This invention relates to power driven apparatus with particular reference to machines used for assembly work, as in automobile plants and the like where production is on a quantity basis.

It has been developed in its special application to apparatus for applying securing members of the threaded type, the driving of screw studs into tapped holes, nut running, screw driving and similar operations, but its use is by no means confined thereto.

In assembly work it is desirable that all securing members hold the assembled parts with a proper degree of tightness. This becomes imperative when the parts are designed to operate at high speed, for failure in this respect is likely to mean damage to parts and injury to persons. The above is particularly true of securing members which are too loose and this difficulty is sought to be overcome by inspection. Trouble of a different kind is also likely to develop, however, when securing members are too tight. With power apparatus excessive tightness is frequently not discovered until injury or destruction of either the securing member or its recipient has occurred.

Sometimes the power apparatus is also damaged.

Among the objects of the invention are to provide power apparatus for driving threaded securing members arranged for convenient manipulation, control, and adjustment, to enable the operator of the apparatus to know at all times and within practical limits the degree of tightness or looseness with which a securing member is being driven, to eliminate or greatly reduce the necessity for inspection, to speed up production while reducing its costs, and in general to improve prior methods and apparatus in the interests of more efficient, more economical and more satisfactory service.

The invention involves apparatus of the described type which will signal to the operator the tightness or looseness of the fastening member during the entire time that it is being driven. The amount of torque exerted by the apparatus is made the basis of the signalling arrangement.

The driving motor is so mounted as to be capable of limited movement under the force of the torque exerted by it. Adjustable means are provided for opposing such movement of the driving motor. The opposing force is so adjusted that the necessary torque to balance the same sets up the fastening member with the desired degree of tightness. Various arrangements and forms of signals may be devised for taking advantage of the movement of the motor. By preference a signal is given when the torque and the adjusted opposing force are in balance and continues to be given so long as this condition lasts, thereby indicating that the fastening member fits with the predetermined or acceptable degree of tightness.

If the fastening member fits too tightly or excessively resistance for any reason, the invention contemplates a second or danger signal to be operated after the first signal is given. This will enable the operator to stop his machine before any damage is done. If the fastening member is set up with so little torque that the adjustable opposing means is not balanced, no signal will be given and the operator will know that the fastening member is too loose. While any type of signal may be used, those of the visual type are preferred, such as a green light when the fastening member fits with the proper tightness and a red light when it fits too tightly.

In order to illustrate the invention a concrete embodiment thereof is shown in the accompanying drawings, in which:

Fig. 1 is a front elevational view with parts cut away to show the bearing supports for the machine;

Fig. 2 is a side elevational view partly cut away along the broken line 2--2 of Fig. 1 and disclosing the interior of the signal chamber;

Fig. 3 is a transverse sectional view substantially on the line 3--3 of Fig. 1;

Fig. 4 is a transverse sectional view substantially on the line 4--4 of Fig. 2; and

Figs. 5, 6 and 7 are wiring diagrams.

The embodiment of the invention chosen for the purpose of illustrating the same consists of a power-driven machine A supported for limited movement in a frame indicated at B and arranged to be manually applied to the work. The machine A has a motor 8 of any suitable or desired type. Secured to motor 8 either directly or through a transfer plate 9 is a case 10 for the transmission mechanism from which projects spindle 11 carrying a chuck or other suitable socket member 12 for engagement with the work. The machine is supported in bearings 13 in frame B for limited rotating movement, the lower bearing engaging the reduced portion of transmission case 10 adjacent the point where the spindle 11 projects therefrom and the upper bearing receiving a stub shaft 14 carried by a cap member 15 secured to the top of motor 8 (Figs. 1, 4 and 3). Stub shaft 14 is in line with spindle 11 so that machine A is rotatable about the axis defined by spindle 11.

While frame B may be arranged to be entirely manually supported as well as directed, in the present instance it is shown secured to a moveable arm 16 (Fig. 2) extending from a pedestal or other suitable support (not shown) upon which arm 16 is preferably arranged for vertical adjustment and for free horizontal movement when adjusted. The particular form of frame shown comprises spaced side members 17 connected together at their opposite ends by transverse members 18 generally arcuate in form and providing the bearings 13 for machine A. The side mem-
bers 17 are slidable in guide sleeves 19 supported by a yoke 20 secured to arm 16. A transverse shaft 21 is supported in bearings in yoke 20 and has a suitable operating connection with frame 5. Five pinions engaging rack teeth on side members 17 as indicated in Fig. 2. A box 22 on yoke 20 may provide suitable means such as a spring motor (not shown) acting on shaft 21 for yielding and maintaining frame B at one limit of its movement. A handle 21a on the other end of shaft 21 provides for manual control and movement of frame B against the force of the spring motor, while a second handle 19a secured to one of the guide sleeves 19 permits convenient positioning of the machine above the securing member which is to be driven.

The upper transverse member 18 of frame B has pivoted thereto at 23 (Fig. 2) a lever 24 with a weight 25 adjustable secured thereon as by a set screw 25a. Lever 24 has an offset portion 24a engaging a plunger 26 slidably received in a guide bore in upper member 18. Plunger 26 engages a button or other wear resisting member 27 (Figs. 2 and 3) carried by a projecting arm 15a on cap member 15 (Figs. 1 and 3). Thus lever 24 with its weight 25 applies a force to machine A for resisting movement of the latter on its bearing 13 in response to the torque exerted by spindle 11. If the torque is sufficient to overcome this force and lift weight 25, means are provided for giving a signal of some character to the operator. By preference electrical means are provided for this purpose including a switch 28 which may comprise fixed contacts 28a projecting from upper member 18 and arranged to be bridged by a contact member 28b adjustable and yieldingly supported in any suitable manner on arm 15a secured to motor 8.

The invention further contemplates the giving of a second signal when an undesirable or excessive torque is exerted by the machine. For this purpose the lower member 18 of the frame may be utilized, reference being had to Figs. 2 and 4. Lower member 18 has stops 29 and 30 arranged to be engaged by cooperating stops carried by a projection 31 secured to transmission case 10 on the machine. Stop 29 is engaged by projection 31 when the machine is not in operation through the action of weighted arm 24. When the force exerted by weighted arm 24 is overcome, projection 31 takes the position shown in Fig. 4 wherein the extension 31a is in contact with stop 30. The latter yieldingly resists further movement of the machine, the stop being in the form of a plunger which is backed by a spring 30a, the tension of which is arranged to be regulated by a screw plug 30b retained in its adjusted position by a lock nut 30c. When the torque exerted by the machine overcomes spring 30a a second signal is given to the operator, the preferred means including a switch 32 (Fig. 4) having electrical contacts 32a on lower member 18 arranged to be bridged by member 32b on projection 31.

Signal control switches 28 and 32 respectively may be arranged to operate any desired type of signal. The preferred type is visual and consists in the showing of lights, preferably of different colors, in such position that the operator cannot fail to notice them. Accordingly, signal lights are disposed upon machine A substantially centrally of the same. In the present instance they are shown within a chamber 33 formed on the front of transfer plate 9, the chamber being closed by a bull's-eye or other lens 34. Within the chamber are mounted the signal lights, such as incandescent bulbs 35 and 36. By preference signal bulb 35 is green and is controlled by switch 28 and signal bulb 36 is red and is controlled by switch 32.

Figs. 5, 6 and 7 illustrate wiring diagrams for use with machines operated by different types of motors. For example, if a compressed air motor is used at B a separate source of electricity will be needed for operating signal lights 35 and 36, such as a battery shown at 37 in Fig. 5. A small battery may be used with flashlight bulbs provided for the signal lamps. If a D. C. electric motor is used, as indicated in Fig. 6, the power for operating the signal lights may be taken directly from the line, standard bulbs conforming to the line voltage being used. Fig. 7 illustrates a practical hook up when a high frequency polyphase induction motor is used. In this case two of the leads to the motor may be tapped and connected to a transformer at 38 and the voltage may be reduced to such an extent that low voltage automobile bulbs may be used for the signal lights.

In the present instance and by preference machine A has an electric motor at 9 of the high frequency polyphase type, the power leads for which extend through a cable 39 (Fig. 2) to main switch 40 secured at any convenient point as upon the supporting yoke 20. The power leads from switch 40 to machine A extend through a flexible cable 41 to signal chamber 33 and then to the motor, the cable being of sufficient length to permit free movement of the machine relative to supporting yoke 20. The transformer (not shown) for the current to the signal lights may be disposed at any suitable or desired position on the machine.

In operating the machine the desired tightness of fit of the securing member to be set up is predetermined by the position of weight 25 (Fig. 2) on lever arm 24. The operator then positions machine A over the securing member to be driven, turns on main switch 40, and pulls down upon handle 21a to move the machine in its supporting frame B against the force of the spring motor in case 22 until chuck 12 engages the securing member. The signal arrangement operates immediately to indicate to the operator the degree of tightness of the securing member as the latter is driven. If the reaction of machine A under the torque exerted by a spindle 11 lifts weight 25, thereby operating switch 28 and causing green light 35 to show, he knows that the securing member is being driven with the predetermined and desired degree of tightness. If the torque is so great that spring 30a of yielding stop 30 is overcome so that switch 32 is operated and red light 36 shows, he is warned that the securing member is too tight and can either stop or lift the machine before injury is done either to the work or to the machine. If the torque exerted by the machine is insufficient to overcome the force exerted by weight 25, the green light 35 will not show and this will be an indication to the operator that the securing member is too loose.

In normal operation with a properly fitting securing member the green light shows as soon as the running-in operation begins and continues to show until the member is driven home when the red light comes on. If the fit is dangerously loose no signal will show during the running-in operation but both the green and red lights will come on in rapid succession at the completion of the operation. However the operator will not
run such a member way in but will stop the machine and will discard the member promptly on the absence of a signal as the member begins to be run in. If the fit is too tight or there are defective threads, the condition will be promptly indicated by a rapid showing of the green and red signals and the machine will be stopped to correct the defect before damage is caused.

While a preferred form of the invention has been herein shown and described, it is to be understood that the invention is not limited to the specific details thereof but covers all changes, modifications, and adaptations within the scope of the appended claims.

We claim as our invention:

1. Apparatus for setting up a threaded securing member comprising a frame, a motor having mechanism including a spindle for transmitting its rotative force to the securing member, means for supporting the stator of said motor in said frame for rotation about the axis of said spindle, means for resisting rotative movement of the motor stator and a signal device operated by said resisting means after a predetermined torque is exerted by the stator to indicate to the operator the tightness of the member during the setting up operation, said resisting means comprising a plunger, a spring engaging said plunger, and means for adjusting the force exerted by said spring.

2. Apparatus for setting up a threaded securing member comprising a frame, a motor and mechanism including a spindle for transmitting the rotative force of the motor to the securing member, means for supporting the stator of said motor in said frame for rotation about the axis of said spindle, means including a lever carrying an adjustable weight for resisting rotative movement of said motor stator, signalling means including a colored light and contact closed by said motor stator on rotative movement of the latter in overcoming the force exerted by said lever, a plunger engageable by said stator for resisting further movement of said motor stator, adjustable means for yielding means for resisting movement of said plunger, and signalling means including a light of a different color and contacts arranged to be closed by said motor stator when the torque of the latter overcomes the resistance of said plunger.

3. In combination, a support, a motor having a rotor and a stator, a spindle driven by the rotor and adapted to drive a securing member, said stator being mounted on the support for limited rotary movement in response to the reaction torque transmitted through the spindle, yieldable means for resisting said torque, a first contact member positionable on the support to be engaged by a cooperating contact member carried by the stator upon rotative movement of the stator through the predetermined arc, one of said contact members being yieldable to permit further movement of the stator in the same direction, a second contact member on the support positioned to be engaged by a cooperating contact member carried by the stator upon rotative movement of the stator through a predetermined arc greater than said first-mentioned arc, and a signal device associated with each of the contact members on the stator, each signal device being operative upon engage-

ment of its associated contact member with the cooperating contact member carried by the stator.

4. Apparatus for setting up a threaded securing member comprising a frame, a motor having mechanism including a spindle for transmitting its rotative force to the securing member, means for supporting the stator of said motor in said frame for rotation about the axis of said spindle, a plurality of yieldable means between the stator and the frame adapted to be engaged in succession on movement of the stator for resisting rotative movement of the latter relative to said frame, and a plurality of signalling devices associated with said yieldable means, each signalling device being operative upon predetermined movement of its associated yieldable means.

5. Apparatus for setting up a threaded securing member comprising a frame, a motor having a stator and a rotor, mechanism including a spindle for transmitting rotative force from the rotor to the securing member, means for supporting the stator of said motor in said frame for rotation about the axis of said spindle, yieldable means continuously urging the stator in a direction for resisting such movement of the motor stator, and means responsive to a predetermined torque exerted by the stator for producing a signal, said yieldable means being operative continuously both before and after the stator exceeds said predetermined torque.

6. In combination, a support, a motor having a stator and a rotor, a spindle driven by the rotor and adapted to drive a securing member, means mounting said stator on the support for rotative movement in response to the torque exerted by the motor, cooperating limit stops carried by said support and stator respectively for limiting rotative movement of the stator in both directions, yieldable means for urging said stator towards one limit position to oppose said torque, and intermediate stop means arranged on said stator and said support respectively for engagement with each other while said stator occupies an intermediate position, said intermediate stop means being yieldable whereby to permit the stator to move to the other limit position, and means operative in response to the engagement of the intermediate stop means for operating a signal.

7. Apparatus for setting up a threaded securing member comprising a frame, a motor and mechanism including a spindle for transmitting the rotative force of the motor to the securing member, means for supporting the stator of said motor in said frame for rotation about the axis of said spindle, cooperating limit stops on said stator and frame respectively for limiting the rotation of the stator in each direction, yieldable means for holding the stator in one limit position and additional yieldable means adapted to urge the stator towards the same position, said additional means being effective only after a predetermined movement of the stator, whereby yieldingly to hold the stator in an intermediate position, and signal means for indicating when the stator occupies said intermediate position.

CHARLES B. COATES.
CLARENCE J. DRESSER.