Sept. 2, 1969 W. J. BAKER 3,464,527

CLUTCH AND INDEXING MECHANISM FOR TOOL SPINDLE

Filed Dec. 13, 1967

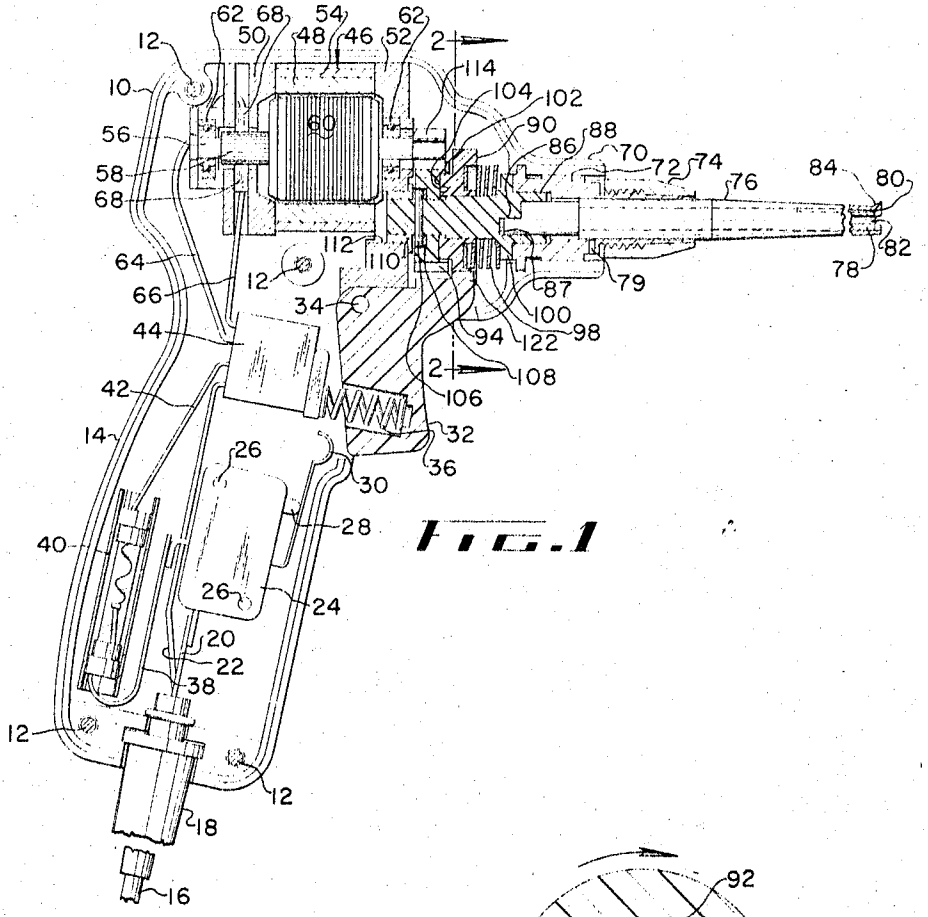


FIG. 1

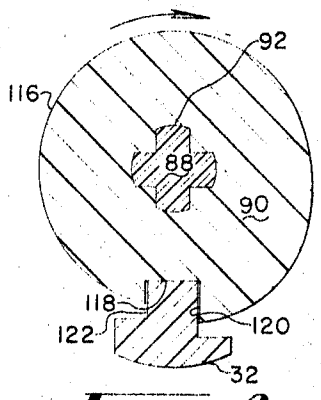


FIG. 2

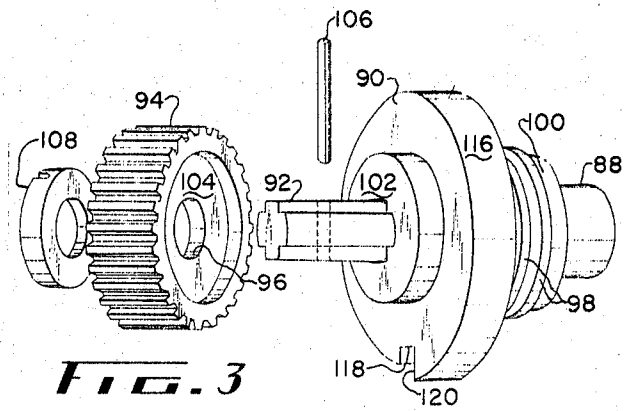


FIG. 3

INVENTOR
WILLIAM J. BAKER
BY Joseph W. Holloway
ATTORNEY

United States Patent Office

3,464,527

Patented Sept. 2, 1969

3,464,527

CLUTCH AND INDEXING MECHANISM FOR TOOL SPINDLE

William J. Baker, Reed City, Mich., assignor to Gardner-Denver Company, a corporation of Delaware

Filed Dec. 13, 1967, Ser. No. 690,139
Int. Cl. F16d 67/02, 47/00; H02k 7/10
U.S. Cl. 192—.072 3 Claims

ABSTRACT OF THE DISCLOSURE

A slip clutch having friction drive members and being particularly suitable for use in motor-driven power tools of the type which incorporate means to arrest the tool operating mechanism at a predetermined position. The clutch includes a notched cam disk splined to the tool drive spindle and in frictional driving engagement with a coaxially aligned gear rotatably mounted on the spindle. The friction faces of the cam disk and the gear are held in engagement by a coil spring; and, the gear meshes with the tool motor pinion. Positive engagement of the cam disk notch by a tool operating lever arrests the tool spindle in a predetermined rotary position and results in slippage of the gear relative to the cam disk thereby allowing the motor to decelerate smoothly and providing variable stopping positions of the motor rotor.

Background of the invention

Tools used for wrapping electrical conductor wire about a terminal usually employ a rotary bit which receives one end of the wire in a longitudinal groove. The bit is usually driven by suitable motor and drive means housed in the tool proper. The highly repetitious nature of the tool usage makes desirable the prepositioning of the wire-receiving groove in the same angular position after each operation to facilitate insertion of the wire in the bit preparatory to the next tool operating cycle.

To achieve this predetermined positioning of the wire-wrapping bit, various rotation arresting or indexing mechanisms have been developed which function to arrest the bit as well as the entire tool rotary drive mechanism including the motor and associated driving components at the completion of each tool operating cycle.

Other tools of the aforedescribed general character usually employ somewhat complicated mechanical clutch devices having interfitting dentil or jaw members which operate to engage with one member rotating relative to the other. Generally speaking, the prior art tools operate to start or stop the tool operating mechanism so abruptly that undue stress and wear are encountered on bearings, gear teeth, and other components often resulting in premature failure of these elements. Furthermore, provision for some form of overload release or slip feature is not inherently part of tools employing the aforementioned drive and indexing systems; and, if desired, this torque limiting feature must be added to the already complex operating mechanism further reducing the reliability and increasing the cost of the tool.

Another problem in the design and use of wire-wrapping tools is due to the repeated identical starting position of the tool motor which results from the operation of the indexing mechanism. This repeated starting from the same position may be highly detrimental to the motor, particularly electric motors employing brush and commutator assemblies. It is well known that current inrush during motor starting can severely limit brush and commutator life and that repeated starting from the same brush to commutator relative position will result in destructive sparkling and burning of the commutator bars so involved.

One development in positive indexing mechanisms for wire-wrapping tools is disclosed in U.S. Patent No. 3,219,-067 issued to J. L. Meyer. In the index device of Meyer, smooth motor and drive system deceleration is obtained by absorbing the kinetic energy of rotation with a torsion coil spring which is connected at one end to an index cam and at the other end to the tool drive spindle. However, the drive system stopping position of Meyer is constant; and, in addition, a reversal of motor rotation direction occurs briefly during the indexing phase of the tool operating cycle. This method of indexing not only creates the aforementioned problem of motor commutator bar burning, but also imparts a reversed electromagnetic force to the motor rectifier resulting in possible electrical damage to that component.

Summary of the invention

The invention resides in the provision of an indexing clutch mechanism particularly suitable for use with wire-wrapping tools powered by electric motors which comprises spring engaged friction drive members interposed between the tool motor and the wire-wrapping bit.

Sufficient frictional engagement of the drive gear with the indexing cam disk is provided to transmit the torque required to perform the wire-wrapping operation. However abrupt arresting or rotation of the indexing cam and tool spindle will cause slippage of the frictionally engaged cam and drive gear relative to each other to absorb tool motor kinetic energy of rotation smoothly by friction braking thereby substantially reducing impact loads on the motor and drive gearing.

Furthermore, the friction braking achieved by the invention prevents any reversal of motor rotation and the undesired reverse generation of electrical energy resulting therefrom.

An object of the invention, i.e. to provide variable relative starting positions of the tool motor commutator and brushes, is accomplished by selecting the engaging force between the friction drive members so that the momentum or rotational energy of the motor is frictionally dissipated through an angle of motor rotation which will provide a substantial number of motor stopping positions. The frictional engaging force is applied by a coil spring member.

Accordingly, the friction drive members also solve the problem of providing a torque limiting or overload release feature as part of the indexing mechanism to prevent tool or wire terminal damage. In reading the following description it will be apparent that the invention performs all of the aforementioned functions desirable in prepositioned rotation arresting mechanisms with a compact structure, simple in construction and reliable in operation.

Brief Description of the drawings

FIG. 1 is a sectioned side elevation view of a typical hand-held wire-wrapping tool embodying the present invention.

FIG. 2 is a fragmentary section view taken along the line 2—2 of FIG. 1.

FIG. 3 is an exploded perspective view illustrating the components of the friction indexing clutch mechanism.

Description of the preferred embodiments

Referring to FIG. 1 of the drawing, a typical electrically powered wire-wrapping tool is illustrated having a casing **10** preferably consisting of two reversely turned mating halves (one shown in FIG. 1) of molded plastic and held in assembly by a plurality of threaded fasteners **12**. The tool casing includes a handle portion **14** for manual gripping by the tool operator.

Extending into the bottom of the tool casing is an electric power cord **16** suitably secured by a strain relief device **18**. Power cord leads **20** and **22** extend into the interior of the handle portion of the tool casing where lead **20** is secured to a terminal of a conventional, normally open, switch **24** fastened to the tool casing by pins **26**. Contacts housed in the switch **24** may be operated to close by the plunger **28** which in turn is moved by a leaf spring member **30**. The switch is closed by the tool operator through digital manipulation of a trigger **32** pivotally secured at **34** and positioned to engage the leaf spring **30**. The trigger **32** is biased by a spring **36** to allow the switch **24** to open when digital pressure of the operator is relieved.

Wire lead **38** leaving the switch **24** is in communication with a fuse **40** followed by a lead **42** which together with lead **22** completes the electric circuit to a rectifier unit **44**, which converts the alternating current power supply to a filtered direct current power supply suitable for energizing the tool motor **46**.

The motor **46** is typical of small direct current types embodying a stator **48** enclosed within a frame consisting of two end members **50** and **52** and a cylindrical sleeve **54**. An armature assembly consisting of an armature shaft **56**, a commutator **58** and suitable armature windings **60** is supported by the frame members **50** and **52** in bearings **62**. The armature assembly is rotatable relative to the stator **48** being separated therefrom by a small air gap.

Direct current electric power is supplied to the motor **46** via the leads **64** and **66** connecting the rectifier unit **44** to the motor brushes **68** completing the electric circuitry of the tool.

Extending from a nose portion **70** of the tool casing **10** is a collet **72** and nut **74**. The collet is suitably secured to the casing **10** by fasteners, not shown. The collet and nut assembly function to retain an elongated sleeve **76** which in turn is appropriately adapted to house a wire-wrapping bit **78** for rotation within the sleeve but prohibiting longitudinal displacement therefrom. The sleeve is prepositioned in the collet by a pin **79**.

The distal end of the bit **78** includes a wire-receiving groove **80** and a terminal-receiving bore **82**. As previously mentioned, it is desirable to preposition the wire-receiving groove to facilitate insertion of the wire into the groove by the tool operator prior to the wrapping operation. In the exemplary tool prepositioning of the wire-receiving groove **80**, as shown in FIG. 1, results in longitudinal alignment with a flared wire guide portion **84** on the sleeve **76**.

The wire-wrapping bit **78** extends into the bore of the collet **72** terminating with a tang portion **86** which is in positive driving engagement with a tang receiving recess **87** formed in a spindle **88**. The spindle **88** forms a part of the rotation arresting or indexing mechanism of the tool.

Included with the spindle as part of the indexing mechanism is a cam disk **90** which is axially slidable over splines **92** formed on the spindle **88** (see FIG. 3) but is in positive rotary engagement with the spindle through complementary grooves engaging the splines **92**. The cam disk **90** forms the driven member of a friction slip clutch.

Also axially aligned with the spindle **88** is a drive gear **94** comprising the driving member of the clutch and having a bore **96** slightly larger than the diameter of the splines **92** such that the gear **94** is rotatable relative to the spindle. The spindle, cam disk and drive gear may be advantageously made of molded plastic, thereby reducing the inertia of these parts and contributing to a lightweight tool design.

The complete assembly of the indexing mechanism includes a coil spring **98** bearing at one end against a collar **100** on the spindle **88**, and at the opposite end against the side of the cam disk **90** forcing the latter into engagement with the drive gear **94** on coacting friction surfaces **102** and **104**, respectively. The drive gear **94** is axially retained on the spindle **88** by a pin **106** and an interposed grooved bushing **108**.

In the assembled position of the indexing mechanism, as shown in FIG. 1, the spindle **88** is rotatively journaled in the collet **72** and has a bushing **110** pressed over the opposite end of the spindle which in turn is journaled in a bore **112** of the motor frame end plate **52**. The drive gear **94** is in mesh with a pinion **114** press fitted over the end of the motor armature shaft **56**.

Indexing of the tool bit **78** is accomplished by the cam disk **90** coacting with the trigger **32**. As best shown in FIG. 2 the cam disk has a spiral cam surface **116** and a radially opening notch **118** which intersects with the cam surface **116** to provide a shoulder **120**. The forward end of the upper surface of the trigger **32** has formed thereon an upwardly extending stop **122** which engages the cam disk notch **118** when the trigger is in the released position as shown in FIGS. 1 and 2.

The functions of the indexing mechanism will be better understood from the following description of the operation of the tool. Assuming the tool to be properly readied for performing the wire wrapping operation in a manner well known, upon digital depression of the trigger **32** the pivotal movement will cause the stop **122** to move out of engagement with the notch **118** in the cam disk **90** and sequentially result in engagement of the trigger with the leaf spring **30** causing depression of the plunger **28** to close the switch **24**.

The resultant energization of the motor **46** will cause the spindle **88** and bit **78** to be rotatively driven through the meshing of the pinion **114** with the drive gear **94** and the frictional engagement of the gear with the cam disk **90**. Direction of rotation will be as indicated by the arrow in FIG. 2.

At the completion of the tool operating cycle release of the trigger **32** will result in opening of the switch **24**. As the spring **36** urges the trigger to pivot upwardly, the stop **122** will either engage the notch **128** immediately, should the instantaneous position of the cam disk **90** coincide, or the stop will ride the cam surface **116** until the inertial rotation of the motor and drive system effects engagement of the stop with the shoulder **120** and still under the urging of the spring **36** the stop then seats fully in the notch **118**. The rotation of the cam disk **90**, spindle **88** and bit **78** is thereby arrested in a predetermined position for the next tool operating cycle. The momentum of the motor armature is still substantial upon arrestation of the spindle and bit to the extent that the drive gear **94** will begin to slip relative to the cam disk **90** and spindle **88** as the frictional engaging force of the cam disk and gear is overcome. The result is that the rotational energy of the armature is absorbed smoothly and dissipated as heat generated on the friction surfaces **104** and **102** on the gear and cam disk, respectively. In the aforedescribed manner the motor is braked without severe shock loads being applied to the gear teeth, bearings, and other rotating components of the tool. Also, the desired irregular stopping position of the commutator **58** relative to the stationary brushes **68** is obtained due to the selection of the spring **98** to exert a friction engaging force which will permit absorption of the motor rotational energy in an amount of angular rotation of the motor armature which will permit a substantial number of stopping positions. For example, the selection of a spring having an engaging force which will permit angular displacement of the drive gear relative to the cam disk of 270° will provide four stopping positions of the motor armature, provide slippage for smooth motor braking, and provide adequate driving engagement of the gear and cam disk for the wire wrapping operation. The spring engaging force could be changed only minutely to

provide a substantially greater number of motor stopping positions without having a deleterious effect on the other mentioned operating characteristics. It will also be appreciated that the friction slip clutch mechanism serves as a torque limiting device to protect the tool components and the wire terminal in the event of sticking of the wire in the bit groove or jamming of the bit on the terminal. Furthermore, the use of the disclosed rotation arresting mechanism need not be limited to tools employing electric motors but could serve to permit smooth braking and provide overtorque protection for tools using pressure fluid motors which are commonly employed for wire wrapping operations.

It will be understood that the above description and acompanying drawings comprehend the preferred structural arrangement of the invention to give a compact and simple device to achieve the desired functions, however, various changes in construction, proportion, and arrangement of the elements may be made without sacrificing any of the advantages or departing from the scope of the appended claims.

What is claimed is:

1. In a tool:

(a) a motor capable of being in an energized condition and a deenergized condition;

(b) spindle means operatively connected to said motor to be driven thereby, said spindle means being operable to be arrested in a predetermined position;

(c) slip clutch means drivably coupling said motor and said spindle and operable to frictionally absorb the rotational energy of said motor upon arresting of said spindle means, said clutch means including:

(1) a driving member comprising a toothed drive gear mounted on said spindle means in axial alignment therewith and in rotatable relationship relative thereto;

(2) a driven member mounted on said spindle in axial alignment therewith and in nonrotatable relationship relative thereto, said driven member including a transverse friction surface engageable with a corresponding transverse friction surface on said driving member;

(3) resilient means operable to hold said driving member and said driven member in frictional engagement for transmitting rotary motion to said spindle upon energization of said motor; and,

(d) indexing means operable to arrest said spindle means in said predetermined position, said indexing means comprising said driven member and an operating member for energizing said tool motor.

2. The invention set forth in claim 1 wherein:

said driven member is interposed between said driving member and said resilient means and said driven member is operable to be engaged by said tool operating member to arrest said spindle in said predetermined position.

3. The invention set forth in claim 1 wherein:

said driven member comprises a notched cam disk operable to engage said tool operating member for positive interfitting engagement of said notch with said operating member thereby arresting the rotation of said cam disk and said spindle means.

References Cited

UNITED STATES PATENTS

2,351,997	6/1944	Morrill	192—2
2,539,836	1/1951	Hoffman	310—77
2,949,989	8/1960	Lindstrom et al.	192—2
3,344,292	9/1967	Hurst	310—76
3,367,460	2/1968	Wanner	192—24
2,839,603	6/1958	Foll et al.	192—148 XR
3,172,512	3/1965	Allen et al.	192—148 XR

BENJAMIN W. WYCHE III, Primary Examiner

U.S. Cl. X.R.

192—2, 12, 24; 310—76; 64—30