

(No Model.)

E. W. BLISS.
GEAR WHEEL.

No. 472,664.

Patented Apr. 12, 1892.

FIG. 1.

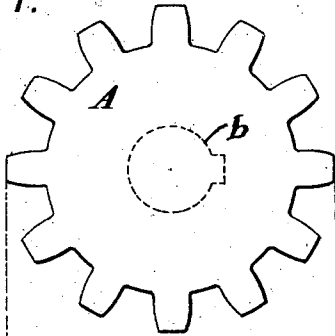
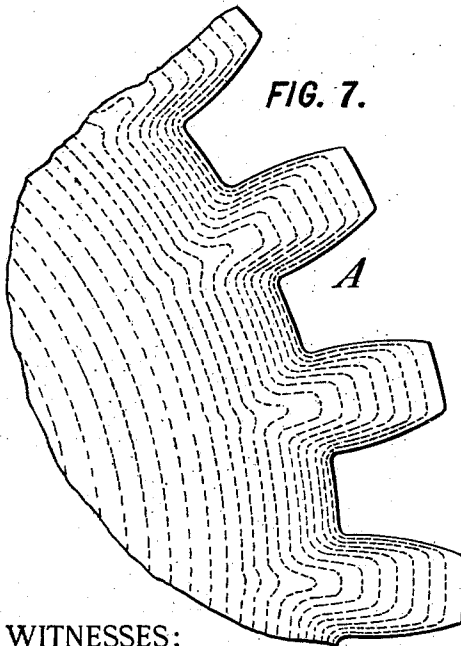


FIG. 2.



WITNESSES:

John Becker
Fred White

FIG. 3.

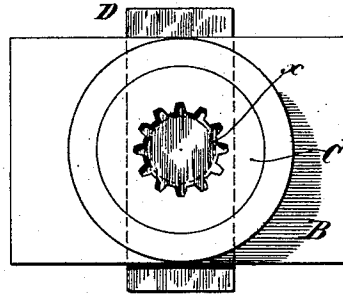


FIG. 4.

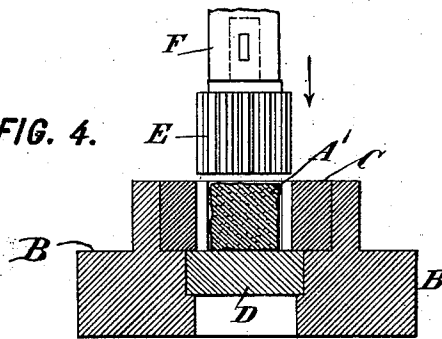


FIG. 5.

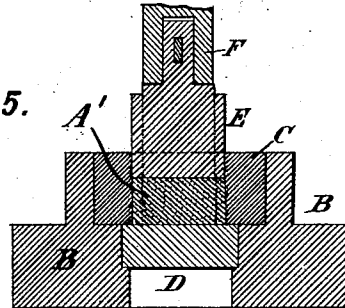
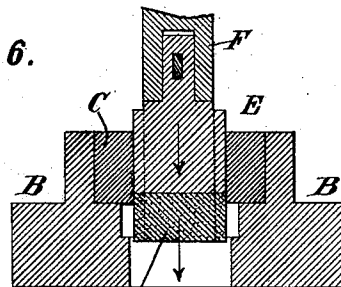


FIG. 6.



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ELIPHALET W. BLISS, OF NEW UTRECHT, ASSIGNOR TO THE UNITED STATES
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GEAR-WHEEL.

SPECIFICATION forming part of Letters Patent No. 472,664, dated April 12, 1892.

Application filed January 28, 1892. Serial No. 419,601. (No model.)

To all whom it may concern:

Be it known that I, ELIPHALET W. BLISS, a citizen of the United States, residing in New Utrecht, in the county of Kings and State of New York, have invented certain new and useful Improvements in Gear - Wheels, of which the following is a specification.

Metal gear-wheels are now commonly made by either casting or cutting. Cast-metal gears are subject to the defects inherent in cast metal, the better grade of gears being made of wrought metal and the teeth formed by cutting or milling out the spaces between them from the solid metal. Such gears are very expensive and are somewhat weakened by the cutting process, which severs the grain of the metal.

My invention provides an improved gear of wrought metal, wherein the teeth are formed by compression, so that the metal is caused to flow and the grain of the metal is continuous instead of being interrupted, as in cut gears. A block or billet of wrought metal, preferably of steel, is heated to the proper temperature and is placed in a die, the inner surface of which is formed with teeth conforming to those to be formed on the gear-wheel. A male die or punch is then forced into the female die by hydraulic or other suitable pressure, whereby the wrought metal is squeezed and forced into the spaces between the teeth of the female die, filling the latter completely and being compressed so as to present a homogeneous mass of metal. The block of metal which has been thus converted into a gear is then forced out of the female die, and after cooling it is bored out, and, if necessary, dressed up in a gear-cutter to smooth the surfaces of the teeth. The gear thus made has the grain of the metal flowing from the body of the gear into the respective teeth without interruption, so that its teeth are much stronger and less liable to break off than with cut gears. At the same time it retains every advantage that wrought gears have over those made of cast metal.

Figures 1 and 2 of the accompanying drawings show a gear or pinion made according to my invention. Fig. 3 is a plan of one form of female die, such as may be used in making

these gears. Figs. 4, 5, and 6 are vertical sections of the dies, showing the successive operations of making the gear. Fig. 7 is a fragmentary plan of the gear on an enlarged scale, showing approximately the direction of the grain of the metal.

The gear A (shown in Figs. 1 and 2) does not differ materially in appearance from ordinary cut gears, but differs essentially therefrom in the direction of the grain of the metal, which, by reason of the pressure, has been distorted and forced to flow into the teeth in lines following the outlines of the teeth and more or less parallel therewith, as shown approximately in Fig. 7. By reason of the uninterrupted grain of the metal the gear-teeth are much stronger than in cut gears, wherein the grain of the metal is necessarily interrupted by cutting out the spaces between the teeth. The metal of the gear is also more compact and tougher than that of ordinary cut gears by reason of the heavy hydraulic pressure to which it has been subjected. The surfaces of the teeth are especially much more dense than in ordinary cut gears, since the metal has been forced into such intimate contact with the inner surfaces of the die, thereby forming, as is believed, a comparatively tough and hard skin or layer by reason of the pressure and perhaps, also, of the chilling effect of the comparatively cool die. In consequence my improved gear is not only stronger than any heretofore made, but there is reason to believe that it will also prove more durable.

In order to enable those skilled in the art to produce gears according to my invention, I will describe one method by which they may be made, although I do not herein claim nor do I confine myself to any method of or apparatus for making these gears.

Referring to Figs. 3 to 6, let B designate the bed or table of a hydraulic press, and C a female die embedded therein, having internally-formed gear-teeth conforming to those to be made on the gear. The bottom of this die is closed by a slide D, which should be made with parallel sides and with a slightly wedge-shaped bottom, so that when driven in its upper surface shall be forced up firmly against the under side of the die. The male die or

punch E is fastened to the upper member or ram F of the press and is formed with external teeth, which are counterparts of those on the gear to be made. Both the male and female dies, however, should be of greater height than the length of the gear. The block or billet of steel or other metal should be of such diameter as to easily drop into the lower die—for example, as shown by the dotted circle *x* in Fig. 3—and should be of a height somewhat greater than the length of the finished gear in order to provide sufficient metal for lateral expansion into the teeth of the die. In Fig. 4 this billet is shown at A' as having been placed in the female die and the male die being brought down upon it.

Fig. 5 shows the completion of the compressing operation. The male die has forced the metal A' to flow laterally and completely fill the female die. After sufficient pressure has been thus exerted the male die is lifted slightly to relieve the pressure on the slide D, whereupon the latter is driven out and the male die is again brought down to force the metal block or gear A' out through the open bottom of the die, as shown in Fig. 6. The pressed gear thus made drops out through the bed of the press, and upon cooling is ready to be bored and formed with a keyway, as shown in dotted lines at *b* in Fig. 1. If necessary, it may be put in a gear-cutter and given a light finishing cut to make its teeth more accurate; but if the female die C is made with its teeth

very smooth and accurately cut and with the proper allowance for the shrinkage of the metal in cooling this finishing cut will not be necessary, as the surface of the teeth of the gear will be made very smooth and hard, and will receive a further polish in the act of forcing it out of the female die.

Although steel is the preferable metal for making my improved gears, yet other metals may be employed—as, for example, wrought-iron, phosphor-bronze, &c.

I claim as my invention the following defined novel features, substantially as hereinbefore specified, namely:

1. A gear-wheel of wrought metal, having compressed cog-teeth.
2. A wrought-metal gear-wheel having the grain of the metal distorted into the teeth.
3. A wrought-metal gear-wheel having the grain of the metal curving from tooth to tooth following the outlines of the teeth.
4. A gear-wheel of compressed wrought metal, having its cog-teeth formed by compression with the grain of the metal distorted into the teeth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

ELIPHALET W. BLISS.

Witnesses:

W. A. PORTER,
E. C. REDHEAD.