United States Patent

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[54] TWO-SPEED NUT-RUNNING TOOL WITH TANDEM MOTORS

8 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** **91/411,**
91/412, 92/150, 60/53, 60/57, 173/12, 192/.033

[51] **Int. Cl.** **F15b 11/16,**
B23q 5/06

[50] **Field of Search** 91/411,
411A, 412, 59, 60; 173/5, 12; 60/57, 53D;
192/.032, .034, .033; 92/150

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ABSTRACT: A two-speed pneumatic nut-running tool having a main motor connectible to the work and coupled in tandem relation to an auxiliary motor by means of an overrunning one-way clutch. Passage means is arranged to conduct live source air separately to both motors so as to cause them to run concurrently in the same direction. The main motor, which is designed to operate faster than the auxiliary motor, is initially permitted by the clutch to overrun the auxiliary motor to deliver an initial torque, less than final torque, to the work until its speed is slowed by the initially produced torque to the speed of the auxiliary motor. The clutch then engages, and the auxiliary motor transmits through the main motor increased torque to the work until a final torque is reached, at which time both motors stall.

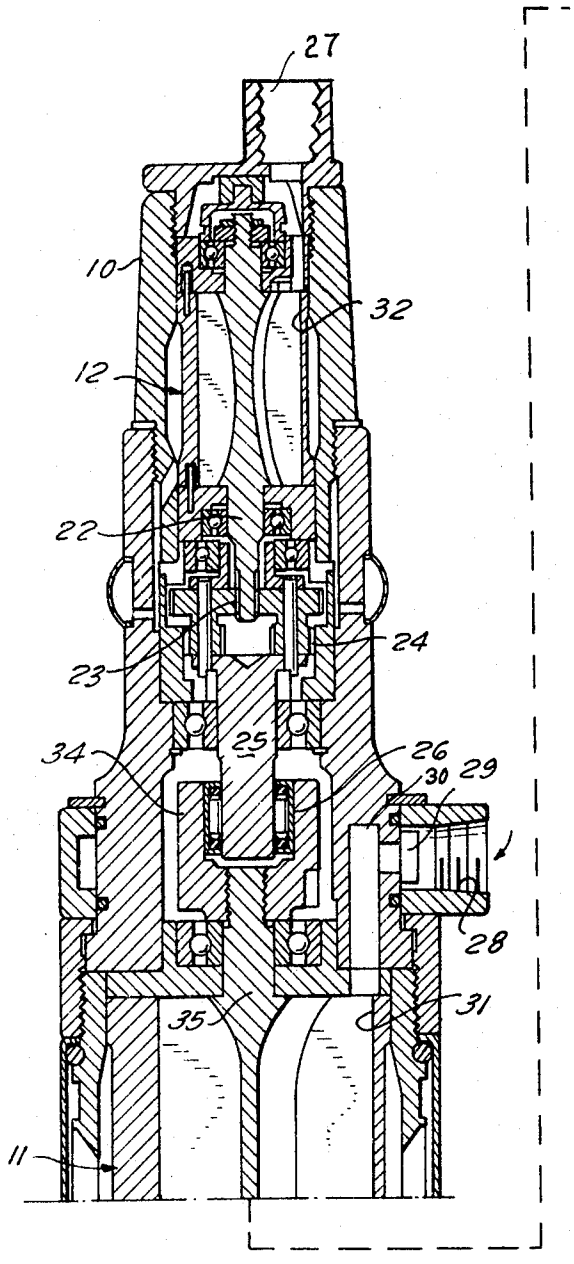
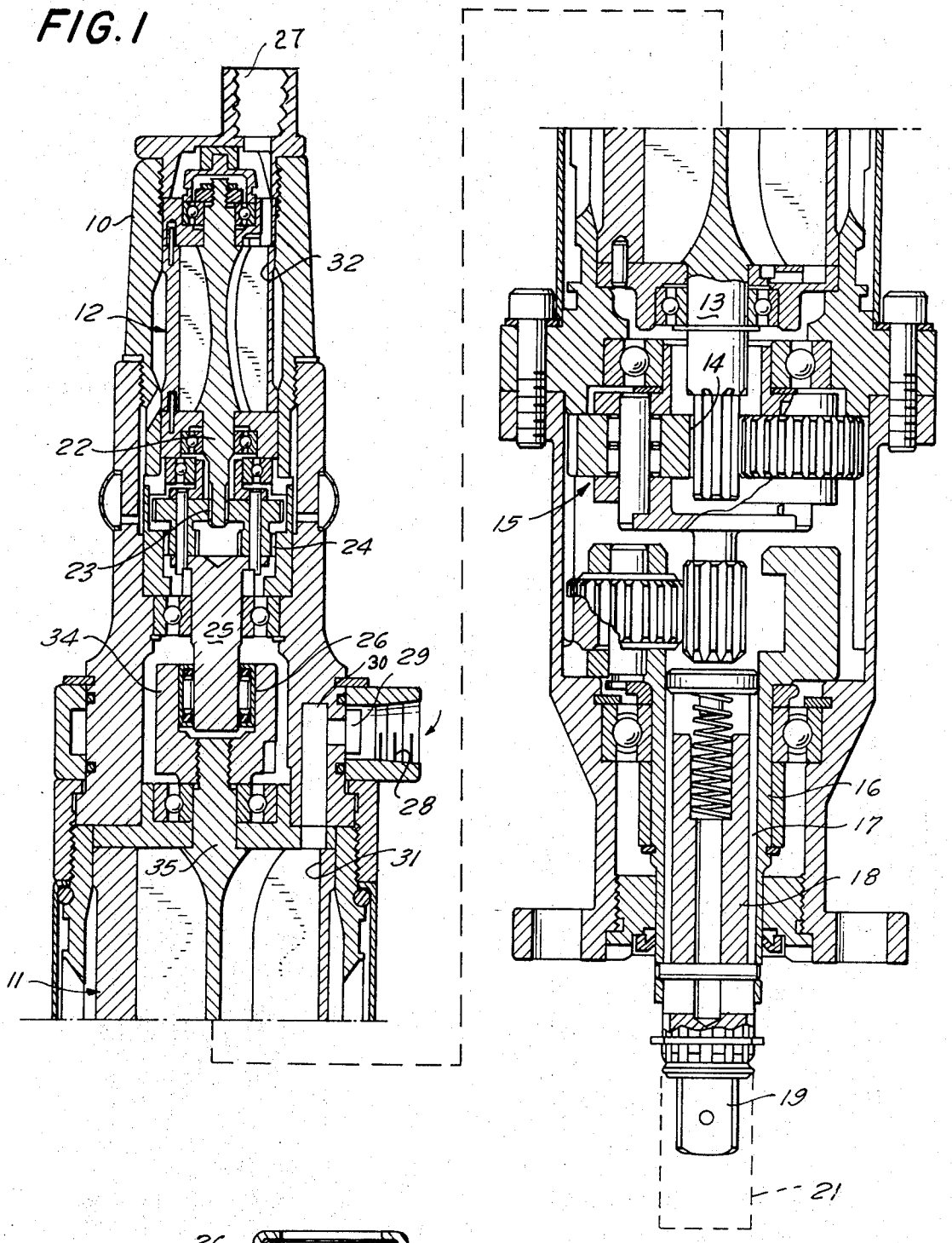


FIG. 1



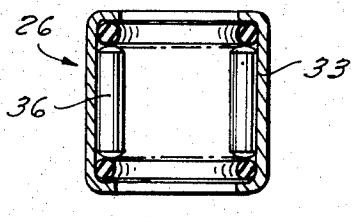


FIG. 2

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TWO-SPEED NUT-RUNNING TOOL WITH TANDEM MOTORS

BACKGROUND OF THE INVENTION

This invention relates to the art of two-speed pneumatic nut-running tools having an initial stage of reduced torque delivery followed automatically by a final stage of increased torque delivery.

Tools of this general nature are known from U.S. Pat. No. 3,187,860. These known tools differ from that of the present invention in that they use a single rotary air-motor which functions through a pair of clutches to deliver two stages of torque to the work. In the present invention, a pair of rotary air-motors is used. They are coupled in tandem relation by means of an overrunning clutch and are caused to be pneumatically operated concurrently and in the same direction. The clutch enables one of the motors to operate faster than the second so as to deliver an initial stage of reduced torque to the work and then functions automatically to enable both motors to simultaneously deliver increased torque to the work at the slower speed of the second motor. The tandem motor arrangement of the present invention is a simple means for attaining final torque at extremely low motor speed. This method of low speed final torquing minimizes variables due to the effect of heat upon the friction conditions of the driven fastener and related surfaces.

BRIEF DESCRIPTION OF THE DRAWING

In the accompanying drawing:

FIG. 1 is a longitudinal section through a pneumatically powered two-speed nut-running tool embodying the invention; and

FIG. 2 is a detail section of the clutch.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

In the accompanying drawing is disclosed a nut-running tool having an elongated housing **10** defined by means of a succession of sections fixed to one another in end-to-end relation.

A conventional air-driven rotary main motor **11** of the radially slidable vane type is arranged within the housing in axially aligned tandem relation to a conventional air-driven rotary auxiliary motor **12** of the radially slidable vane type.

The output end **13** of the rotor shaft of the main motor has a splined driving connection **14** with a double stage of reduction gearing **15**, the output spindle **16** of which has a splined driving connection **17** with a work shaft **18**. The work shaft terminates in a squared end **19** carrying a socket **21** adapted for engagement with a threaded fastener such as a bolt or nut.

The main motor is designed to deliver to the work a degree of torque which is less than, or a fraction of, the final torque required to bring the work to a predetermined degree of tightness.

The rotor shaft **22** of the auxiliary motor has a splined driving connection **23** with reduction gearing **24**. The auxiliary motor is designed to operate at a low speed relatively slower than that of the main motor. Its function is to cooperate with the main motor after the latter has delivered an initial degree of torque to the work, less than the required final torque, to increase the torque delivery to the work at a very low speed until the final torque has been delivered. Toward this end, the output spindle **25** of the reduction gearing **24** of the auxiliary motor is coupled by means of a conventional one-way clutch **26** of the free-wheeling or overrunning type to the main motor.

An inlet port **28** connects with passages **29**, **30** leading to the rotor chamber **31** of the main motor. A second inlet port **27** connects with passages leading to the rotor chamber **32** of the auxiliary motor. Both inlet ports are connectable by means of hose lines (not shown) through a common valve with a common source of live air. Upon application of source air through the valve to both inlet ports, both motors are caused to be separately operated and to run concurrently.

The clutch **26** is directionally connected between the motors. It enables the auxiliary motor to drive the main motor when the speed of the main motor is slowed to that of the auxiliary motor; and it permits the main motor to rotate ahead of or at a faster speed than that of the auxiliary motor but does not allow the faster rotating main motor to drive the auxiliary motor. Here, the clutch **26** (FIGS. **1**, **2**) is of the roller type. It includes a cylindrical casing **33** which is press fitted in a recess of an adapter **34** that is fixed upon the input shaft end **35** of the rotor of the main motor; and includes the usual ring of rollers **36**, which rollers contact the surface of the spindle **25** of the auxiliary motor. The arrangement is such that when the main motor **11** is rotating faster than the spindle **25**, the clutch rollers **36** are caused to be rotated about their axes in one direction so as to roll around and relative to the spindle; but when the speed of the main motor is slowed to that of the spindle **25**, the spindle transmits a rotative force to the rollers forcing them about their axes in the opposite direction whereby they are caused to engage in the usual manner the spindle **25** with the clutch casing **33**. When the spindle is so engaged, the rotation of the auxiliary motor **12** is transmitted through the clutch to the rotor of the main motor.

In summary of the operation of the tool: After the socket end **21** has been engaged with the work live air fed to the inlet ports **27** and **28** causes both motors **11** and **12** to operate concurrently. The main motor **11** initially runs at a faster speed than the auxiliary motor and while it does so the clutch **26** free-wheels or overruns relative to the slower running auxiliary motor **12**. In this action, the faster running main motor runs the work down to a predetermined initial degree of torque, less than the finally required torque. The auxiliary motor runs free during this time until the rotor of the main motor slows down to the spindle speed of the auxiliary motor upon delivery of the initial torque. The output spindle **25** of the auxiliary motor is then drivingly engaged by the clutch **26** with the rotor shaft **35** of the main motor. Both motors then operate at the low speed of the auxiliary motor, each delivering torque to the work until a final predetermined torque has been delivered, at which time both motors stall. The operator may then remove the tool from the work.

I claim:

1. A two-speed nut-runner comprising an air-driven rotary main motor carrying a work shaft adapted for engagement with a threaded fastener, an air-driven rotary auxiliary motor, a one-way free-wheeling clutch coupling the auxiliary motor to the main motor in tandem relation, means for feeding operating air separately to both motors so as to cause them to run concurrently in the same direction, the main motor adapted when unloaded to run faster than the auxiliary motor and adapted under a predetermined load to be slowed to the speed of the auxiliary motor, the clutch adapted to free-wheel relative to the auxiliary motor when the main motor is running faster than the latter and adapted to engage the auxiliary motor drivingly with the main motor when the speed of the main motor is slowed to that of the auxiliary motor.

2. A two-speed nut-runner comprising an air-driven rotary main motor, a work spindle drivingly engaged by the main motor adapted for engagement with the work, and air-driven rotary auxiliary motor, an overrunning clutch coupling the auxiliary motor with the main motor, means for effecting pneumatic operation of both motors separately and concurrently in the same direction, the main motor normally having an operating speed faster than that of the auxiliary motor, the clutch adapted to allow the main motor to overrun the auxiliary motor when the main motor is caused to run faster than the auxiliary motor, and the clutch being adapted to transmit the rotation of the auxiliary motor to the main motor when the main motor is caused to be slowed to the speed of the auxiliary motor.

3. A two-speed nut-runner as in claim **2**, wherein the motors are axially aligned and coupled to one another by the clutch in tandem relation.

4. A two-speed nut-runner having an air-driven rotary main motor adapted for driving engagement with the work, an air-

driven auxiliary motor, a one-way clutch coupling the auxiliary motor to the main motor, means for pneumatically causing operation of both motors separately and concurrently in the same direction, the clutch adapted to be free running when the main motor is running faster than the auxiliary motor and adapted to be engaged when the speed of the main motor corresponds to that of the auxiliary motor.

5. A two-speed pneumatic nut-runner as in claim 4, wherein the clutch includes a cylindrical casing carried by the main motor, a ring of rollers disposed in the casing, the auxiliary motor carries a spindle axially disposed in the ring of rollers, the casing and rollers being adapted to rotate around the spindle when the main motor is rotating faster than the spindle, and the rollers being adapted to engage the spindle with the casing when the speed of the main motor corresponds to that of the auxiliary motor.

6. A two-speed pneumatic nut-runner as in claim 4, wherein the main motor has an initial operating speed faster than that of the auxiliary motor and is adapted to produce in the work an initial predetermined torque less than final torque and to become slowed in speed to that of the auxiliary motor upon delivery of the initial torque.

7. A two-speed pneumatic nut-runner as in claim 6, wherein the auxiliary motor is adapted to transmit to the work through the main motor increased torque following engagement of the clutch.

8. A method for producing in a threaded fastener final torque at low speed comprising: directionally coupling by means of an overrunning clutch a rotary air-motor having a predetermined normal speed in tandem relation with an auxiliary rotary air-motor having a relatively low speed and a torque producing capacity greater than that of the main motor; providing the main motor with work driving means; providing conduit means for communicating a source of live air separately to both motors to cause them to operate concurrently and in the same direction; and arranging the main motor so that it will have a capacity of torque delivery which is less than a final predetermined torque to be produced in the fastener.