April 24, 1928. 1,666,955

H. H. ASBRIDGE

GRINDING OF GEAR WHEEL TEETH

Filed June 11. 1926 3 Sheets-Sheet 1

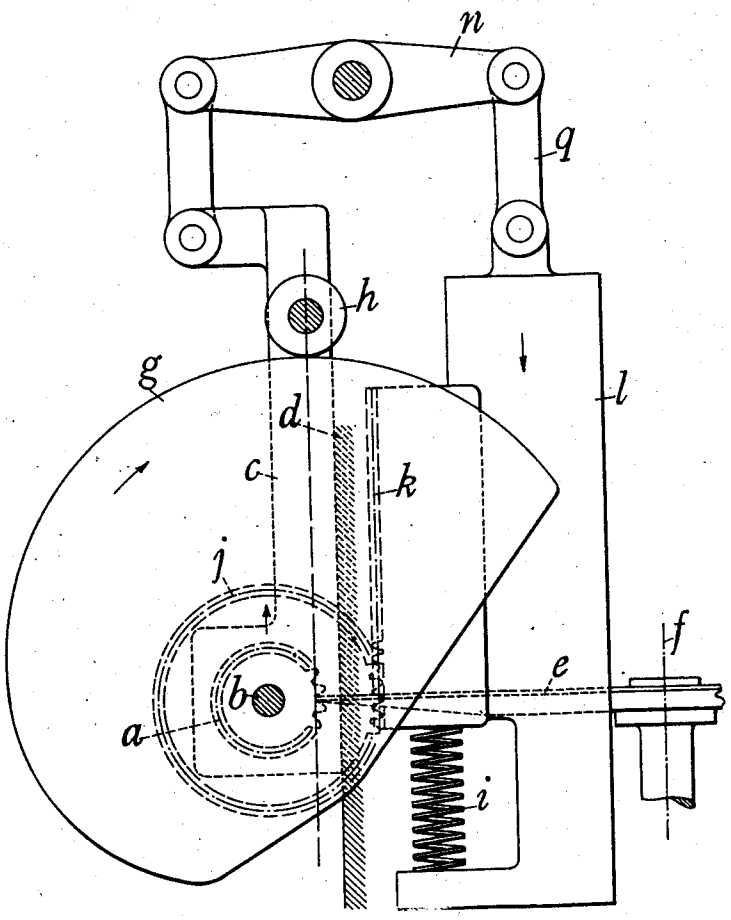


Fig.1

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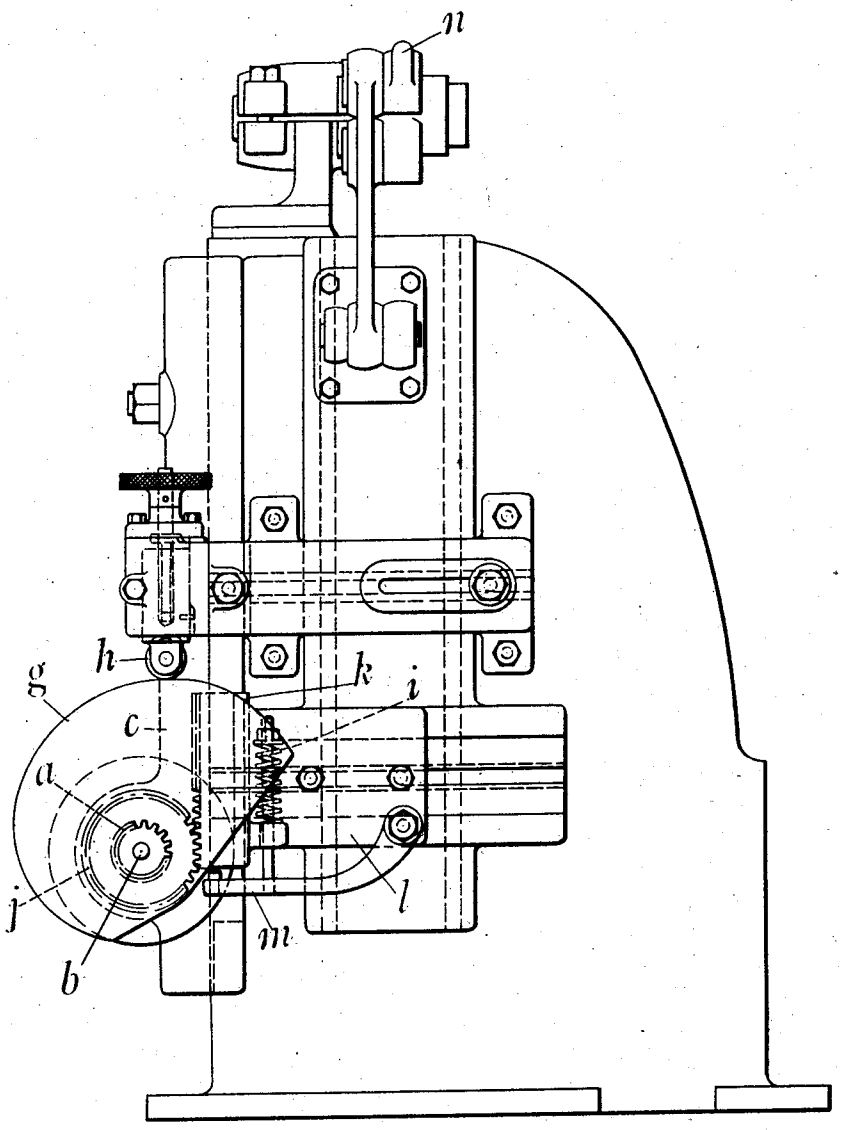


Fig.2

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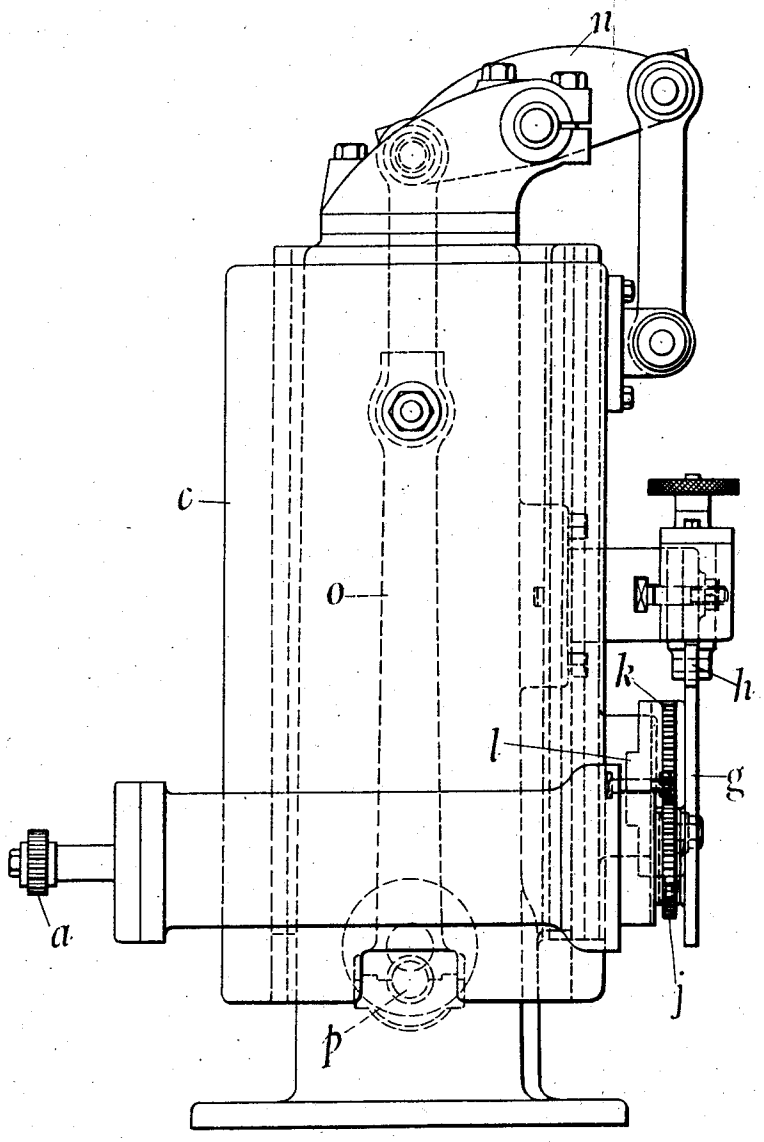


Fig 3

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UNITED STATES PATENT OFFICE.

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GRINDING OF GEAR-WHEEL TEETH.

Application filed June 11, 1926, Serial No. 115,400, and in Great Britain November 24, 1925.

The problem of grinding the faces of gear wheel teeth for the purpose of imparting to them accurately a predetermined form, by methods involving the rolling of the wheel relatively to the flat surface of a revolving grinding disc, is one which has been attacked in a number of ways.

For the purpose of elucidating my present invention I will refer to three known methods of procedure, all of them having this in common, that during the grinding operation, the wheel is reciprocated relatively to the grinding disc by means of a slide, and during reciprocation has imparted to it an angular motion about its axis.

The method described by Noyes in his British Patent specification No. 107,608 is characterized in this that a templet or cam corresponding in shape to one face of the tooth is secured to the spindle carrying the wheel to be ground and arranged to bear against a fixed abutment. In one direction of motion of the slide carrying the wheel the latter is rocked in one direction by the interaction of the templet and abutment. During the reverse motion of the slide the wheel is rocked in the other direction by a spring which keeps the templet in contact with the abutment.

The second method is that described by Boella in his British specification No. 159,503. Boella mounted on the spindle carrying the wheel to be ground an accurately shaped master or pattern wheel of the same size engaging a fixed rack, so that reciprocation of the wheel by the slide was accompanied by an angular motion of the wheel about its axis. To avoid slackness or backlash between the master wheel and the rack one tooth on the rack was made free and was pressed in the direction of an adjacent fixed tooth by means of a spring.

The third method is that of The Lees Bradner Company, described in their British specification No. 195,381. In this method a double acting cam fixed on the spindle carrying the wheel to be ground is located between a pair of fixed abutments so that during the reciprocation of the slide carrying the wheel positive angular motions are imparted to the wheel about its axis in both directions of movement.

Each of the methods above described though possessing certain features in common are distinguished by the other features above mentioned, and represent different attempts to overcome the well known mechanical difficulties associated with the problem under consideration.

My experience in the construction of gear grinding machines leads me to the conclusion that the method in which a templet acting on a single fixed abutment for producing angular motion of the wheel in one direction and a spring for producing the opposite angular motion contains the maximum of advantages, but in the form proposed by Noyes is inconvenient, and, is indeed, impracticable where a rapid rate of working is required. The difficulty is occasioned by the fact that a large angular movement of the cam is necessary (usually about 120°), and this necessitates correspondingly large compressions or extensions of the spring, with the result that breakage of the spring and other difficulties are liable to occur. Further in order that the templet shall be kept at all times in contact with the abutment when operating at high speeds the strength of the spring must be such that other complications are introduced.

The disadvantages of the spring method proposed by Noyes have been obviated in the Boella and The Lees Bradner Company methods by the elimination of the spring but not without incurring difficulties.

The object of the present invention is to provide a machine in which the spring with its advantages are retained and its disadvantages are eliminated. Stated otherwise, the object of my invention is to provide a mechanism in which the angular motion of the wheel is obtained in the one direction by the interaction of a templet and a fixed abutment, and in the other direction by a spring the movement of which is less than, and may be much less than, that corresponding to the movement of the templet.

Briefly, the invention comprises the mounting of the spring on a movable carrier the

movements of which are coordinated with those of the slide carrying the toothed wheel. In particular the invention comprises the mechanical arrangements hereinafter described.

In the three accompanying sheets of explanatory drawings:—

Figure 1 is a diagram showing schematically one manner of carrying my invention into effect.

Figures 2 and 3 are side and front elevations showing a portion of a gear grinding machine embodying the mechanism illustrated in Figure 1.

Referring to Figure 1, the toothed wheel *a* to be ground is secured to a spindle *b* which is carried on a slide *c* capable of reciprocating on a guide *d*. The grinding disc is indicated by *e*. This has a flat upper face on which each tooth face rolls in turn. The disc revolves about an axis *f*. As before, the rolling of the toothed wheel is obtained by a combined reciprocatory movement of the slide *c* and an angular movement about the axis of the spindle *b*. The angular movement in one direction is obtained by a suitably shaped templet *g* which is secured to the spindle *b* and which makes contact at its periphery with an abutment roller *h* fixed on any convenient stationary part of the machine frame. The angular movement in the opposite direction during the return stroke of the slide is obtained by the spring *i* which is arranged to operate in the following manner. On the spindle *b* is secured a toothed wheel *j*, preferably of twice the diameter of the wheel being ground. This engages with a rack *k* slidably mounted on a slide *l*. The spring *i* is carried on the slide and is so arranged in conjunction with the slide and the rack that movement of the rack relatively to the slide in one direction is resisted by the spring. The slide *l* is connected to the main slide *c* in any convenient manner such as by means of a lever *u* and links *q* so that they receive equal but opposite movements.

The spring *i* is always under suitable compression. Starting from the position shown in Figure 1, the slide *c* moves upwards and during this movement the interaction of the templet *g* and its abutment *h* causes the toothed wheel *a* to turn through the required angular distance relatively to the disc *e*. At the end of this movement the wheel is actually carried by the slide clear of the disc to allow the wheel to be moved about its axis relatively to the templet for the purpose of bringing a face of the next tooth into action, but this operation can be disregarded for the present. During the upward movement of the slide *c*, the slide *l* moves downward, carrying the spring with it. Also the rack *k* moves downward by reason of its engagement with the toothed wheel *j*. Any relative movement between the parts *k* and *l* is accommodated by the spring. During the downward motion of the slide *c* (accompanied by an upward movement of the slide *l*) the templet *g* is held in contact with the roller *h* by the spring acting through the rack *k* and wheel *j*.

Usually the variation in length of the spring during the cycle of operations is small, and never is it large in comparison with the angular movement of the templet. The mounting of the spring on a movable carrier enables me, therefore, to obviate the difficulty of the previous spring arrangement in which one end is stationary, and to secure all the advantages associated with the use of a templet acting in conjunction with a single abutment.

Referring now to Figures 2 and 3, the practical embodiment of the invention there shown will be readily followed from the above description, the parts being identified by the same reference letters. Instead of arranging the spring to act directly on the slide *l* and rack *k*, it is arranged in conjunction with a lever *m* carried on the slide *l*. The slides *c* and *l* are coupled by a centrally pivoted and equal armed lever *n* mounted at the upper end of the frame or standard of the machine. Reciprocation of the slide *c* is effected by a connecting rod *o* actuated by a crank *p*. The roller abutment *h* is mounted adjustably on the machine standard as shown.

As already stated, the slide *c* is given a movement in excess of that required for actual grinding in order that during each cycle the wheel may be carried clear of the grinding disc for indexing purposes, that is to say for intermittently bringing another tooth face into position for grinding. The necessary rotation of the spindle relatively to the templet during indexing is effected by any suitable means, and to avoid complication such means have been omitted from the drawings.

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

1. In a gear cutting machine, a grinding disc having a flat face, a templet and stationary abutment, the rolling of a tooth face relatively to the flat grinding face being effected, in one direction, by the interaction of said templet and stationary abutment, a spring for effecting rolling of the tooth in the opposite direction, means comprising a movable carrier for the spring, and means for co-ordinating the movements of the carrier with those of a member carrying the toothed wheel, substantially as described.

2. In gear grinding machines of the kind specified, the combination comprising a pair of slides, means for producing opposite reciprocatory movements of the slides, a work

spindle on one of the slides, a templet on the spindle, an abutment carried on the fixed frame of the machine in contact with the templet, a toothed wheel on the spindle, a rack carried by the other slide and engaged by the said toothed wheel, the rack being movable relatively to its slide, and a spring the action and reaction of which are taken by the rack and its slide respectively, substantially as described.

3. In gear grinding machines of the kind specified, the combination comprising a pair of slides, means for producing opposite reciprocatory movements of the slides, a work spindle on one of the slides, a templet on the spindle, an abutment carried on the fixed frame of the machine in contact with the templet, a toothed wheel on the spindle, a rack carried by the other slide and engaged by the said toothed wheel, the rack being movable relatively to its slide, a lever supporting the rack and pivoted on the slide carrying the rack, and a spring acting on the lever, substantially as described.

In testimony whereof I have signed my name to this specification.

HARRY HALES ASBRIDGE.