Nov. 17, 1931. A. M. DRAKE 1,832,104

INTERNAL GRINDING MACHINE

Filed Feb. 13, 1928 6 Sheets-Sheet 1

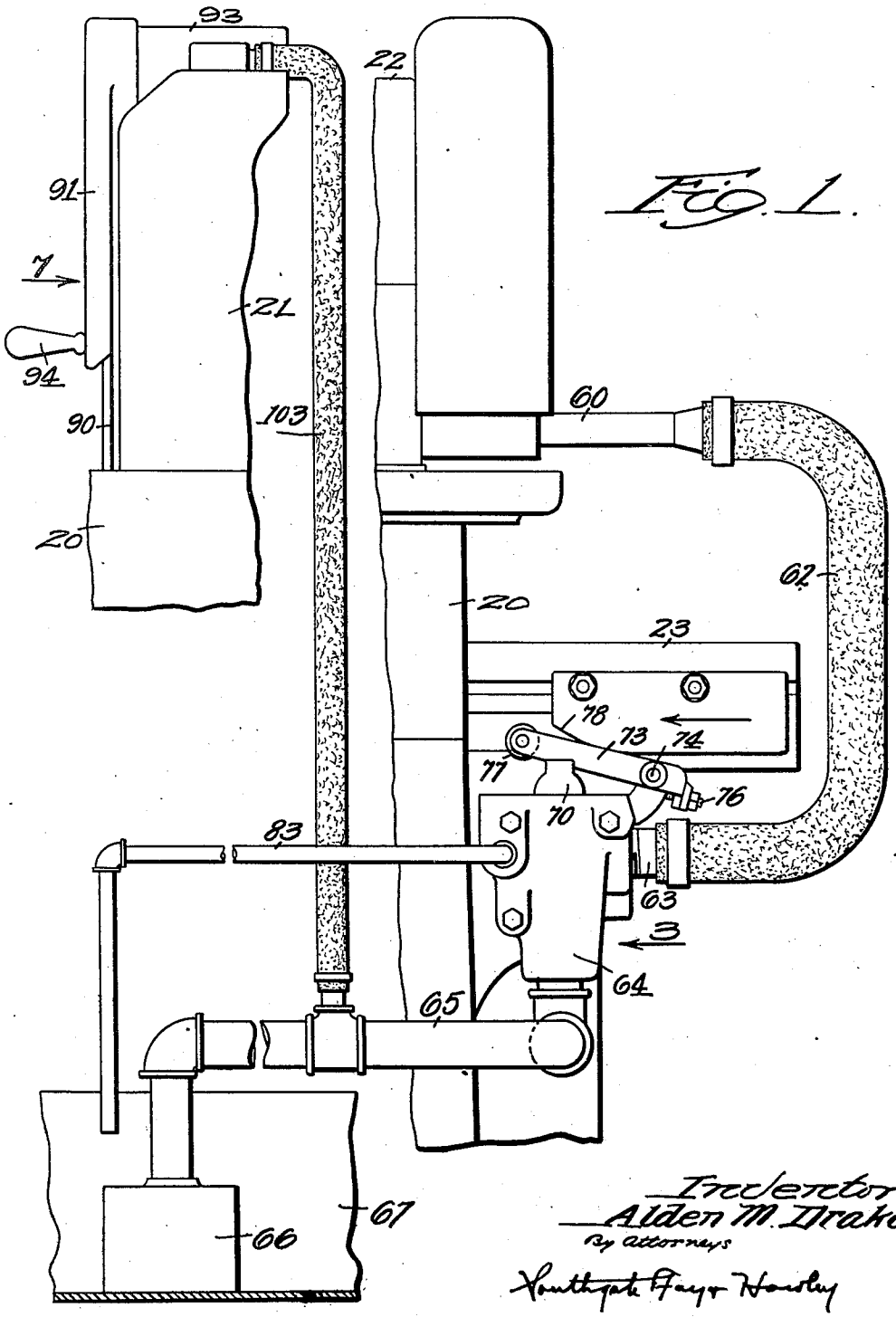

Fig. 1.

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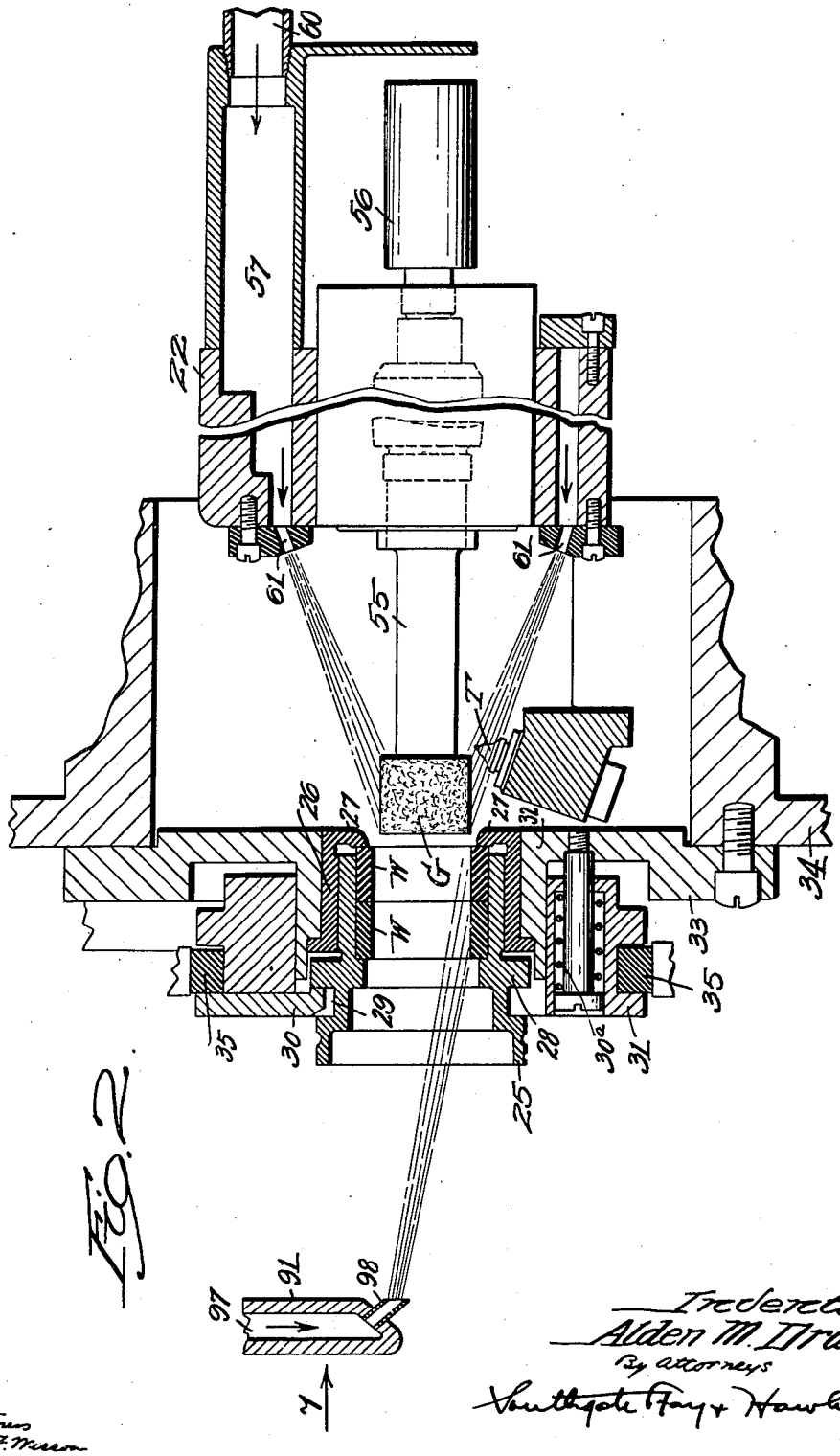

Fig. 2.

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INTERNAL GRINDING MACHINE

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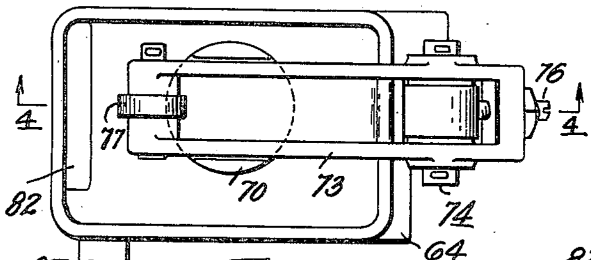

Fig. 5.

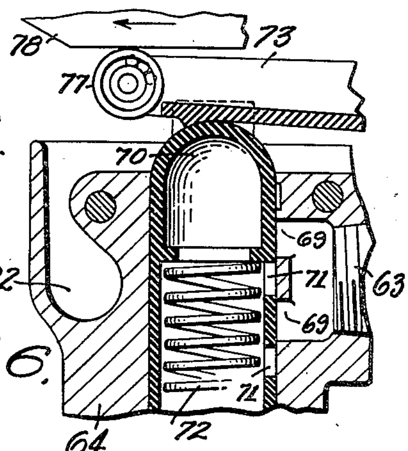

Fig. 6.

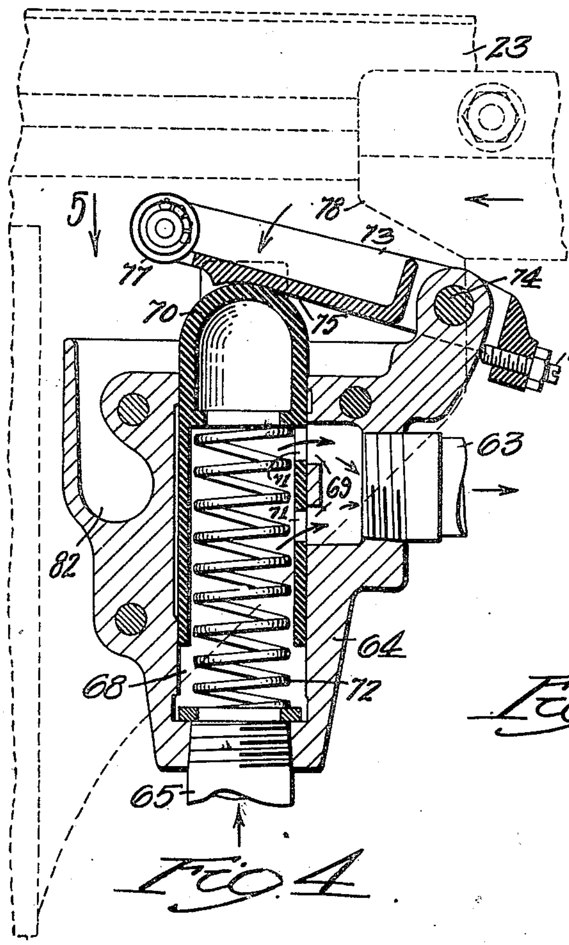

Fig. 4.

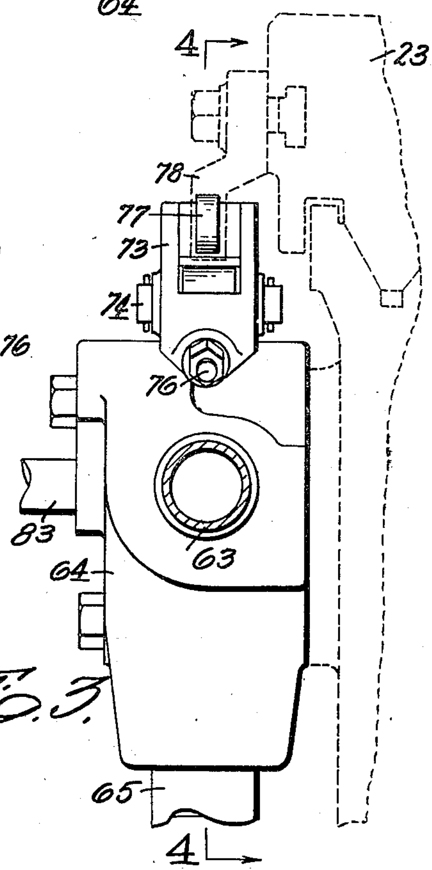

Fig. 3.

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INTERNAL GRINDING MACHINE

Filed Feb. 13, 1928 6 Sheets-Sheet 4

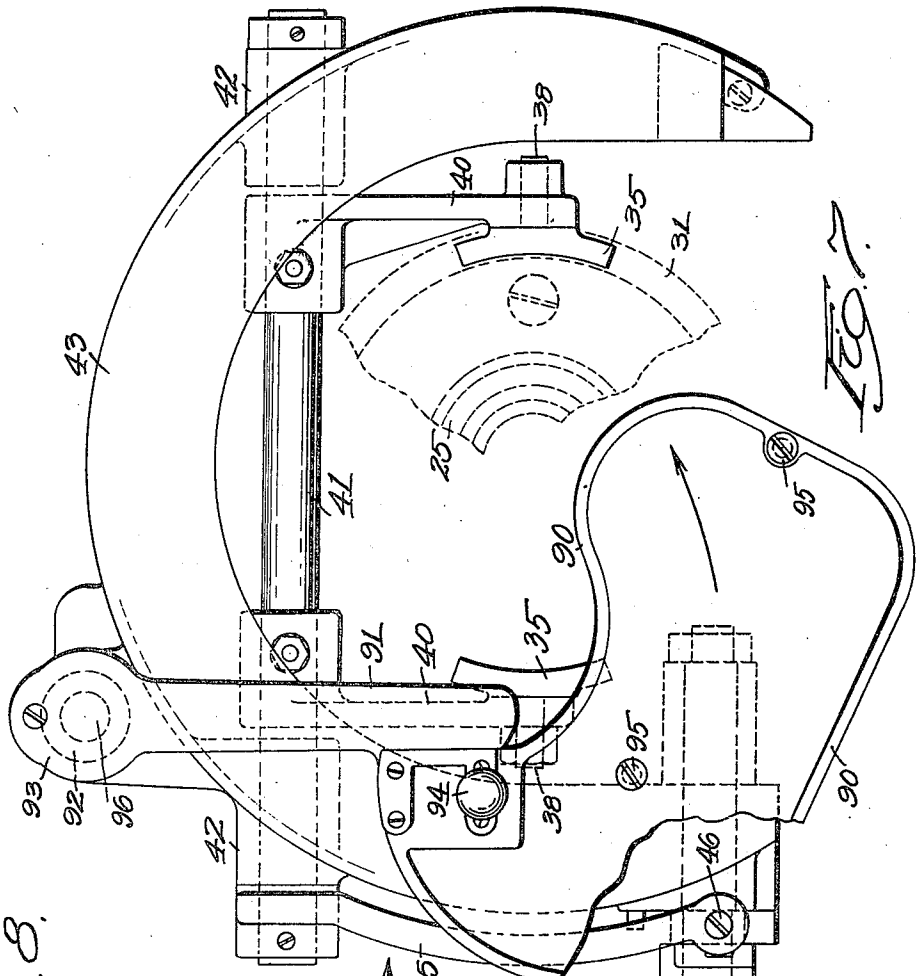

Fig. 7.

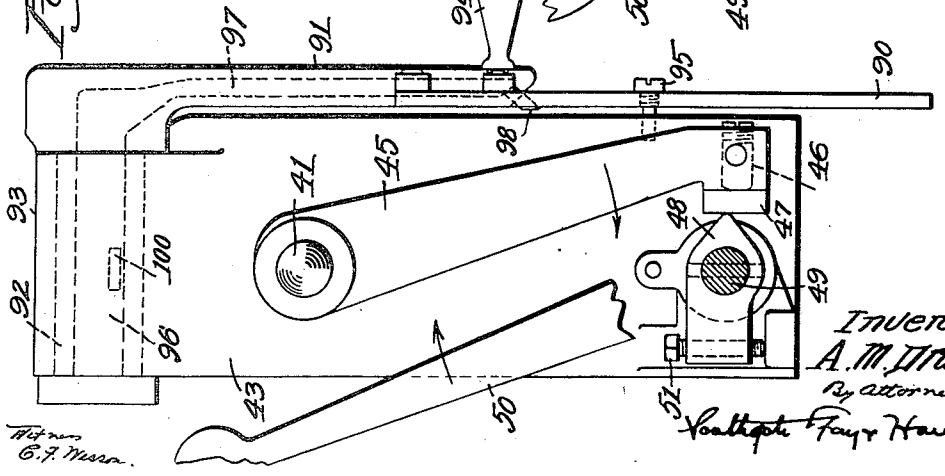

Fig. 8.

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INTERNAL GRINDING MACHINE

Filed Feb. 13, 1928 6 Sheets-Sheet 5

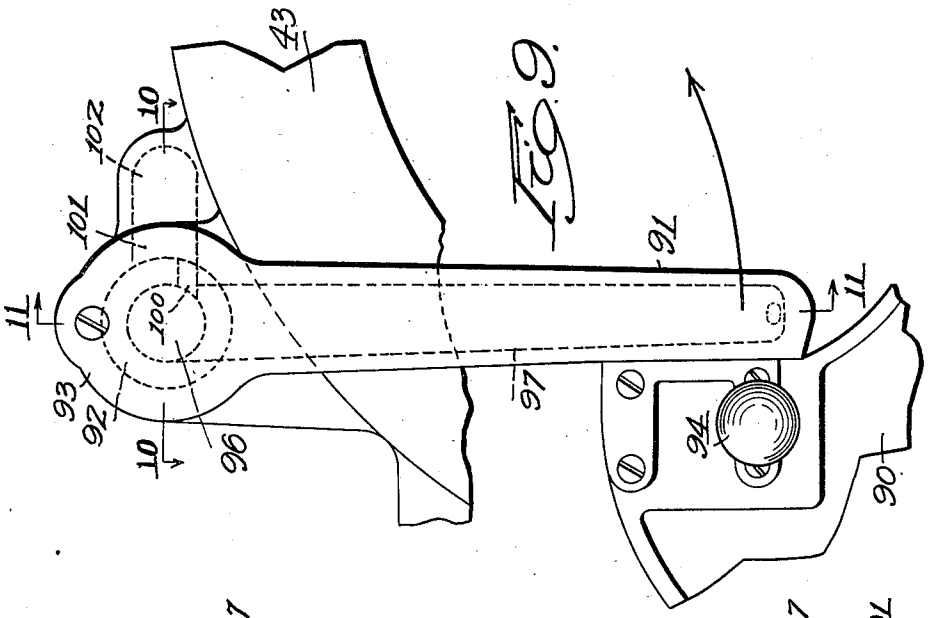

Fig. 9.

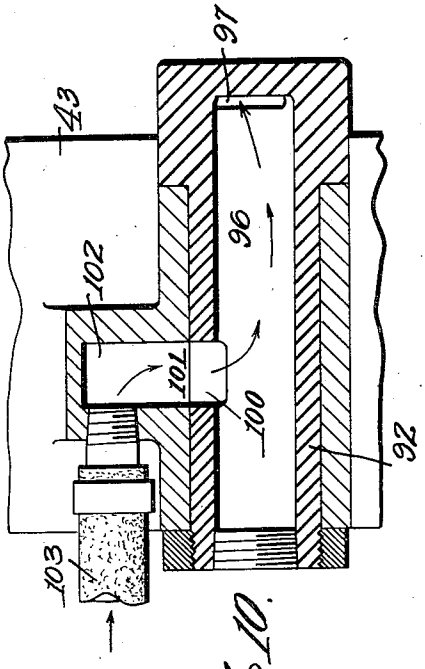

Fig. 10.

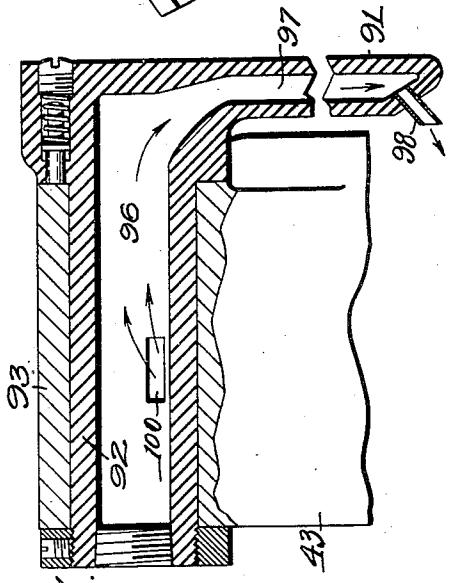

Fig. 11.

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INTERNAL GRINDING MACHINE

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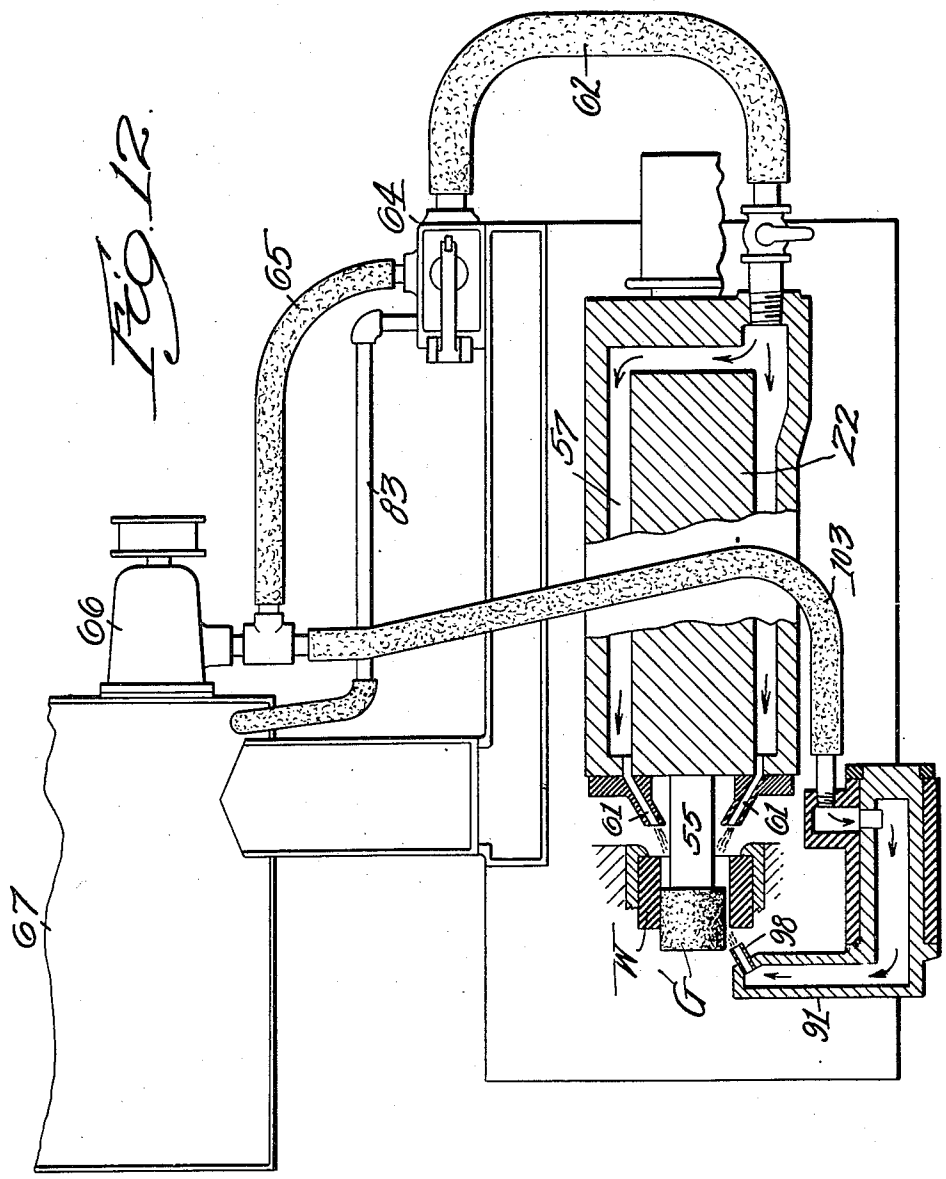
Fig. 12.



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1,832,104

UNITED STATES PATENT OFFICE

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INTERNAL GRINDING MACHINE

Application filed February 13, 1928. Serial No. 253,813.

This invention relates to improvements in an internal grinding machine of the general type in which the work is supported by a hollow spindle of relatively large internal diameter and in which the wheel enters the work through the spindle and from the rear side of the work.

One important object of my invention is to provide improved devices by which water or other liquid may be supplied for cooling the grinding wheel and work, and by which the supply of liquid may be automatically controlled.

Another object is to so apply the water that the wheel truing device and associated parts of its support and of the work head will be cooled and maintained at a substantially uniform temperature, in addition to the cooling of the wheel and work.

A further feature of my invention relates to the provision of improved means for securing the work in the work spindle and for releasing the work therefrom.

My invention further relates to arrangements and combinations of parts which will be hereinafter described and more particularly pointed out in the appended claims.

A preferred form of the invention is shown in the drawings in which

Fig. 1 is a partial rear elevation of parts of a grinding machine embodying my improvements;

Fig. 2 is a fragmentary sectional plan view through the grinding spindle and work support;

Fig. 3 is an end elevation of a control valve mechanism, looking in the direction of the arrow 3 in Fig. 1;

Fig. 4 is a sectional side elevation of the valve mechanism, taken along the line 4—4 in Fig. 3;

Fig. 5 is a plan view, looking in the direction of the arrow 5 in Fig. 4;

Fig. 6 is a partial view similar to Fig. 4 but showing the parts in a different position;

Fig. 7 is an end elevation, looking in the direction of the arrow 7 in Fig. 1;

Fig. 8 is a front elevation of certain parts, looking in the direction of the arrow 8 in Fig. 7;

Fig. 9 is an enlarged partial front elevation of the splash guard and its supporting arm;

Fig. 10 is a sectional plan view, taken along the line 10—10 in Fig. 9;

Fig. 11 is a sectional elevation, taken along the line 11—11 in Fig. 9; and

Fig. 12 is a diagrammatic view showing the general relation of the parts.

Referring to the drawings, I have shown parts of a grinding machine comprising a frame 20, a work head 21 and a wheel head 22. The wheel head 22 is preferably mounted for movement transversely on the frame 20 and the work head 21 is supported on a table 23 slidable axially on the frame 20.

The work W (Fig. 2) is shown in the form of annular rings, secured in a holder or shuttle 25, fitting within a sleeve 26 provided with a flange 27 against which the rear end of the work abuts. The holder 25 is also provided with a flange 28 and with a circumferential groove 29.

For the purpose of definition, the rear end of the work may be regarded as that part directed toward the interior of the bearing member or hollow work supporting spindle 34, hereinafter described, and the opposite end, which faces outwardly of the spindle, may be designated as the front or forward end.

Lugs 30 project from a clamping member 31, slidable axially on a hub portion 32 of a face plate 33, which in turn is mounted on a rotatable bearing member or hollow, work supporting spindle 34 of relatively large internal diameter, in the work head 21. Recesses (not shown) in the flange 28 of the holder 25 permit the holder to be inserted in the sleeve 26, after which the holder is turned angularly so that the lugs 30 will be out of alignment with said recesses and will engage the flange 28 and thus hold the work firmly against the flange 28. Springs 30^a are provided for yieldingly pressing the lugs 30 against the holder 25.

Runners 35 are positioned in a groove 36 in the member 31, said runners being pivotally mounted at 38 (Fig. 7) in the lower ends of arms 40, secured to a rock shaft 41 pivoted in bearings 42 in a casing 43 supported on the

outer end of the work head 21. An arm 45 (Fig. 8) is secured to the outer end of the shaft 41 outside of the casing and is provided with a stud 46 threaded in the lower end of the arm 45 and having an enlarged head 47 engaged by a cam 48. The cam 48 is mounted on a rock shaft 49 having a handle 50 secured thereto. A stop screw 51 limits rearward movement of the handle 50.

When the parts are in the position shown in Fig. 8, the arms 40 will be swung forward, moving the projections 30 (Fig. 2) outward and thus releasing the holder 25 so that it may be easily turned and removed for renewal of the work. After a new holder is inserted, the handle 50 is pulled forward, releasing the arm 45 and consequently the arms 40, and allowing the springs 30ª to pull the projections 30 inward against the flange 28, firmly retaining the work in position.

I have thus provided convenient means for holding the work in the rotating work support and for locking or releasing the work from the outside of the casing 43, thus avoiding the necessity of any adjustment or manual manipulation in the less accessible interior of the casing.

The rotating bearing member or work support 34 is of large diameter, so that a grinding wheel G (Fig. 2) and a wheel truing device T may be positioned within the hollow interior of the rotating work support. For more specific details of the construction of the work head, reference is made to my prior application Serial No. 91,208, filed February 27, 1926, which matured into Pat. No. 1,662,240.

The wheel G is mounted on the forwardly projecting end of a spindle 55, rotatable in suitable bearings in the wheel head 22, and provided with a pulley 56 by which it is rotated by a belt (not shown). The wheel head 22 is preferably provided with a recess or chamber 57 surrounding the bearings of the spindle 55 and having a water supply pipe 60 connected to the outer end thereof. The water traverses the recess 57 from end to end of the spindle bearings and then escapes through nozzles or openings 61 at the front end of the wheel head. These nozzles are so positioned and constructed that the water is forced out in the form of jets, directly impinging upon the grinding wheel G. One of the jets also directly engages the truing device T.

The supply pipe 60 is connected by a hose 62 (Fig. 1) with a pipe 63 threaded into a valve 64 (Fig. 4). A supply pipe 65 (Fig. 1) connects the valve 64 with a pump 66 in a tank 67. The valve 64 thus controls the flow of water from the pump 66 to the wheel head 22. The valve 64 has a cylindrical opening 68 (Fig. 4) aligned with the pipe 65 and provided with ports 69 connecting with the outlet pipe 63. A hollow plunger 70 is slidable in the opening 68, said plunger being open at its lower end and closed at its upper end, and having ports 71 in its side wall which, in certain positions, may be aligned with the ports 69 previously described. A spring 72 is mounted within the plunger 70, forcing the same yieldingly upward.

A control lever 73 is pivoted at 74 on a projection from the valve 64, said lever having a surface 75 engaging the upper end of the plunger 70. A stop screw 76 limits upward movement of the plunger and lever, and a cam roll 77 is mounted on the swinging end of the lever 73.

A cam plate 78 is mounted on the work table 23 and engages the roll 77 as the work is moved outward to inoperative position for inspection or replacement. When thus engaged, the roll 77 and lever 73 are forced downward, depressing the plunger 70 and bringing the ports 71 and 69 out of alignment, as indicated in Fig. 6, thus shutting off the water supply to the wheel spindle and grinding wheel. The valve 64 is provided with a surrounding cup-like recess 82, connected to a drain pipe 83 by which any leakage past the plunger 70 will be returned to the tank 67.

A splash guard 90 (Figs. 7 and 8) is mounted on the lower end of a depending arm 91 having a bearing portion 92 supported in a bearing 93 on the casing 43. A handle 94 is provided for swinging the arm 91 and splash guard 90 to and from operative position. Stop screws 95 limit swinging movement of the parts 90 and 91 in both directions.

The bearing portion 92 of the arm 91 is provided with an axial recess 96 communicating with a passage 97 cored in the arm 91 and terminating in a nozzle or opening 98, through which water may be directed to the inner faces of the work W, as indicated in Fig. 2.

The axial opening or chamber 96 (Figs. 10 and 11) is provided with a port 100 which is aligned with a port 101 in the bearing support 93 when the splash guard is in lowered or operative position. The port 101 is connected through a passage 102 to a supply pipe 103 (Fig. 1) which is connected as a branch pipe from the main supply pipe 65 between the pump 66 and the valve 64.

When the splash guard is in operative position, water is ejected through the nozzle 98 to the interior of the work, and when the splash guard is raised for inspection or replacement of the work, the water supply is automatically cut off.

It is sometimes desirable to wash out the sleeve 26 which supports the work holder 25 after the work holder has been removed and before replacement thereof. For this purpose, it is merely necessary to swing the splash guard downward and the water will be

immediately supplied through the nozzle 98.

I have thus provided a copious supply of cooling water for the grinding wheel and work, which water, after striking the wheel and work, is deflected in all directions and cools the entire structure of the work head and also the wheel truing device and its supporting structure. In this way the work head and truing device are kept substantially at a uniform temperature and consequently maintain their established relation.

This is a very important advantage in internal grinding in which accuracy to the ten-thousandth part of an inch is now demanded. Comparatively slight temperature changes have been found to throw the truing device out of position sufficiently to cause the production of substantial errors in such accurate work.

It will appear, therefore, that I have provided convenient means for inserting and removing the work, an abundant supply of cooling water for both the work and the wheel, as well as the truing device and the surrounding or associated structure, and that I have provided means for automatically shutting off the flow of water from the wheel as the work is run out for replacement, and for shutting off the water supply from the work as the splash guard is raised to permit access thereto.

Having thus described my invention and the advantages thereof, I do not wish to be limited to the details herein disclosed otherwise than as set forth in the claims, but what I claim is:—

1. In a grinding machine, a wheel head and a grinding wheel thereon, said head having a hollow annular portion, a closure therefor providing a plurality of axially extending nozzles communicating with said hollow annular portion, a spindle by which the work is supported, means to supply water to said annular member, whereby jets of water will be directed axially of the wheel head, and on the wheel axially thereof to cool the wheel, additional means to supply water from substantially the opposite direction, and means to direct said additional supply on the work substantially axially thereof to cool the work.

2. In a grinding machine, having a spindle by which the work is supported, a grinding wheel, a wheel head having a hollow annular portion, a closure therefor providing a plurality of axially extending nozzles communicating with said hollow annular portion, means to support said wheel for rotary movement within said annular member, means to supply water to said annular portion and jets whereby jets of water will cool the wheel from the rear thereof, additional means to supply water from the front to cool the work and means to separately control the flow of water to the wheel and to the work.

3. In a grinding machine, having a hollow work spindle in which the work is supported, a grinding wheel adapted to enter the work spindle axially at the rear of the work head, a wheel head having a hollow annular portion, a closure therefor providing an axially extending nozzle communicating with said hollow annular portion, means to support said wheel for rotary movement within said annular member, means to supply water to said annular member and nozzle whereby to direct a jet of water from one axial direction toward the wheel, and means to direct an additional jet of water toward the work, said jets approaching each other from opposite directions.

4. In a grinding machine, having a hollow work spindle in which the work is supported, a grinding wheel adapted to enter the work spindle and work, from the rear of the work head, a wheel head having a hollow annular portion, a closure therefor providing an axially extending nozzle communicating with said hollow annular portion, means to support said wheel for rotary movement within said annular member, means to supply water to said annular member and nozzle, whereby to direct a jet of water toward the wheel from the rear and axially thereof, and means to direct an additional jet of water toward the work from the front thereof.

5. In a grinding machine, having a hollow work spindle in which the work is supported, a grinding wheel adapted to enter the work from the rear of the work head, a wheel head having a hollow annular portion, a closure therefor providing an axially extending nozzle communicating with said hollow annular portion, means to support said wheel for rotary movement within said annular member, means to supply water to said annular member and nozzle whereby to direct a jet of water toward the wheel from the rear and axially thereof, means to direct an additional jet of water toward the work from the front thereof, and separate means to control the front and rear jets.

6. In a grinding machine, a hollow work spindle in which the work is supported, a grinding wheel adapted to enter the work from the rear of the work head, a wheel head having a hollow annular portion, a closure therefor providing an axially extending nozzle communicating with said hollow annular portion, means to support said wheel for rotary movement in said annular member, means to supply water to said annular member and nozzle whereby to direct a jet of water toward the wheel from the rear thereof, and means to direct an additional jet of water toward the work from the front thereof, and means to shut off said rear jet as the work is moved to replacement position.

7. In an internal grinding machine, a work head, a work suporting spindle, an enclosing casing for the work mounted on said head, a

splash guard adjacent said casing, a support therefor, and means to supply a jet of water through said splash guard support to the work supported by said spindle within said casing.

8. In an internal grinding machine, a work head, a work supporting spindle, an enclosing casing for the work mounted on said head, a splash guard adjacent said casing, said casing being formed with a conduit therein means to supply water through said conduit to the work supported by said spindle within said casing, and means to control said water supply by movement of said splash guard.

9. In an internal grinding machine, a work head, a work supporting spindle, an enclosing casing for the work mounted on said head, a splash guard adjacent said casing, a support therefor, means to supply a jet of water through said splash guard support to the work supported by said spindle within said casing, and means to shut off said jet of water when said guard is removed from operative position.

10. In an internal grinding machine, a grinding wheel, a wheel spindle, a hollow annular casing for said spindle, means including a closure for the casing providing a plurality of axially extending nozzles communicating with said hollow annular portion, to direct a flow of water through said casing and, in the form of jets, to said wheel, a work support, and means controlled by said support to shut off the water as the work and wheel are separated for replacement of the work.

11. In an internal grinding machine, a grinding wheel, a wheel spindle, a hollow annular casing for said spindle, means including a closure for the casing providing a plurality of axially extending nozzles communicating with said hollow annular portion, to direct a flow of water through said casing and, in the form of jets, to said wheel, a work support, a table on which said support is mounted, a control valve and means on said table effective to shut off the water as the table moves outward to separate the wheel and work for replacement of the work.

12. In an internal grinding machine, a hollow work supporting spindle, means to support the work at one end of said spindle, a grinding wheel entering the rear of the work through said hollow spindle, a truing device positioned within said hollow spindle, and means to cool said wheel, work and truing device.

13. In an internal grinding machine, a hollow work supporting spindle, means to support the work at one end of said spindle, a grinding wheel entering the rear of the work through said hollow spindle, a truing device positioned within said hollow spindle, and means to cool said wheel, work and truing device and said work supporting spindle.

14. In an internal grinding machine, a hollow work supporting spindle, means to support the work at one end of said spindle, a grinding wheel entering the rear of the work through said hollow spindle, a truing device positioned within said hollow spindle, and means to supply a jet of water on said grinding wheel, said jet also engaging and cooling said truing device.

15. In a grinding machine, a work spindle, an enclosing casing therefor, a work holding device in said casing, yielding means to clamp said holding device to hold the work, and manually operated means to release said holding device, said latter means including a rock shaft extending through said casing to the outside thereof, a handle mounted at the outside of said casing, and operative connections between said handle and said rock shaft.

16. The combination in a grinding machine as set forth in claim 15, in which said connections include a cam directly actuated by said handle, and lever connections between said cam and said shaft.

17. The combination in a grinding machine as set forth in claim 15, in which said connections include a cam directly actuated by said handle, and lever connections between said cam and said shaft, said cam engaging a surface on one end of said lever and being effective to lock said work-holding device in inoperative position when engaging said lever.

18. In an internal grinding machine, a work supporting spindle, an open ended enclosing casing therefor, a splash guard adjacent the open end of said casing, a support therefor, and means to supply a jet of water through said splash guard support to the work supported by said spindle within said casing.

19. An internal grinding machine having a work head including a work supporting spindle, an open ended enclosing casing therefor on said work head, a splash guard supported by said casing adjacent the open end thereof, means to supply water through the splash guard support to the work supported by said spindle within said casing, and means to control said water supply by movement of said splash guard.

20. In an internal grinding machine, a work supporting spindle, an open ended enclosing casing therefor, a splash guard mounted adjacent the open end of said casing, a support therefor, means to supply a jet of water through said splash guard support to the work supported by said spindle within said casing, and means to shut off said jet of water when said guard is removed from operative position.

In testimony whereof I have hereunto affixed my signature.

ALDEN M. DRAKE.