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3,334,450

SAFETY DEVICE FOR GRINDING HEADS

Filed Jan. 21, 1965

2 Sheets-Sheet 1

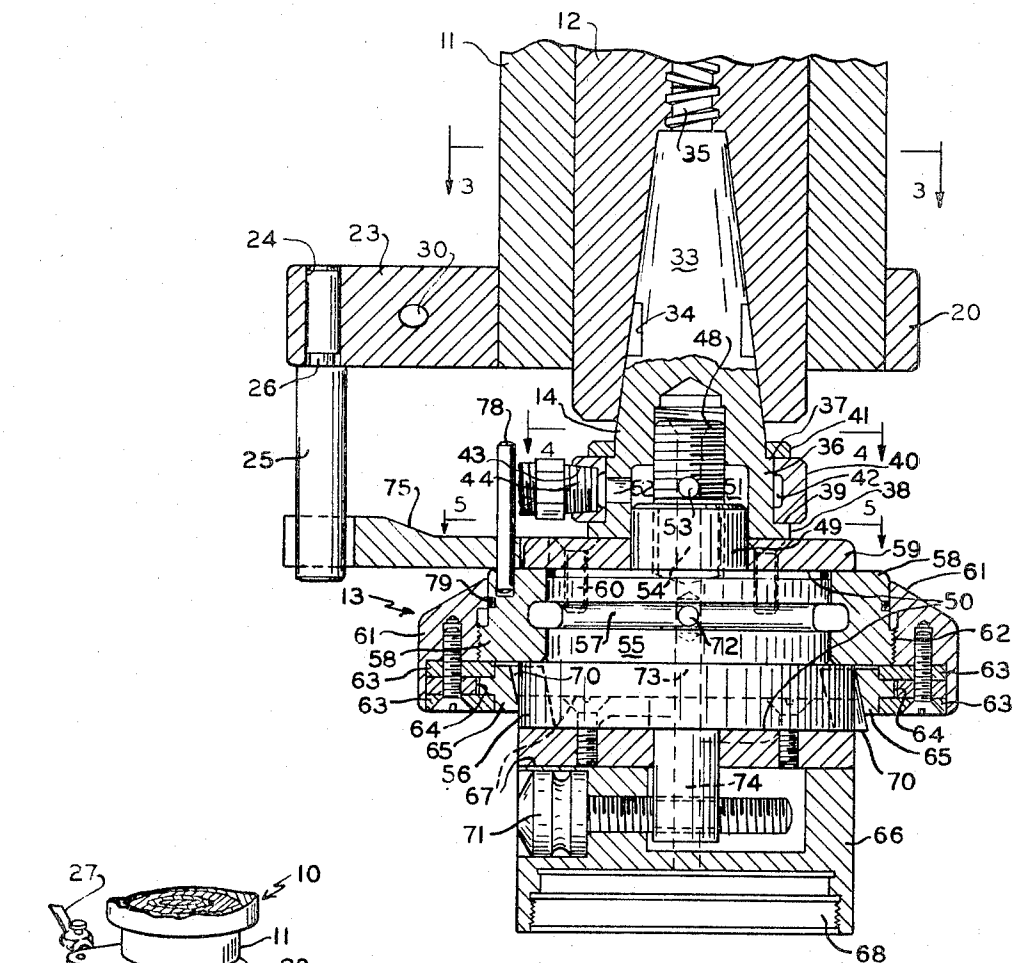


Fig. 2

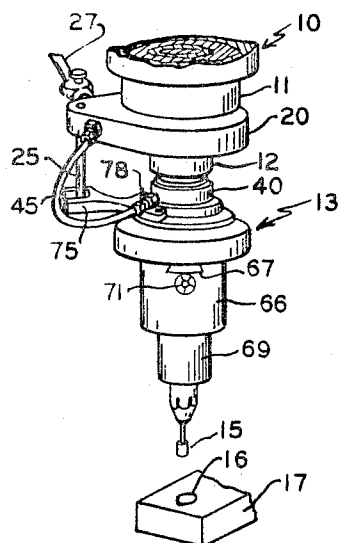


Fig. 1

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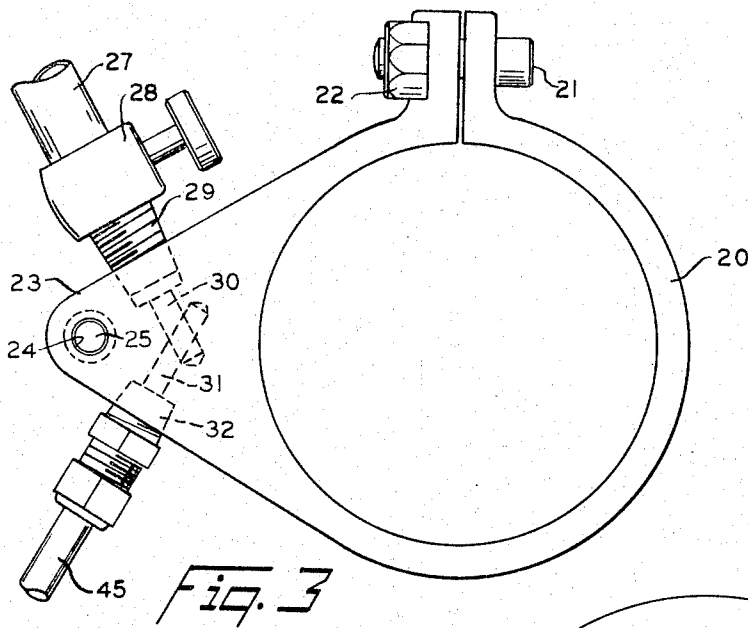
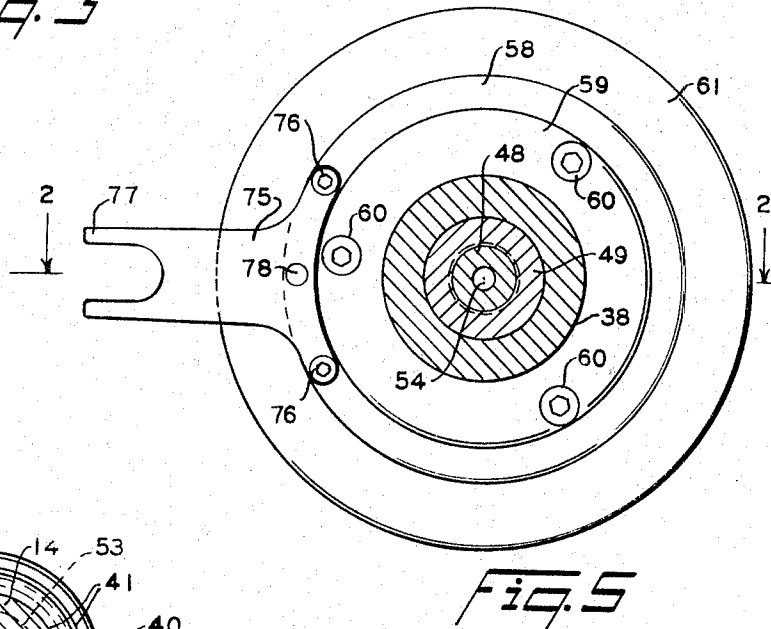
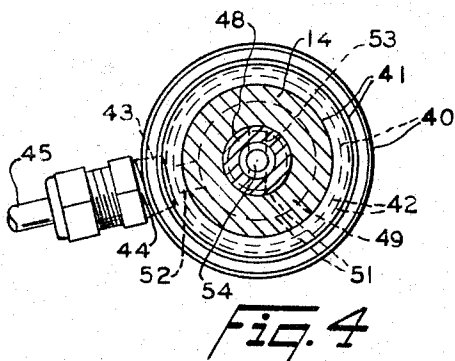
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SAFETY DEVICE FOR GRINDING HEADS

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This invention relates to a safety device for grinding heads which are rotatably carried by the spindle of a machine and which have an air motor for rotating an orbitally carried grinding wheel at high speeds.

The grinding head is secured to and rotated by the machine spindle to impart the orbital movement to the grinding wheel and a normally non-rotating slip ring portion of the head is provided to supply a continuous flow of fluid under pressure to the air motor. Other normally non-rotating portions may be provided for adjustment of the orbital path of the grinding wheel while the other parts of the head are rotating.

The slip ring portion is carried on one of the rotating portions so as to be capable of independent rotation and a torque rod is usually provided projecting radially from the slip ring portion so as to engage a stationary portion of the machine to prevent rotation of the ring. The air supply hose has also heretofore been connected to the slip ring, usually with a heavy metal coupling.

A mist of oil is provided in the air supply to furnish lubrication for the moving parts but recent developments have been made in such grinding heads to provide increased accuracy in the control over the size and location of the hole in the work which is ground by the head. This increased accuracy is only possible by manufacturing the parts of the head, which move with respect to one another, to tolerances which are measured in fractions of a ten thousandths of an inch. Should the slip ring seize or set-up with the rotating part to which it is so closely connected, the air supply hose would be suddenly rotated and twisted about the head so as to damage the machine or the head and possibly cause serious injury to the operator.

The principal object of the present invention, accordingly, is to provide in the means for normally preventing rotation of the slip ring and other non-rotating parts, shearable portions which will break without damage if the head sets up.

Another important object is to provide means for preventing rotation of the slip ring and other non-rotating parts, including the air supply system, which project from the head a minimal distance so that if any of the non-rotating parts set-up there will be no parts whipping about the head to injure the operator or the machine.

A still further object is to provide such safety means in a grinding head which do not necessitate any increase in the overall length of the head and the consequent impairment of accuracy.

Other objects and advantages will become apparent from the following description taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is perspective view of a grinding head secured in a machine and showing the device of the invention;

FIGURE 2 is an enlarged longitudinal sectional view on the line 2-2 of FIGURE 5 of a portion of the parts shown in FIGURE 1;

FIGURE 3 is a plan view of the torque ring as viewed in the direction of the arrows 3-3 of FIGURE 2; and

FIGURES 4 and 5 are sectional views, respectively, on the lines 4-4 and 5-5 of FIGURE 2.

Referring to FIGURE 1, a boring machine, or similar machine, having a non-rotating quill or sleeve 11, and a rotating spindle 12, is partially shown at 10. A grinding head 13, more particularly described in U.S. Patent

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3,153,354, issued Oct. 20, 1964, to the same inventor, is secured in the spindle 12 by the shank 14 so as to be capable of movement up and down with the spindle in the usual manner. The head 13 carries a rapidly rotating grinding wheel 15 is an orbital path for grinding the sides of the hole 16 in a jig 17 which is secured on the work holder, not shown, of machine 10 beneath the spindle 12.

Referring to FIGURES 2 and 3, a torque ring 20 is clamped in conventional manner around the non-rotating sleeve 11 by means of the screw 21 and nut 22. The torque ring is provided with a radially projecting portion 23 having a hole 24 therein and secured in the hole the reduced end of a shearable pin 25 is secured, as by a pressed fit, so as to project downward alongside the head 13. Pin 25 is provided with a groove forming a further reduced portion 26 at the junction of the pin with the ring 20 to provide a weak point in the pin.

Best seen in FIGURE 3, an air supply hose 27 is provided at its delivery end with a shut off valve 28 and a nipple 29 threaded into the portion 23 of the torque ring in fluid conducting communication with a passage 30 in the ring. Passage 30 intersects another passage 31 provided at the other side of portion 23 with a threaded opening 32 adapted to receive another hose fitting as hereinafter described.

Referring again to FIGURE 2, the shank 14 is provided with a tapered portion 33, provided with wrench flats 34 and a threaded portion 35 to fit within the spindle 12. Below the tapered portion 33 an enlarged annular portion 36 of the shank is provided forming a shoulder 37 between portions 33 and 36. Below the annular portion 36 a flange 38 provides another shoulder 39 at the bottom of the annular portion.

Referring also now to FIGURE 4, a slip ring is provided around the annular portion 36 of the shank held in place between shoulders 37 and 39 by the retainer washer 41, which is secured to the shank as by a press fit. An annular groove in the inner surface of slip ring 40 forms, with portion 36 of the shank, an annular pressure chamber 42. A threaded inlet opening 43 radially through the slip ring 40 is provided to receive the nipple 44 of a hose fitting of a 1/8 inch plastic hose 45 connecting inlet 43 with the passage 31 in the torque ring 20 in which a similar hose fitting is secured, as best seen in FIGURE 1.

Referring again to FIGURE 2, an axially extending threaded stud 48 secures spindle 14 to an axially projecting boss 49 at the top of the upper body portion 50 of the head 13. The boss 49 fits in the opening within the annular portion 36, the opening providing an annular pressure chamber 51 above boss 49 around the screw stud 48. A radially extending passage 52 through the annular portion 36 connects the chambers 42 and 51, and a radially extending passage 53 through the screw stud 48 intersects an axially extending passage 54 therethrough, the hose 45 thereby being in continuous fluid conducting communication with fluid passages in the head 13, as will hereinafter be described.

Referring now to FIGURES 2 and 5, and as more fully set forth in the aforesaid Patent 3,153,354, the head 13 will now be briefly described. The body 50, below the boss 49, comprises a circular bearing portion 55 and an enlarged flange portion 56. The bearing portion has an annular groove 57 therearound midway between boss 49 and flange 56.

An annular normally stationary adjustment member 58 extends around the bearing portion 55 and is adapted to be held stationary while body 50 rotates. Member 58 is rotatably held in place between the flange 56 of the body and a cap washer 59 around the boss 48, the cap washer being secured to the body 50 by screws 60.

Another annular member, the fine adjusting member 61, is carried on the member 58 by a threaded connection

at 62 so as to be precisely adjustable up and down with respect to the member 58. Adjusting member 61 has secured thereto two spaced bearing rings 63, 63 forming an inwardly facing annular groove 64 therebetween. In this groove is carried an annular flange of a rotating camming ring 65, as shown.

Below the body 50, a motor carrier member 66 is slidably carried by a double dovetail slide 67 as more fully described in the aforesaid Patent 3,153,354, and the carrier 66 is provided with a threaded recess 68 in which the air motor 69 (FIG. 1) is secured.

Flange 56 of the body 50 has a dovetail slide diametrically across the lower face thereof in which the upper portion of the slide 67 is carried, and the upper surface of carrier 66 has an inverted dovetail slot diametrically thereacross in which the lower portion of the slide 67 is secured, as seen in FIG. 1.

The upper portion of slide 67 carries two camming pins 70, at either end, at the same small angle to the vertical and the camming ring 65 is provided with slots at the same angle in its inner surface in which the pins are contained. Movement of the member 61 up or down on the adjustment member 58, therefore, cams the slide 67 to right or left, respectively, as shown in FIG. 2.

Carrier 66 is provided with a coarse adjustment screw 71 for moving the carrier transversely with respect to the axis of rotation of the body 50, and an axial air passage in body 50 in prolongation of the passage 54 through the screw stud 48 is intersected by a radial passage 72 connected to the groove 57 and to an axially extending passage 73 offset behind the axis of body 50 in FIGURE 1. A cooperating axially extending passage 74 through the carrier 66 is in communication at all times with passage 73 and the recess 66, into which the end of air motor 69 is secured, for supplying air under pressure to the air motor 69.

As best seen in FIGURE 5, a torque arm 75 is secured to the top surface of the adjustment ring 58 radially outward of the cap washer 59 by screws 76. The torque arm 75 projects radially of the head 13 and is provided with a forked end 77 which is engaged with the shearable pin 25 when the head is secured in the machine 10. A pin 78 projects upward from arm 75 for engaging the coupling of the frangible hose 45 where it is connected to slip ring 40 for holding ring 40 stationary while shank 14 rotates, as shown in FIG. 1.

In operation the device 13, secured as described above in the spindle 12 of machine 10, rotates with the spindle except that the annular adjustment member 58, and associated member 61, is normally held from rotation with the rotating portions of the device by the engagement of torque arm 75 with the pin 25. A rubber O-ring 79, or other locking device, may be provided for preventing the accidental rotation of the fine adjusting member 61 with respect to the adjustment member 58.

Pin 78 projecting alongside slip ring 40 prevents rotation of the slip ring when the coupling of hose 45 engages the pin.

Air under pressure, from the relatively heavy supply hose 27, mixed with a mist of atomized oil enters passage 30 in torque ring 20 through valve 28 and nipple 29. Through passage 31 and its associated nipple, the air and atomized oil is conducted by the frangible hose 45 to the slip ring 40 and its enclosed annular chamber 42. Passage 32 is always in communication with chamber 42 and leads the air to the chamber 51, radial passage 53, axial passage 54, radial passage 72, and passages 73 and 74, to the air motor which rotates the grinding wheel 15 at high speed.

It will be understood that the axis of rotation of the grinding wheel 15 is initially offset from the axis of rotation of spindle 12 and body 50 by turning the coarse adjustment screw 71 before the machine 10 is started. The grinding wheel 15 is therefore carried in an orbital

path approximating the wall contour of the hole 16 in work to be ground when the spindle and sleeve are lowered in the machine to bring the wheel 15 in the hole 16.

While the wheel 15 is rotating and carried in its orbital path, the diameter of the orbital path may be increased by carefully controlled increments by turning the fine adjustment member 61 down with respect to the non-rotating adjustment member 58.

It will be apparent that the precision required in grinding such holes in jigs and the like necessitate that the annular adjustment member 58 must fit the bearing portion 55 of the body and fit between cap washer 59 and flange 56 closely and with tolerances measured in fractions of a ten-thousandths of an inch. The oil-laden air from hose 27 to the air motor is free to enter the groove 57 in the bearing portion 55 of body 50 to lubricate these closely fitting parts, but the possibility of the non-rotating part 58 seizing or setting up against the normally rotating parts always exists. Should the air hose 27 be directly connected to the annular normally non-rotating member 58 as described in the aforesaid Patent 3,153,354, the consequence of such setting up of parts would be disastrous. The relatively heavy hose would be whipped around the device at great speed carrying its relatively heavy metal coupling and, in certain cases, the attached oil atomizer connected thereto. An ordinary torque rod extending radially from the member 58 would also be most surely bent and also whirled around by the head.

In the device of the present invention, however, the torque arm 75 projects only a small distance radially beyond the fine adjustment member 61, which is the only part of the head which the operator touches during the operation of machine 10. The shearable pin 25, which breaks immediately if the head sets up, and torque arm 75 are above the operator's hand at all times.

The easily broken plastic hose 45 would break or be pulled from its coupling at one end or the other and, since the coupling connecting the hose to the slip ring 40 is above torque arm 75, the short hose 45 would remain above the operator's hand in any event.

It will be apparent to those familiar with the art that the hose 45 could be connected to the annular adjustment member 58 to supply air directly through the annular groove 57 instead of through slip ring 40, but the use of the separate slip ring is preferred.

An advantage of securing the torque ring directly to the sleeve of the machine is that the head 13 need not always be carried vertically but may be advanced toward the work 17 at an angle if that should be desired.

As will be apparent to those familiar with the art, the invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The embodiment disclosed is therefore to be considered in all respects as illustrative rather than restrictive, the scope of the invention being indicated by the appended claims.

What is claimed is:

1. In a grinding head carried by a sleeve-supported machine spindle, the head having a fluid pressure operated motor and normally rotating and normally non-rotating members, including at least one element rotatable coaxially with the spindle and a non-rotating slip ring carried by and independently rotatable with respect to the coaxially rotatable element, the slip ring having a fluid inlet and forming with the coaxially rotatable element an annular fluid pressure chamber in continuous fluid pressure communication with the inlet and the motor; a safety device for restraining the non-rotating head members from rotation and for supplying fluid under pressure to the slip ring, comprising: a torque ring secured to the machine spindle sleeve, a shearable pin fixed in the torque ring and projecting down alongside the head, a torque arm projecting radially from the head and

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engaged with the shearable pin, the torque arm being fixed to a normally non-rotating member, a supply conduit connected to a source of fluid under pressure and having its discharge end secured to the torque ring, and a frangible hose fluid conductively connected at one end to the conduit discharge end and at the other end to the slip ring fluid inlet.

2. In combination with a machine having a sleeve-supported driving spindle, an orbital grinding device comprising: normally rotating and normally non-rotating members including a rotating fluid pressure operated motor, at least one element secured to the spindle and normally rotating coaxially therewith, and a normally non-rotating slip ring carried by and independently rotatable with respect to the coaxially rotating element, the slip ring having a fluid inlet and forming with the coaxially rotating element an annular fluid pressure chamber in continuous fluid pressure communication with the inlet and the motor; a torque ring secured to the machine spindle sleeve; a shearable pin fixed in the torque ring and projecting alongside the normally non-rotating members; a torque arm projecting laterally from and being secured to a normally non-rotating member so as to engage the shearable pin; means interengaging the normally non-rotating members; a supply conduit connected to a source of fluid under pressure and having its discharge end secured to the torque ring; and a frangible hose connecting the discharge end of the conduit to the slip ring inlet in fluid conductive relation; whereby the shearable pin and frangible hose break and prevent damage if any of the normally non-rotating members seize to the normally rotating members.

3. In combination with a machine having a work holder and a sleeve-supported rotating driving spindle movable toward and away from the work holder, an orbital grinding device comprising: a shank secured to the spindle for supporting the device and for rotation coaxially with the spindle; the shank having a protruding annular portion; a slip ring secured around the annular portion and forming therewith an annular pressure chamber having a fluid pressure inlet in the ring, the ring being free for rotary motion relative to the shank; a body member coaxial with the annular portion; screw means securing the

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body member to the shank for rotation therewith; a fluid pressure operated motor slidably secured to the body member for rotation therewith and adjustable transversely thereto; intersecting radially and axially extending passages in the annular portion, the screw means, and body member for continuously conducting fluid under pressure from the annular pressure chamber to the motor; means carried by the body and including an annular member for adjusting the motor laterally with respect to the body member, the annular member being secured coaxially around the body member and being free for rotary motion relative thereto; a grinding wheel secured to and driven by the air motor; a torque ring secured to the machine sleeve; a shearable pin projecting from the torque ring alongside the body; a torque arm secured to and projecting laterally from the annular adjustment member so as to be engaged by the shearable pin for normally preventing rotation of the annular member; an air supply hose connected to a source of fluid under pressure and having its delivery end secured to the torque ring; frangible hose means operatively connecting the supply hose delivery end to the slip ring fluid inlet; and a stop pin carried by the torque arm and normally engaging a portion of the frangible hose means for preventing rotation of the slip ring; whereby dangerous swinging of the air supply hose is prevented if any of the normally non-rotating parts of the device seize to the rotating parts.

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