

United States Patent

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| [73] | Assignee | Lear Siegler, Inc.
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- [56]

References Cited

UNITED STATES PATENTS

387,470	8/1888	Weeden	29/159.2
2,542,912	2/1951	Ensign	29/159.2
3,034,383	5/1962	Schulte et al.	72/469
3,186,210	6/1965	Leshner et al.	72/46.7
3,258,834	7/1966	Rork	29/159.2

FOREIGN PATENTS

72,333	5/1953	Netherlands	72/266
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- [54] APPARATUS FOR FORMING GEARS
2 Claims, 3 Drawing Figs.

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| [52] | U.S. Cl..... | 72/343,
72/467, 72/479, 29/159.2 |
| [51] | Int. Cl..... | B21h 5/00 |
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72/343, 352, 476, 479, 467, 469, 64; 76/89.2 |

ABSTRACT: Method and apparatus for forming a gear from a cylindrical blank by forcing it through a circular-toothed die. The ends of the teeth of the die are tapered to facilitate displacement of metal. The blank is subjected to a multiplicity of rapid impacts by means equivalent to an air hammer.

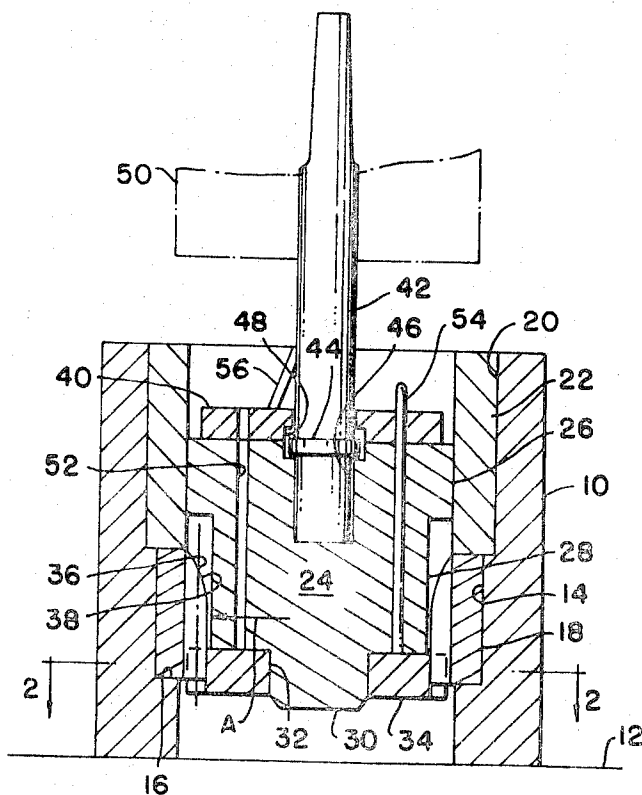


FIG. 1

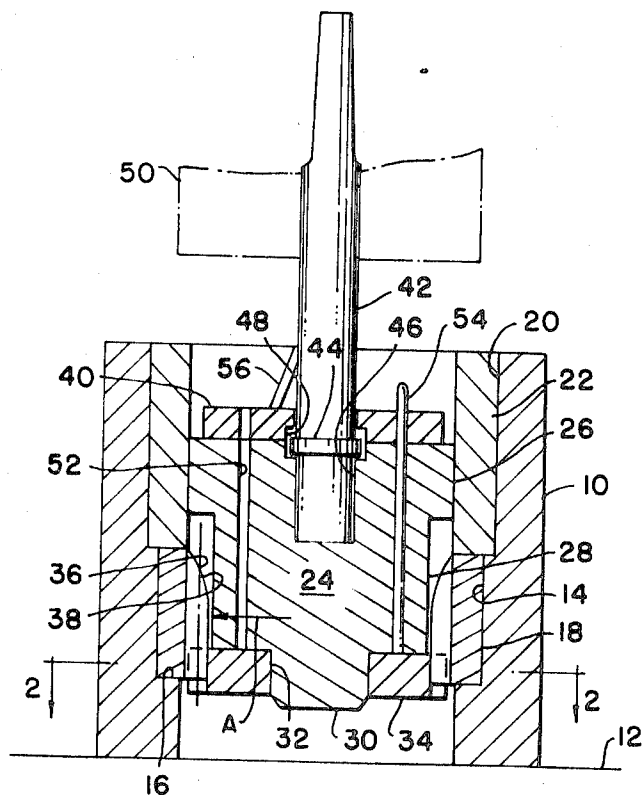


FIG. 2

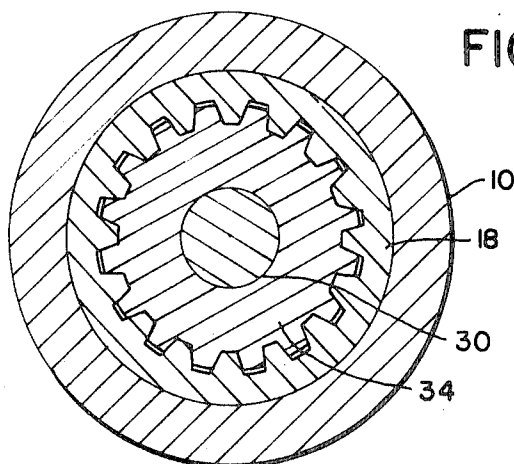
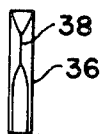


FIG.3



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APPARATUS FOR FORMING GEARS

BRIEF SUMMARY OF THE INVENTION

In accordance with the present invention a cylindrical gear or pinion, such for example as a spur or helical gear or pinion, is produced from a circular blank. The operation employs an internally toothed die the teeth of which are substantially conjugate to the teeth to be formed on the gear or pinion. The ends of the teeth are tapered preferably to a substantially sharp edge to facilitate entry of the teeth of the die into the material of the blank.

The blank is initially of a diameter approximately equal to the pitch diameter of the gear to be formed. The material displaced outwardly from the tooth spaces is approximately equal to the material appearing as portions of the teeth radially outwardly of the pitch cylinder. The actual flow of metal however, may involve lateral displacement of material from the portion of the blank which becomes tooth spaces into the dedendum portion of the gear teeth with resulting substantially radially outward displacement of the blank into the addendum portions of the gear teeth.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a longitudinal section through the apparatus for forming gears.

FIG. 2 is a section on the line 2-2, FIG. 1.

FIG. 3 is a fragmentary view looking at the top of a tooth of the die in the direction of the arrow A, FIG. 1.

DETAILED DESCRIPTION

The apparatus for forming the gear teeth comprises an outer shell 10 which is supported on a solid support surface 12. The shell is provided with an internal annular recess 14 forming a shoulder 16 on which the internally toothed cylindrical die 18 is supported. Mounted within a second internal enlargement 20 within the shell is an annular pilot 22.

Vertically movable inside the pilot 22 is an arbor 24 having a cylindrical enlargement 26 fitted to slide within the pilot 22. Below the enlargement 26 the arbor is reduced as indicated at 28 to a diameter having slight clearance as indicated with the crests of the teeth of the die. At its lower end the arbor 24 is further reduced having a portion 30 received within the opening 32 in an annular blank 34.

The die 18 is provided with a multiplicity of teeth 36, the teeth being tapered both laterally and radially, as best seen in FIG. 3 to provide a substantially sharp entering edge 38 to initiate the flow of metal from the portions of the blank which are to be tooth spaces into the portions of the blank which are to be teeth.

The arbor 24 has an annular plate 40 fixed thereto adapted to retain the arbor on a driver or spud 42 having a radial flange 44 formed thereon. The end of the driver 42 beyond the flange 44 is received in a recess 46 formed at the top of the arbor, and the recess and plate 40 are formed to provide an annular pocket 48 in which the flange is received. With this arrangement there is limited vertical movement permitted between the arbor 24 and the driver 42.

Means are connected to the driver 42 for imparting a multiplicity of rapid blows or impacts of substantial amount. This means may for example take the form of a conventional air hammer, a portion of which is indicated diagrammatically in broken lines at 50.

The magnitude of the impacts required to drive the gear blank through the die will depend upon several factors, among which are the material of the blank, the size of the blank, and the pitch of the gear teeth. In general, it may be said that the magnitude of these impacts may be on the order of several hundred foot-pounds.

Means are provided to separate the finished work gear from the reduced end 30 of the arbor 24. This means may take the form of a plurality of air passages 52 connected to a suitable supply of compressed air (not shown), pressure being ad-

mitted to the passages after the work gear 34 has passed beyond the ends of the teeth 36 of the die 18. Alternatively, mechanical means may be provided for this purpose comprising ejector pins 54 extending through suitable openings in the die in combination with means (not shown) effective to force the pins downwardly to separate the finished gear 34 from the die. It will be appreciated that in some cases the forces developed in the formation of teeth on the exterior of the blank will cause some reduction in size of the opening 32 in the blank so that the finished gear may be tightly engaged on the reduced portion 30 of the arbor.

It will be understood that the arbor with the gear firmly assembled thereon moves in slight increments of axial motion as a result of the impacts delivered thereto by the driver 42. The driver 42 will have a limited reciprocating motion, the inner end separating slightly from the bottom of the recess 46 on its upward movement and impacting this surface when driven forward by means of the air hammer or equivalent driving mechanism associated with the driver.

The radially outwardly extending flange 44 is trapped within the annular pocket or channel 48 in the assembly of the die 24 and plate 40 so that the arbor may be elevated by upward movement of the driver 42 after a finished gear has been separated from the arbor, in order to provide for placement of a succeeding blank on the arbor in position to again be driven by a series of blows or impacts through the die.

In the foregoing the illustration has been of spur teeth formed on a cylindrical blank, but it is to be understood that the invention may be practiced in an operation which produces helical teeth on the blank. The only requirement is that the teeth of the die be correspondingly helically formed. After the tapered entering end of the die teeth have entered sufficiently into the work blank, subsequent blows or impacts result in developing both axial forces and forces tending to rotate the blank in the helical die. The teeth of the die are of such length from end to end as to provide adequate engagement of fully formed die teeth so as to produce the correct lead or helix angle on the teeth of the gear of the blank.

Alternatively, the rotation imparted to the blank 34 in order to develop helical teeth thereon may result from helical guide means acting between the arbor 24 and the pilot 22. Thus, for example, helical teeth, one of which is indicated at 56, may be provided on the interior of the pilot 22 and on the exterior of the enlarged portion 26 of the arbor. Since these helical tooth formations will be engaged for the full axial extent of the enlarged portion 26 of the arbor, a good guiding action will be obtained, and the tendency to distort the teeth of the work blank, at least during their initial formation, will largely be avoided.

The drawing and the foregoing specification constitute a description of the improved method and apparatus for forming gears in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What I claim as my invention is:

1. Apparatus for forming an external gear from an annular blank having an outer cylindrical surface whose diameter is substantially equal to the pitch diameter of the gear to be formed, comprising an internally toothed annular die having longitudinally tapered teeth, a stationary support for said die engaging said die outwardly of the tooth spaces thereof, a cylindrical pilot in alignment with said die, a movable blank support comprising an arbor having a cylindrical portion slidable longitudinally in said pilot, a reduced portion adapted to enter into and guidingly support the blank, and an annular radial shoulder engaging a side of the blank, a driver loosely connected to said arbor, and means for reciprocating said driver to deliver a multiplicity of rapid impacts of a magnitude on the order of several hundred foot-pounds from said driver directly to said arbor to drive said blank through said die.

2. Apparatus as defined in claim 1 in which helical teeth are formed on the blank comprising helical teeth on said die, and helical teeth extending between the pilot and the portion of the arbor slidable longitudinally therein.