July 11, 1950 P. VAN SITTERT 2,514,914

IMPACT WRENCH

Filed Aug. 6, 1945 2 Sheets-Sheet 1

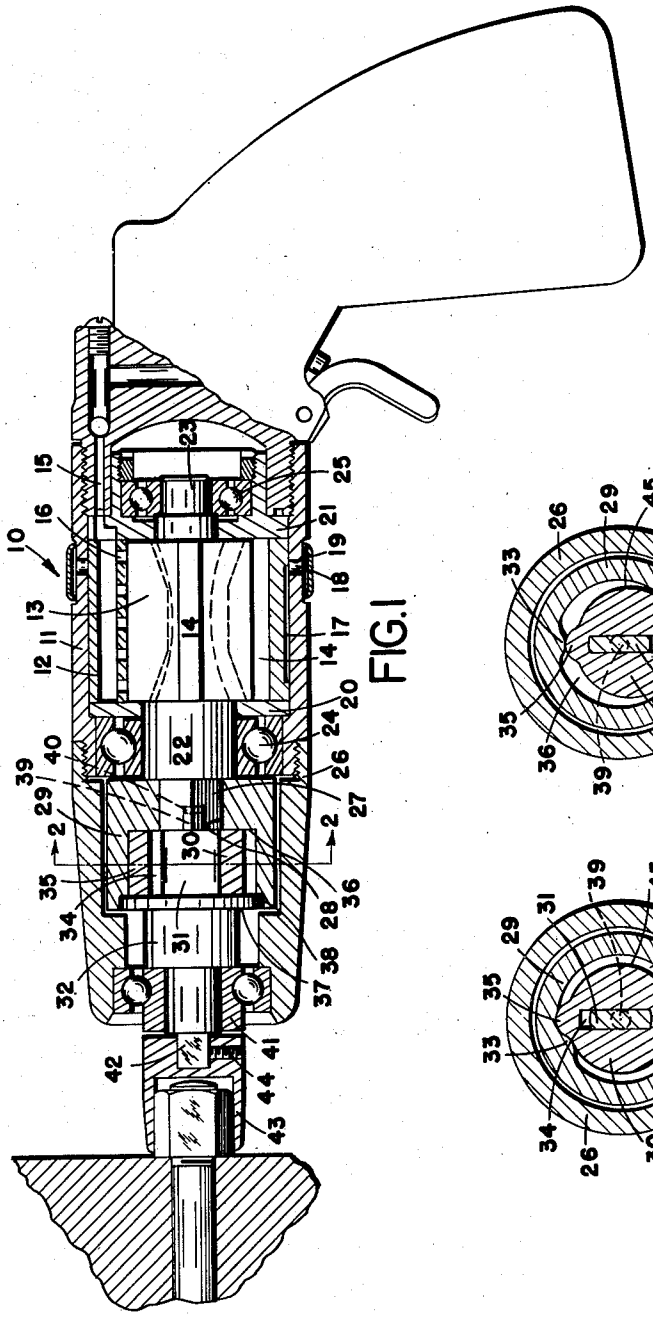


FIG.1

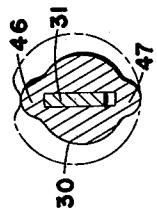


FIG.4

FIG.3

FIG.2

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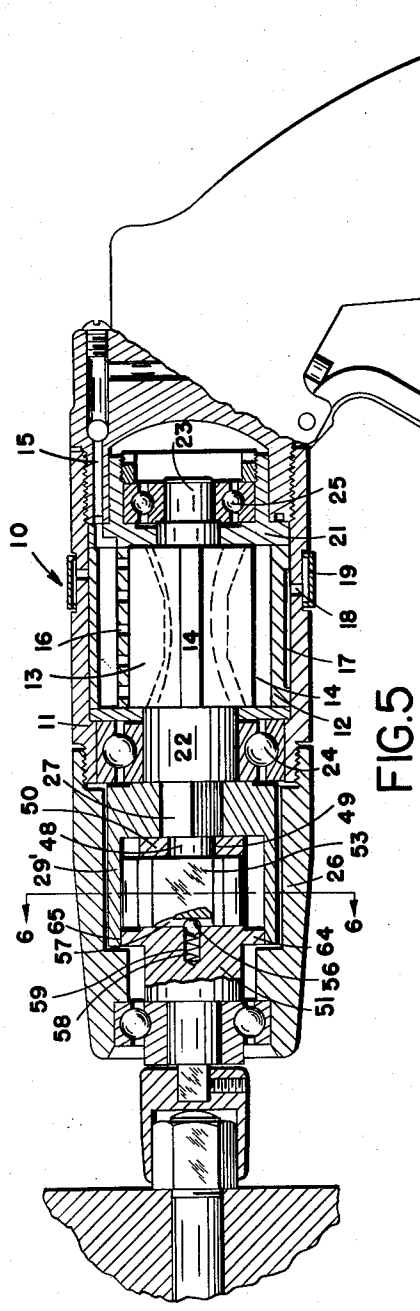


FIG.5

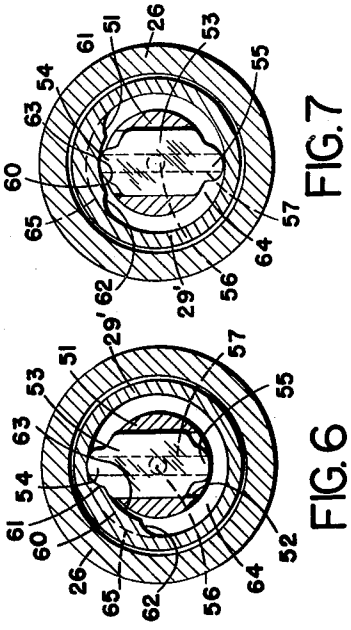


FIG.7

FIG.6

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IMPACT WRENCH

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Application August 6, 1945, Serial No. 609,155

9 Claims. (Cl. 192—30.5)

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The present invention relates to rotary tools, and more particularly it relates to power operated reversible rotary wrenches, including automatically operated impact means for tightening or loosening the work when considerable resistance to rotation of the work is encountered by the driven part of the wrench.

An object of the invention is to provide in a rotary wrench adapted to engage the work for normally rotating the same, novel means for automatically imparting a rapid succession of rotation impacts to the work.

Another object is to provide in a rotary impact wrench for setting or removing nuts, bolts or the like, a simple assembly which is strong, durable and efficient.

Other objects and advantages more or less ancillary to the foregoing and the manner in which the various objects are attained, reside in the specific construction and aggroupment of the elements peculiar to this structure, as will become apparent from a more complete examination of this specification, in the claims of which there are assembled certain specific combination of parts and specific constructions indicative of the scope and spirit of the invention.

Three embodiments of the invention are illustrated in the accompanying drawings, in which:

Figure 1 is a longitudinal view partly in section of a rotary wrench embodying the invention;

Figures 2 and 3 are transverse sections taken in a plane indicated by the line 2—2, looking in the direction of the arrows, and to illustrate the clutch parts in different positions;

Figure 4 is a partial transverse section similar to Figure 3, illustrating a modification of the invention;

Figure 5 is a longitudinal view partly in section of a rotary wrench embodying a further modification of the invention;

Figures 6 and 7 are transverse sectional views taken in a plane indicated by the line 6—6 also illustrating the clutch parts in different positions.

Referring first to Figure 1 of the drawings for a more detailed description thereof, the reference numeral 10 generally designates a reversible motor, such as an air motor of any suitable design. For purposes of illustration the air motor is shown to include a cylinder casing 11 enclosing a cylinder 12 in which is contained a rotor 13 having a plurality of vanes 14. Motive fluid which is directed into a duct 15 is admitted through ports 16 to act against the vanes 14 and produce rotation of the rotor 13. The motive

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fluid is exhausted into a passage 17 through ports not shown and discharged to the atmosphere through ports 18 covered by a deflector ring 19. The rotor 13 is restrained from axial movement by two bearing plates 20 and 21, which are firmly seated as shown in the cylinder casing 11. The rotor is supported radially at journals 22 and 23 by suitable bearings 24 and 25.

Forward of the casing 11 and secured to it by suitable means, such as threads, is a hollow housing 26. This housing 26 encloses and is spaced from the outer circumference of a driving flywheel 29, which forms a part of the novel impact clutch hereinafter described. The very forward end of the rotor is formed with a square shank 27, which mates with a square aperture 28 in the driving flywheel 29.

The forward end of the flywheel 29 has a recess defined therein to enclose a slotted driven head 30. The recess in the flywheel is large enough so that the head 30 may slide transversely between the walls of the recess by virtue of its mounting on a rectangular stem 31 defined from a driven spindle or shaft 32. The interior of the flywheel recess is cylindrically shaped except for a longitudinally extending rounded clutch tooth 33, which projects into the recess and extends throughout the length of the cylinder thus defined in the flywheel 29.

The driven head 30 which contains a slot 34 long enough to provide for lateral sliding movement upon the flat spindle stem 31 is of exterior cylindrical form except for an external elongated rounded clutch tooth 35. This clutch tooth 35 is preferably formed adjacent one end of the slot 34 and extends substantially parallel to it along the outer surface of the head 30. The clutch teeth 33 and 35 are each of symmetrical form and rounded on each side so as to function equally as well for either clockwise or counter-clockwise rotation of the rotor 13. When resistance to rotation is encountered by the driven shaft 32, the driven head 30 is caused to slide transversely on the flat spindle stem 31 in the recess of the flywheel 29. It is restricted from endwise movement by the annular wall 36 at the depth of the recess in the flywheel 29, and by a flange 37, see Figure 1, which is integral with the spindle or shaft 32 and fitted into a counterbore 38 in the flywheel 29 at the top of its recess.

The innermost end of the driven shaft 32 is cylindrically formed as a pilot 39, which is journalled in a bearing 40 in the end 27 of the rotor 13. The outer end of the shaft is journalled in a radial bearing 41 of conventional design. Drive

from the driven shaft 32 is imparted through its square end 42 engaged in the head of a work engaging socket 43, and the end 42 is held thus engaged by any suitable means, such as a set screw 44.

In the operation of this form of the device motive fluid directed through passage 15 and ports 16 acts against the blades 14 to produce rotation of the rotor 13, and the flywheel 29 is driven by the square shank 27 in the socket 28. The clutch tooth 33 of the flywheel in passing around the outer cylindrical surface of the head 30, forces the head transversely on the rectangular stem 31 of the spindle 32, until it is in the position shown in Figure 2, with the round clutch tooth 35 moved away from the stem 31 and into a position for engagement with the rounded clutch tooth 33 of the drive flywheel 29. Considering the direction of rotation of the flywheel 29 to be clockwise, as viewed in Figure 2, the tooth 33 will then impinge against tooth 35, as shown, and give to the head 30 and the spindle 32 an appreciable angular acceleration.

Directly following this impact the head 30 is driven transversely on the stem 31 through the coaction of the surfaces of the drive and driven teeth, as drive tooth 33 passes over driven tooth 35 to the position shown in Figure 3. The inertia of the head 30 is of such a magnitude that considerable angular acceleration is imparted to the head before its clutch tooth 35 is driven out of engagement with the driving clutch tooth 33. Continued rotation of the flywheel 29 about the head 30 produces contact between the drive tooth 33 and the cylindrical surface 45 with first contact being made below a position on the perpendicular bisector of the portion 31. Thus, continued rotation results in urging the head 30 from the position shown in Figure 3 to the position shown in Figure 2, which it assumes as the drive clutch tooth 33 passes under it on the side opposite the driven clutch tooth 35.

The time interval in which the drive tooth 33 is under the head 30 is of an appreciable length and amounts to a period of dwell such as experienced in cam operation. The fact that the head 30 is momentarily held at rest in a position shown in Figure 2, without any opportunity being given for the resilience of the parts to act, permits the inertia of the head 30 to momentarily hold it in position for engagement between the drive and driven clutch teeth 33 and 35, respectively, and thus complete the impact cycle.

In Figure 4 is shown a slight modification of the form illustrated in Figures 1 through 3. In this form the same principles of construction are present, and the only difference structurally is the provision of two driven clutch teeth 46 and 47 along the outer surface of the head 30 for producing two impacts per revolution.

Another modified form of the invention is shown in Figure 5, wherein like parts of the two forms are numbered the same, the square drive end 27 of the rotor 13 being extended to form the pilot 48 which is journalled in the bore 49 of the inner end 50 of the spindle 51. This inner end of the spindle 51 is formed with a transverse aperture 52 in which is carried a head 53, having opposed rounded clutch teeth 54 and 55. The aperture 52 and head 53 may be round or rectangular in cross section, or of any other regular, useful shape. Movement of the head 53 in the aperture 52 is resisted somewhat or damped by the action of a hardened ball 56 operating in a central groove 57 extending longitudinally of

the head 53, said ball being urged by a compression spring 58 received in a bore 59 formed centrally of the spindle 51.

The flywheel 29' is formed with a symmetrical clutch member 60 having similar sloping clutch surfaces 61 and 62 separated by a dwell surface 63 of an appreciable size. In this construction two impacts will be delivered for each revolution of the rotor. Figure 6 shows the arrangement of parts during the moment of impact, at which time angular acceleration will be imparted to the spindle 51 through the contact between the clutch surface 61 and the clutch tooth 54. The sliding friction induced by the action of the ball 56 in the groove 57 serves to assist the mass of the head 53 both in the matter of full transfer of energy upon impact before separation of the drive surface and the driven clutch tooth 54, and in the matter of keeping the head 53 in clutch engaging position prior to impact. In this construction the surface of dwell 63 is of such a magnitude that the head 53, after being moved transversely through the action of the sloping drive surface 61 on the driven clutch tooth 54, is momentarily held in this latter position in order to bring it completely to rest. In this position shown in Figure 7 the opposed driven clutch tooth 55 is then in proper position for the next impact from the clutch member 60, whereupon the impact cycle is repeated again and again.

The spindle 51 also has a circular flange 64 intermediate of its length which is received into the full circular bore 65 in the open end of the flywheel 29' adjacent to the outer end of the clutch member 60. The flange 64 is of a diameter and width to provide for both relative rotation and an additional bearing surface between the flywheel 29' and the spindle 51 in the same manner as the construction shown in Figure 1. Each of the spindles 32 and 51 therefore has three points of suspension or bearings, and receives forces of impact from the flywheel on a portion that extends the entire distance between the two inner bearings for the purpose of minimizing the bending moments of the impact forces.

Thus there is provided in a rotary power wrench, a novel clutch which couples the drive and driven shafts of the wrench, so that there is a free-running operation of the driven shaft, until the work engaged by the wrench head begins to tighten, whereupon resistance to rotation of the driven shaft is encountered and the clutch elements are thus caused to engage and disengage to provide a series of rapid impacts for further tightening the work.

Also, in each construction there are properties of frictional drag present between the driven spindle and the driving flywheel which serve to absorb any rebound that may occur between the nut and the socket driving it. In Figure 1 these properties exist between the pilot 39 and its bearing 40, between the tooth 33 and the surface 45, and between the flange 37 and the counter-bore 38; in Figure 5 they are to be found between the pilot 48 and the bore 49, and between the flange 64 and the circular bore 65.

Although the foregoing description is necessarily of a detailed character, in order to completely set forth the invention, it is to be understood that the specific terminology is not intended to be restrictive or confining and it is to be further understood that various rearrangements of parts and modifications of structural detail may be resorted to without departing from

the scope or spirit of the invention as herein claimed.

I claim:

1. In a rotary power driven wrench, a drive shaft and a driven shaft, a clutch for coupling said shafts together, one member of said clutch being rotatable with the drive shaft and the other member of said clutch being rotatable with said driven shaft and transversely slidable relatively thereto, said driven shaft being provided with means for guiding said driven clutch member during sliding movement thereof, and clutch teeth integral with said drive and driven members of the said clutch adapted to clutch together in a free running relation prior to load on the driven shaft and to force each other apart so as to ride over each other and enable rotation of said drive member relative to said driven member when load is encountered by the driven shaft from the resistance to rotation of the work engaged by the wrench the tooth of said drive member during said relative rotation being adapted to slide said driven member into position for reengagement of said clutch teeth.

2. In a rotary wrench of the class described having a reversible motor, a flywheel rotatable in either direction by said motor having a substantially annular recess defined therein, a driven member having a portion thereof extending longitudinally of said recess, a work engaging socket connected to an end of said driven member for rotation therewith, a head having a slot defined therein and slidably mounted on said driven member, clutch means on said flywheel and head adapted normally to couple said flywheel and said driven member together to impart free-running rotation to said work engaging socket and to force said head to slide on said member in one direction to decouple said flywheel from said driven member and enable relative rotation therebetween, the clutch means on said flywheel during said relative rotation being adapted to slide said head in the other direction to subsequently recouple said flywheel and driven member to automatically impart a succession of impacts through the work engaging socket to the work engaged thereby when the same is subjected to load by the resistance of the work rotation.

3. In a rotary tool of the class described having a reversible motor, a flywheel rotatable in either direction by said motor and having a substantially annular recess defined therein, a driven shaft having a portion thereof extending into the flywheel recess, a head non-rotatably supported by said driven shaft within the said recess and slidable relative to said shaft in a direction transversely of the axis of rotation thereof, means carried by said flywheel and means carried by said head adapted to normally engage with each other to impart free running rotation to said driven shaft, said means being so shaped and so proportioned as to slide said head transversely relative to the driven shaft and ride over each other when said driven shaft is subjected to load by the work engaging portion of the tool and upon continued relative rotation of said flywheel to slide said head in the opposite direction and impact against each other during rotation, until such load is relieved.

4. In an impact driving connection, the combination of a first member, a second member, one of said members being adapted to drive the other, a third member non-rotatably connected to said second member and slidable linearly transversely

thereof, a longitudinally extending internal clutch tooth on said first member, a longitudinally extending external clutch tooth on said third member the center plane of which tooth is parallel or approximately parallel with the plane of relative movement between said second and third members whereby said third member is moved relative to said second member and said teeth permitted to ride over each other when the driven member is subjected to load, and said internal clutch tooth being adapted to move said third member to its original position relative to said second member.

5. In an impact driving connection, the combination of a first member, a second member, one of said members being adapted to drive the other, a third member non-rotatably connected to said second member and slidable linearly transversely thereof, a longitudinally extending internal clutch tooth on said first member, a longitudinally extending external clutch tooth on said third member the center plane of which tooth is parallel or approximately parallel with the plane of relative movement between said second and third members whereby said third member is moved relative to said second member and said teeth permitted to ride over each other when the driven member is subjected to load, and internal clutch tooth being adapted to positively move said third member to its original position relative to said second member upon continued relative rotation between said first and second members.

6. In an impact driving connection, the combination of a first member having a recess extending longitudinally of its axis of rotation, a second member having a portion projecting into said recess, a third member located in said recess and non-rotatably connected to said second member but movable relative thereto, a longitudinally extending internal clutch tooth on the inner wall of said recess, a longitudinally extending external clutch tooth on the outer wall of said third member whereby said third member is moved relative to said second member and said teeth caused to override over each other when the driven member is subjected to load, said internal tooth being adapted to move said third member to its original position relative to said second member.

7. In an impact driving connection, the combination of a first member having a recess extending longitudinally of its axis of rotation, a second member having a part thereof projecting into said recess, a third member located in said recess and non-rotatably connected to said second member but slidable transversely thereof, a longitudinally extending internal clutch tooth on the inner wall of said recess, a longitudinally extending external clutch tooth on the outer wall of said third member the center plane of which tooth is parallel or approximately parallel with the plane of relative movement between said second and third members whereby said third member is moved relative to said second member and said teeth caused to ride over each other when the driven member is subjected to load, said internal tooth being adapted to positively restore said third member to its original position relative to said second member upon continued relative rotation between said first and second members.

8. In an impact driving connection, the combination of a first member having a recess extending longitudinally of its axis of rotation, a

second member having a part thereof projecting into said recess, a third member located in said recess and non-rotatably connected to said second member but slidable transversely thereof, a longitudinally extending internal clutch tooth on the inner wall of said recess, a longitudinally extending external clutch tooth on the outer wall of said third member the center plane of which tooth is parallel or approximately parallel with the plane of relative movement between said second and third members whereby said third member is moved relative to said second member and said teeth caused to ride over each other when the driven member is subjected to load to enable rotation of said first member relative to the driven member, said internal tooth being adapted to bear on said third member during said relative rotation to restore it to its original position relative to said second member.

9. In a rotary wrench of the class described having a reversible motor, a flywheel rotatable in either direction by said motor and having a substantially annular recess defined therein, a driven shaft having a portion thereof extending into said flywheel recess, a head confined within said flywheel recess and non-rotatably connected to said driven shaft, said head being provided with

a slot of greater width than the width of said shaft to thereby permit the head to slide transversally of said driven shaft, a clutch tooth extending longitudinally along the outer surface of said head, and a like clutch tooth carried by said flywheel adapted to impart against said first mentioned clutch tooth an angular acceleration to said driven shaft and to slide said head into such positions to effect successive disengagement and re-engagement of said clutch teeth during each revolution of said flywheel relative to said driven shaft.

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