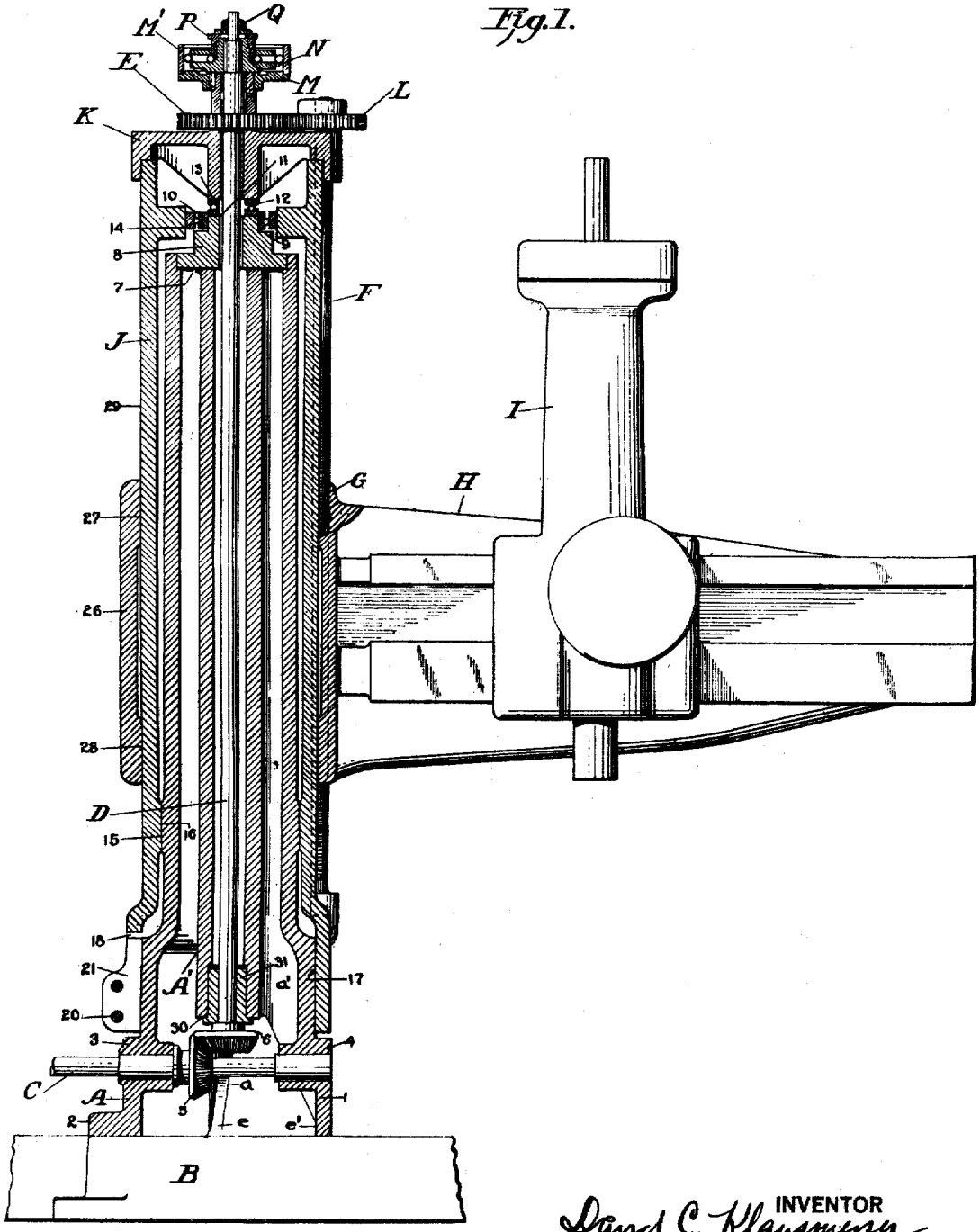
June 3, 1924. 1,496,577

D. C. KLAUSMEYER

DISCRIMINATING SLIP DEVICE

Filed Aug. 12, 1921 3 Sheets-Sheet 1

Fig. 1.



David C. Klausmeyer INVENTOR

BY

Albert F. Nathan

ATTORNEY

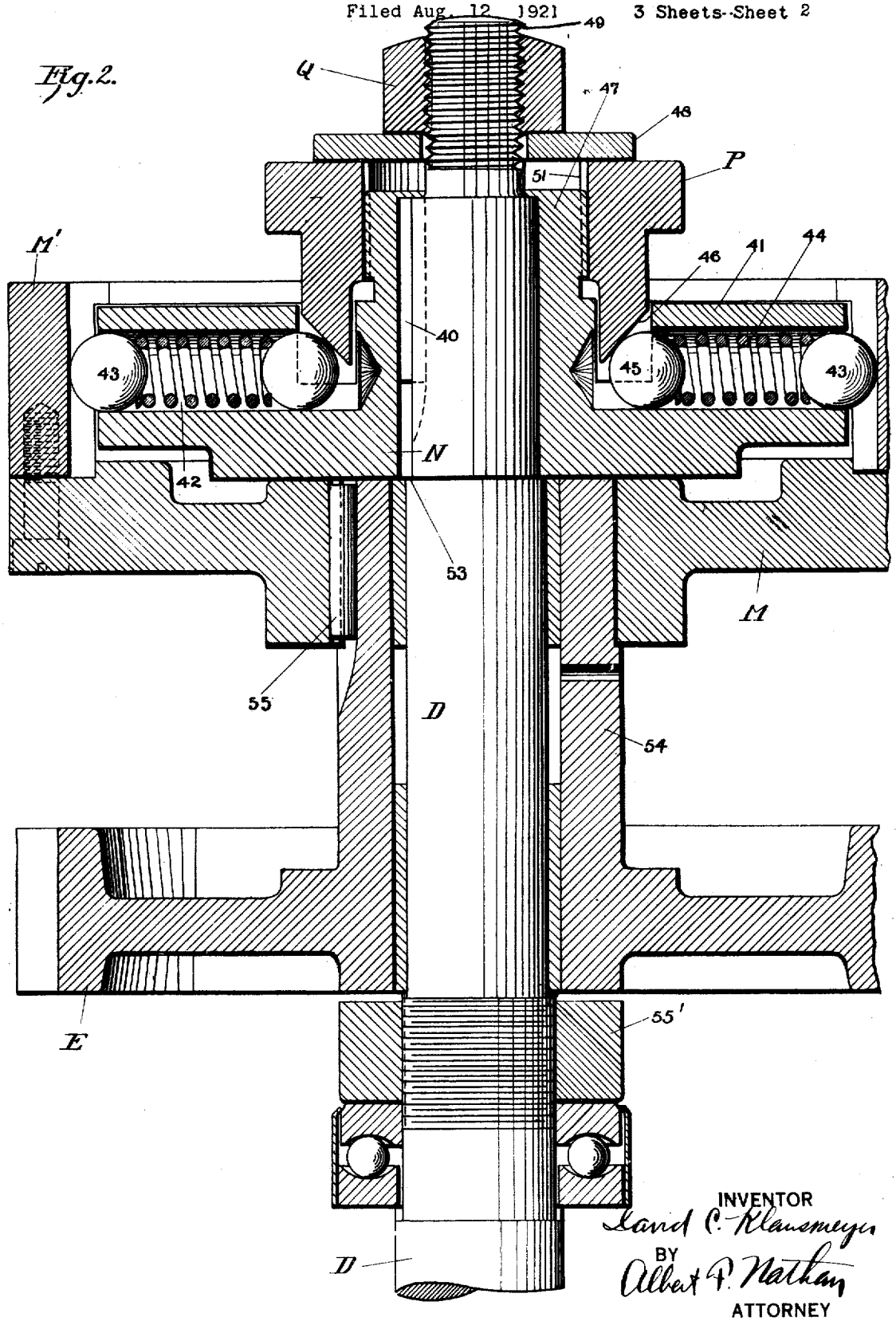
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D. C. KLAUSMEYER

DISCRIMINATING SLIP DEVICE

Filed Aug. 12, 1921 3 Sheets-Sheet 2

Fig. 2.



INVENTOR
David C. Klausmeyer
BY
Albert P. Nathan
ATTORNEY

June 3, 1924. 1,496,577

D. C. KLAUSMEYER

DISCRIMINATING SLIP DEVICE

Filed Aug. 12 1921 3 Sheets-Sheet 3

Fig.3.

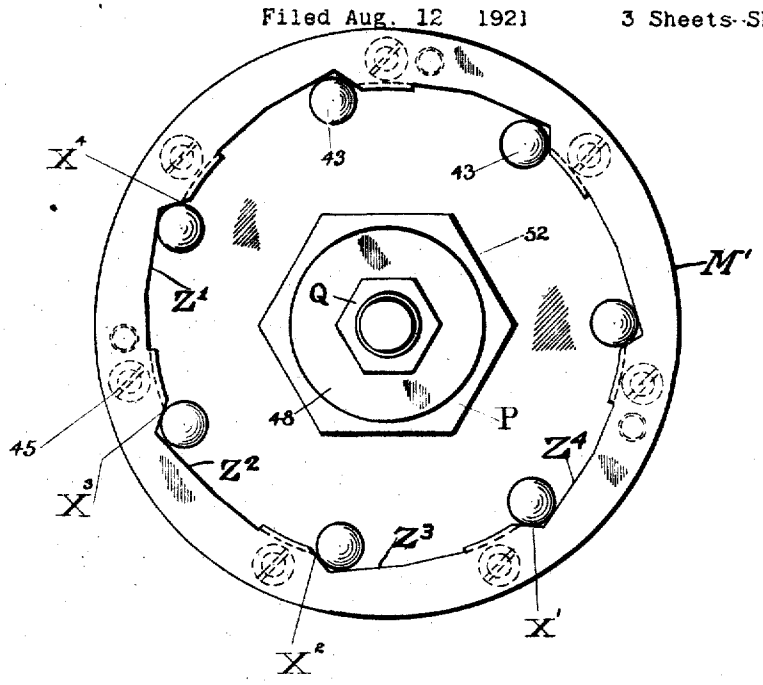
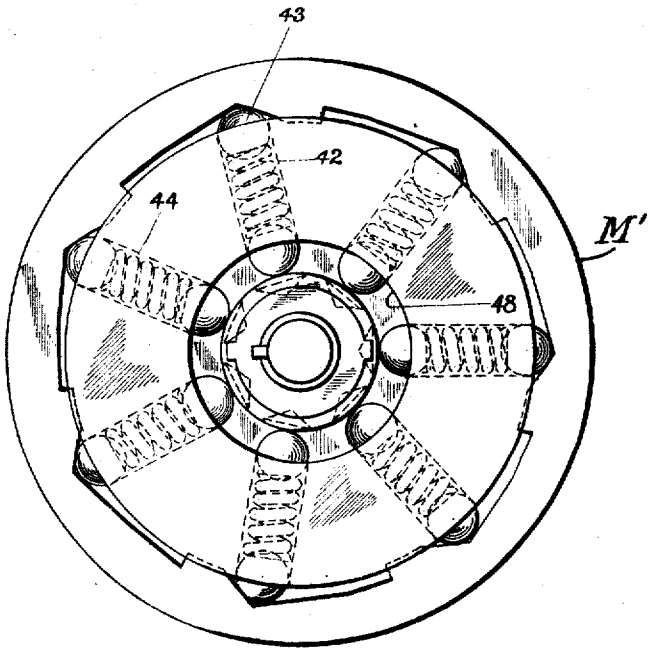


Fig.4



INVENTOR
David C. Klausmeyer
BY
Albert P. Mathews
ATTORNEY

Patented June 3, 1924. 1,496,577

UNITED STATES PATENT OFFICE.

DAVID C. KLAUSMEYER, OF CINCINNATI, OHIO, ASSIGNOR TO THE CINCINNATI BICKFORD TOOL COMPANY, OF CINCINNATI, OHIO, A CORPORATION OF OHIO.

DISCRIMINATING SLIP DEVICE.

Application filed August 12, 1921. Serial No. 491,710.

To all whom it may concern:

Be it known that I, DAVID C. KLAUSMEYER, a citizen of the United States, and residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented a new and Improved Discriminating Slip Device, of which the following specification is a full disclosure.

This invention deals with machine-tool organizations, and with sub-combinations thereof, relating more especially to improvements whereby the motion may be transmitted within safe limits of torque of different magnitudes in the respective directions of transmission.

In various species of machinery, it is very essential to resort to means for definitely limiting the amount of power transmittable from the prime-mover in order to prevent the machine from being damaged in case the propelled element should meet with some undue obstruction in either direction of its travel. Heretofore, this result has been attained by embodying a so-called slip-clutch at an appropriate station in the transmission-train but such slip-clutches have the disadvantage of making no allowance for the difference in normal torque not uncommonly required when the propelled element is advanced and when it is returned. In the case of a radial-drill, for example the arm is a heavy element which slides on a column against the constant pull of gravity when it is to be elevated, and which slides aided by the same weight when it is being lowered. In other words, depending upon the direction of the transmitted motion, the safety slip-mechanism should be adapted, on the one hand, to overcome the normal frictional resistance of the arm increased by the constant force of its weight and, on the other hand, to overcome the same normal resistance diminished by the force of its weight. Consequently, the slip-device may have to transmit but little force when lowering the arm, and considerable force when raising it. Unless the slip device is so constructed to compensate for these different forces, it will be perceived that it will be inadequate to meet the full requirements of either one or the other of its alternative uses.

This invention proposes a safety device in the nature of a slip-clutch which will discriminate between the two directions of propulsion and which will automatically deliver a greater torque to meet the requirements in the one case, and deliver a lesser diminished torque to meet the requirements in the other case; thereby preserving, so to speak, the proper factor of safety irrespective of the two distinguishable ultimate requirements. When applied to a radial-drill for instance, this invention equally relieves the transmission from excessive strains irrespective of whether the radial arm is unduly obstructed in its downward or in its upward travel. In ordinary constructions, if the slip-device is designed and adjusted so as properly to yield in case the arm is unduly opposed in its elevation, it is obvious that the slip-device will transmit too much power to yield when the arm encounters a like opposition during its descent and this inability of a conventional slip-device to discriminate between the two conditions, is likely to occasion considerable damage.

This invention also seeks to accomplish the foregoing desideratums without depending upon impositive transmitting elements which are always more or less unsatisfactory and which, if long standing, are very likely to get materially out of adjustment and incapable of responding under the initially determined excess conditions of torque. This is notably true of various sorts of friction-clutches which depend upon the condition of the contacting surfaces, the lubrication thereof, etc. While the discriminating characteristics of this invention are applicable to friction clutches, this invention finds its best expression in a positive construction prohibiting creeping; and not wholly dependent upon friction for the purpose of transmitting torque up to the predetermined amount clockwise and up to the predetermined amount anti-clockwise. Such a construction is more reliable and more certain in its action inasmuch as its yield depends upon the forcible retraction of a part (such as a ball) against a definitely sustained resistance (such as a spring) and for an appreciable distance of travel (such as the length of the facet); in contradistinction from the mere drag between two surfaces held in frictional engagement.

Unlike positive clutches which admit of no slippage in case the feed is performed against some undue resistance, and unlike conventional friction clutches which tend more or less to creep and thereby impair

the accuracy of the feed; this invention proposes a peculiar clutch which up to safe limits of torque will be positive but which therebeyond will be impositive and capable of yielding. Unlike conventional positive and impositive clutches (which are equally operable in both directions) this invention proposes a discriminating clutch which will be much more resistant to yielding when driven in the one, than when driven in the other direction.

Other objects and advantages will be in part indicated in the following description and in part rendered apparent therefrom in connection with the annexed drawings.

To enable other skilled in the art so fully to apprehend the underlying features hereof that they may embody the same in the various ways contemplated by this invention, drawings depicting a preferred typical construction have been annexed as a part of this disclosure and, in such drawings, like characters of reference denote corresponding parts throughout all the views, of which:—

Fig. 1 is a side elevation, largely diagrammatic in character, of a radial-drill embodying this discriminating slip-device in the transmission which raises and lowers the arm. Fig. 2 is a longitudinal section of one of the numerous available forms of this mechanism. Fig. 3 is a plan of Fig. 2 with the male member of this clutch removed. Fig. 4 is a plan of Fig. 2 with the tension regulator removed.

This invention is shown embodied in a radial-drill of the species in which the elevating screw is propelled through the agency of a power-driven shaft arranged coaxially with the stationary, upright post or trunk, although it will be understood that the invention is applicable to other types presenting somewhat different details of construction. In the type herein illustrated, the post or trunk is indicated by A and it assumes the formation of a casting bolted or otherwise mounted in unitary relations with a base indicated by B in the form of a suitable casting and providing the usual bed for supporting the article to be drilled. This post, as shown, is tubular in form and, preferably, its various parts and features are cast together so as to constitute a unitary or integral element. The post comprises a hollow base portion 1 providing a flange 2 or bolt-receiving lugs located at its sides and its rear. In this embodiment, the base portion provides apertured bosses 3 and 4 within which is journaled a driving shaft C bearing a beveled gear 5 adapted to intermesh with the complementary beveled gear 6 secured to an upright driving shaft D arranged, in this instance, so as to extend coaxially through the stationary post and terminating exteriorly at its upper end in propelling relations with suitable change gear E and L which, in turn, are effective to rotate an elevating screw F located externally of the column and passing through a suitable nut G secured to the arm H so as to enable the latter, together with the drill head I, to be elevated or depressed by the above mentioned power driven instrumentality.

At its upper end, the post A is provided with an annular seat 7 adapted to receive a bearing block 8 mounted concentrically and provided with an annular seat 9 adapted to receive an annular ball-bearing 10 and also provided with a seat 11 adapted to support a thrust ball-bearing 12. Enveloping the above mentioned post, is a sleeve J in the nature of a tube; said sleeve being secured at its upper end to a cap K which is provided with a hub 13 adapted to bear against the thrust bearing 12, whereby the sleeve, together with the parts carried thereby may be hung from its upper end and have its weight in the whole or in part taken up by the aforesaid thrust bearing 12. This sleeve is provided with an internal annular rib 14 concentrically receiving the side ball-bearing 10 so that at its upper end, said sleeve will be free to rotate and to be, at the same time, maintained truly concentric with the axis of the post. Adjacent this lower end, said sleeve is also conformed to rotatably bear against the post and, to that end, it is provided with an ample annular bearing surface 15 preferably formed in the nature of a slight, annular ridge adapted to uniformly contact with a corresponding surface 16 provided by the post. These bearing portions 15 and 16 are truly cylindrical so as to permit of the slight axial adjustments in the position of the sleeve incidental to the assembly of the element in the factory or subsequently.

The elevating screw F, above mentioned, is at its upper and lower ends, journaled in suitable bosses provided by the cap K and the lower portion of the sleeve, so as to be carried by the sleeve and spaced a sufficient distance therefrom so as to pass through the feed nut G provided by the arm H. The latter is provided with a portion 26 circumscribing the sleeve and internally having annular bearing surfaces 27 and 28 accurately fitting aroung the sleeve J. The periphery 29 of the sleeve is ground to true cylindrical form so that the arm may freely slide thereon and be given any desired position through the instrumentality of the feed screw F.

At an appropriate point in the transmission for raising and lowering the heavy arm H, the slip-clutch shown by Figs. 2 to 4 is serially inserted. This mechanism comprises two members M and N which are arranged, preferably, in nested relation and

which are relatively movable both in a clockwise and in an anti-clockwise direction. One of these members may be utilized as the driver and the other as the follower; it being immaterial which is connected with the prime-mover. For convenience in mounting, they may both be supported by the same shaft; in which case, the shaft may be used as a power-transmitting element, and one of said members may be secured to rotate as a unit with the shaft in either direction. The male member N is, in this instance, secured to the shaft by means of a key 40 and it has a disk-like portion 41 that is provided with a series of radial perforations 42 in which are mounted a series of detents 43 which are normally pressed radially outward by means of expansile springs 44 which are adjustable as to tension, as will presently be described. These detents are shown in the form of hardened balls and they normally engage two series of facets provided by the female member M of the clutch. These run-ways are preferably made of hardened steel and, to that end, they are formed on the inner periphery of a hardened ring M′ which is fastened appropriately, as by screws 45 to the part M so as to form a component part thereof. The member M is loosely journaled on the shaft D and motion is transmitted from one of these members to the other through the detents 43, as will be understood.

It is desirable to be able to adjust the pressure of the detent balls against the raceways and, inasmuch as there is a plurality of detents, it is desirable that the tension may be adjusted uniformly so that each will bear the same load. This is accomplished by locating a member 45 in the nature of a support for the inner end of each spring. This member 45 may, to good advantage, be in the shape of a ball. These balls are, in turn, supported by the conical face 46 of a collar P which is slidably mounted on the periphery of the hub 47 of the male member N and the end of the collar enters an annular groove 48 which is cut in the outer face of the member N and intersects the radial perforations so as to expose the spherical detents 45 and enable their radial positions to be adjustably determined by axially shifting the collar P. The position of the collar is, in turn, determined by a nut Q acting through a washer 48; the nut being threaded to the extremity 49 of the shaft D. By turning the nut, the tension of the detents 43 may be regulated at will. As a matter of convenience in ascertaining the tension, the collar P may be splined, as indicated by 51, to the hub 47 and its outer periphery may be provided with wrench receiving faces 52 so that, by applying a wrench to the collar P, the male member N may be turned relative to the female member M and the extent of resistance in each direction readily ascertained and regulated by manipulating the nut Q.

Inasmuch as the pressure of the balls 45 against the conical seat 46 tends to urge the member N in an axial direction, it is preferable to provide the shaft D with a shoulder 53 against which the member N may rest.

The member M may comprise a sleeve 54 affixed by the key 55 to the part presenting the run-ways and this sleeve may present a gear E which is suitably meshed with some other gear forming a part of the transmission train. A collar 55′ is screw-threaded to the shaft D and serves as an adjustable shoulder for limiting the axial movement of the shaft D.

A very consequential characteristic of this invention is shown by Figs. 3 and 4 and comprises two distinct series of facets x^1, x^2, x^3, x^4, etc., and z^1, z^2, z^3, z^4, etc. These facets determine the resistance in the opposite directions and they are consequently sloped forwardly and backwardly as is shown. The facets x^1, x^2, etc., are disposed at a more acute angle to the direction of retreat of the balls and the facets z^1, z^2, z^3, are sloped at a steeper angle to said direction of retreat. Consequently, it requires a greater torque to compel the balls to climb the facets x^1, x^2 than to climb the facets of the other series. As a result of this construction, the device will transmit a greater torque without yielding in the one direction than in the other and yet, by virtue of the fact that the balls are normally seated in the pockets formed by the construction, the device is positive in action and quite devoid of any tendency to creep. Likewise it responds very surely and easily to precisely the torque predetermined by the user. It will, of course, be understood that, while the facets of the two series are shown applied alternately in the same plane, they may be arranged in adjacent planes, and the balls correspondingly arranged so that the balls offering the greater torque will cooperate with the corresponding facets, and conversely.

It will thus be seen that this invention is well adapted to accomplish the objects enumerated in the foregoing and it is particularly applicable to machine-tools, such as radial drills, where a heavy and ponderous element is required to be lifted in the one case, and lowered in the other, without imposing any unnecessary strains on the power-driven elements, should an undue opposition be encountered.

Having thus revealed this invention, I claim as new and desire to secure the following combinations and elements, or equiv-

alents thereof, by Letters Patent of the United States:—

1. A radial-drill combining an elevatable arm; a power-driven transmission for elevating said arm; and a clutch effective in either of two directions of rotation serially related to said transmission and adapted to transmit only a predetermined torque during the depression of said arm and only a greater predetermined torque during its elevation.

2. A machine-tool combining a column; a translatable sleeve thereon; a transmission for feeding said sleeve; and a slip-clutch effective in either of two directions of rotation in series with said transmission and comprising a member having a differentially serrated run-way; and a spring-pressed retractile-element engaging said run-way to oppose the slipping of said clutch more strongly in the one than in the other direction.

3. A machine-tool combining a member; a power-driven transmission for feeding or retracting said member; and a slip-clutch effective in either of two directions of rotation determining the effect of said transmission, said clutch being positive in action when conveying a predetermined torque in the member-retracting direction and when conveying a materially greater predetermined torque in the opposite direction.

4. A machine tool combining a member adapted to be fed and retracted; and a friction clutch therefor adapted to transmit power of unequal amount in oppositely directed rotations and comprising a movable detent and a member having an annular runway consisting of a first series of facets inclined in one direction and a second series of facets inclined in another direction, the inclination of the facets of the two series being at substantially different angles to the direction of movement of said detent; said detent being adapted to slide successively on the facets of either series.

5. A machine-tool combining a member having a slide-way; a frame-element slidable thereon; a power-driven transmission for moving said frame-element; and a slip-clutch effective in either of two directions of rotation in said transmission, said slip-clutch being inherently more readily yieldable to strains of predetermined magnitudes imposed in one tl. in the contrary direction.

6. A machine-tool combining a member adapted to be moved in either of two contrary directions but normally against greater opposition in the one than in the other; a power-driven transmission for moving said member in either of said directions according to the direction of flow of motion through said transmission; and a slip-device operative to transmit power in opposite directions but more resistantly in one than in the other, said slip-device being serially arranged with said transmission so as more resistantly to propel said member against its greater opposition, and conversely.

7. A discriminating clutch combining a first member having a series of radial guideways; a second member circumscribing the first and having its inner periphery provided with an annular serrated race-way, the facets of which are alternately long and short, the long facets being gradually and the short facets being steeply sloped; and spring-pressed detents located in said guideways and projecting into engagement with said race-way for yieldingly locking said members together, said detents being retractible sufficiently to permit complete rotation of one member relative to the other member when the clutch is subjected to a predetermined strain.

8. A coupling adapted to transmit a predetermined load in one direction and a greater predetermined load in the opposite direction, said coupling comprising a first member; a second member concentric therewith; and having a plurality of radial guide-ways; balls therein; two series of facets arranged annularly on the first member, the facets of the one series being sloped at a greater angle to the radius than the facets of the other series; expansile springs for urging said balls against said facets; and means for simultaneously adjusting the tension of all of said springs.

9. A transmission comprising a rotary shaft; a member having a hub and an annular perforated portion overhanging said hub; a collar shiftably mounted on said hub and having wedge-portions adjacent the inner ends of said perforations; balls movable in said perforations and supported by said wedge-portions; a gear-unit journaled on said shaft and having an annular flange circumscribing the perforated portions and having its inner periphery provided with two series of conversely-sloped long and short facets and making different angles to the line of movement of said balls; balls in the outer ends of said perforations and projecting against said series; expansile springs intervening between said detents and said tension-determinants; and a nut at the end of said shaft for adjustably shifting said collar.

10. A friction clutch adapted to transmit power of unequal amounts in opposite directions of rotation comprising a first rotatable member provided with an annular runway presenting a first series of forwardly sloped facets and a second series of rearwardly sloped facets; a second rotatable member movable relatively to said first member; and detent means mounted on said second

member in yieldable engagement with the facets of either series, the inclination of the facets of one series being substantially different from the inclination of the other with respect to the movement of the detent, said detent means being adapted to transmit a predetermined torque when engaging one series of facets and a substantially greater torque when engaging the facets of the other series.

11. A yieldable coupling comprising a plurality of relatively rotatable members; two series of inclined facets carried by said rotatable members; yieldable detents for cooperation with said facets and arranged to transmit power in different amounts on different directions of rotation.

12. A safety-coupling combining a first member adapted to be power-driven in opposite directions; a follower-member; an impositive driving connection between said members for transmitting unequal power in different directions of rotation, said driving connection comprising two series of facets provided by one member and yielding detents movable with the other member and cooperating with said facets, the facets of one series being sloped at a different angle to the direction of yield of said detents than the facets of the other series.

13. A discriminating clutch combining a first member having series of radial guideways; a second member circumscribing the first and having its inner periphery provided with a serrated race-way, the facets of which are alternately long and short, the long facets being gradually and the short facets being steeply sloped; and spring-pressed balls located in said guideways and projecting into engagement with said race-way, and means for regulating the pressure of said balls against said race-way.

14. A coupling adapted to transmit a predetermined load in one direction and a greater predetermined load in the opposite direction, said coupling comprising a first member; a second member concentric therewith and having a plurality of radial guideways; balls therein; two series of facets arranged annularly on the first member, the facets of the one series being sloped at a greater angle to the radius than the facets of the other series; expansile springs for urging said balls against said facets; and a shiftable cone supporting the ends of said springs for simultaneously adjusting their tension.

15. A transmission comprising a rotary shaft; a member having a hub and an annular perforated portion overhanging said hub; a collar shiftably mounted on said hub and having wedge-portions adjacent the inner ends of said perforations; tension-determinants movable in said perforations and supported by said wedge-portions; a gear-unit journaled on said shaft and having an annular flange circumscribing the perforated portions and having its inner periphery provided with two series of conversely-sloped long and short facets; detents in the outer ends of said perforations and projecting against said series; expansile springs intervening between said detents and said tension-determinants; said long and short facets and co-acting detents constituting means for transmitting power of unequal amounts from said member to said gear-unit in oppositely directed rotations thereof; and means at the end of said shaft for adjustably shifting said collar.

16. A slip-clutch of the nature revealed characterized by a first member presenting a first series of forwardly sloped facets and a second series of backwardly and more steeply sloped facets; a second member movable relatively to the first member; detent-means mounted on said second member in yieldable engagement with facets of said series, said means being adapted successively to up-ride the facets of one series when said members are relatively moved in one direction and to up-ride the facets of the other series when said members are relatively moved in the other direction; resilient means for urging said detent-means into cooperation with said series; and means for adjusting the tension of said resilient means.

17. A yieldable-coupling combining two coaxial relatively rotatable members providing two serrated annular and internal run-ways, the facets of the one being sloped and arranged differently from the facets of the other; radially-urged spring-pressed balls cooperating with said run-ways to offer greater opposition to a relative movement between said members in the one than in the other direction; and means for regulating the tension on said balls.

18. A safety-coupling combining a first member adapted to be power-driven in opposite directions; a follower-member; a plurality of balls movable as a unit with one of said members and radially movable with respect thereto; and two series of facets provided by the other member, the facets of the one series being sloped at a different angle to the direction of radial movement of said balls than the facets of the other series; resilient means controlling said balls; and means for adjusting the tension of said resilient-means.

19. A mechanism of the nature disclosed combining two relatively movable members, one of which is provided with a first series of facets inclined in one direction and a second series of facets inclined in a different direction and at a different angle than the first-mentioned series, said two series comprising an annular runway; an impositive driving connection between said members

comprising a detent; spring-pressed means tending to move said detent in a direction at a greater angle to the facets of one than the other series, said detent being adapted to transmit a certain predetermined torque and then to slip when acting upon one series of facets and to transmit a different predetermined torque and then to slip when acting upon the other series of facets.

20. A machine-tool combining a member having a slide-way; a frame-element slidable thereon a power-driven transmission for moving said frame-element; and a slip-clutch in said transmission, effective in either of two directions of rotation and adapted to transmit only a predetermined power and then to slip, said slip-clutch being inherently more readily yieldable to strains of a predetermined magnitude in one than in the contrary direction.

21. A machine-tool combining a member adapted to be moved in either of two contrary directions but normally against greater opposition in the one than in the other; a power-driven transmission for moving said member in either of said directions according to the direction of flow of motion through said transmission; and a slip-device operative to transmit power in opposite directions but more resistantly in one than in the other, said slip-device being serially arranged with said transmission so as more resistantly to propel said member against its greater opposition, and conversely.

22. A machine-tool combining a member; a power-driven transmission for feeding or retracting said member; and a slip-clutch active in either of two directions of rotation and determining the effect of said transmission, said clutch being positive in action and setting when conveying a predetermined torque in the member-retracting direction and a materially greater predetermined torque in the opposite direction.

23. A machine-tool combining a member adapted to be fed and retracted; and a propelling clutch therefor for transmitting power in either of two directions comprising a pawl and a member provided with a runway having a first series of facets inclined in one direction and a second series of facets inclined in another direction, said pawl being movable in a direction which is at unequal angles to the two sets of facets for transmitting power of unequal amounts in opposite directions of rotation.

24. A machine-tool combining a member having a slide-way; a second-element slidable thereon; a power-driven transmission for moving said second-element; and a slip-clutch effective in either of two directions of rotation in said transmission, said slip-clutch being inherently more readily yieldable to strains imposed in one than in the contrary direction.

25. A machine-tool combining a member adapted to be moved in either of two contrary directions but against greater opposition in the one than in the other, a power-driven transmission for moving said member in either of said directions according to the direction of flow of motion through said transmission; and a slip-device operative in opposite directions but more resistantly in one than in the other, said slip-device being serially arranged with said transmission so as more resistantly to propel said member against its greater opposition, and conversely the difference in propelling capacity of said slip-device being such that it will yield wherever said member is abnormally opposed by an additional resistance of substantially the same magnitude in either of its directions of motion.

In witness whereof, I hereunto subscribe my name, as attested by the two subscribing witnesses.

DAVID C. KLAUSMEYER.

Witnesses:
C. C. SLETE,
META NORDMAN.