R. B. WEAVER.

PROCESS OF GRINDING GEARS.

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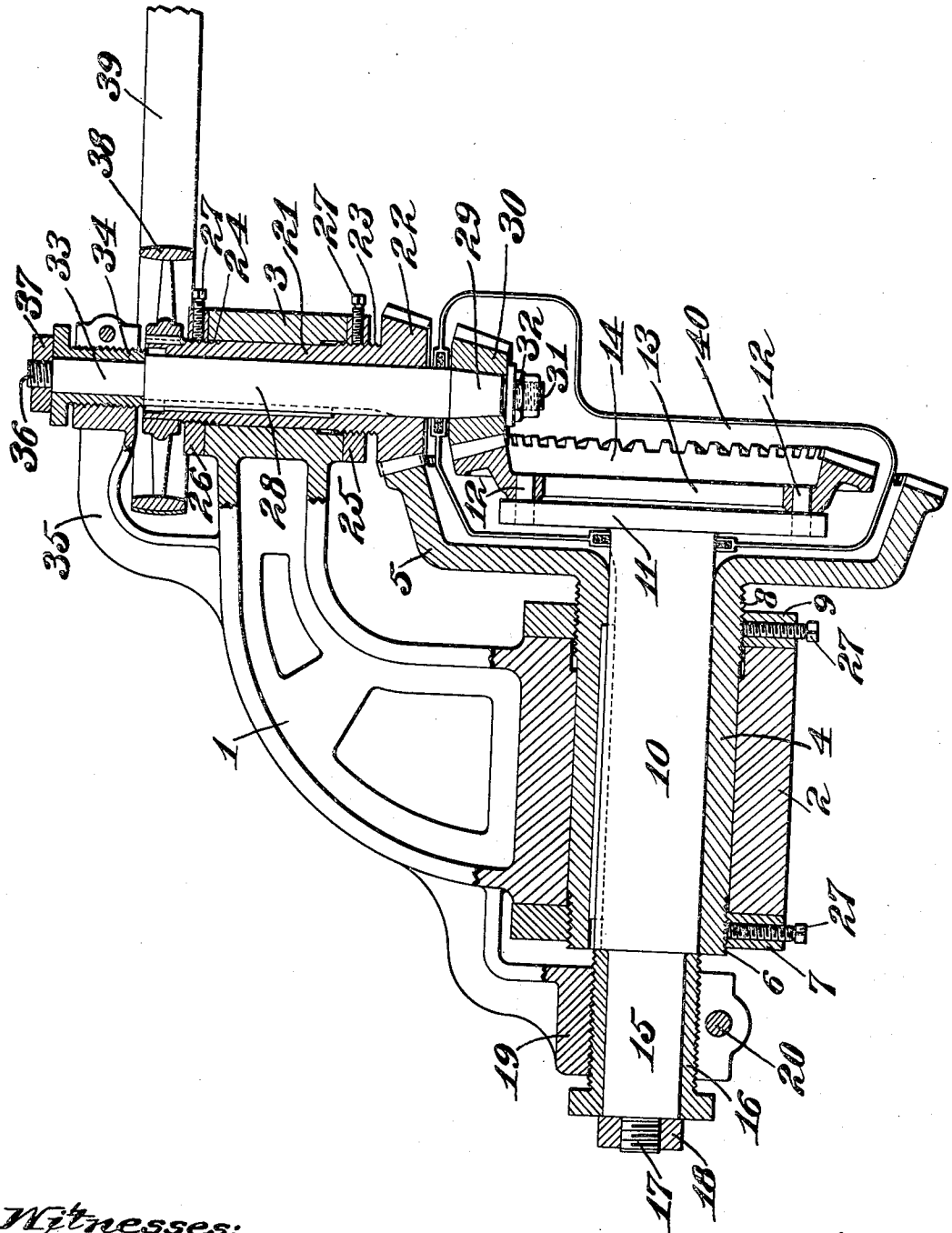

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UNITED STATES PATENT OFFICE.

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To all whom it may concern:

Be it known that I, ROBERT B. WEAVER, a citizen of the United States, and a resident of the city of Detroit, in the county of Wayne and State of Michigan, have invented a new and useful Improvement in Processes of Grinding Gears, of which the following is a specification.

This invention relates to the grinding and finishing of gears and it has for its principal object to remove the high spots on the rubbing surfaces or teeth of coöperating gears without materially affecting or multiplying the low spots.

In many cases it is absolutely necessary that the rubbing surfaces and teeth of cooperating driving gears, including bevel, spur and other toothed gears, and spiral and worm gears, be accurately shaped and free of appreciable high and low spots to secure a smooth and quiet-running action.

There have been numerous devices arranged for grinding coöperating gears where one of the gears being ground is driven directly by the companion gear also being ground, the rubbing faces of both of which are ground with emery or other abrasive material sprinkled thereon. This, however, has not been a success, because if there is any irregularity in the spacing of the rubbing surfaces or teeth, although infinitesimal, it is maintained until the grinding is finished. In fact, it will at times grow worse.

The present invention consists essentially in positively driving two or more coöperating or intermeshing gears in fixed relation and free of back lash and at their proper velocity ratio by means independent of or external to themselves.

The invention further consists in the steps and combinations of steps hereinafter specified and pointed out in the claims.

To illustrate an application of the present invention, I have shown in the accompanying drawing a machine adapted for grinding and finishing bevel gears, the figure showing the device partly in elevation and partly in section.

As illustrated in the drawing, the machine comprises a yoke or frame 1 having two bearing portions 2 and 3, respectively, arranged at right angles to each other. Journaled in the bearing portion 2 is a spindle 4 having on its inner end a bevel gear 5. The outer end portion of the spindle 4 is screw-threaded, as at 6, to receive an internally screw-threaded ring or collar 7, and the portion adjacent to the gear 5 is also screw-threaded, as at 8, to receive a similar ring or collar 9. The rings 7 and 9 are adapted to bear respectively against the opposite ends of the bearing portion 2; and by adjusting said rings on the spindle 4 the latter is also adjusted lengthwise in its bearing.

The spindle 4 is bored axially to receive a cylindrical shank portion or stud 10 of a gear-holder which is splined or feather-keyed to rotate fixedly therewith, but permitted independent endwise movement. The shank is provided on its inner end with a face-plate or disk 11 having pins 12 adapted to fit perforations in an annular portion 13 of a bevel gear 14 to be ground, as hereinafter set forth. The outer end portion 15 of the shank 10 is reduced considerably in diameter and is rotatably fitted in a bearing sleeve 16, while the extreme end portion 17 is further reduced and screw-threaded to receive a retaining nut or thrust collar 18.

The bearing sleeve 16 is externally screw-threaded and secured in a screw-threaded bore in the split lower portion of a bracket extension 19 on the yoke or frame 1; and a clamping bolt 20 is obviously provided on the split portion of the bracket extension 19 whereby the bearing sleeve may be securely held in position. By adjusting the bearing sleeve in and out on the bracket extension 19, obviously the shank 10 carrying the face-plate or disk 11 is also adjusted with respect to the spindle 4.

Journaled in the bearing 3 is a spindle 21 having on its inner end a bevel pinion 22 adapted to mesh with the master gear 5. It is to be here noted that the gear 5 and pinion 22 are accurately and correctly cut so

as to fit snugly with no back lash. The spindle 21 is screw-threaded, as at 23 and 24 to receive thrust collars 25 and 26, respectively, similar to the collars 7 and 9 which are provided on the above mentioned spindle 4. By adjusting the respective collars on the spindles 4 and 21, said spindles may be adjusted so that the gear 5 and pinion 22 are brought together into proper mesh. The several thrust collars may be held in place by set screws 27 or other suitable securing devices.

The spindle 21 is bored axially to receive a shank or stud 28 which is splined to rotate fixedly therewith, but permitted endwise adjustment in a manner similar to the before mentioned shank 10. The inner end portion 29 projects beyond the pinion 22 and is tapered to receive a counterpart axial taper bore or seat in a bevel pinion 30 to be ground in connection with the gear 14. The extreme end portion 31 of the shank or stud 28 is reduced and screw-threaded to receive a securing nut 32 adapted to clamp the pinion 30 on the taper 29.

The outer end portion 33 of the shank or stud 28 is reduced in diameter and journaled in a bearing sleeve 34 adjustably mounted in a bracket extension 35 of the frame 1 in a manner similar to the before mentioned bearing sleeve 16. The extreme outer end portion 36 of the shank is further reduced and screw-threaded to receive a retaining nut or thrust collar 37.

The master gears may be driven by any suitable means, but a pulley 38 is preferably keyed onto the upper end portion of the spindle 21 which carries the pinion 22; and this pulley is driven by a belt 39. The abrasive material may be dusted or sprinkled onto the gear teeth by hand or from a suitable chute; but it is preferable to place a casing 40 about the gears to be ground to retain the grinding material in contact with said gears.

In the operation of the machine, the gears to be ground are placed on the respective holders therefor, and the spindles for the master gear 5 and pinion 22 are adjusted in their bearings so that said gear and pinion mesh with exact nicety and without back lash. The respective bearing sleeves 16 and 34 are next adjusted in the bracket extensions 19 and 35 so that the carriers for the gears to be ground are adjusted with respect to the spindles of the master gears to bring said gears to be ground just so closely together that, when they are revolved, they touch on a few of the high spots of their rubbing faces. Then the abrasive material is applied to the gears or filled into the casing 40, as the case may be, and the gears are rotated together. The master gears being accurately cut and set in mesh without any back lash, the gears which are to be ground are compelled to revolve at their correct velocity ratio, irrespective of any high spots or low spots, and the abrasive material acts upon the touching high spots without affecting the low spots. After the gears are run in this position for a short time, they are adjusted closer together until they touch at other high spots, and so on. As the high spots are gradually worn down, the gears are fed closer together until a uniform bearing is had all over the surface of the teeth. Obviously, therefore, this uniform bearing will then represent an absolutely uniform and correct velocity ratio between the two gears which have thus been ground. By this method of grinding, bevel and other gears are produced which are extremely accurate and quietly running.

It is to be understood that the machine itself forms no part of the present invention and my process is not limited to any particular form of gear, but includes bevel, spur and other toothed gears, and spiral and worm gears. In fact, all forms of gears whose coöperating rubbing surfaces or teeth must be accurately shaped and polished.

What I claim is:

1. The process of grinding gears which consists in placing a set of gears ready to be ground in coöperative working relation and driving said gears with continuously invariable velocity ratio by means independent of themselves.

2. The process of grinding gears which consists in placing the gears to be ground in coöperative working relation and driving such gears with continuously invariable velocity ratio in the presence of an abrasive material.

3. The process of grinding gears which consists in placing a set of gears to be ground in coöperative working relation until the high spots of the coöperating rubbing faces touch, driving such gears positively by means independent of themselves while maintaining abrasive material in contact with the tooth faces and feeding said gears closer together as the high spots are worn down, until the final coöperative working relation of the gears is reached.

4. The process of grinding mating gears which consists in driving said gears by positive means at uniform speeds, the respective speeds bearing the same ratio to each other as the velocity ratio of said gears, and gradually bringing the teeth of said rotating gears into mesh with each other in the presence of an abrasive material.

5. The method of grinding gears which consists in placing a set of gears to be ground in coöperative working position, fixing said gears respectively to coöperative master gears which are accurately formed

and fitted to operate free of back lash and correlated to the respective gears to be ground so as to positively drive them at continuously invariable velocity ratio, driving said gears, and maintaining an abrasive material in contact with the rubbing faces of the gears.

Signed at Detroit, Michigan, this 25th day of September, 1911.

ROBERT B. WEAVER.

Witnesses:
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