

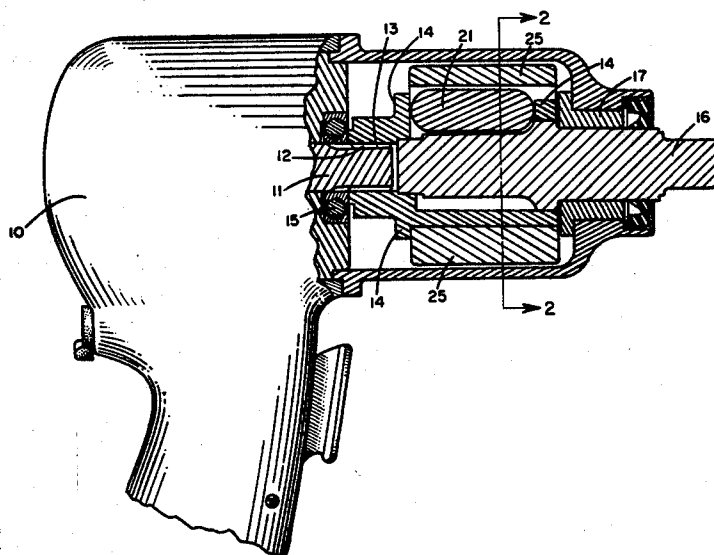
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[54] **ROTARY POWER TOOL CLUTCH MECHANISM**
7 Claims, No Drawings
 [52] U.S. Cl. 173/93,
 173/93.5
 [51] Int. Cl. B25d 15/00
 [50] Field of Search 173/93,
 93.5

ABSTRACT: This invention pertains to a rotary impact power tool, such as a wrench, wherein a motor drives a cage member which mounts an impact element between an outside positioned hammer member and an inside positioned output shaft having an impact-receiving jaw. Cam means periodically actuated by the output shaft move the hammer member ahead of the cage member to move the impact element radially inwardly to engage the impact-receiving jaw.



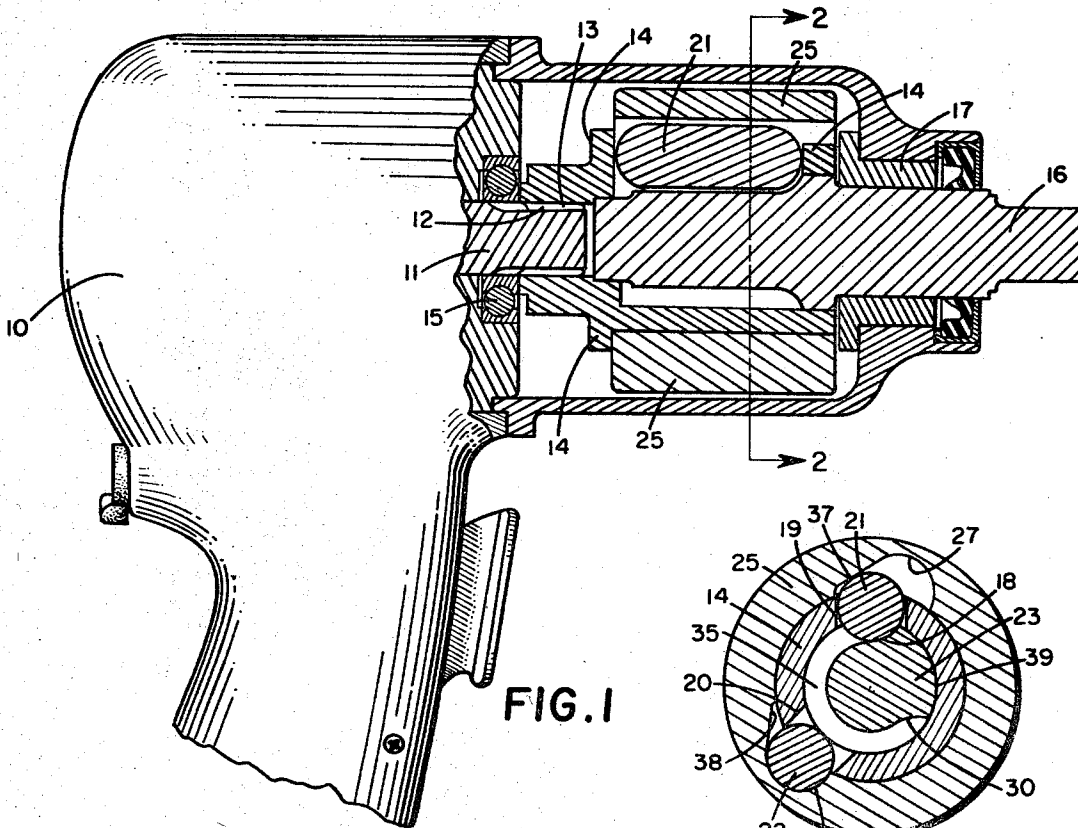


FIG. 1

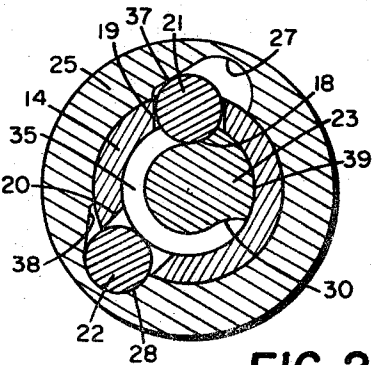


FIG. 2

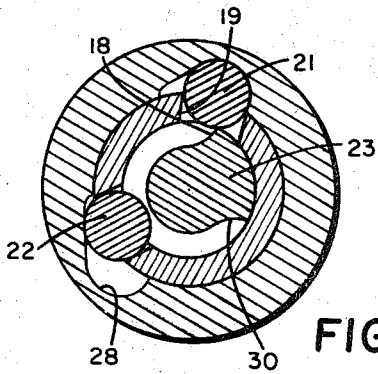


FIG. 3

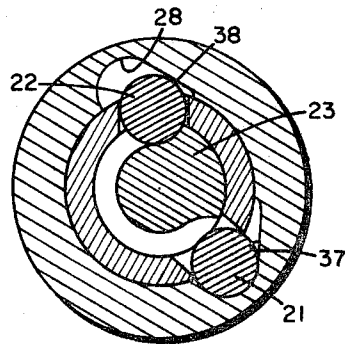


FIG. 4

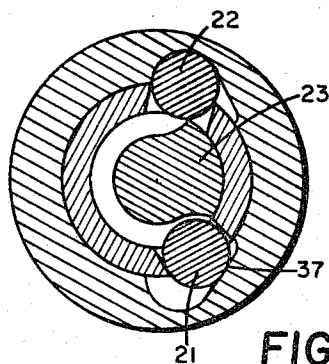


FIG. 5

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ROTARY POWER TOOL CLUTCH MECHANISM

An object of the invention is to provide an impact tool wherein there are relatively few clutch parts, and wherein the clutch parts are easily and inexpensively formed, resulting in a low-cost, reliable, durable tool.

Another object of the invention is to provide an impact wrench which is capable of efficient operation at high torque as well as at low torque.

Still another object of the invention is to provide an impact wrench design which avoids sharp reentrant angles on the hammer and anvil, thereby eliminating high stress concentrations which lead to failure of the hammer and anvil parts.

For a better understanding of the present invention, reference is had to the following description, taken in conjunction with the drawings and claims.

With reference to the drawings:

FIG. 1 is a side view of a tool with the clutch shown in longitudinal section;

FIG. 2 is a transverse section taken along line 2-2 of FIG. 1, showing the clutch in its "impact" position;

FIG. 3 is a similar view showing the clutch in its "disengaged" position;

FIG. 4 is a similar view showing the clutch at the beginning of the "cam engagement" position; and

FIG. 5 is a similar view showing the clutch at the end of the "cam engagement position" as it is ready for impact upon further rotation.

An aspect of the present invention lies in the provision of an inexpensive, reliable, durable rotary power impact tool wherein a motor is mounted within a housing, and an output shaft is also mounted on the housing for rotary power output. An impact receiving jaw is radially disposed on the periphery of the output shaft. A cage member is driven by the motor and mounts an elongated-impact element adjacent to the output shaft near the impact-receiving jaw with its axis parallel to the axis of the output shaft and radially displaced therefrom to rotate in an irregular orbit about the output shaft. A ringlike hammer member surrounds the orbit of the impact element, and means mount the hammer member in the housing for rotary motion essentially in unison with the impact element, but the hammer member is capable of limited relative rotary motion in respect to the impact element. Cam means are periodically actuated by the output shaft to move the hammer member forward ahead of the cage member to cause the impact element to move radially inwardly into the path of the impact-receiving jaw and transmit an impact blow from the hammer transversely through the impact element to the impact-receiving jaw.

With reference to FIG. 1 there is shown a housing 10 within which is contained a motor (not shown) having a drive shaft 11. The motor and its forward-reverse control are well known in the art. Drive shaft 11 has a male splined end 12 which is in rotary driving engagement with a female splined end 13, of a cage member 14, thereby to cause the cage member 14 to rotate in unison with the drive shaft of the motor. A bearing 15 mounts the drive shaft 11 in the housing.

An output shaft 16 is mounted by a sleeve bearing 17 in the forward end of the housing 10, and it extends from outside the housing to a location inside the housing, adjacent to but spaced slightly from, the end of the motor drive shaft 11. The output shaft 16 includes an impact-receiving jaw 23 having a forward face 18 and a reverse impact face 30, and the jaw is radially disposed on the periphery of output shaft 16, shown best in FIGS. 2 to 5. The cage member 14 is essentially ring shaped and has a pair of slots 19, 20 which extend radially through it, and which extend lengthwise in a direction parallel to the output shaft 16 of the tool.

An elongated impact element 21 (or impact roller) is mounted in slot 19 with its axis parallel to the axis of the output shaft 16, and the impact element 21 is radially displaced from the shaft 16 so that it can rotate in an irregular orbit about the output shaft. A cam roller element 22 is mounted in slot 20 of the cage member with its axis parallel to the axis of

the output shaft, and it likewise rotates in an irregular orbit about the shaft as the cage member 14 is driven by the motor drive shaft 11.

A ringlike hammer member 25 is mounted in the housing and surrounds the cage member 14, the impact element 21, and the cam element 22. Preferably it is mounted on the cage member, and it is capable of rotary motion essentially in unison with the impact element 21, cam element 22 and cage member 14, but it is capable of limited relative rotary motion in respect to these elements. The bore of the hammer member 25 is axially grooved at two locations 27, 28 to accommodate the impact element 21 and the cam roller 22.

The face 18 of the impact receiving jaw 23, together with the cam roller 22 and the slanted face 38 of the groove 28 form the cam means for periodically actuating the clutch mechanism in a forward direction. An annular space 35 exists between the output shaft 16 and the bore of the cage member 14 throughout most of the circumference of the cage member, and both the impact element 21 and the cam roller 22, at times in the operating cycle, extend inwardly into this space 35, and extend outwardly into axial grooves 27 and 28 in the bore of the hammer member 25.

In operation in the forward direction the rotating motor drive shaft 11 directly rotates the cage member 14 through the splined connection 12, 13, thereby directly rotating both the impact roller element 21 and the cam roller element 22. As shown in FIGS. 2 to 5 rotation is in a clockwise direction.

In FIG. 2 the moment of impact is shown and the massive ring hammer member 25 is exerting force on the impact roller element 21 from area 37 of the wall of groove 27, and the impact element 21 is in contact with the face 18 of the impact receiving jaw 23 of the output shaft 16. Consequently the impact blow from the hammer member 25 is transmitted transversely through the elongated impact element 21 to the jaw 23 on the output shaft 16. Thus the solid, rollerlike, elongated impact element 21 transfers the high impact forces from the hammer to the impact receiving jaw 23 of the output shaft 16, there being no sharp reentrant corners or angles involved which would lead to high stress concentrations and premature failure at high torques.

After the impact blow, a disengaging action takes place, shown already accomplished in FIG. 3. During the disengaging action, cage member 14 is driven forward relative to the hammer 25 displacing the impact element 21 outwardly into groove 27 in the bore of the hammer element, and simultaneously the slanted wall area 38 of groove 28 displaces the cam roller 22 inwardly into space 35. Rotation of cage 14, the roller elements 21 and 22 and the hammer 25 then takes place in unison. The impact roller element 21 passes over the outer surface 39 of the jaw 23 from the area of the impact face 18 to a position beyond face 30 which is the end of the land area 39, as shown by the change between FIGS. 3 and 4. During this motion, acceleration of the hammer takes place. FIGS. 4 and 5 show the beginning and end of the cam action of cam roller 22 as the cage 14 drives the roller 22 off of the impact-receiving face 18 and against face 38 of the hammer element 25, thus causing hammer 25 to rotate forward ahead of the cage element 14. As this is happening face 37 of the hammer 25 causes roller 21 to be cammed radially inwardly into space 35, which is the position shown in FIG. 5. The cage member 14, the hammer member 25 and the roller elements 21, 22 are now in the proper position for another impact blow when further rotation of these members has carried roller 21 around to the impact receiving face 18, as shown in FIG. 2. Repeated cycling of the tool causes repeated blows from the hammer to the output shaft.

Reverse action of the tool is similar to the aforescribed forward action, but with the motor shaft 11 operating in the reverse direction. The impact roller and the cam roller have reversed roles, the impact roller in the forward direction becoming the cam roller in the reverse direction, and the cam roller in the forward direction becoming the impact roller in the reverse direction. Because of this "symmetry of action," the two rollers preferably are identical.

During reverse operation face 30 of the impact jaw 23 takes the place of face 18, becoming the reverse direction impact receiving face.

While there have been described what are at present considered to be the preferred embodiments of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is aimed, therefore, in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. A rotary impact tool comprising, in combination;
 - a housing, a motor mounted in said housing;
 - an output shaft mounted on said housing for rotation and including an impact-receiving jaw generally radially disposed on its periphery;
 - an elongated impact element;
 - a cage member driven by said motor and mounting said impact element adjacent to the output shaft in the vicinity of the impact-receiving jaw with its axis parallel to the axis of the output shaft and radially displaced therefrom to rotate in an orbitlike path about the output shaft;
 - a ringlike hammer member surrounding the orbit of said impact element;
 - means mounting said hammer member in said housing for rotary motion essentially in unison with said impact element but being capable of limited relative rotary motion in respect thereto; and
 - cam means periodically actuated by the output shaft to move said hammer member forward ahead of the cage member to cause said impact element to move radially inward into the path of said impact-receiving jaw in position to contact said impact-receiving jaw and transmit an impact blow from said hammer member transversely through said impact element to said impact-receiving jaw.
2. A rotary impact tool comprising, in combination;
 - a housing, a motor mounted in said housing;
 - an output shaft mounted on said housing for rotation and including an impact receiving jaw and a cam shoulder each radially disposed on its periphery;
 - a generally cylindrical roller impact element;
 - a cage member driven by said motor mounting said roller impact element adjacent to the impact-receiving jaw with its axis parallel to the axis of the output shaft and radially displaced therefrom to rotate in an orbit about the output shaft;
 - a ringlike hammer member surrounding the orbit of said roller impact element, means mounting said hammer member in said housing for rotary motion essentially in unison with said roller impact element but being capable of limited relative motion in respect thereto; and
 - cam means periodically actuated by said cam shoulder on said output shaft to move said hammer forward ahead of the cage member to cause said impact element to move radially inward to contact said impact-receiving jaw and transmit an impact blow from said hammer member transversely through said impact element to said impact-receiving jaw.
3. A rotary impact tool, comprising, in combination;
 - a housing;
 - a motor having a motor drive shaft mounted in said housing;
 - a centrally located output shaft including an impact-receiving jaw and a cam shoulder;
 - means rotatably mounting said output shaft in said housing;
 - a cage member having slot means therein;
 - means mounting said cage member around said output shaft at the location of said impact-receiving jaw;
 - means connecting said motor drive shaft to said cage member to rotate said cage member as said motor and motor drive shaft rotate;
 - a ringlike hammer member having longitudinal groove means in its bore;
 - means coaxially mounting said hammer around said cage member and said output shaft for rotation with and in respect to said cage member and said output shaft;

a generally cylindrical roller impact element mounted in said slot means in said cage member and extending radially through said slot means from said output shaft into said groove in said hammer member and with its axis parallel to the axis of said output shaft, the roller impact element allowing limited relative rotary motion between said cage member and said hammer member; and

cam means actuated by said cam shoulder on said output shaft for periodically during rotation causing said hammer member to rotate forward ahead of said cage member thereby to force said roller impact element radially inward into the annular path of said impact-receiving jaw to deliver an impact blow from said hammer member through said roller impact element to said impact-receiving jaw.

4. A rotary impact tool as set forth in claim 3, further characterized by said cam means comprising a second generally cylindrical cam roller element mounted in a second slot in said cage member and extending radially through said slot from said output shaft into said groove in said hammer member and with its axis parallel to the axis of said output shaft; said cam roller element being actuated by said cam shoulder during forward operation of said tool; and during reverse operation of said tool, said cam roller element operating as the roller impact element.

5. A rotary impact tool comprising, in combination:

- a housing, a motor mounted in said housing;
- a centrally located output shaft having an impact-receiving jaw and a cam shoulder radially disposed on its periphery;
- means rotatably mounting said output shaft to said housing;
- a ringlike cage member driven by said motor surrounding said impact-receiving jaw and journaled on said output shaft, said cage member having two slots through its wall;
- two roller elements, one mounted in each of said two slots in said cage member with their axes parallel to the axis of the output shaft but displaced radially therefrom, the diameters of said roller elements being such that they extend radially beyond the periphery of said cage member; and

- a ringlike hammer member surrounding said cage member and journaled thereon, said hammer member having two axially extending grooves in its bore to loosely accommodate the portions of said roller elements beyond the periphery of said cage member causing said cage member and said hammer member to rotate essentially in unison but allowing limited relative rotary motion therebetween, said two axially extending grooves being spaced and shaped so that as the first roller is forced outwardly by the cam shoulder into one groove in the hammer member the second roller is forced inwardly by the hammer member into the path of the impact-receiving jaw to transmit an impact blow from said hammer member through said second roller element to said impact-receiving jaw.

6. A rotary impact tool comprising, in combination:

- a housing, a motor mounted in said housing;
- a centrally located output shaft having an impact-receiving jaw radially disposed on its periphery;
- means rotatably mounting said output shaft to said housing;
- a slotted cage member journaled on said output shaft and surrounding said impact-receiving jaw;
- a driving connection from said motor to said cage member;
- a grooved ringlike hammer member surrounding said cage member and journaled thereon;
- an impact element carried in the slot in said cage member and extending into the groove in said hammer member allowing limited relative rotary motion between the cage member and the hammer member, said groove being shaped so that motion of said hammer member ahead of said cage member forces said impact element into the annular path of said impact-receiving jaw to transmit an impact blow from said hammer member through said impact element to said impact-receiving jaw; and
- cam means actuated by said output shaft periodically to cause said relative motion of said hammer member ahead of said cage member.

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7. A rotary impact tool as set forth in claim 6, further characterized by said output shaft including a cam shoulder radially disposed on its periphery, and by said cam shoulder-

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forming part of said cam means for periodically causing said motion of the hammer member ahead of said cage member.

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