Feb. 1, 1944. P. S. CLAUS 2,340,735

TOOL FEEDING MACHANISM

Filed Nov. 24, 1942

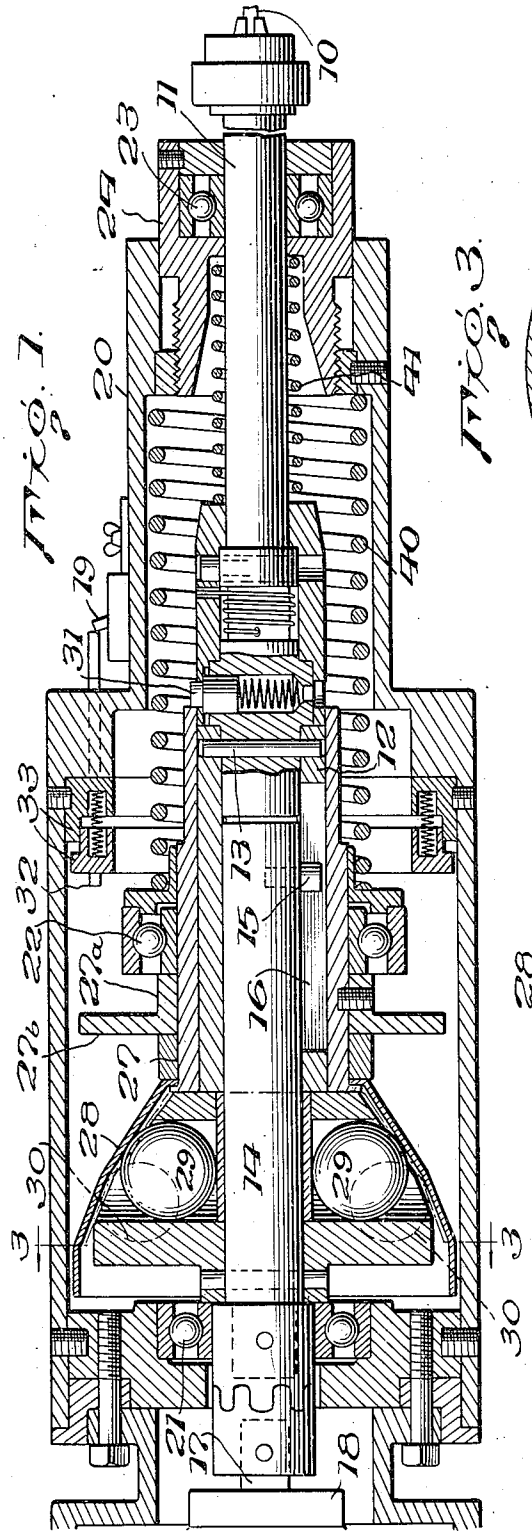


Fig. 1.

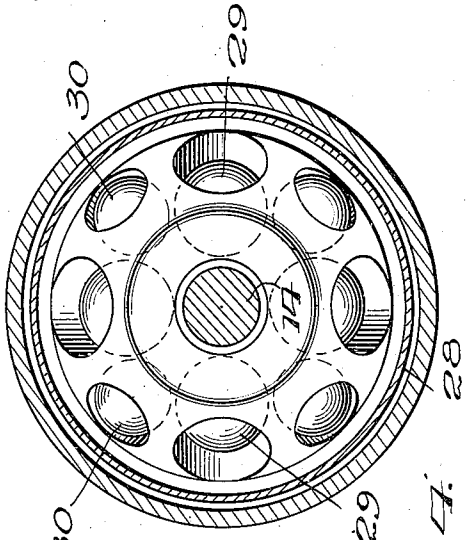


Fig. 3.

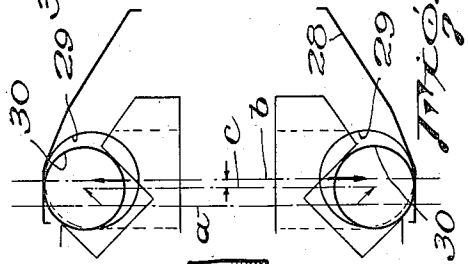


Fig. 4.

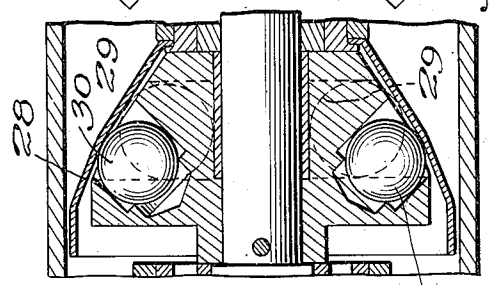


Fig. 2.

INVENTOR.
Philipp S. Claus,
BY Church & Church
Its ATTORNEYS

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TOOL FEEDING MECHANISM

Philip S. Claus, Redford, Mich.

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8 Claims. (Cl. 77—33)

This invention relates to improvements in tool feeding mechanisms and has to do particularly with the provision of an automatic feed head for rotary drill bits, milling cutters, reamers and the like.

There are numerous materials, metallic as well as fibrous, that are not homogeneous or of uniform density throughout, so that relatively hard spots or portions are encountered therein when being drilled or cut and, as a consequence, the driving torques which are thus caused to be variable during the cutting stroke must, or should be, compensated for. This compensation for variations in torque cannot be readily accomplished with the ordinary power-driven machine, whether it be gear or hand fed. In instances where hydraulic feed is provided, it is possible to at least partially eliminate or overcome some of the undesirable features of the gear and hand-feed machines, but, as the action of the hydraulic feed is rather sluggish, it does not possess a truly sensitive action so far as concerns compensation for variances in driving torques. The primary object, therefore, of the present invention is to provide a tool feeding mechanism which is highly sensitive, so far as concerns compensation for or controlling excess pressures that might be exerted on the drilling tool.

In the present feeding mechanism, the means for advancing the drill or cutting tool comprises inertia members responsive to the rotary motion of a driving shaft and adapted to engage a conically-shaped pressure plate associated with a driven shaft carrying the drill, whereby outward movement of the inertia members against said plate effects an advance of the driven shaft and tool, and a further object of the present invention is to impose a relatively greater point pressure on the tool at the initial portion of the cutting or drilling stroke and a reduced point pressure on the tool near the end of the drilling stroke, notwithstanding the fact that the driving shaft is running at substantially maximum speed and exerting its maximum effect on the inertia members.

Still another object is to dispose certain of the inertia members with respect to others of said members as to partially relieve the pressure exerted by the pressure plate on one of said groups of members.

More specifically, the invention contemplates a feeding mechanism wherein one group of inertia members engages the conical pressure plate at points spaced longitudinally of the driving shaft from the points at which a second set of members engage said plate, so that, as the pressure plate is advanced and approaches the limits of its advance movement, the members of that set which engage the plate in the rear of the other set, will assume a position beyond the end of, or out of contact with, the conical surface of the plate. Hence, even though the members are under the maximum influence of the driving shaft, the point pressure exerted on the tool through the pressure plate will be reduced by reason of the fact that one group of inertia members no longer tends to advance the pressure plate and driven shaft. Thus, the full effect of all the inertia members may be made use of during the major portion of the drilling stroke and automatically reduced toward the end of the stroke.

With these and other objects in view, the invention consists in certain details of construction and combinations and arrangements of parts, all as will hereinafter be more fully described and the novel features thereof particularly pointed out in the appended claims.

In the accompanying drawing,

Figure 1 is a longitudinal sectional view of an automatic feed head for a twist drill embodying the present invention and illustrating one set of inertia members;

Fig. 2 is a similar view taken in a plane to illustrate the second set of inertia members;

Fig. 3 is a sectional view on the line 3—3 of Fig. 1; and

Fig. 4 is a schematic illustration of the positions of the inertia members near the end of the drilling stroke.

The major portion of the structure illustrated in the present instance is fully shown and described in applicant's pending application Serial No. 417,051, and for present purposes a general description of the drill proper will suffice. As shown in Fig. 1, the drill 10 is carried on what is termed the driven shaft 11 which comprises a sleeve 12 secured to said shaft by a pin 13. Rotary motion is imparted to this driven shaft from the driving shaft 14 which has a lug 15 engaging in a longitudinal slot 16 in sleeve 12. This lug and slot connection permits the driven shaft to be advanced or moved axially during the drilling operation. Driving shaft 14 is clutched to the armature shaft 17 of electric motor 18 and the latter may be controlled by a switch 19 mounted on the forward portion of the housing 20 in which the two shafts are suitably journaled in a series of bearings 21, 22 and 23, the latter being

carried in an adjustable stop 24 in the forward end of the housing.

For advancing the driven shaft 11 with the drill 10 axially with respect to driving shaft 14 for feeding the drill into the work, there is a sleeve 27 loose on sleeve 12, and fast on sleeve 27 there is a so-called pressure or pusher plate 28, preferably of conical or tapering formation, against which the inertia members 29, 30 engage. Sleeve 27 is of sectional formation, having an intermediate portion 27a formed with a radial flange 27b. The pressure plate 28 is secured to the rear end of sleeve 27 and the forward end of said sleeve engages an abutment 31 carried by the driven shaft. Thus, as will be apparent, when driving shaft 14 is rotated, centrifugal force will urge the inertia members 29, 30 outwardly from the shaft and this movement of said members will force the pressure plate 28 forwardly, so that the sleeve 27, on which said plate is mounted, through abutment 31, will, in turn, advance the driven shaft 11 and drill forwardly. At the proper time in this advance movement, the flange 27b will engage a push-rod 32 to actuate switch 19 and de-energize motor 18. This de-energization of the motor, the deceleration of the revolving parts of braking elements 33, and the return movement of the driven shaft are fully described in said pending application and need not be repeated here.

As previously pointed out, it is the purpose of the present invention to apply a greater force to the drill point during the initial portion of the drilling stroke and a reduced point pressure at the end of the stroke. For this purpose, the inertia members are arranged in the two sets 29, 30, with one set of said members (30 in the present instance) contacting the conical surface of pressure plate at points in rear of the points at which members 29 contact said plate. With four members in each set, all eight members contact the conical surface of the pressure plate during the major portion of the drilling stroke, but, as the balls approach the outer limit of their movement away from shaft 14, the rear set of members 30 will move out of contact with said conical surface, leaving only the forward set in engagement with said surface, as illustrated in Fig. 4. Thus, the thrust imposed on the plate is reduced although the drill point is maintained in its advanced position as the four members still in contact with said conical surface impose sufficient force thereon to hold the drill point advanced. It will be appreciated that, when the members 30 move out of contact with said conical surface on to the truly cylindrical end portion of plate 28, they do not, in this position, have any effect so far as concerns the axial movement of sleeve 27 and driven shaft 11. Due to this reduction in the force applied to the pressure plate, the drill can make a sufficient number of revolutions at the end of the stroke to form a perfectly smooth surface on the bottoms of drilled holes, so that said surfaces are free of burrs or irregularities.

It will also be observed that, in the present structures, the two sets of inertia members move in different paths under the influence of driving shaft 14. That is, in the structure shown, members 29 move radially outward at an angle of 90° with respect to the shaft and members 30 move in a path at a considerably less angle of approximately 45° with respect to said shaft. The importance of this is two-fold. First, the inclination of the path of travel of members 30 with respect to the path of travel of members 29, as they move away from the shaft, causes the centers or points of contact of members 30 with plate 28 to approach or come nearer to the centers or the plane, transversely of the shaft, in which the points of contact between members 29 and plate 28 are located. In other words, the longitudinal spacing of the points of contact of the two sets of inertia members is reduced, so that, at the time the members are under the maximum influence of shaft 14, their centers will be comparatively close together and members 30 will not move out of contact with plate 28 too far in advance of the time at which members 29 reach the outermost limit of their travel, or approximately the outer edge of the conical surface. The positions of the inertia members at this point in the drilling stroke are illustrated in Fig. 4. The original spacing of the centers of the two sets of members is indicated by the lines *a*—*b* in Fig. 4, and the spacing of said centers, near the end of the drilling stroke, is indicated by the lines *c*—*b*.

A second advantage of this arrangement of the two sets of inertia members is that the members 30 will tend to reduce the stress imposed on members 29. Due to the fact that members move outwardly from the shaft in a truly radial plane or at 90° to the shaft, the plate 28, under the influence of the springs 40, 41, which cause its retraction, imposes what is termed a maximum lateral pressure against those members. On the other hand, due to the inclination of the paths or lines of movement of members 30, they have a greater tendency to overcome the influence of springs 40, 41 than do the members 29, or, in other words, the members 30, under the influence of shaft 14, have a greater thrust effect on plate 28 than do members 29. Hence, as stated, by having the members move along lines inclined with respect to the shaft, or at a lesser inclination than do the members 29, the latter are relieved to some extent of the stress imposed thereon by plate 28.

What I claim is:

1. A compensating feeding mechanism for rotary cutters comprising a driving shaft, a driven shaft, and means for advancing said driven shaft axially, said means including a cone-shaped plate associated with the driven shaft, and inertia members responsive to the rotary motion of the driving shaft and engageable with the conical surface of said plate, certain of said inertia members engaging said plate in advance of the others longitudinally of said shafts and being movable out of contact with the conical surface of said plate while said driving shaft is rotating at substantially its maximum speed to partially relieve the thrust of said members as a group on said plate.

2. A compensating feeding mechanism for rotary cutters comprising a driving shaft, a driven shaft, and means for advancing said driven shaft axially, said means including a cone-shaped plate associated with the driven shaft, a set of inertial members responsive to rotary motion of the driving shaft and engageable with the conical surface of said plate, a second set of inertia members responsive to rotation of the driving shaft and engageable with said plate surface at points spaced axially of the shafts from the points of contact of the first set of members, and means for decreasing the distance by which the points of contact of one set of members are spaced from the points of contact of the other

members as said members move outwardly from the driving shaft.

3. A compensating feeding mechanism for rotary cutters comprising a driving shaft, a driven shaft and means for advancing said driven shaft axially, said means including a cone-shaped plate associated with the driven shaft, and a plurality of inertia members engageable with said plate and responsive to rotary motion of the driving shaft, certain of said members being movable outwardly from the driving shaft in a path disposed substantially at right angles to said shaft and the others being movable outwardly from said shaft in a path at less than a right angle to said shaft.

4. A compensating feeding mechanism for rotary cutters comprising a driving shaft, a driven shaft, and means for advancing the driven shaft axially, said means including a substantially conical pressure plate associated with the driven shaft and a plurality of inertia members associated with the driving shaft and movable outwardly from said shaft into contact with said plate under the influence of the rotary motion of said shaft, certain of said members being movable in paths disposed at an angle to the paths in which the other members move.

5. A compensating feeding mechanism for rotary cutters comprising a driving shaft, a driven shaft, and means for advancing the driven shaft axially, said means including a substantially conical pressure plate associated with the driven shaft and a plurality of inertia members associated with the driving shaft and movable outwardly from said shaft into contact with said plate under the influence of the rotary motion of said shaft, certain of said members being movable in paths disposed at an angle to the paths in which the other members move and the members of one group contacting said plate at points spaced axially of the driving shaft from the points at which members of the other group contact said plate.

6. A compensating feeding mechanism for rotary cutters comprising a driving shaft, a driven shaft, and means for advancing the driven shaft axially, said means including a substantially conical pressure plate associated with the driven shaft and a plurality of inertia members associated with the driving shaft and movable outwardly from said shaft into contact with said plate under the influence of the rotary motion of said shaft, certain of said members being movable in paths disposed at an angle to the paths in which the other members move and the members of one group being movable out of contact with the conical surface of said plate at a predetermined point in their movement outwardly from the driving shaft.

7. A compensating feeding mechanism for rotary cutters comprising a driving shaft, a driven shaft, and means for advancing the driven shaft axially, said means including a substantially conical pressure plate associated with the driven shaft and a plurality of inertia members associated with the driving shaft and movable outwardly from said shaft into contact with said plate under the influence of the rotary motion of said shaft, certain of said members being movable in paths disposed at an angle to the paths in which the other members move, the members of one group contacting the conical surface of said plate at points in the rear of the points at which the members of the other group contact said surface, and the members of said first group being movable out of contact with said conical surface at a predetermined point in their movement outwardly from the driving shaft.

8. A compensating feeding mechanism for rotary cutters comprising a driving shaft, a driven shaft, and means for advancing the driven shaft axially, said means including a substantially conical-shaped plate associated with the driven shaft and two sets of inertia members responsive to rotary motion of the driving shaft to urge all of said members outwardly away from said shaft into contact with the conical surface of said plate, and means for moving one set of said members out of contact with said surface as they approach the outer limit of their movement away from the driving shaft whereby the point pressure on the cutters is reduced while said driving shaft is rotating at substantially its maximum speed.

PHILIP S. CLAUS.