

March 4, 1969

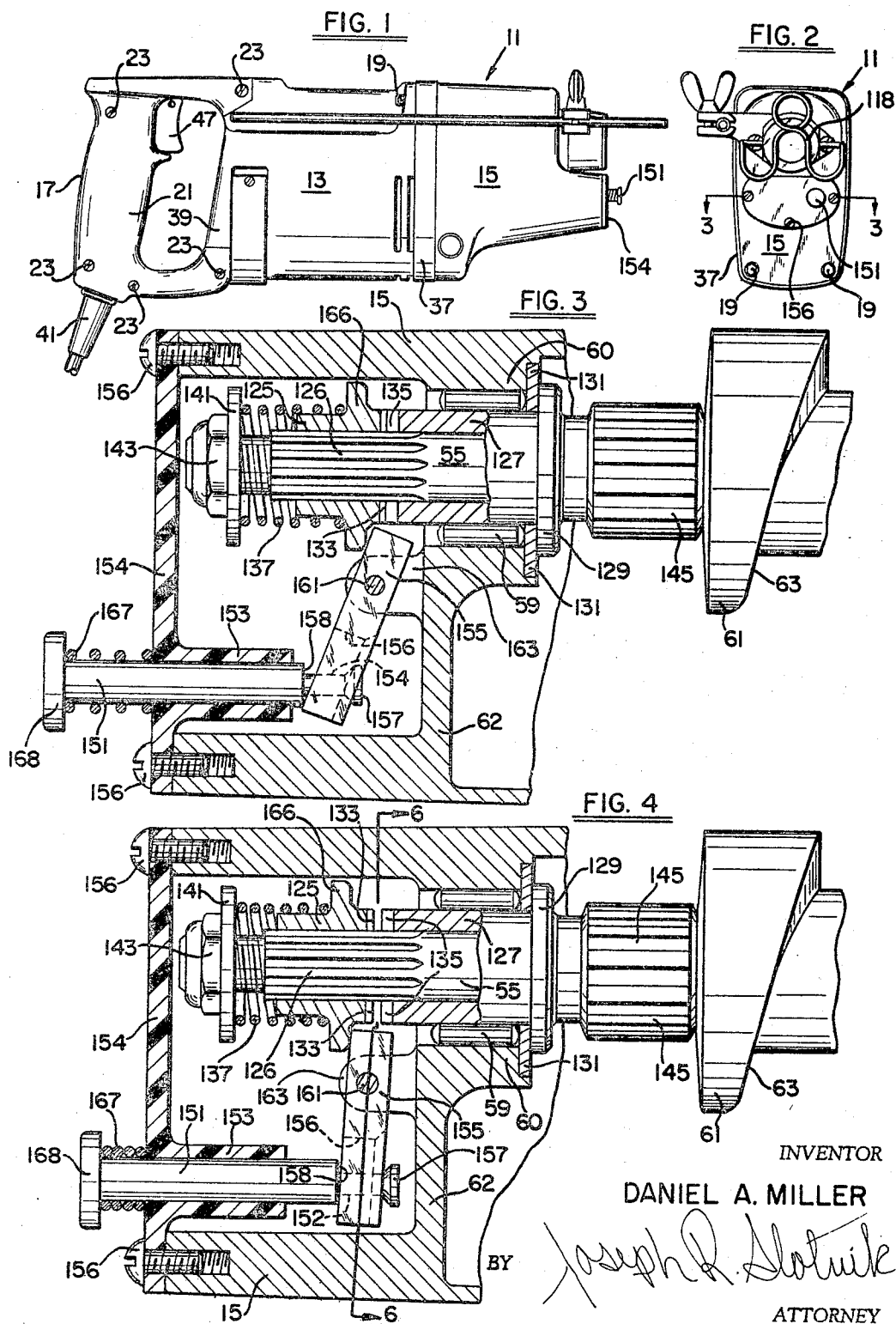
D. A. MILLER

3,430,708

TRANSMISSION FOR ROTARY HAMMER

Filed Oct. 2, 1967

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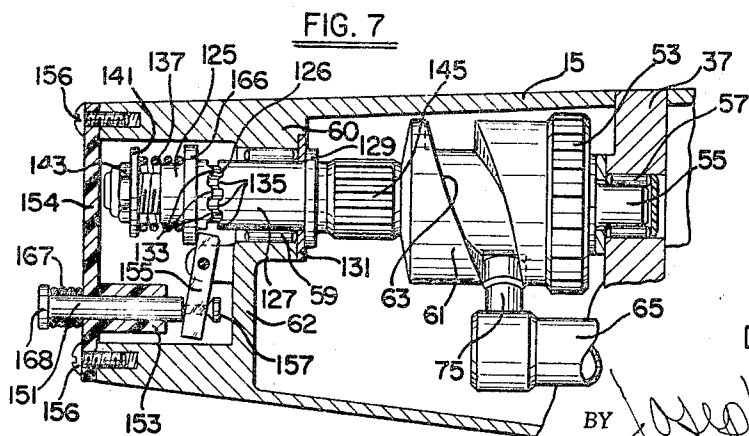
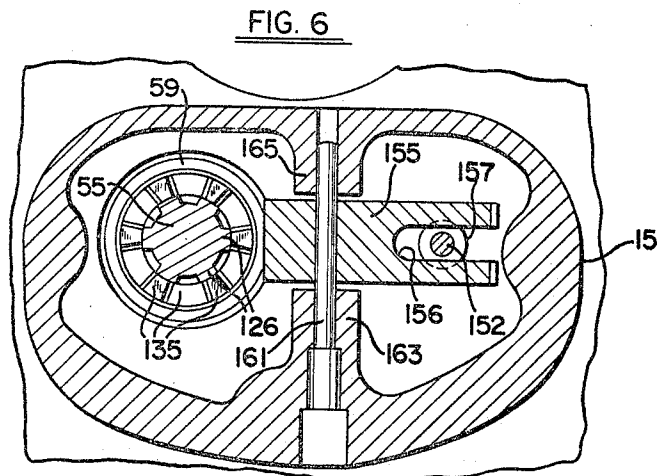
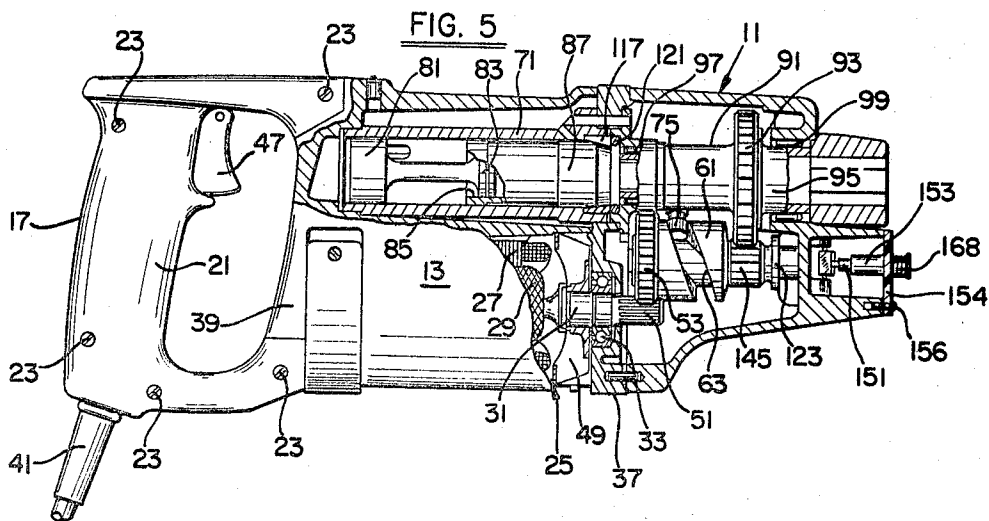
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3,430,708

TRANSMISSION FOR ROTARY HAMMER
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12 Claims

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ABSTRACT OF THE DISCLOSURE

The device disclosed herein is a hand-held, power operated, portable tool which includes a housing having a drive motor therein and a tool bit socket rotatably supported therein. The motor is drivingly connected to and rotates the socket through a transmission which includes an adjustable torque and manually releasable clutch. In addition, the motor drives an impact mechanism which is adapted to strike a tool bit carried by the socket so that during normal operation, the motor rotates and imparts a hammer blow to the tool bit. However, when the clutch is released, rotation of the socket ceases and the tool bit receives only a hammering action.

Summary of the invention

The present invention relates to an improved transmission rotatably interconnecting a drive motor and a driven tool carrying member in a rotary hammer device, which transmission includes a manually releasable clutch adapted to rotatably connect or disconnect the motor and the tool carrying member. The clutch is readily operable by the user during tool operation and facilitates easy conversion from rotary hammering to hammering only without requiring a different tool bit. The clutch also is releasable at torque overload and is adjustable for varying the torque level at which release is effected to prevent injury to the operator during use.

Main objects of the present invention, therefore, are to provide an improved transmission for use in a rotary hammer in which a drive motor imparts a hammer blow to a tool bit through an impact mechanism and, in addition, the motor is connected by the transmission to a tool bit carrying socket member to rotate the latter, wherein the transmission includes a normally engaged clutch which is readily and manually releasable to alternately provide rotary hammering operation of the tool bit and hammering action alone, which clutch is releasable and may be re-engaged during tool operation and is controllable by convenient means exteriorly of the tool housing and which facilitates rotary hammering and hammering alone using a single tool bit.

Additional important objects of the present invention are to provide an improved transmission device of the above character wherein the clutch is releasable at a predetermined torque level to prevent injury to the operator and damage to the tool during use and which includes means for selectively and readily adjusting the torque level at which the clutch releases.

Further important objects of this invention are to provide a transmission of the above character which is relatively inexpensive to manufacture, light, compact and rugged in construction, and reliable in use.

Other objects and advantages of the present invention will become more apparent from a consideration of the detailed description to follow taken in conjunction with the drawings annexed hereto.

Brief description of the drawings

FIG. 1 is a side elevational view illustrating a rotary hammer embodying the present invention;

FIG. 2 is an end view of FIG. 1;

FIG. 3 is an enlarged sectional view of FIG. 2 taken along the line 3-3 thereof, and shown with the clutch in the "engaged" position;

FIG. 4 is a view similar to FIG. 3 but with the clutch in the "disengaged" position;

FIG. 5 is an enlarged view, similar to FIG. 1, shown with parts broken away and removed and partly in section to illustrate the clutch parts of the present invention;

FIG. 6 is a sectional view of FIG. 4 taken along the line 6-6 thereof; and

FIG. 7 is a diminished view, similar to FIG. 4 but with the clutch parts shown in plan.

Broad statement of the invention

Broadly described, the present invention relates to a power-driven tool of the type having a housing, a drive motor within said housing and including rotatable shaft, a tool bit socket rotatably supported in said housing, a transmission rotatably interconnecting said motor shaft and said tool bit socket, an impact mechanism driven by said motor and adapted to strike a tool bit which is rotatable with but movable axially relative to the tool bit socket, and includes that improvement which comprises clutch means in said transmission, said clutch means including first and second separable jaws in driving and driven relationship with said tool bit socket and said motor shaft, respectively, said jaws having cooperable face portions which, when engaged, transmit rotary movement from said motor shaft to said tool bit socket, means normally biasing one of said jaws in a first direction causing cooperative engagement between said face portions, and manually operable means adapted to move said one jaw in a second direction opposite said first direction to separate said jaws and release said face portions from cooperative engagement.

Detailed description

Referring now more particularly to the drawings, a rotary hammer embodying the present invention is illustrated at 11 in FIGS. 1 and 2 and is seen to include a motor housing 13 having an end housing 15 secured thereto at one end by screws 19 and which together form a tool housing. The motor housing 13 has an end handle 17 at its other end with a handle cover 21 secured thereto by screws 23. The motor and end housings 13, 15 together with the end handle and handle cover 17, 21 may be constructed of cast aluminum, magnesium or other suitable metal, or, if the tool is to be of the "all insulated" type, these parts may be constructed of an insulating, non-metallic material such as those selected from the group consisting of polyamides, polycarbonates, polyphenylenes, oxides, phenylenes, acetals, rigid vinyls and glass fiber reinforced polyesters or thermoplastics.

As shown in FIG. 5, an electric motor 25 is disposed within the motor housing 13 and is seen to be of the universal type having a stationary field 27 and a rotating armature 29 which includes an armature shaft 31 journaled fore and aft by bearings 33 (only one of which is shown) and which are carried by a motor housing cover 37 and an end wall 39, respectively. The motor 25 receives electrical current from a suitable source through a line cord 41 trapped between the end handle 17 and handle cover 21 and through brushes (not shown) engageable with a commutator (not shown). An on-off trigger switch 47 is also enclosed in the handle 17 and cover 21 and controls current flow through the brushes to the armature 29 in the usual manner. A motor cooling fan 49 is rotatable with the armature shaft 31 and serves to move cooling air past the motor 25 during use of the tool as is customary.

The armature shaft 31 extends forwardly of the bear-

ing 33 into the end housing 15 and is formed with gear teeth 51 or, alternatively, may have a pinion (not shown) suitably fixed thereto. The teeth 51 drivably engage an intermediate gear 53 integral with or otherwise suitably secured to a cam shaft 55 (see FIGS. 3, 4 and 7). A bearing 57 carried by the motor housing cover 37 supports the rear end of the cam shaft 55 while another bearing 59 positioned within a boss 60 formed on a front wall 62 of the end housing 15 operatively supports the shaft 55 near its forward end through a clutch sleeve 127.

A generally cylindrical cam 61 is formed integral with or otherwise fixed to the cam shaft 55 for rotation therewith and is provided with a generally sinusoidal shaped, continuous cam groove 63 in its periphery. An elongated push rod 65 extends generally parallel to the cam shaft 55 and has a cam follower pin 75 press fitted therein at one end and adapted to ride in the cam groove 63 so that when the motor 25 is energized and the cam 61 rotated, the push rod 65 is caused to reciprocate longitudinally by reason of cooperative engagement between the cam follower pin 75 and the cam groove 63.

The other end of the push rod 65 is interconnected by means (not shown) with a reciprocating cross-head 81 formed integrally with a relatively short, disc-shaped piston 83 and which is slidably supported within a cylinder sleeve 71 (see FIG. 5). The piston 83 is disposed within a cylindrical blind bore 85 formed in a floating ram 87 which also is slidably guided within the cylinder sleeve 71. The piston 83 sealingly engages the wall of the ram bore 85 trapping air within the bore thereby forming an air-spring providing alternate compression and rarefaction effects during reciprocating movement of the piston 83. Thus, during use, this air spring moves the ram 87 forwardly or toward the right, as seen in FIG. 5, during forward piston movement, and rearwardly or toward the left as the piston 83 retracts or moves rearwardly. Preferably, venting means is provided for the air trapped in the blind bore 85 so that this air can adjust itself to a substantially constant working level. Although not illustrated nor described here, one form of venting means found to be highly acceptable is that disclosed in the U.S. patent to Akerman, No. 3,034,302, granted May 15, 1962 and owned by the assignee of the present application.

The forward end of the floating ram 87 is adapted to move into close proximity to the rearward end of a socket-like, tubular neck portion 91 of a gear 93 which also has a forwardly extending, tubular extension 95 formed integral therewith. The neck portion 91 and the tubular extension 95 form a tool bit receiving socket or spindle and are rotatably supported by bearings 97, 99. A tool bit (not shown) is adapted to have its shank received in the tubular extension 95 and gear 93 and the socketed neck portion 91. The tool shank (not shown) when in place extends rearwardly beyond the neck portion 91 and is adapted to be impinged or struck by the floating ram 87 during its forward movement. Since the tool bit is longitudinally slidable in its mounting, this impact or striking by the ram 87 produces a hammering action on the bit to perform the desired work operation. To prevent the ram 87 from impacting against the neck portion 91 on the bearing 97, a bumper assembly including a tapered, split collet 117 and an O-ring 121 is positioned within the cylinder sleeve 71.

It will be appreciated that the impact mechanism described briefly above does not form a part of the present invention and the details thereof are therefore not important here. The impact mechanism described is intended to be illustrative only and for a detailed illustration and description thereof, reference may be made to applicant's copending application Ser. No. 672,274, dated October 2, 1967, and owned by the assignee of the present application.

To transmit rotary movement to the tool bit 109, the cam shaft 55 and a first clutch sleeve 125 have interfitting

splines 126 so that the shaft 55 and the clutch sleeve 125 rotate conjointly while the latter is adapted to move longitudinally relative to the former. An elongated, second clutch sleeve 127 is rotatably disposed on the cam shaft 55 and is rotatably supported by the bearing 59. The second clutch sleeve 127 is restrained against axial movement by the cam 61 and by a flange 129 formed on the sleeve 127 and which is spaced from the bearing 57 by a washer 131. The clutch sleeves 125, 127 are provided with confronting clutch teeth 133, 135 which when engaged cause the clutch sleeves to rotate conjointly.

The first clutch sleeve 125 is normally biased toward the second clutch sleeve 127 under the action of a compression spring 137 caged between a flange 166 on the first clutch sleeve 125 and a washer 141 slidable on the cam shaft 55. An adjusting nut 143 is threaded on the outer end of the cam shaft 55 to hold the washer 141 in place while permitting adjustment thereof to vary the force of the spring 137 on the first clutch sleeve 125.

The second clutch sleeve 127 has a pinion 145 formed integral therewith or pressed thereon and which engages and drives the spindle gear 93 so that when the clutch teeth 133, 135 are engaged, the spindle gear 93 and the tool bit (not shown) carried therewithin rotate. However, by moving the first clutch sleeve 125 from the position shown in FIG. 3 to the position shown in FIGS. 4 and 7 and away from the second clutch sleeve 127, the teeth 133, 135 are separated and rotation of the second clutch sleeve 127 along with the spindle gear 93 and tool bit ceases. Thus, in this position of the parts, the tool bit undergoes hammering action only.

The first clutch sleeve 125 is retractable from the second clutch sleeve 127 against the action of the spring 137 by means of a release button 151. As shown in FIGS. 3, 4, and 7, the button 151 is slidably disposed in an apertured boss 153 formed on a cover 154 secured to the end housing 15 by screws 156. The release button 151 has a reduced diameter portion 152 bounded by a shoulder 158 and an enlarged head 157 and the reduced portion 152 is received in a slot 156 formed in a release lever 155 (see also FIG. 6). The release lever 155 is pivoted by a pin 161 to a pair of spaced bosses 163, 165 on the end housing 15 and is engageable behind the flange 166 on the first clutch sleeve 125. Thus, when the release button 151 is pressed inwardly, the shoulder 158 engages the release lever 155 and pivots it about the pivot pin 161 from the position shown in FIG. 3 to the position shown in FIG. 4, thereby sliding the first clutch sleeve 125 toward the left to disengage the clutch teeth 133, 135. As described above, with the parts in this position, the tool 11 is set for hammering only. When it is desired to employ the tool for rotary hammering, pressure on the button 151 is released whereupon the compression spring 137 moves the clutch sleeve 125 toward the right and re-engages the clutch teeth 133, 135. A compression return spring 167 on the release button 151 and caged between the cover 154 and a head 168 on the button 151 returns the latter to the position shown in FIG. 3 when pressure is removed to space the lever 155 from the flange 166 and to prevent the button 151 from rattling during tool operation.

In addition to manual release, the clutch sleeves 125, 127 can separate at a predetermined level of torque. Thus, the teeth 133, 135 are outwardly tapered, as shown in FIG. 7, so that excessive torque thereon (as when the tool bit "seizes") will cause the teeth 135 to ride up on teeth 133 and compress the spring 137 whereupon the clutch is released. The nut 143 provides a ready adjustment for the torque level at which the clutch releases.

It will be appreciated that the operation of the tool 11 is converted from rotary hammering to hammering alone simply by depressing the button 151, and that there is no need to change tool bits when it is desired to convert the tool from one operation to the other as in many

rotary hammers. Thus, for example, when installing a self-drilling anchor, the desired tool bit is inserted into the tool 11 and the anchor inserted into the tool bit. The tool 11 is then turned "on" and the anchor driven into the material, for example, concrete, using both a hammering and drilling action (with the button 151 released). The anchor is then withdrawn from the hole it has formed in the material, cleaned and a swaging plug inserted into the bottom thereof. The combined anchor and plug is inserted in the tool bit and, with the button 151 depressed, is driven into the hole using a hammering action only. This causes the plug to swage the anchor into tight engagement with the concrete surface.

It will be appreciated that this particular illustration is given by way of example only and that a tool embodying the present invention has many other uses.

By the foregoing, there has been disclosed an improved transmission for rotary hammers calculated to fulfill the inventive objects hereinabove set forth, and while a preferred embodiment of the present invention has been illustrated and described in detail, various additions, substitutions, modifications and omissions may be made thereto without departing from the spirit of the invention as encompassed by the appended claims.

I claim:

1. In a power-driven tool of the type having a housing, a drive motor within said housing and including a rotatable shaft, a tool bit socket supported in said housing, a transmission rotatably interconnecting said motor shaft and said tool bit socket, an impact mechanism driven by said motor and adapted to strike a tool bit which is rotatable with but movable axially relative to the tool bit socket; that improvement which comprises clutch means in said transmission, said clutch means including first and second separable jaws in driving and driven relationship with said tool bit socket and said motor shaft, respectively, said jaws having cooperable face portions which, when engaged, transmit rotary movement from said motor shaft to said tool bit socket, means normally biasing one of said jaws in a first direction causing cooperative engagement between said face portions, and manually operable means adapted to move said one jaw in a second direction opposite said first direction to separate said jaws and release said face portions from cooperative engagement.

2. A construction as defined in claim 1 wherein said manually operable means is actuated from outside said housing.

3. A construction as defined in claim 1 wherein said face portions include interengaging teeth.

4. A construction as defined in claim 3 wherein said biasing means acts upon said first jaw, said teeth being outwardly tapered so that when the torque in said tool reaches a predetermined level, the teeth on said first jaw

ride up on the teeth on said second jaw, against the force of said biasing means, thereby rotatably disengaging said first and second jaws and said motor shaft and tool bit socket.

5. A construction as defined in claim 4 which includes means for adjusting the force of said biasing means on said first jaw.

6. A construction as defined in claim 1 wherein said first and second jaws comprise first and second sleeves respectively rotatable with and rotatable on a cam shaft, said first sleeve being slidable on said cam shaft toward and away from said second sleeve, said biasing means acting upon said first sleeve to bias it into driven relation with said second sleeve, said manually operable means operatively engaging said first sleeve and adapted, when actuated, to move said first sleeve against said biasing means and away from said second sleeve.

7. A construction as defined in claim 6 wherein said first sleeve is splined to said cam shaft.

8. A construction as defined in claim 6 wherein said cam shaft is driven by said motor shaft, said impact mechanism being driven by cam means associated with said cam shaft.

9. A construction as defined in claim 6 wherein said manually operable means includes a push button slidably supported relative to said housing and accessible exteriorly thereof, and means interconnecting said push button and said first sleeve.

10. A construction as defined in claim 9 wherein said interconnecting means includes a lever pivoted on said housing.

11. A construction as defined in claim 10 wherein said first sleeve has an outwardly extending flange, said lever having one end engageable with said flange and its other end interconnected with said push button.

12. A construction as defined in claim 11 which includes resilient means normally biasing said push button in a direction where said lever is spaced from said flange.

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