May 25, 1926. 1,585,902

D. F. DOMIZI

MILLING DEVICE

Filed Oct. 12, 1922 3 Sheets-Sheet 1

Fig. 1.

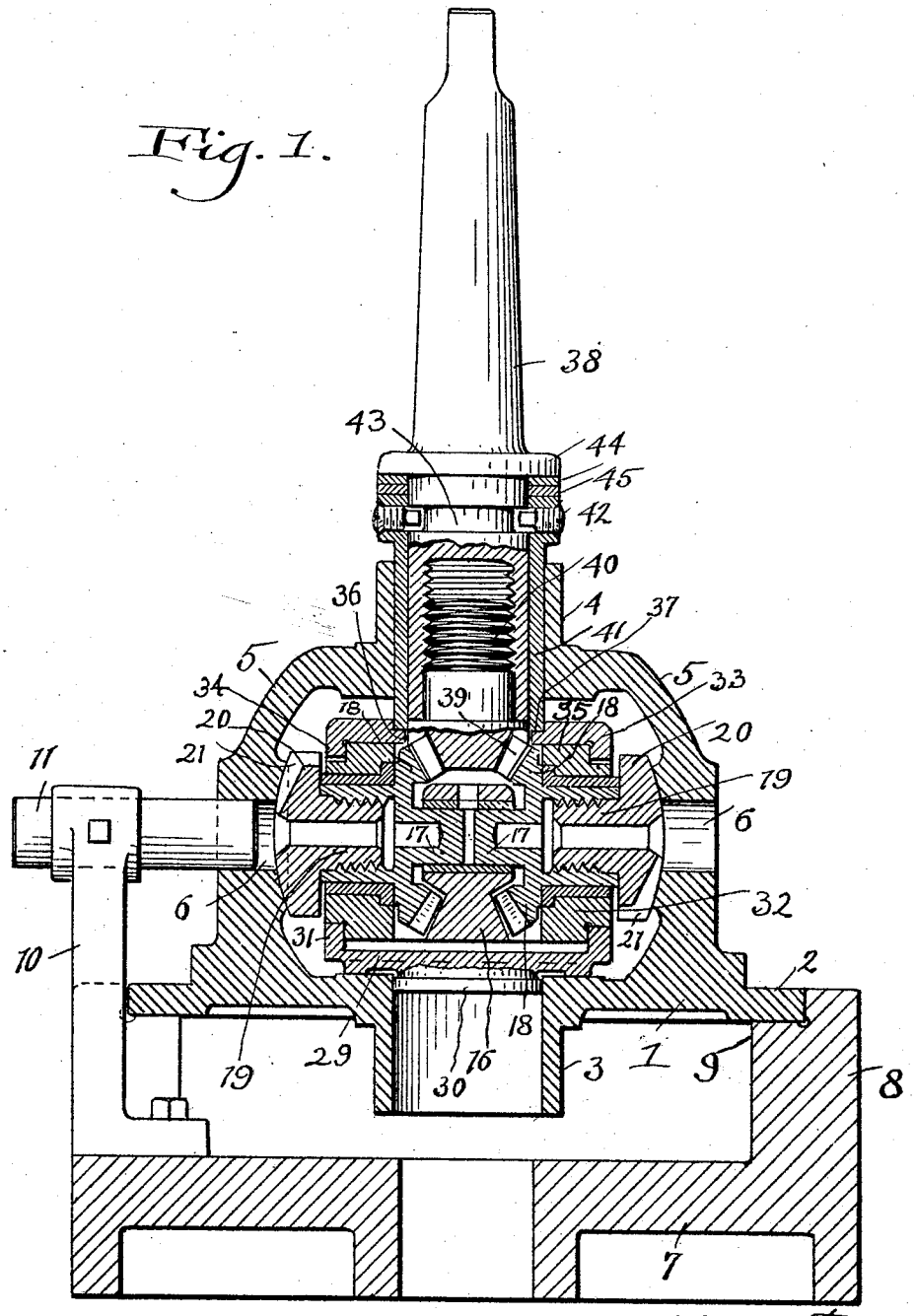

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Fig. 2.

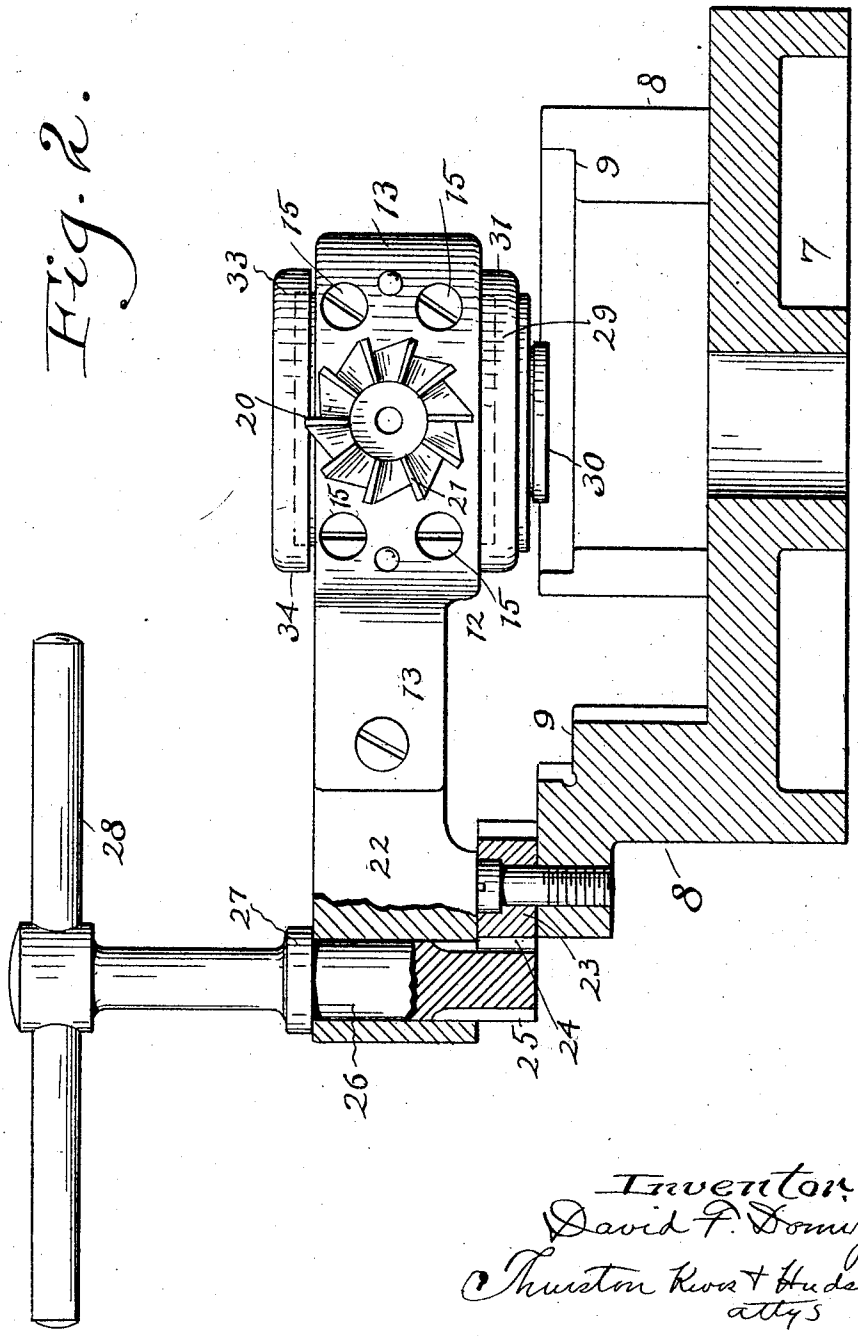

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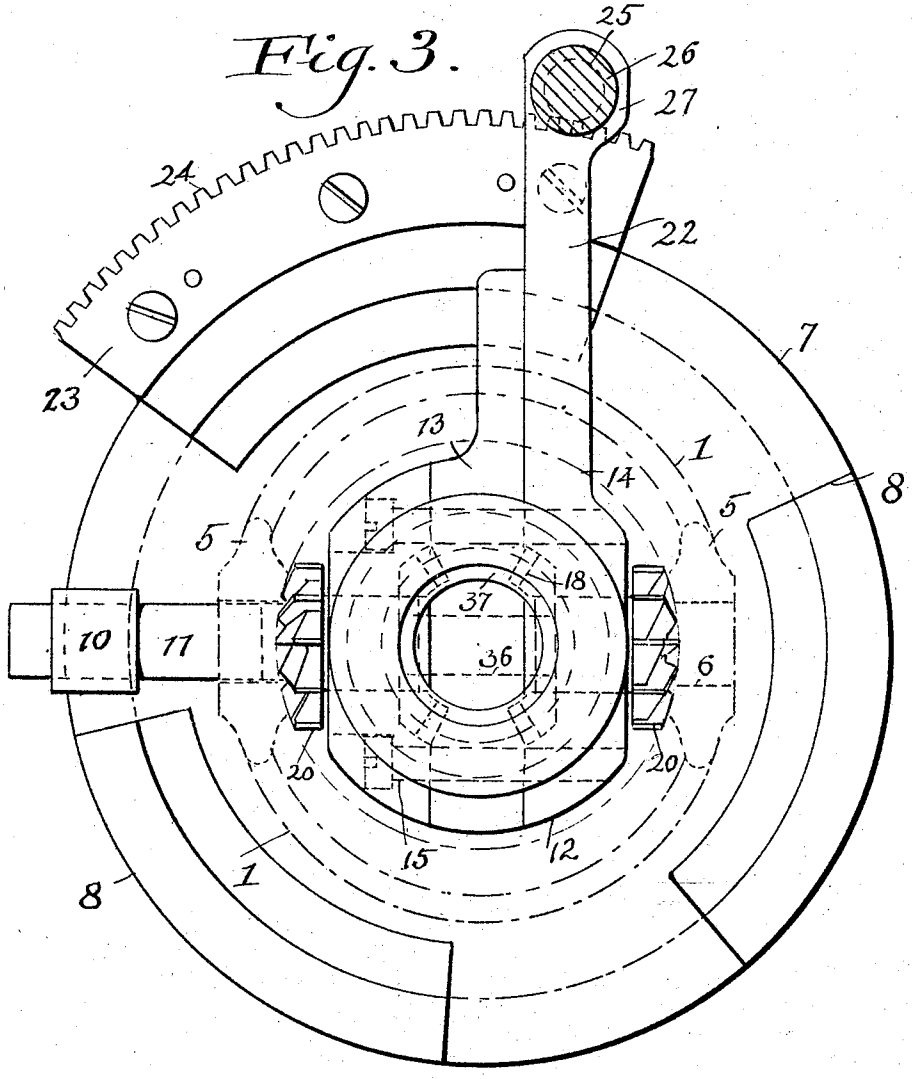
Fig. 3.



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UNITED STATES PATENT OFFICE.

DAVID F. DOMIZI, OF CLEVELAND, OHIO.

MILLING DEVICE.

Application filed October 12, 1922. Serial No. 594,148.

This invention relates to a milling device for forming within a differential gear case the spherical seats for the side pinions of the differential gearing.

Heretofore the bearings in the gear case for the side pinion of the differential gear have been machined with what is known as a spot facing on a drilling machine. Great difficulty has been experienced, however, in obtaining exact alignment of the bearing seats and although a little variation from the correct setting does not destroy the function of the device, there is looseness or back lash between the gear teeth which causes the differential to rattle or be noisy in operation.

It is the object of this invention to provide a milling device with which the seats for the differential pinions on opposite sides of the gear case can be formed simultaneously and in exact alignment. It is also an object of the invention to provide a milling device which can be quickly set up within the gear case prior to the milling operation, which is adapted to be driven from the spindle of a drill press and which can be quickly removed after the milling operation is completed.

A further object is to provide a cutter carrying tool adapted to be supported within the gear case for turning movement about the axis of the hubs of the gear case in such a manner that upon turning movement of the tool the cutters engage the opposite arms of the gear case making a path for themselves as they enter between the arms and generating spherical seats upon the inner faces of the arms.

Other objects will be apparent from the following description and accompanying drawings.

The following description and accompanying drawings set forth in detail certain means embodying my invention, the disclosed means, however, constituting but one of the various mechanical forms in which the principle of the invention may be applied.

Reference should be had to the accompanying drawings forming a part of this specification in which Fig. 1 is a central vertical section through the bed of a drill press with a gear case supported thereon and the improved tool assembled within the gear case; Fig. 2 is a view partly in section and partly in side elevation showing the mounting of the milling tool upon the bed of the drill press; Fig. 3 is a horizontal section showing the milling tool assembled within the gear case.

Referring to the accompanying drawings, the differential gear case upon which the tool is designed to operate consists of a casting having an end 1 provided with a peripheral attaching flange 2 and a hub 3 at the center of the end portion 1. The gear case has a hub 4 at its opposite end in axial alignment with the hub 3 and the hub 4 is connected to the solid end 1 by means of oppositely disposed arched arms 5.

The arms 5 are provided with aligned bores 6 the axis of which is disposed at right angles to the axis of the hubs 3 and 4.

The differential gear case housing above described is supported upon the bed of the drill press which has a housing supporting member 7 thereon, the support 7 having upstanding segmental flanges 8 which are provided with inner shoulders 9 at their upper edges in which the flange 2 of the gear case fits. At one side thereof the support 7 carries a bracket 10 in which is slidably mounted the locking pin 11 which is of a size to fit within one of the bores 6 in the arms of the gear case and which is adapted to be inserted in one of the said bores to hold the gear case against rotative movement upon the support.

The milling tool consists of milling cutters carried by a supporting member or housing 12 formed of two complemental recessed sections 13 and 14 connected by bolts 15. The housing 12 carries the milling cutters upon opposite sides thereof and the gears for driving the milling cutters are housed within the chamber formed between the two recessed sections of the housing. The housing section 13 is wider than the section 14 and has integral therewith a bearing member 16, which is disposed centrally within the gear chamber of the housing. Aligned stub shafts 17 are journaled at their inner ends in the bearing member 16 and have their outer ends journaled in openings in the side sections 13 and 14 of the housing. Inwardly facing bevel gears 18 preferably integral with the stub shaft 17 are carried by the stub shafts within the housing. The outer ends of the stub shafts 17 are substantially flush with the outer faces of the side sections 13 and 14 of the housing and are bored and tapped to receive the threaded shanks 19 of the milling cutters 20. The milling

cutters 20 have cutting edges formed to generate a spherical seat and preferably have outer cutting faces which are spherical in contour, the faces thereof forming segments of a sphere whose center lies in the axis of rotation of the cutters, the faces of the cutters being provided with cutting teeth 21. The side section 14 of the housing 12 has an integral laterally extending arm 22, the outer portion of which rests upon an arcuate plate 23 attached to the upstanding flange 8 of the housing support. The arcuate plate 23 has gear teeth 24 formed upon its outer edge which are adapted to be engaged by the pinion 25 carried by the outer end of the arm 22. The pinion 25 is formed by cutting teeth in the end of the spindle 26 which is adapted to be inserted through a vertical bore in the outer end of the arm 22 and is provided with an integral shoulder 27 which bears upon the upper face of the arm 22 and a handle 28 at its upper end by means of which it can be turned.

For rotatably supporting and centering the housing 12 within the gear case, a supporting washer 29 is provided which has a circular boss 30 on its underside adapted to fit within the bore of the hub 3 and a peripheral vertical flange 31 forming a cup-shaped recess in the upper face thereof adapted to receive a circular centering boss 32 formed on the lower face of the housing 12. An upper washer 33 has a circular flange 34 adapted to fit over an annular centering boss 35 formed on the upper face of the housing 12. The upper washer 33 has a central circular opening 36 registering with the opening in the top of the housing 12 and forming an opening through which the gear of the driving spindle can be inserted.

An annular shoulder 37 is formed in the upper face of the washer 33 at the edge of the central opening 36, the shoulder 37 being for the purpose of receiving a centering sleeve which fits in the upper hub of the gear case and surrounds the driving spindle. The cutter driving spindle 38 has its upper end formed to provide a driving connection with the driving spindle of the drill press and carries a bevel gear 39 at its lower end which is adapted to mesh with the oppositely facing gears 18 within the housing 12. The lower end of the spindle 38 is bored and tapped to receive the threaded shank 40 of the beveled gear 39. A centering and bearing sleeve 41 is rotatably supported upon the lower end of the spindle 38 by means of screw studs 42 which project through the sleeve 41 and engage in a peripheral groove 43 in the spindle 38. The lower end of the sleeve 41 engages the annular shoulder 37 formed in the bearing washer 33 and receives the downward thrust of the driving spindle during the operation of the tool. The spindle 38 is provided with an integral peripheral shoulder 44 above the upper end of the sleeve 41 and a suitable thrust bearing such as bearing washers 45 are interposed between the shoulder 44 and the upper end of the sleeve 41. The bearing washers 45 serve to transmit the thrust from the driving spindle 38 to the bearing sleeve 41 and to prevent thrust being exerted upon the studs 42.

In operation the gear case is placed upon the support 7 in the position shown in Fig. 1 and the pin 11 is inserted into one of the bores 6 in the arms 5 to hold the gear case against rotative movement. The housing supporting washer 29 is then placed within the gear case with its boss 30 fitted into the bore of the hub 3. The housing 12 is then inserted through the side of the gear case between the arms 5 with its centering boss 32 fitting within the cup-shaped recess of the washer 29. In inserting the housing 12 the arm 22 will be at the end of the arcuate plate 23 opposite the position thereof shown in Fig. 3 so that the milling cutters 30 will be outside the gear case and adjacent opposite sides of the arms 5. The upper washer 33 is then put in place upon the boss 35 at the top of the housing 12 and the operating spindle 26 is inserted in the outer end of the arm 22 of the housing. The driving spindle 38 will then be lowered to bring the driving gear 39 into engagement with the gears 18 within the housing and to bring the centering and bearing sleeve 41 into engagement with the shoulder 37 in the washer 33.

Upon rotation of the spindle 38 the two milling cutters 20 will be rotated in opposite directions. By rotating the spindle 26 the housing 12 will be turned about the central axis of the gear case hubs and the milling cutters 20 will be brought into engagement with the arms 5 of the gear case. As the housing 12 is turned the milling cutters 20 cut their way into the inner faces of the arms 5 and generate spherical seats therein which are in exact alignment for the reason that the milling cutters are held in perfect alignment and at exactly the same distance from the axis of the gear case hubs during the milling operation. After the gear seats have been formed as above described the tool may be removed and replaced by a tool having finishing cutters whose faces are on a slightly larger radius. The second tool is constructed exactly the same as the first and operates in the same way.

Having described my invention, I claim—

1. A milling tool comprising a housing, a pair of axially aligned milling cutters having convex outer cutting faces, said cutters being journaled in said housing on opposite sides thereof, means for centering and pivotally supporting said housing, means for driving said cutters, and means independent

of said driving means for turning said housing.

2. A milling tool comprising a housing having axially aligned openings on opposite sides thereof and an opening in the top, stub shafts extending through the said side openings and carrying inwardly facing bevel gears within the housing, milling cutters secured to the outer ends of said stub shafts, a rotary actuating spindle carrying a bevel gear adapted to be inserted downwardly through the opening in the top of the housing into mesh with the two inwardly facing gears therein, a bearing member for said spindle engaging the top of the housing, and a seat for said bearing member in the top of said housing.

3. A milling tool comprising a housing, axially aligned stub shafts projecting into the housing from opposite sides thereof, bevel gears on said shafts within the housing, milling cutters carried by the outer ends of said shafts, said cutters having cutting edges lying in a spherical surface, and a rotary actuating spindle carrying a bevel gear adapted to mesh with the bevel gears on the stub shaft, the axis of the spindle passing through the center of the spherical surface in which the cutting edges of the cutters lie, said housing being rotatable about the axis of the spindle.

4. A milling tool comprising a driving spindle, a housing supported independently of the spindle for rotative movement with respect to the axis of the spindle, a milling cutter carried by the housing, and means for driving the cutter from said spindle.

5. A milling tool comprising a driving spindle, a housing having an opening in its top to receive said spindle, aligned stub shafts in said housing whose axis is at right angles to the axis of the spindle, bevel gears fixed to the stub shafts, a bevel gear fixed to the spindle and meshing with the stub shafts, milling cutters fixed to the outer ends of said stub shafts, and a lever connected with said housing for turning the same about said spindle.

6. In a milling machine for forming spherical seats in a differential gear case, a base member for supporting the gear case, a tool support having a projection fitting in the lower hub of the gear case, a tool comprising a housing having aligned transversely extending stub shafts journaled in said housing, milling cutters having cutting edges adapted to cut spherical seats fixed to the outer ends of said stub shafts, bevel gears fixed to the inner ends of said stub shafts and a spindle having a bevel gear thereon, said spindle being insertable through the upper hub of the gear case and into said housing to engage the gear carried by the spindle with the gears on the stub shafts.

7. In a milling machine, means for supporting a differential gear case, a tool comprising a housing having a pair of milling cutters journaled therein and insertable through the side of the gear case, means for rotatably supporting said housing within the gear case, gearing within said housing for driving said cutters, and a spindle having a gear adapted to mesh with the gearing in the housing for driving said cutters, said spindle being insertable through one of the hubs of the gear case.

8. In a milling machine for forming gear seats in a differential gear case, a support adapted to hold a gear case with the hubs thereof disposed vertically, means associated with the support for holding the gear case against rotation, a tool adapted to be inserted through the side of gear case, said tool comprising a housing carrying a pair of milling cutters on opposite sides thereof which have cutting edges adapted to cut spherical seats, means engaging the hubs of the gear case for centering and rotatably supporting said housing, means for driving said cutters, and means for turning said housing to enter said cutters into said gear case to form gear seats therein.

9. In a milling machine for forming spherical gear seats in a differential gear case, means for supporting the gear casing with the hubs thereof disposed vertically and for holding said gear case against rotation, a supporting and centering washer having a bottom portion adapted to fit in the lower hub of the gear case, and a cup shaped top portion, a tool comprising a housing having a bottom portion adapted to fit in the cup shaped top of the supporting washer and having a central opening in the top thereof, aligned horizontally disposed stub shafts journaled in said housing, cutters having cutting edges adapted to cut spherical seats carried by the outer ends of said stub shafts and bevel gears on said stub shaft within the housing, an upper annular washer having a cup shaped lower face adapted to fit over the top of the housing, the central opening of the washer registering with the opening in the top of the housing, said housing and washers being insertable through the side of the gear case, driving spindle insertable through the upper hub of the gear case, a bevel gear fixed to the lower end of said spindle and adapted to enter the housing and mesh with the bevel gears therein, a bearing sleeve carried by said spindle and fitting in the upper hub of the gear case, and means for turning the housing to enter the milling cutters into the gear case to form the gear seats therein.

10. A milling tool for generating internal spherical seats comprising a housing, means for centering and rotatably supporting said housing for turning movement about a fixed axis, a rotary cutter carried by said housing

having cutting elements lying in a spherical surface, the center of which lies in said axis, means for driving said cutter and means for turning said housing about its axis.

11. A milling tool for generating internal curved surfaces comprising a housing having a cylindrical projection at one end for centering and rotatably supporting the same and an opening at the opposite end axially aligned with said projection, a rotary cutter at one side of said housing, a spindle adapted to be inserted into said housing through said opening, means for driving the cutter from said spindle, and means for turning said housing about its axis.

12. A milling tool for generating internal curved surfaces comprising a driving spindle, a housing having an opening in its top to receive said spindle, means independent of the spindle for supporting said housing for turning movement about the axis of the spindle, a stub shaft carried by the housing and extending at right angles to the spindle, a milling cutter upon the outer end of the shaft, a bevel gear upon the inner end of the shaft within the housing, and a bevel gear on the spindle meshing with said first mentioned bevel gear, said spindle and bevel gear carried thereby being removable through the opening in the top of the casing.

In testimony whereof, I hereunto affix my signature.

DAVID F. DOMIZI.