed circumferentially of said blank, and each adapted to operate on said blank to form the space between two adjoining teeth of a gear, means to actuate said holder to cause said elements to simultaneously operate on said blank, means for detachably securing said elements to said holder, and means for simultaneously adjusting all of said elements in unison in relation to the center of the holder.

7. In a device for cutting gears and the like, a fixed work holder, a fixed base having a tool guide rigid therewith and located adjacent the work holder, a frame having a tool holder movable in a fixed path thereon, means for securing said base and frame together, and means for moving said tool holder along said tool guide.

8. In a device for cutting gears and the like, a base having a tool guide rigid therewith, a frame having a tool holder movable in a fixed path thereon, means for securing said base and frame together, means on said frame adjacent said work to guide said tool holder in correct position with respect to said work, and means for moving said tool holder along said tool guide.

9. In a device for cutting gears and the like, a base having a bore therein, a rigid guide in said bore adapted to guide a tool holder therethrough, a standard rigidly secured to said base coaxially with said bore, and means on said standard to support a blank, whereby the tool moving through said guide in said bore will be disposed coaxially with respect to said blank.

10. In a device for cutting gears and the like, a tool holder in the form of a tube, a plurality of guides on the inner surface of said tube, said tube being inclined from one end of the tube towards the other, a plurality of cutting elements fitting snugly into said guides and slidable in said tube, and means to fixedly secure said elements to said holder within said guides.

11. In a device for cutting gears and the

like, a tool holder in the form of a tube, a plurality of guides on the inner surface of said holder, keys in the tool fitting snugly into said guides, said holder being inclined from one end to the other, a plurality of cutting elements slidable in said holder, and means to fixedly secure said elements to said holder within said guides, said means permitting limited adjustment of said elements longitudinally of said holder.

12. In a device for cutting gears and the like, a tool holder in the form of a tube, a plurality of guides on the inner surface of said holder, keys in the tools fitting snugly into said guides, said holder being inclined from one end to the other, a plurality of cutting elements slidable in said holder, and means to fixedly secure said elements to said holder within said guides, whereby each of said elements forms a broach.

13. In a device for cutting gears and the like, a tool holder in the form of a tubular member, a plurality of cutting elements slidably mounted on the interior of said member, means securing said elements to each member, bearing members contacting with the ends of said elements, and nuts threaded into opposite ends of said tubular member and holding said bearing members in contact with said elements.

14. In a device for cutting gears and the like, a tool holder in the form of a tubular member, a plurality of cutting elements slidably mounted on the interior of said member, means securing said elements to each member, bearing members contacting with the ends of said elements and having wedge shaped surfaces coacting with the corresponding surfaces on said elements, and nuts threaded into opposite ends of said tubular members and holding said bearing members in contact with said elements.

15. In a device for cutting gears and the like, a tool holder in the form of a tube, a plurality of guides on the inner surface of said tube, said guides being inclined from one end of the tube towards the other, a plurality of cutting elements slidable in said guides, and means for holding said cutting elements in place, comprising a member having a wedge shaped surface engaging a like surface on the ends of said cutting elements.

16. In a device for cutting gears and the like, a tool holder in the form of a tube, a plurality of guides on the inner surface of said tube, said guides being inclined from one end of the tube towards the other, a plurality of cutting elements slidable in said guides, means for holding said cutting elements in place, comprising a member having a wedge shaped surface engaging a like surface on the ends of said cutting elements, and acting to force the said cutting elements outwardly into engagement with said guides.

17. In a device for cutting gears and the like, means to support a blank, a tool comprising a plurality of cutting elements disposed circumferentially of said blank and each adapted to operate on said blank to form the space between two adjoining teeth of the gear, and means to actuate said tool to cause said elements to simultaneously operate on said blank, each of said elements forming a broach with a plurality of teeth thereon, the teeth throughout most of the length of the element being spaced at different distances from the center of the tool and the remaining teeth being at substantially the same distance from the center of the tool whereby said remaining teeth act to give a finished cut to the gear teeth.

18. In a device for cutting gears and the like, a standard, a tubular tool holder having cutting elements on the interior thereof forming a tool adapted to act on a blank on said standard, and means to reciprocate said tool holder and elements, said standard being of small diameter than the smallest inside diameter of the tool, whereby it may be received within said holder as the tool operates on the blank.

19. In a device for cutting gears and the like, a standard having a plate on the top thereof and overhanging said standard, means for securing a blank on top of said plate, and a tool movable parallel to said standard and adapted to cut teeth in said blank, the parts being so arranged that said tool will pass through said plate in its cutting movement.

20. In a device for cutting gears and the like, a standard having a plate on the top thereof and overhanging said standard, means for securing a blank on top of said plate, a tool movable parallel to said standard and adapted to cut teeth in said blank, the parts being so arranged that said tool will pass through said plate in its cutting movement, and a thin wear plate disposed between said first named plate and said blank.

21. In a device for cutting gears and the like, means to support a blank from which a gear is to be cut, a movable tool adapted to cut teeth in said gears, means to reciprocate said tool, a guide for said tool during its reciprocation, and means to move said guide with said tool during at least a part of said movement.

22. In a device for cutting gears and the like, means to support a blank from which a gear is to be cut, a movable tool adapted to cut teeth in said gear, means to reciprocate said tool, a guide for said tool during its reciprocation, means to move said guide with said tool to a point adjacent said blank, means to stop said guide at said point, and means to move said guide away from said point after completion of the cutting operation.

23. In a device for cutting gears and the like, means to support a blank from which a

gear is to be cut, means to reciprocate a tool to cut said gear, a fixed guide adjacent said blank and adapted to guide said tool past the work, a movable guide in alignment with said fixed guide, and means to move said movable guide into proximity with the fixed guide to form a substantially continuous guide for the tool when performing the cutting operation.

24. In a device for cutting gears and the like, means to support a blank from which a gear is to be cut, means to reciprocate a tool to cut said gear, a fixed guide adjacent said blank and adapted to guide said tool past the work, a movable guide in alignment with said fixed guide, means to move said movable guide into proximity with the fixed guide to form a substantially continuous guide for the tool when performing the cutting operation, and means to move said movable guide away from the blank to permit the removal thereof.

25. In a device for cutting gears and the like, a tool holder, means to reciprocate said holder, a guide for said holder in its reciprocating movement, said guide being formed of two parts, means to move said holder horizontally into position with respect to one of said parts, and means to secure the second part to the first part to form a guide for the holder.

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