

Feb. 24, 1948.

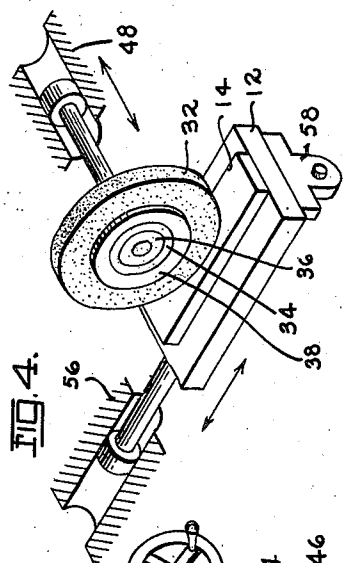
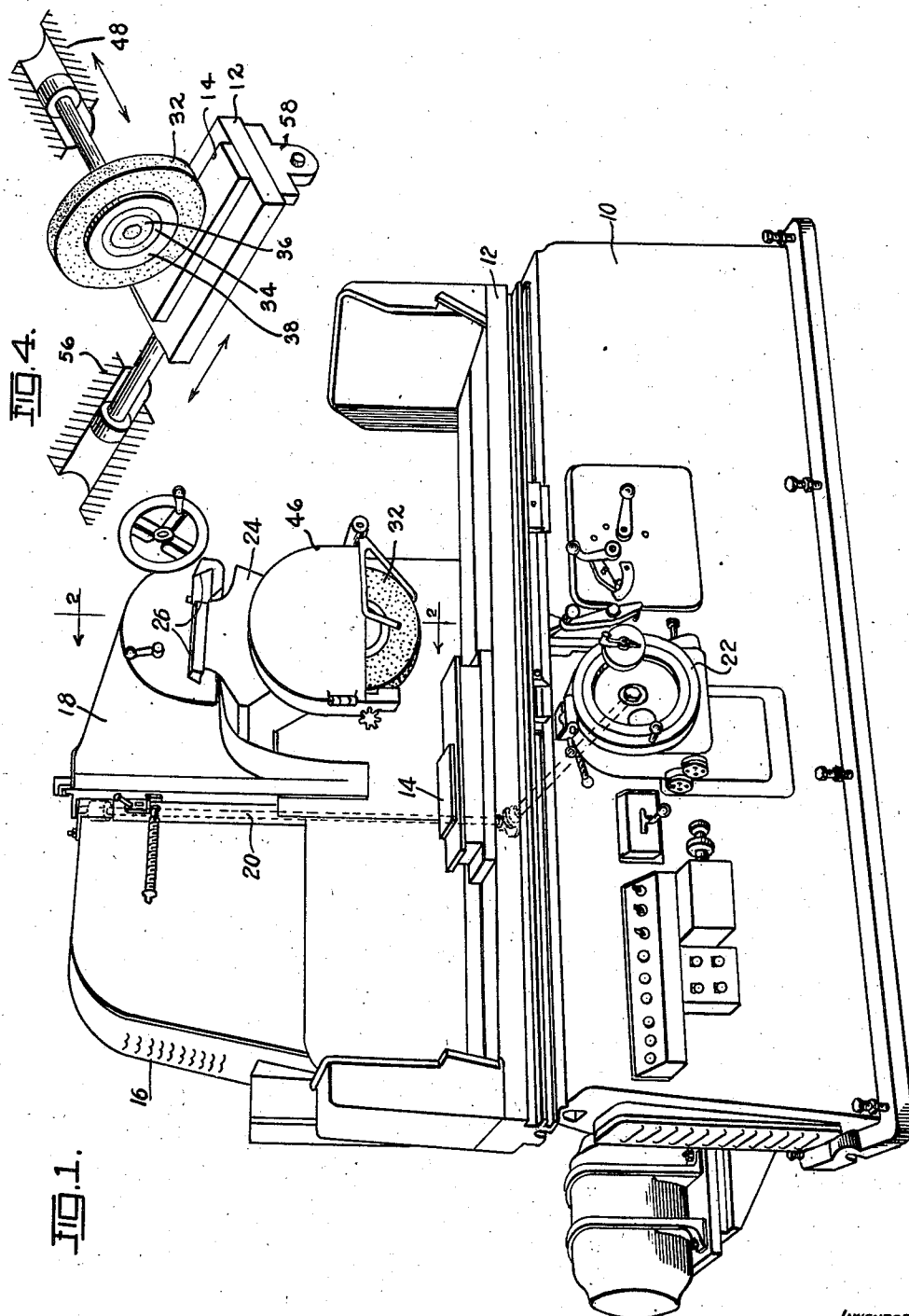
J. C. WILSON

2,436,466

METHOD AND APPARATUS FOR GRINDING AND LAPPING

Filed Sept. 27, 1945

3 Sheets-Sheet 1



INVENTOR.
JOHN C. WILSON

JOHN C. WILSON

Foulmin + Foulmin
ATTORNEYS

ATTORNEYS

Feb. 24, 1948.

J. C. WILSON

2,436,466

METHOD AND APPARATUS FOR GRINDING AND LAPPING

Filed Sept. 27, 1945

3 Sheets-Sheet 2

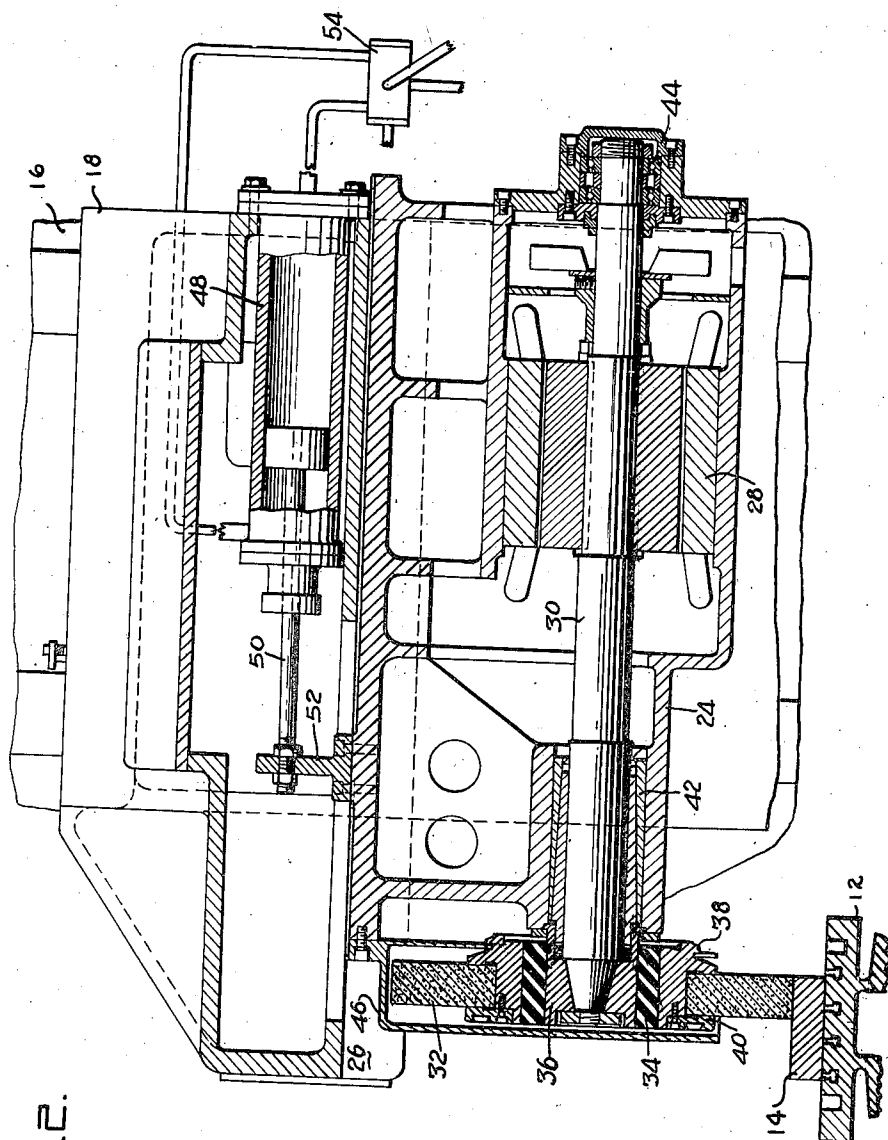


FIG. 2.

JOHN C. WILSON, ^{Inventor}

By *Toulmin + Toulmin*
Attorneys

Feb. 24, 1948.

J. C. WILSON

2,436,466

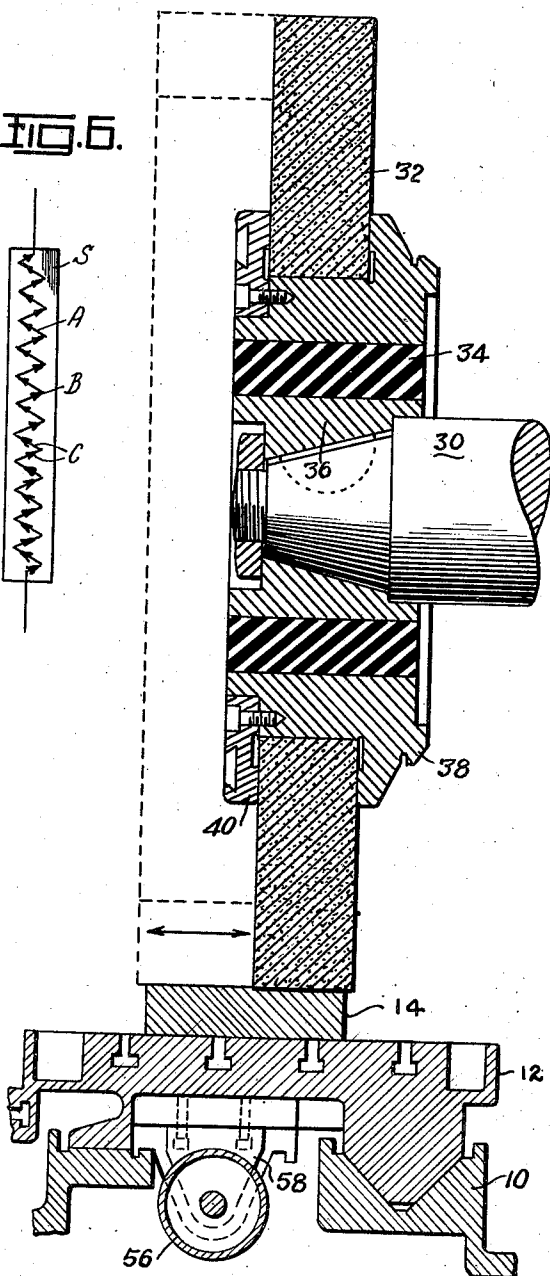
METHOD AND APPARATUS FOR GRINDING AND LAPPING

Filed Sept. 27, 1945

3 Sheets-Sheet 3

FIG. 3.

FIG. 5. FIG. 6.



INVENTOR

JOHN C. WILSON,

BY

Toulmin & Toulmin
ATTORNEYS

UNITED STATES PATENT OFFICE

2,436,466

METHOD AND APPARATUS FOR GRINDING
AND LAPPING

John C. Wilson, Springfield, Ohio, assignor to The
Thompson Grinder Company, Springfield, Ohio,
a corporation of Ohio

Application September 27, 1945, Serial No. 618,813

9 Claims. (Cl. 51—45)

1

This invention relates to grinding and lapping machines and methods and is particularly concerned with a method and apparatus whereby both grinding and lapping may be accomplished in the same machine and with the same wheel.

Usually, when it is desired to produce a workpiece having a lapped finish thereon, the workpiece is ground in one machine and lapped in another. This involves two set-ups of the workpiece in a machine with the attendant loss of time and labor and introduces the possibility that the workpiece will be incorrectly sized. Also, two machines are required thus necessitating a greater investment than if only one device were necessary.

Accordingly, the particular object of this invention is to provide a method and apparatus for both grinding and lapping workpieces at one set-up and with the same abrasive member.

Another object is to provide a support for the grinding wheel which is operable for lapping a workpiece when the surface speed of the wheel is reduced.

A still further object is to provide a method and apparatus for producing workpieces on a grinding machine which have superior surface finishes thereon.

These and other objects and advantages become more apparent upon reference to the following specification taken together with the accompanying drawings in which:

Figure 1 is a perspective view of a grinding machine constructed according to this invention;

Figure 2 is a section taken substantially along the line 2, 2 of Figure 1 showing more in detail the construction of the spindle and the grinding wheel support;

Figure 3 is an enlarged sectional view through the grinding wheel and the support therefor of this invention;

Figure 4 is a diagrammatic view illustrating the motor means for reciprocating the wheel and also for reciprocating the work;

Figure 5 is a diagrammatic view illustrating the path of the grinding wheel when grinding a workpiece, and

Figure 6 is a view similar to Figure 5 but showing the path of the wheel when the workpiece is being lapped.

General arrangement

A grinding machine constructed according to this invention has a grinding wheel and a workpiece supporting means which are relatively movable in at least two directions. The relative movement is utilized for traversing the wheel

2

and workpiece for grinding the required area of the latter.

The grinding wheel support according to this invention comprises resilient means disposed between the wheel and its supporting shaft. Then, when the wheel is driven at grinding speed, say, at a surface speed of about 6,000 feet per minute, the wheel support is substantially rigid and a true grinding operation takes place. However, if the surface speed of a grinding wheel is reduced to only a few hundred feet per minute, then the resiliency of the wheel support becomes effective and the grinding wheel acts as an abrasive lapping member. By rapidly oscillating the wheel axially relative to the workpiece, when the wheel is operating at low speeds, the entire surface of the workpiece may be lapped to a high finish and to a high degree of accuracy.

Structural arrangement

Referring to Figure 1, there is shown a grinder having a bed 10 upon which is reciprocable a table 12 that detachably mounts a workpiece 14.

Mounted adjacent the bed 10 or connected therewith is a column 16 which supports a saddle 18 on vertically disposed ways. Mechanism such as the screw 20 and hand wheel 22 may be provided for reciprocating this saddle on the column 16. Transversely reciprocable in the saddle 18 is a wheel head 24 that is carried on the ways 26.

Reference to Figure 2 will show that the wheel head 24 carries a motor 28, the shaft 30 of which extends leftwardly through the wheel head to support a grinding wheel 32. According to this invention there is provided a resilient member such as the rubber-like annular sleeve 34 between the wheel 32 and the shaft 30. The ring 34 may be secured in any suitable permanent manner with the hub 36 that attaches to the shaft 30 and to the flanged wheel receiving ring 38, the latter being provided with the annular plate 40 which secures the wheel on the said ring.

The shaft 30 may be journaled in the precision adjustable sleeve bearings 42 adjacent the wheel and the precision anti-friction bearings 44 at the opposite end of the said shaft. A wheel guard 46 may be provided for guarding the operator against sparks and chips.

The wheel head is rapidly reciprocable parallel to the wheel spindle axis in the ways 26 by a motor 48 which is carried in the saddle and whose plunger 50 is attached to the wheel head by the lug 52. The motor 48 is preferably fluid operable and may be controlled by a valve 54. The valve may, in manners well-known to those

3 skilled in the art, be automatically actuated by the reciprocation of the wheel head to effect the rapid axial oscillation of the wheel 32.

The table 12 may be reciprocated by a motor 56 carried in the machine bed 10 and whose plunger is connected with the said table by a lug 58. The motor 56, like the motor 48, may be controlled in any of several well-known manners for driving the table in either direction and at any predetermined speed. It will be apparent that the motors 48 and 56 provide means for relatively reciprocating the workpiece and grinding wheel in two directions while the screw 20 provides a means for relative reciprocation thereof in a third direction.

Operation

In operation, the workpiece 14 is secured either to the table 12 or to any suitable workpiece carrying device mounted thereon.

A grinding operation is carried out by reciprocating the table 12 relative to the wheel and, if the width of the workpiece requires, gradually, and preferably intermittently, moving the wheel transversely over the workpiece. Such an operation is diagrammatically indicated in Figure 5.

After the workpiece has been ground down to a predetermined point, the surface speed of the wheel is slowed down from its grinding speed of about 6,000 feet per minute to a few hundred feet per minute. The workpiece and wheel are then brought into engagement under a moderate pressure, and the wheel is rapidly oscillated transversely relative to the workpiece by the motor 48 while the motor 56 is actuated relatively slowly to pass the workpiece beneath the wheel. This operation is diagrammatically illustrated in Figure 6 where it can be clearly seen the fine pitch oscillatory path A is produced by the rapid axial reciprocation of the wheel 32 by the motor 48 and the movement of the work table by the motor 56. It is to be further noted that the reversal of axial reciprocatory movement of the wheel at B is arranged to take place substantially instantly so that the passage of the wheel, as indicated at C, over the work surface will at all times be in a direction substantially perpendicular to the lines of grinding scratches produced in the work surface, these grinding scratches being parallel to the lines of feed travel D indicated in Figure 5. Thus, under these conditions of operation, the abrasive action will be roughly at right angles to the peaks and ridges produced in the prior grinding operation with the same wheel which makes for efficient abrading action not obtainable in methods where the cutting is substantially parallel to these peaks and ridges.

During the lapping operation, the resilient ring 34 serves to yieldably urge the wheel against the workpiece maintaining proper working pressure and correct seat of the wheel against the workpiece and to provide a true lapping action thereof whereby the high spots, peaks, and ridges of the workpiece are most effectively cut off and a high surface finish is obtained. The resilient wheel mounting fully protects the grinding and lapping wheel from vibration of the machine and makes practical the rapid reversal of axial reciprocating movement shown in Figure 6 so that the wheel may effect the lapping operation on the workpiece.

It will be apparent that the practice of the methods of this invention and the use of the apparatus thereof will produce workpieces having a superior surface finish and which are precisely

sized. Furthermore, this may be accomplished in a single machine and at one setup.

It will be understood that various modifications and arrangements in structure could be made without departing from the spirit of my invention and, accordingly, I desire to comprehend such modifications and substitutions of equivalents as may be considered to come within the scope of the appended claims.

I claim:

1. The method of forming workpieces in a grinding machine which comprises; relatively reciprocating the workpiece and wheel in one direction while rotating the grinding wheel at grinding speed; and thereafter rapidly axially reciprocating the wheel and slowly reciprocating the work in perpendicular directions while rotating said wheel at substantially less than grinding speed.

2. The method of forming workpieces by a grinding wheel which comprises; resiliently supporting the said wheel on a drive shaft; driving the said wheel at grinding speed; relatively reciprocating the wheel and workpiece in a direction perpendicular to the grinding wheel axis; reducing the speed of the wheel to substantially less than grinding speed; and simultaneously slowly relatively reciprocating the wheel and workpiece perpendicular to said axis and rapidly axially reciprocating said wheel to effect a cutting action of said wheel on said workpiece in a substantially normal direction to the direction of said first mentioned relative reciprocation of wheel and workpiece.

3. In a method of forming workpieces by a grinding wheel; yieldably supporting the said wheel; driving the wheel at grinding speed; reciprocating the workpiece relative to the wheel for grinding the former; reducing the speed of the wheel to substantially less than grinding speed; and again reciprocating the workpiece relative to the wheel while rapidly axially oscillating the wheel for lapping the former to trace a path on said workpiece substantially perpendicular to the direction of workpiece reciprocation.

4. In a method of grinding and lapping workpieces with a single grinding wheel; resiliently supporting and driving said wheel; traversing the workpiece in a straight path while the wheel is operating at grinding speed; and thereafter continuing the traversing of the workpiece and rapidly axially reciprocating the grinding wheel to effect an oscillatory path of relative work and wheel travel substantially perpendicular to said traversing movement while the wheel is running at substantially less than grinding speed.

5. In a grinding machine; a work supporting means; means for reciprocating said means; a grinding wheel having a drive shaft; means comprising a substantially annular resilient member yieldably connecting said wheel with said drive shaft; means for driving said wheel at high and low speeds; and means for rapidly reciprocating said wheel and moving said work supporting means to cause said wheel to trace an undulating path of sharp reversals substantially perpendicular to the movement of said work supporting means.

6. In a grinding machine adapted for both grinding and lapping a workpiece; workpiece supporting means including a reciprocable table and a first motor means for reciprocating said table; a grinding wheel and a drive shaft therefor and

5

a second motor means for rapidly reciprocating said shaft and wheel in an axial direction substantially perpendicular to the direction of reciprocation of said workpiece supporting means; means comprising a resilient hub securing said wheel to said drive shaft; and means for driving said wheel at a high surface speed to effect a grinding operation and at a low surface speed to effect a lapping operation of said wheel on said workpiece.

7. In a combined surface grinder and surface lapping machine utilizing a common abrasive wheel for performing grinding and lapping operations, the combination of a machine frame, a work table reciprocatable on said frame, a saddle vertically movable on said frame, a wheel head mounted for horizontal movement on said saddle transverse to the reciprocatory movement of said table, a grinding wheel spindle journaled in said wheel head having its axis extending perpendicular to said work table reciprocation and parallel to said wheel head reciprocation, a resilient mounting hub on said spindle, a grinding wheel mounted on said resilient mounting means, a hydraulic cylinder interconnected between said frame and said work table to effect reciprocation thereof, a second hydraulic cylinder carried in said saddle and connected to said wheel head to effect reciprocation thereof, adjusting means for radially moving said spindle and wheel into relative adjustment with a work piece on said work table, and means for at one time rotating said grinding wheel at grinding speed and intermittently axially moving said spindle carrier in synchronism with the reciprocation of said table and at another time rapidly reciprocating said wheel spindle axially independent of the reciprocation of said work table, said means including a hydraulic control valve operable by the reciprocation of said wheel head.

8. In a grinding machine; a reciprocable work supporting means; a grinding wheel having a drive shaft; resilient means supporting said wheel on said drive shaft; means for axially reciprocating said wheel and shaft; and means

6

for driving said wheel at high speed during reciprocation of said work supporting means relative thereto and at right angles to the axis of said shaft and for driving said wheel at low speed during said reciprocation of said work supporting means while rapidly axially reciprocating said wheel in a direction perpendicular to the direction of work supporting means reciprocation.

9. In a surface grinding and lapping machine, a frame, a work table reciprocably mounted on said frame, a grinding wheel spindle mounted on said frame for radial and axial movement relative to said work table, a grinding wheel, resilient means interconnecting said grinding wheel to said spindle, means for slowly reciprocating said work table, means for intermittently or rapidly reciprocating said wheel spindle in axial direction, means for selectively driving said wheel at a high rotative speed or at low rotative speed, and means for radially adjusting said grinding wheel and spindle to predetermined positions relative to said work table.

JOHN C. WILSON.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
528,726	Hyde	Nov. 6, 1894
1,790,446	Suhner	Jan. 27, 1931
1,914,647	Raule	June 20, 1933
2,022,542	Flygare et al.	Nov. 26, 1935
2,033,395	Peaslee	Mar. 10, 1936
2,127,210	Dunbar	Aug 16, 1938
2,171,892	Richardson	Sept. 5, 1939
2,239,091	Flygare	Apr. 22, 1941
2,276,625	Patrick	Mar. 17, 1942
2,378,903	Baldenhofer	June 26, 1945

FOREIGN PATENTS

Number	Country	Date
745,444	France	Feb. 14, 1933