July 31, 1928. 1,679,155

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POWER HAND TOOL

Filed July 26, 1926

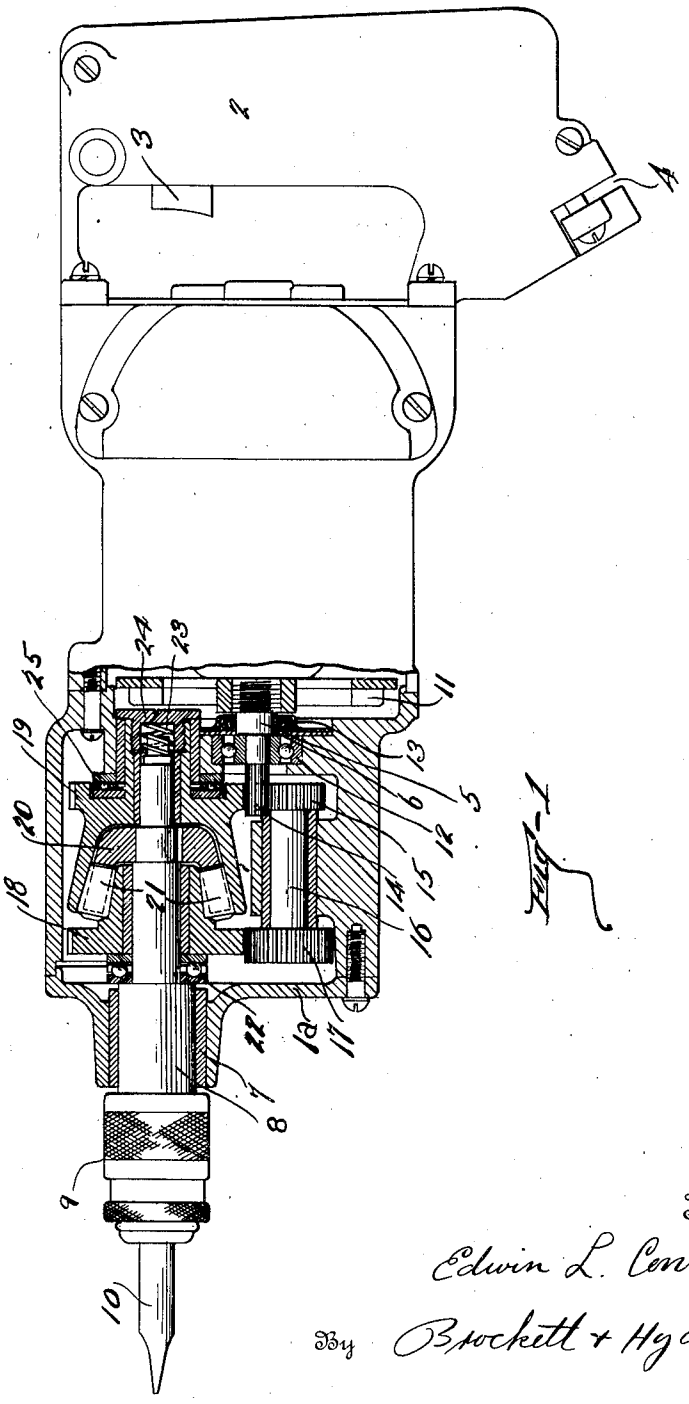



Fig. 1

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Patented July 31, 1928. 1,679,155

# UNITED STATES PATENT OFFICE.

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## POWER HAND TOOL.

Application filed July 26, 1926. Serial No. 125,002.

This invention relates to power hand tools of the general type comprising a handled frame in which are mounted a power unit of small capacity and high speed such as an electric motor, a tool to be driven thereby, and operatively connected therebetween a transmission mechanism whereby the high speed of the motor is transformed to a suitable comparatively slow speed of the tool; the transmission also preferably including clutch means whereby the connection between the motor and tool may be interrupted when desired.

Particularly, this invention relates to power means for driving home screws, bolts and the like, the general arrangement being that described and the particular requirement being a very great speed reduction between the motor and the screw driver blade or bolt head receiving means provided. Ordinarily gearing has been employed in such a tool for the purpose of speed reduction, and owing to the high speeds demanded of the gears the transmission has been necessarily noisy in spite of the highest quality of workmanship employed. Moreover, in a power tool for the purpose described it is necessary that provision be made for a slip or "give" in the transmission operative as the driven object reaches home; the purpose being obviously to insure driving to a tight seat, and yet prevent injury to the tool or work, such as by thread stripping as the seat is reached. For this purpose separate and comparatively complicated friction or semi-positive driving elements have heretofore been inserted in the transmission.

It is the object of my invention to provide a transmission capable of a great reduction in speed between the motor and the tool, simple in construction and operation, quiet in operation and employing elements which in themselves perform the clutching function referred to.

The exact nature and particular advantages of my invention will be apparent from the following description taken in connection with the accompanying drawing which is a side elevation of a screw driver chosen for illustration of the invention, the parts shown in operating relation and broken away to show the transmission details.

The tool shown comprises a base, frame, or casing 1 carrying at its rear end a handle 2 within which may or may not be mounted a motor controlling switch operated by the trigger 3, and terminating downwardly in an opening 4 for the electric motor cable running to the source of power supply. In the central part of the casing 1 is a motor, details of which are not shown, but the rotor shaft 5 of which projects through a partitioning web 6 into a cup shaped compartment forward of the motor and closed by the cover plate $1^a$ in which the transmission is located. A fan 11 may be mounted upon the rotor shaft for motor cooling purposes. Forward of the transmission is a bearing 7 in which a tool carrying member 8 is mounted for rotation, the outer end of the tool carrying member being provided with the usual chuck 9 to receive the screw driver blade 10 and the rear portion of the tool carrying member extending into the transmission housing portion of the casing in a manner to be described. The general structure so far described is old and common practice in the art.

The rotor shaft 5 is carried in a bearing 12 in the partition, the bearing being provided with the packing 13 to prevent the lubricating medium in the transmission chamber from entering the motor portion of the tool, and the end of the motor shaft terminates forwardly in the pinion 14. Meshing with this pinion is a gear 15 carried upon a counter-shaft 16 mounted to rotate in an inwardly projecting portion of the casing and carrying at its opposite end the gear 17 of somewhat larger diameter than the gear 15.

Upon the tool carrying member 8 are mounted for free rotation thereon a pair of driving members 18 and 19 provided with the corresponding conical driving surfaces indicated.

Each of the members 18 and 19 is provided with a flange, preferably integral as shown, in which are cut gear teeth, those upon the member 18 meshing with the gear 17 and those upon the member 19 meshing directly with the pinion 14, the pitch diameters of the flange gears being preferably equal. It will be evident therefore that rotation of the motor will effect rotation of the members 18 and 19 in opposite directions and at different speeds. Fixed upon the tool carrying member 8 is a spider 20 pro-

vided with fingers extending between the driving surfaces of the members 18 and 19. Lying between the driving surfaces referred to and spaced by the fingers of the spider 20 are a number of rolling planetary elements 21 slightly conical to correspond with the surfaces, the prolongation of any rectilinear element of any of these surfaces passing through a point common to all the elements and lying in the axis of the member 8.

The member 19 is backed with respect to the casing 1 by the thrust bearing 25. The member 18 is backed against a shoulder upon the member 8 by the thrust bearing 22. The member 8 is normally urged outwardly of the casing 1 by the spring 23 positioned coaxially with the tool carrying member 8 by a turned down end portion of the member and the depression indicated in a cap member 24 which is screw threaded into a shank portion of the member 19 whereby the member 19 is longitudinally positioned against the thrust bearing 21.

Thus by the arrangement described the inward motion of the tool carrying member 8 is opposed by the spring 23, and limited by the action of the rollers 21 between the driving surfaces of members 18 and 19, inward thrust of the tool being transmitted through the thrust bearing 22 and the driving member 18 acting through the rollers against the member 19 backed upon the frame through the thrust bearing 21; and outward motion of the tool carrying member is limited by contact of the thrust bearing 22 against the end of the bearing 7, acting through the member 18 and the spider 20, fixed upon the tool carrying member.

Operation of the tool is as follows: Upon grasping the tool by the handle 2, depressing the trigger 3 to cause actuation of the motor the driving members 18 and 19 are rotated as described in opposite directions and at speeds differing slightly, the speed of the member 18 being somewhat greater than that of the member 19 owing to the gear 17 being of somewhat greater diameter than the gear 15. At this time there is no rotation of the blade 10 since owing to the spring 23, the driving members 18 and 19 are maintained apart sufficiently so that the rollers 21 do not contact with either of them with enough force to be moved thereby.

Maintainig the motor in rotation the screw driver blade is next inserted in the slotted head of the screw to be driven and the tool forced against the screw whereupon the parts assume the position shown in the drawing. That is, the member 8 moves inwardly against the spring 23 to cause the rollers 21 to be tightly engaged between the driving surfaces of the members 18 and 19. As the pressure is first applied the rollers slip somewhat upon the driving surfaces. However, as the pressure reaches a certain point the surfaces close upon the rollers with force enough to prevent slippage and effect their rotation. Although as described, the member 18 is rotating in a counter-clockwise direction and at a greater speed than that of member 19 yet owing to the greater mean diameter of the driving surface of the member 19 the rollers will be caused to move each in a clockwise direction upon its own axis and at such a speed with respect to the member 18 that all of the rollers will move bodily in a clockwise direction about the axis of the member 8. This bodily movement of the rollers is transmitted through the fingers of the spider 20 to the member 8, thus causing movement of the screw blade in a clockwise direction to drive the screw and at a speed very much slower than that of the motor.

As the screw reaches home its resistance to rotation increases to a point sufficient to cause slippage of the rollers upon the driving surfaces and the screw driver blade stops turning whereupon the tool is removed from the screw thus releasing the pressure upon the rollers and allowing the blade to remain motionless.

The material of the rollers may be either metal, or of a hard fibrous nature, the latter under light loads, being quieter in operation and affording smoother engagement and better traction; the angularity of the cones varying somewhat with the materials of the rollers as compared with that of the members 18 and 19.

It will be apparent that the arrangement described is of a planetary type, the speed of the screw driver blade when the driving surfaces are functioning, being the differential or resultant of the independent speeds of the driving members 18 and 19. It will also be noted however, that the driving surfaces not only provide an efficient speed reducing medium, but serve as a friction clutch whereby the drive is automatically engaged, varied or disengaged by pressure of the tool against the driven screw.

While I have specificially illustrated a screw driver, it is obvious that a bolt head receiving member could as well be substituted for the screw driver blade shown, and that the tool would then be equally adapted to drive and properly seat bolts, the functioning of the tool parts being unaltered; and that similarly other threaded articles could be accommodated and manipulated; and that in fact my invention would have equal application in any hand tool wherein similar speed reduction and clutching functions would be desirable.

It is equally obvious that my invention comprehends the use of rolling planetary elements other than the conical rollers illustrated. For instance balls might be preferable in certain instances, in which case

the members 19 and 18 would be formed as cup or cone respectively as well known in the art.

I would also call attention to my choice of proportions in the example illustrated. By making the parts 18 and 19 of equal diameter, it is possible to assemble or remove the parts 18, 19, 20 without disturbing the shaft 16 or parts immediately associated therewith, and a most compact arrangement of the entire transmission is effected.

What I claim is:

1. In a tool of the class described, motor means, a pair of members having driving surfaces, driving connections between said motor means and said members whereby said members are driven at differing speeds, a tool carrying member, and planetary elements engageable between said driving surfaces and having driving connection with said tool carrying member.

2. In a tool of the class described, a frame, a tool carrying member mounted for rotation therein, a pair of members rotatably mounted on said tool carrying member and having driving surfaces, means for rotating said surfaced members at differing speeds, and planetary elements engageable between said driving surfaces and having driving connection with said tool carrying member.

3. In a tool of the class described, a casing, a tool carrying member rotatably mounted therein, a pair of members rotatably mounted on said tool carrying member and having driving surfaces and toothed portions, planetary elements engageable between said driving surfaces and having driving connection with said tool carrying member, a countershaft having geared connection with the toothed portion of one of said surfaced members, and motor means having geared connection with said countershaft and with the toothed portion of the other of said surfaced members, the arrangement being such that said surfaced members are driven in opposite directions and at differing speeds.

4. In a tool of the class described, a casing, a tool carrying member rotatably mounted therein, a pair of members rotatably mounted on said tool carrying member and having driving surfaces and toothed portions, planetary elements engageable between said driving surfaces and having driving connection with said tool carrying member, a countershaft having geared connection with the toothed portion of one of said surfaced members, and a high speed motor secured with said casing and having a pinion, said pinion having geared connection with said countershaft and arranged to latch with the toothed portion of the other of said surfaced members, whereby said surfaced members are driven in opposite directions and at differing and relatively low speeds.

In testimony whereof I hereby affix my signature.

EDWIN L. CONNELL.