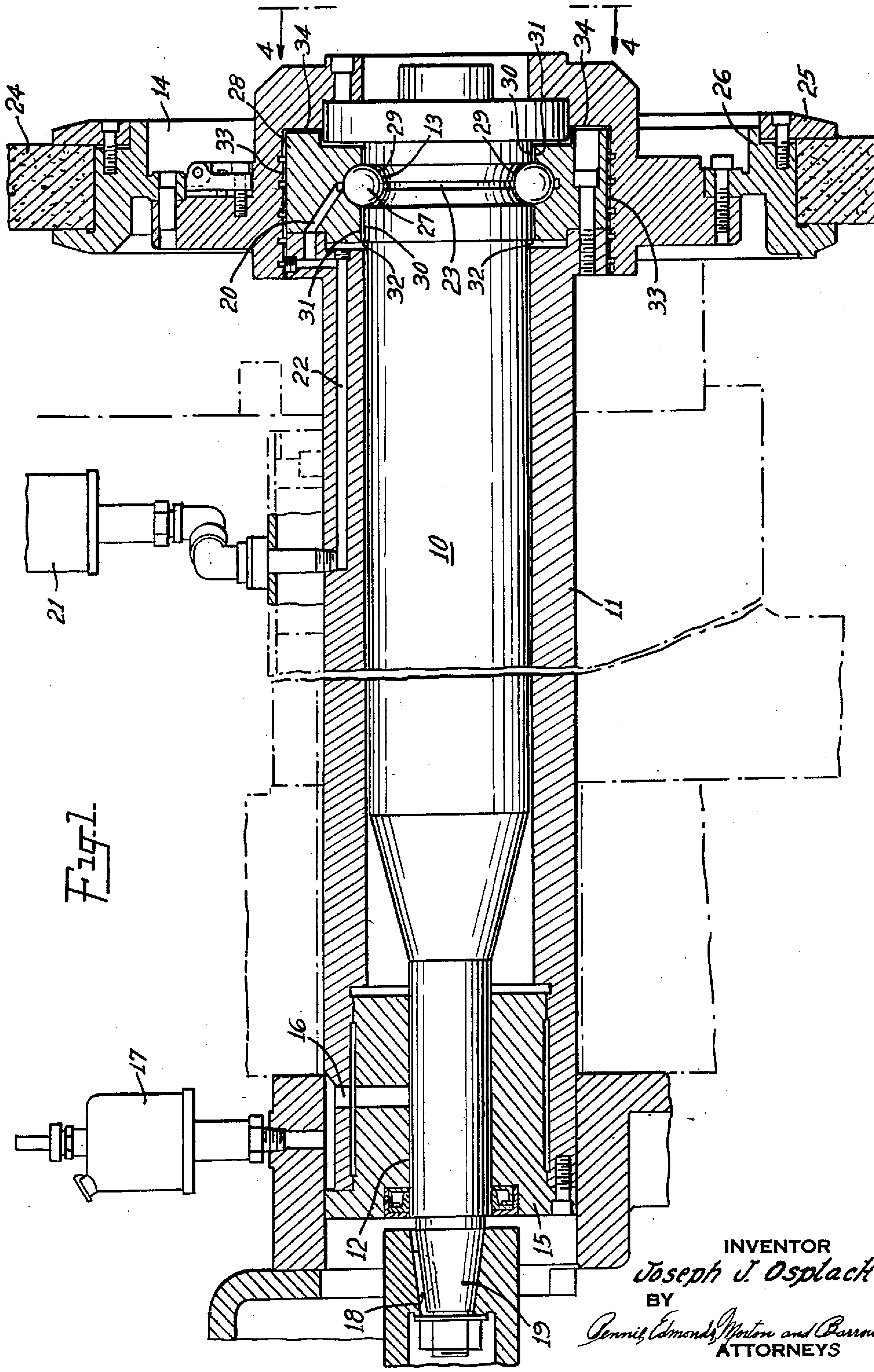
March 3, 1953 J. J. OSPLACK 2,629,976

GRINDING WHEEL SPINDLE

Filed June 4, 1949 2 SHEETS—SHEET 1



INVENTOR
Joseph J. Osplack
BY
Pennie, Edmonds, Morton and Barrows
ATTORNEYS

March 3, 1953 J. J. OSPLACK 2,629,976

GRINDING WHEEL SPINDLE

Filed June 4, 1949 2 SHEETS—SHEET 2

Fig. 2.

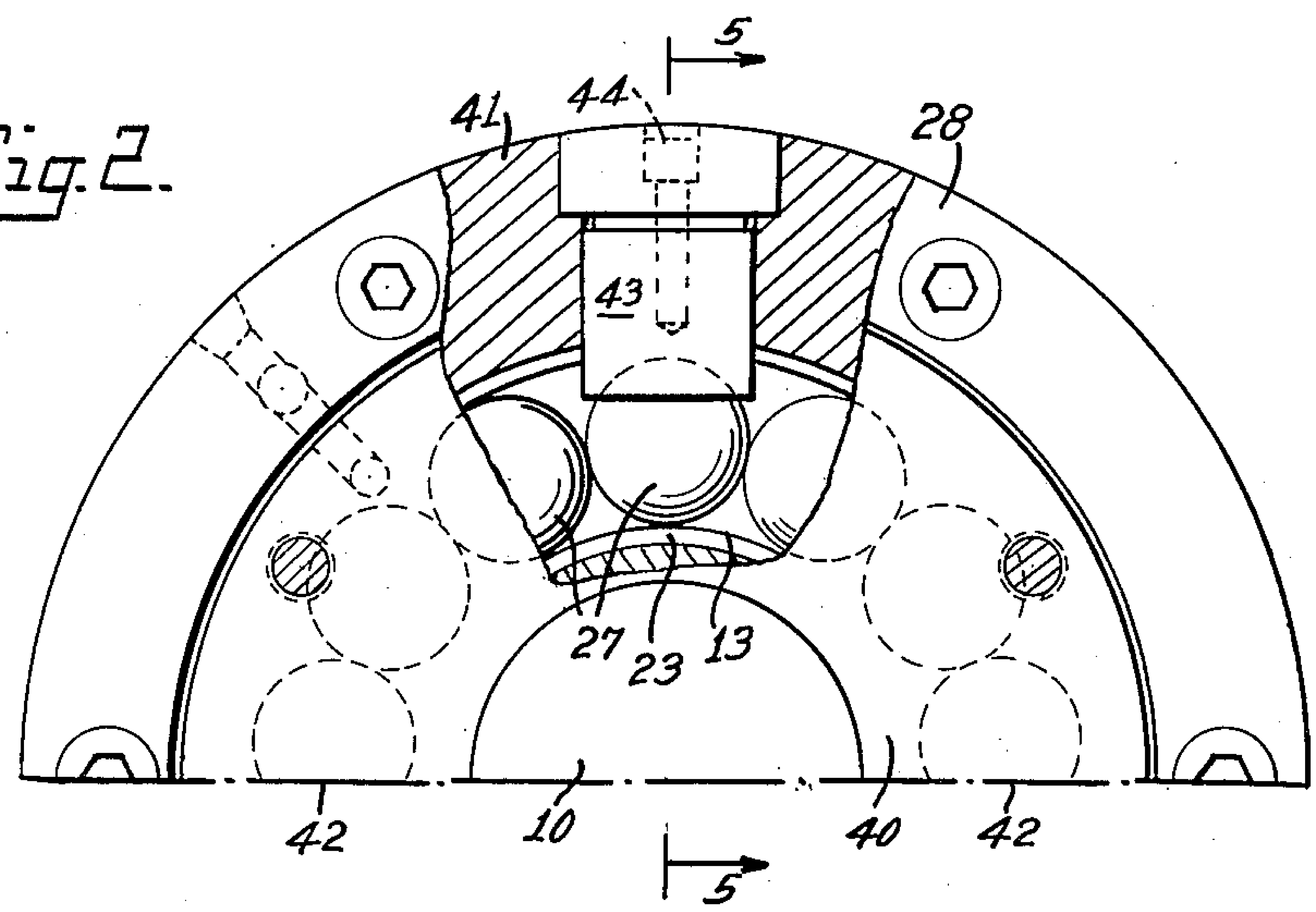
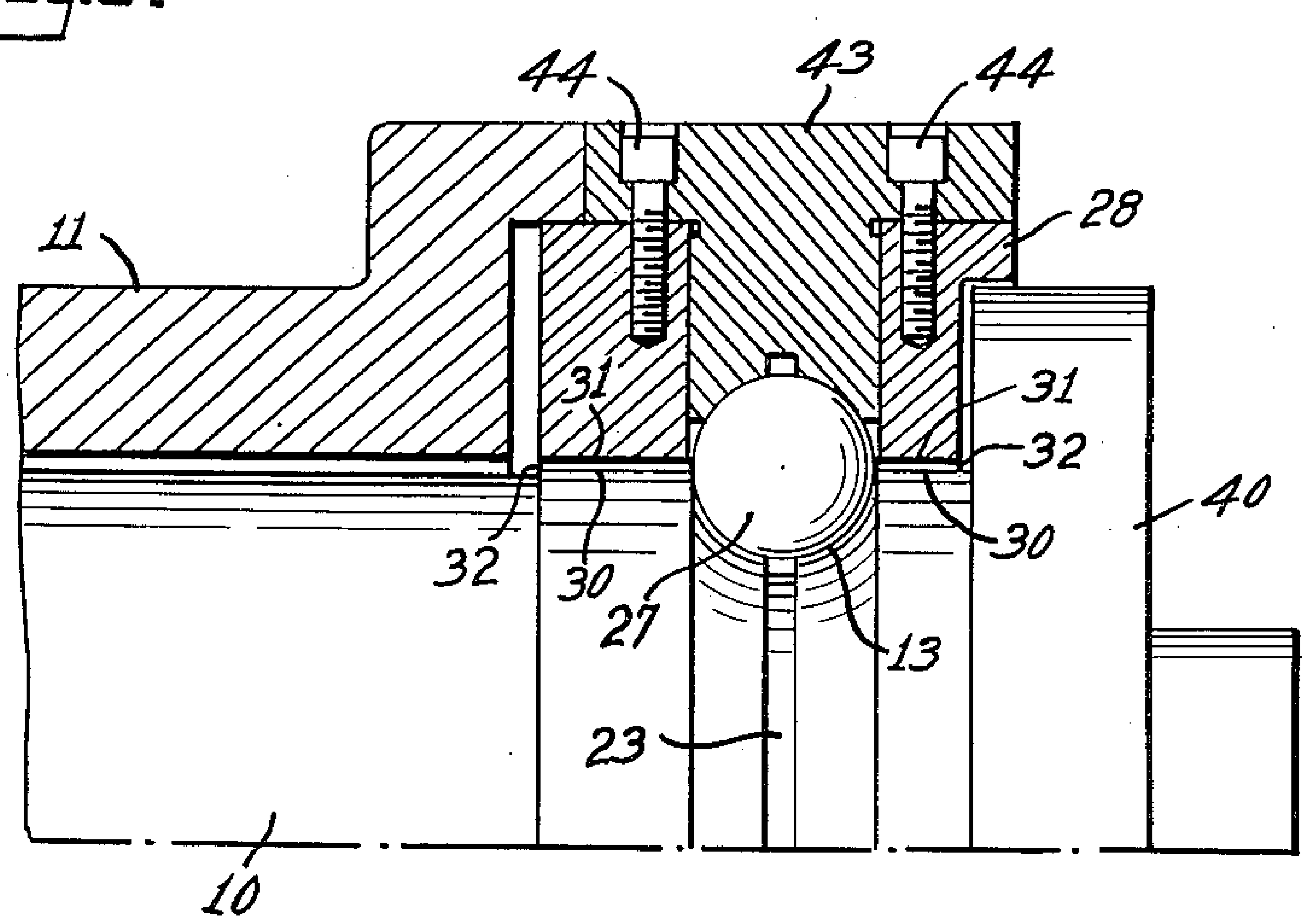


Fig. 3.



INVENTOR
Joseph J. Osplack
BY
Pennie, Edmonds, Morton and Barrows
ATTORNEYS

Patented Mar. 3, 1953 **2,629,976**

UNITED STATES PATENT OFFICE

2,629,976

GRINDING WHEEL SPINDLE

Joseph J. Osplack, Detroit, Mich., assignor to Vinco Corporation, Detroit, Mich., a corporation of Michigan

Application June 4, 1949, Serial No. 97,181

3 Claims. (Cl. 51—166)

1

This invention relates to an improved grinding wheel spindle and, particularly, to the mounting of a spindle of a grinding wheel in which an annular antifriction bearing having opposing plain or friction contact surfaces is located substantially in the same plane as the grinding wheel so as to counteract or minimize effects of unbalance, play, and thermal elongation of the wheel and spindle.

In grinding machines wherein a small bearing is used to carry a heavy wheel mounting on the spindle, unbalance of the wheel, play in the bearing support surfaces of the grinding wheel which cause chatter in the work piece, and thermal elongation of the spindle due to overheating are conditions deprecatory of precision in the grinding operation. In particular, the grinding coolant is usually absorbed into the pores of the abrasive on the grinding wheel. While the spindle is running, this absorption is more or less evenly distributed. However, when the wheel stands idle for a period of time, say, several hours, the coolant settles to the under side of the grinding wheel and effects a considerable unbalance upon renewed use of the wheel. Further, in a hobbing grinding wheel, the inherent characteristics of the thread surface promote additional unbalance. That is to say, as the thread runs off the wheel, a thin thread develops at each end of the grinding wheel. Of course, this results in wheel unbaance, since the runoff thread ends are, practically speaking, never 180° apart. Counterweights may be used to compensate for this unbalance; but even with the most exacting care, the condition is never completely remedied. Although this may be of limited importance on finer pitches, in coarser pitches it is detrimental to high degrees of precision.

And under conditions of heavy loads, the contact surfaces between the spindle and its bearing support surfaces become overheated, resulting in elevated spindle temperatures. This is particularly true where the spindle is supported along its entire length by friction bearing surfaces. As a result the spindle shaft expands, thereby indeterminably altering the location of the grinding wheel. This elongation, of course, tends to adversely affect the precision of the grinding operation.

Further, when the contact surfaces or bearings become excessively worn, a condition to which many conventional bearings are readily susceptible upon overloading and overheating, a certain amount of play in the wheel results. High speed operation, particularly with these deformed ball bearings, results in a chattering in the work piece so that it is not satisfactorily machined.

2

In my U. S. Patent No. 2,352,911, issued July 4, 1944, I have described and claimed certain improved antifriction bearings. In particular, I have disclosed therein a modified form of annular ball bearing to serve as a mounting between rotatable and nonrotatable members wherein the ball bearings are placed in opposing annular races, said races being provided with plain bearing surfaces on each side. The clearance between these plain bearings is such that they are normally out of contact but will be brought into engagement under abnormal loads sufficient to otherwise exceed the elastic limit of the bearing balls and their races. For instance, excessive axial load or shock, particularly of a momentary or limited nature, will bring these surfaces into contact and they then function as plain bearing surfaces of the friction type. Among other things, the ball bearings in the races are protected against deformation or excessive wearing, and as a result play in a wheel operated and supported by these bearings is kept to an absolute minimum.

I have now discovered that locating annular ball bearings of this type substantially in the same plane as the grinding wheel so that they function as bearing surfaces for the driving spindle of the wheel and spindle support will substantially overcome or reduce the adverse conditions I have already enumerated. My invention contemplates a spindle mounted on a bearing substantially in the same plane as the grinding wheel, the mounting comprising a nonrotatable member surrounding and spaced from the spindle, opposing antifriction element races located in the nonrotatable member and the spindle periphery, antifriction elements situated in said races, plain bearing surfaces located at each side of the opposing races, the clearance between the bearing faces less than the compression which the antifriction bearing parts will withstand without exceeding their elastic limit. In this way I have found that play in the driving wheel is substantially minimized, wheel unbalace is counteracted, and thermal extension of the spindle shaft forward of the ball bearing is eliminated. Preferably the spindle is mounted at the grinding wheel extremity on a ball bearing of this type and at the driving end upon, for instance, a narrow plain bearing surface.

In the accompanying drawings I have illustrated this improvement as incorporated in a hobbing grinding machine.

Figure 1 is a modified longitudinal cross-sectional view of a shaft-driven hobbing grinding wheel.

Figure 2 is a modified frontal cross-sectional view taken across section 4—4 of Figure 1 illustrating the placement of the annular ball bearings and their races in detail.

Figure 3 is a cross-sectional view taken across section 5—5 of Figure 2 so enlarged as to illustrate the details of the annular ball bearing set-up not apparent in Figure 1.

Figure 1 illustrates a modified cross-sectional view of a hobbing grinding machine embodying my invention. The machine comprises essentially a spindle 10 mounted inside of housing 11 and supported therein at one extremity by narrow plain bearing surfaces 12 and at the other extremity by annular ball-bearing surfaces 13, the latter located so as to be substantially in the same plane as the grinding wheel 14. The plain bearing surfaces 12 are contained in section 15, rigidly attached to housing 11; the bearing may be lubricated by a sealed-in grease. In addition, this extremity of the spindle may be further lubricated by oil from duct 16 supplied by reservoir 17. The spindle is shaft driven at this end by means of Woodruff key 18 affixed to the spindle extremity 19. The spindle 10, grinding wheel 14 and housing 11 move together as one unit thereby permitting lateral movement of the abrasive grinding face 24. The actuating mechanism has not been shown. At the opposite extremity are located the annular ball bearings 13 placed substantially in the same plane as the grinding wheel 14. These bearings are of the antifriction type and are lubricated by oil from duct 20, supplied by oil reservoir 21 and line 22. An inner lubricating duct 23 carries the lubricant to the lower portion of the annular ball-bearing races. The abrasive grinding surface 24 is attached to the grinding wheel 14 by means of ring clamp 25 and adapting unit 26.

The antifriction-type elements 27 at the grinding wheel extremity of the spindle are placed substantially in the same plane as the grinding wheel and are located in opposing annular races in the spindle 10 and nonrotatable member 28, the nonrotatable member being rigidly attached to spindle housing 11. The annular faces 29 of the inner or spindle member of the bearing at each side of the bearing balls are so finished to provide plain bearing surfaces 30 at each side of the bearing balls. The outer or nonrotatable member 28 of the bearing is similarly finished on each side 31 of the bearing race and the clearance 32 between these two surfaces 30 and 31 is such that they are normally out of contact but will be brought into engagement under abnormal loads sufficient to otherwise exceed the elastic limit of the bearing balls and their races. That is, the clearance 32 is less than the deformation which the bearings balls and races will withstand without exceeding their elastic limit.

Sufficient clearance is provided at surfaces 33 and 34 so that the grinding wheel will run unobstructed above the extension of the fixed housing 11. The precise construction of the grinding wheel and its attachment to the spindle has been described in detail only where it is necessary to illustrate my invention.

Operational overheating of the spindle is thus minimized due to the use of the ball-bearing surfaces hereinbefore described. In particular, employment of the antifriction bearing at the grinding wheel extremity of the spindle reduces objectionable overheating so as to prevent thermal elongation of the spindle forward of these ball bearings. Since the ball bearings will not readily deform, the grinding wheel is less subject to play after long periods of wear and thus chattering of the work piece at high speeds is substantially eliminated. In addition, the construction of the spindle and the use of the bearing as described are such as to counteract conditions of wheel unbalance.

Figure 2 illustrates a modified frontal cross-sectional view of the annular ball bearing of Figure 1 taken across section 4—4. The inner member 40 is a part of the spindle 10 and constitutes the lower annular surface or race for the ball bearings 27. The outer member 41 is a part of nonrotatable member 28 which is attached to the spindle housing and provides the upper surface or race for the bearing balls. The balls move in the annular path 42 in races between the inner member or spindle surface 10 and the outer or nonrotatable surface 28. Removable plug 43 facilitates simple removal of the balls from their races. By removing fastening nuts 44 the plug 43 is lifted out and the balls easily removed. The plug is held in place by these nuts and is composed of a material softer than the races and the balls. In this way, as the balls pass beneath the plug, the load on them is momentarily removed, the remaining balls assuming the load.

Figure 3 illustrates a cross-sectional view taken across section 5—5 of Figure 2 so as to show in detail the nature of the ball-bearing surfaces and the plain bearing surfaces. The removable plug 43 is shown in this side view and is held by nuts 44. The position of the inner or spindle member 10 of the annular ball bearing is also illustrated as is the outer or nonrotatable member 28. The clearance between the plain bearing surfaces of the nonrotatable and spindle members is such that they are normally out of contact but will be brought into engagement under abnormal loads sufficient to otherwise exceed the elastic limit of the bearing balls and their races.

I claim:

1. In a grinding machine, a spindle, a grinding wheel supported by said spindle, said spindle being mounted on two remotely separate bearings, one bearing located substantially in the same plane as the grinding wheel and comprising a nonrotatable member surrounding and spaced from said spindle, opposing antifriction element races located in the nonrotatable member and the spindle periphery respectively, antifriction elements situated in said races, and plain bearing surfaces located at each side of said opposing races, the clearance of said plain bearing surfaces being less than the deformation which the antifriction bearing parts will withstand without exceeding their elastic limit, and the second bearing located at the other extremity of the spindle.

2. In a grinding machine, an elongated spindle, a unitary housing for supporting said spindle, a grinding wheel supported on one end of said spindle, a bearing for the end of said spindle which is adjacent to said grinding wheel, said bearing comprising a non-rotatable member fixed to said housing and surrounding and spaced from said spindle, opposing anti-friction element races located respectively in the non-rotatable member and on the spindle periphery, anti-friction elements situated in said races, plain bearings located at each side of said opposing races, the clearance between the surfaces of said plain bearings being less than the deformation which the anti-friction bearing parts will withstand without exceeding their elastic limit, said anti-friction elements and said races being located substantially in the same plane as the grinding wheel, and a bearing for the end of said spindle

which is remote from said grinding wheel, said bearing being mounted in said housing.

3. A grinding machine as set forth in claim 2 in which the bearing at the end of the spindle which is remote from the grinding wheel has plain bearing surfaces.

JOSEPH J. OSPLACK.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,598,215	Montine	Aug. 31, 1926
1,908,621	Avilla	May 9, 1933
2,352,911	Osplack	July 4, 1944

FOREIGN PATENTS

Number	Country	Date
59,022	Sweden	Jan. 13, 1923
521,370	Great Britain	May 20, 1940