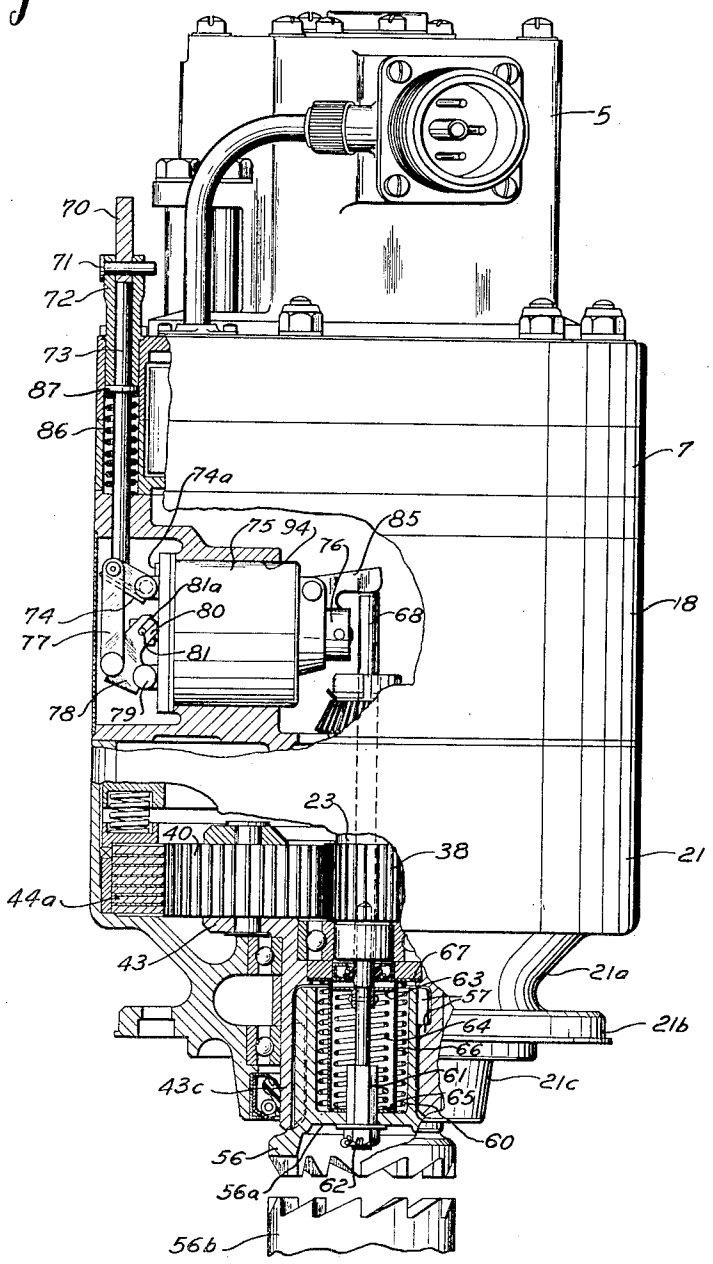
Nov. 9, 1943. R. M. HEINTZ 2,334,003

JAW MESHING MECHANISM FOR ELECTRIC STARTERS

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Fig. 1.



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Fig. 2.

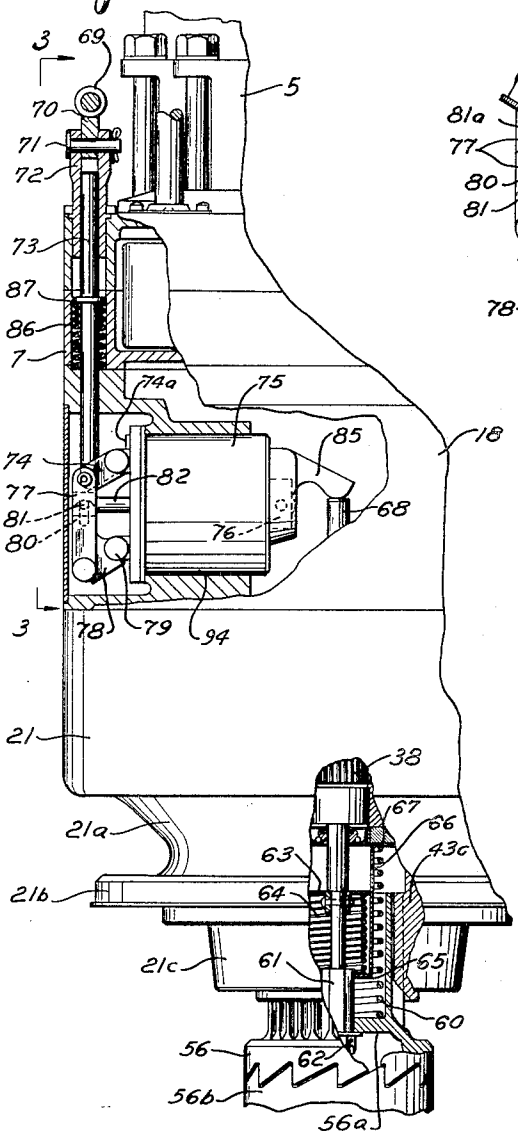


Fig. 4.

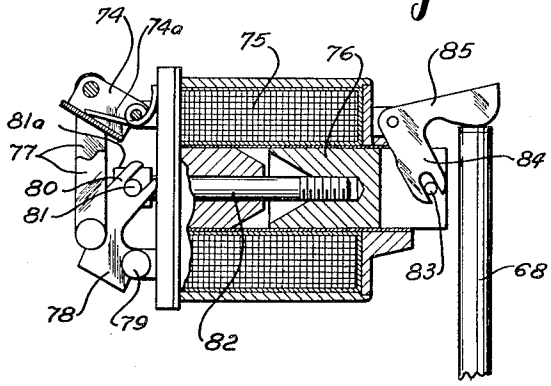


Fig. 3.

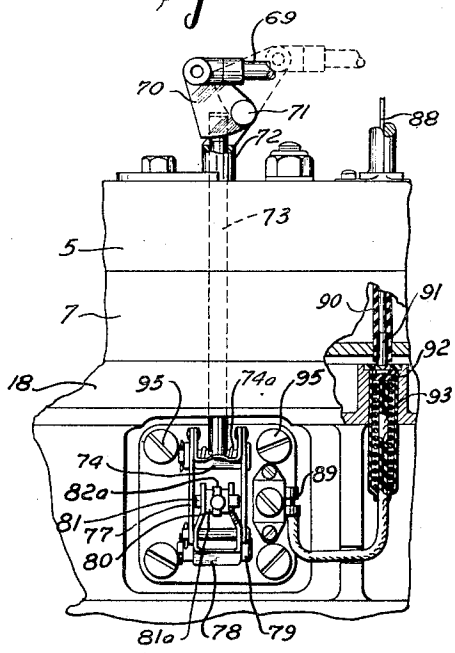
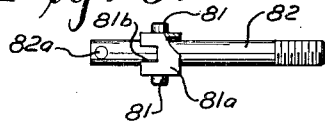


Fig. 5.



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JAW MESHING MECHANISM FOR ELECTRIC STARTERS

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Fig. 6.

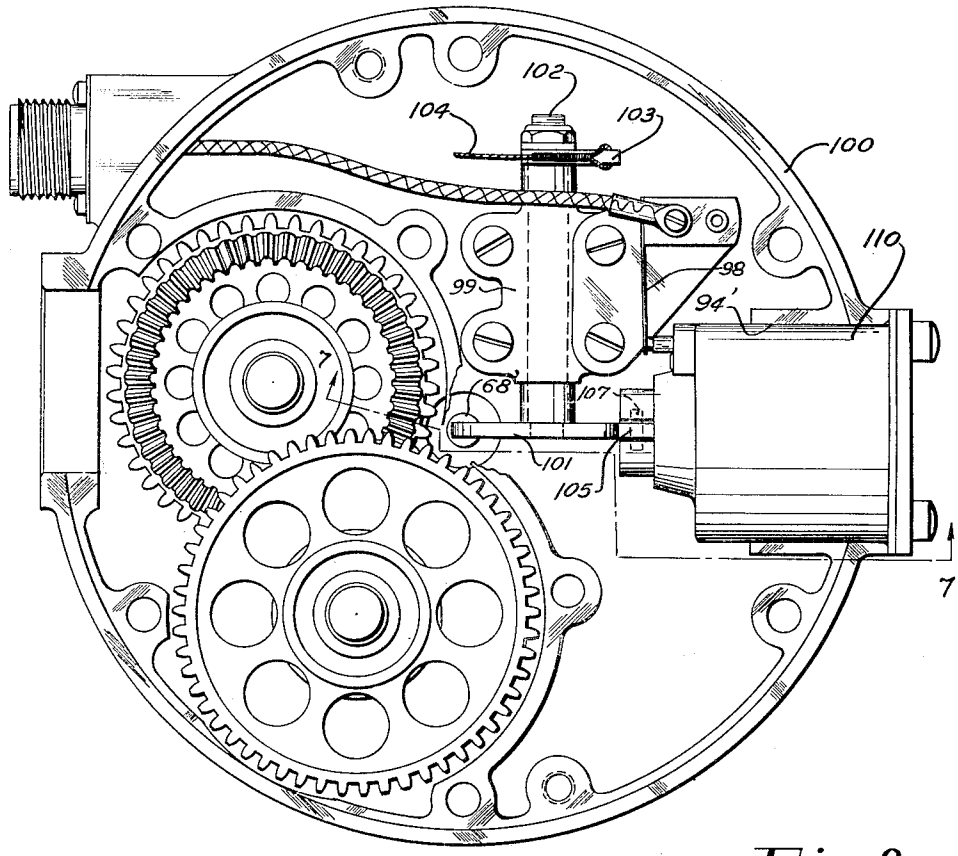


Fig. 8.

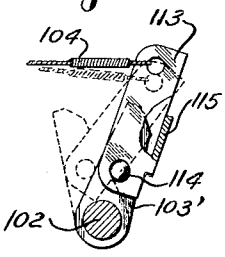
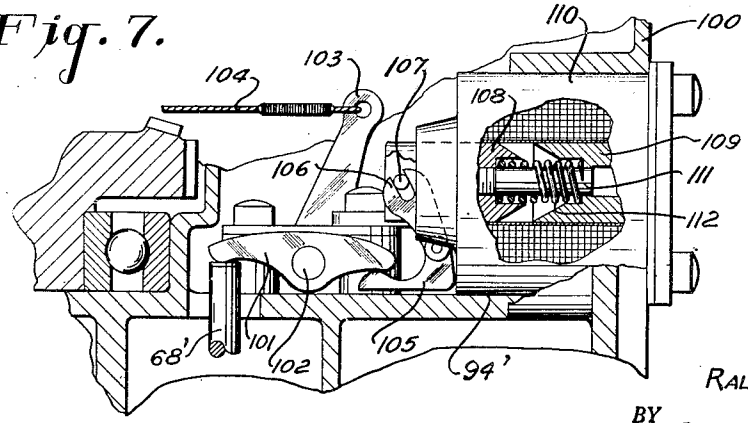


Fig. 7.



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UNITED STATES PATENT OFFICE

2,334,003

JAW MESHING MECHANISM FOR ELECTRIC STARTERS

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Application April 20, 1942, Serial No. 439,751

18 Claims. (Cl. 192—83)

This invention relates to mechanisms for operating an extensible jaw clutch member on a starter for internal combustion engines and the like, the present application constituting a continuation-in-part of my application Serial Number 403,406, for Power transmission device, filed July 21, 1941, now matured into Patent #2,303,-637, issued December 1, 1942.

The general object of the invention is to provide improved mechanism for extending the jaw clutch member on an electric starter to engage a similar jaw clutch member on an internal combustion engine during the time that the starter is operating to crank the engine.

A particular object is to provide a novel manual means on a starter for extending the jaw clutch member to accomplish the starting operation.

A further object is to provide novel solenoid means operable by closing an electrical circuit for extending the jaw clutch member.

A further object is to provide a combination of manual and solenoid means which may be used selectively to extend the jaw clutch member for the purpose described.

A still further object is to provide a jaw meshing mechanism extending through a starter housing which does not interfere with the separating of the various major parts of the housing when such is taken apart.

Additional objects and advantages will be apparent to those skilled in the art as the description proceeds in connection with the accompanying drawings, in which:

Figure 1 is an elevational view of a starter with parts broken away to show the jaw meshing mechanism as it appears when the jaw clutch member is retracted;

Figure 2 is a fragmentary elevational view of the starter shown in Figure 1 with parts broken away to show the mechanism as it appears when the jaw clutch member is extended;

Figure 3 is a fragmentary elevational view, with parts broken away, looking in the direction of the arrows 3—3 in Figure 2;

Figure 4 is a sectional view on a larger scale of the solenoid and linkage for operating the push rod associated with the jaw clutch member.

Figure 5 is a view of the adjustable rod connecting the movable core element of the solenoid with the manual operating linkage;

Figure 6 is a top plan view of an alternative arrangement with certain parts removed;

Figure 7 is a sectional view taken on the line 7—7 of Figure 6, parts of the solenoid being broken away to show its internal construction; and

Figure 8 illustrates a modified form of the crank arm 103.

The present application relates to the jaw meshing mechanism disclosed in Figures 1, 6 and 7 of the parent application, this structure being illustrated herein in Figures 1 to 5, inclusive. In these figures the reference numerals correspond with those in the parent application. The present application, by way of Figures 6 to 8 also shows structural modifications embodying the principles of the invention.

In the starter disclosed and claimed in the parent case an electric motor in the motor housing 5 drives through intermediate gearing a sun gear 38 on a hollow shaft 23. A plurality of planet gears 40 on a planet gear carrier 43 mesh with sun gear 38 and ring gear teeth incorporated in a multiple disc clutch mechanism 44*a*. By restraining rotation of the ring gear the clutch mechanism causes torque to be exerted upon the planet gear carrier 43 in a manner well understood in the art. These elements of the driving mechanism are illustrated in Figure 1.

The planetary gear carrier 43 is extended at its lower axial portion to provide a sleeve extension 43*c* which projects downwardly to a point partially outward of the lower end of the control unit housing 21. In turn, the housing 21 is provided with an end extension 21*a* having an attachment flange 21*b* by which the entire transmission gear unit of my invention may be mounted upon or associated with the crank housing of an airplane engine, for instance, suitable bolts, not shown, being employed for the purpose. Upon the flange 21*b* the housing 21 projects by way of extension to provide a hollow boss 21*c* and the engine engaging clutch or driven member of the unit designated 56 is mounted within the end portion of the housing 21 and directly within the hollow portion of the sleeve extension 43*c* of the planet gear carrier 43. The engine engaging or driven member 56 is a common type of clutch and is interlocked to the extension 43*c* of the gear carrier 43 by splined connecting teeth 57 formed on both the parts 56 and 43*c*. The numeral 56*b* indicates the co-mating clutch member on the engine to be started.

The arrangement of the engine engaging clutch and its mode of connection with the gearing of the general unit is such as to enable the high speed operation of an inertia member on the motor shaft to be transmitted by reduction gear-

ing including the friction unit and planetary gear parts to connect said inertia member with said driven member or engine engaging clutch 56.

The clutch member 56, at its inner sleeve portion, has the outer closed end 56a thereof engaged at the inner side by an expansion coil spring 60 normally tending to project the clutch outwardly from the sleeve portion 43c of the planet gear carrier 43.

Passing through the closed end 56a of the clutch member 56 is an actuating rod 61 having a head 62 abutting with the outer surface of the part 56a. The rod 61 has a spring seat 63 thereon engaged by one end of an expanding spring 64, the opposite end of said spring engaging the outer end shoulder portion 65 of a fixed sleeve 66 mounted in the extension 43c of the gear carrier 43 in fixed relation to the latter by the provision of an inner end flange 6 interengaging a groove in the part 43c. The actuating rod 61 is adapted at its inner end to enter a socket or holder end portion of a secondary actuating rod 68 disposed in alignment with the motor shaft and concentric with the axis of the engine engaging clutch 56. The secondary actuating rod 68 is slidable in and through the sun gear carrying shaft 23 with the means for actuating the parts 68 and 61, which virtually form a composite actuating rod, shown clearly in Figure 1 of the drawings.

Referring now to Figure 3, there is illustrated a push rod 69 adapted to be manually actuated and leading externally of the casing to a suitable point where manual pressure may be applied thereto. The rod 69 is connected to a cam 70 pivoted at 71 to a bracket 72. The cam 70 is adapted to engage a push rod 73 mounted in the starter casing.

The rod 73 coacts with a swinging link 74 supported adjacent to the windings 75 of a solenoid including a movable core element 76. The link 74 is attached by links 77 to a swing lever 78 pivoted at 79, thereby constituting a four bar linkage astride the axis of the solenoid. The lever 78 has a bifurcated end portion 80 engaging side pins 81 on a collar 81a slidable on a plunger rod 82 which is screw threadedly connected with the movable core element 76. Notches 81b in the collar 81a normally engage and seat a pin 82a to prevent rotation of the rod 82, this cooperation being maintained by a spring 74a acting on the link 74. Adjustment of the effective length of the rod 82 may be readily accomplished without disassembling by disengaging the collar 81a from the pin 82a and screwing the rod into or out of the core element 76. The core element 76 in turn carries a pin 83 engaging the lower bifurcated arm 84 of an actuating bell crank lever 85, the upper arm of which normally engages the upper end of the secondary actuating rod 68, previously described.

Spring means 86, see Figure 2, in hollow portions of the housing parts 7 and 5, bears at the upper end thereof against a shoulder 87 on the push rod 73 and tends to maintain the rod in its uppermost position and the associated cam 70 and rod 69 in the broken line position shown in Figure 3. Also, this spring means 86 will restore these parts to such positions along with the connected parts that lead to the solenoid plunger 76 when manual pressure is not exerted against the manually operable rod 69 and likewise to restore these parts to such positions after the solenoid is operated electrically by means now to be described.

From the foregoing it is to be understood that the engine engaging clutch or driven member 56 may be operated by the manual means connected with the manually operated rod 69, or said member 56 may be operated by the energizing of the solenoid comprising the parts 75 and 76, previously referred to, through the closing of an electric circuit which includes said solenoid means.

Figure 3 in a general way illustrates the lead wire 88 of the electric circuit connecting with the solenoid means at the contact 89, and in order to permit of separation of the housing parts 5, 7, and 18, the electrical connection depicted in Figure 3 is made up of a contact rod 90 enclosing the lead wire 88 and having a lower contact member 91 yieldably engaging a spring actuated contact member 92 normally urged upwardly as shown in Figure 3 by the spring 93.

It is to be understood that the solenoid unit is removable bodily from the housing 18, being normally contained, as to the solenoid parts proper, in a horizontal or radially disposed recess 94 formed in the said drive housing 18.

Therefore, if repair or replacement of the solenoid unit is required, it is only necessary to remove certain screws 95, seen best in Figure 3, and the solenoid may be displaced after disconnection of the rod 73 and certain disconnection of contacts, etc., not material to the invention.

Another feature of the present construction and arrangement is that the separation of the various housing parts 5, 7, 18 and 21 does not require the dismantling of the jaw meshing mechanism notwithstanding that elements of this mechanism are contained within each of the said parts. The push rod 73, contained within the parts 5 and 7, has no connection with the four bar linkage 74, 77, 78, other than contact engagement; and the push rod 68, carried by the part 21, has no attachment with the solenoid or bell crank lever 85. When the part 7 is removed from the motor housing 5 the spring 86 and the push rod 73 may be allowed to drop out, but no further disarrangement or unfastening of jaw meshing elements is involved. The push rod 69 and cam 70 remain with the motor housing 5, the solenoid remains with the drive housing 18, and the push rods 61 and 68 remain with the control unit housing 21. When the housing parts are assembled together the upper end of push rod 68 will seat upon the bell crank lever 85, the push rod 73 will be in approximate contact with the link 74, and the electrical contacts 91 and 92 will be in engagement.

Figures 6 and 7 illustrate a modification of the manual and electro-magnetic jaw meshing mechanism. The view in Figure 6 is looking axially toward the jaw clutch member (not shown) operable by the push rod 68', the upper part of the housing and mechanism being removed. The push rod 68' is operated by a rocker arm 101 on a shaft 102 carrying a crank arm 103. A pull cord or wire 104 is attached to the crank 103 in the manner shown and leads externally of the housing 100 to a point or station from which the starter is to be operated.

The rocker arm 101 may also be operated to depress the push rod 68' by means of a bell crank lever 105 having a bifurcated end 106 engaged by a pin 107 actuated by a movable core element 108 in a solenoid indicated generally at 110. Movable core element 108 is guided by a central guide rod 111 slidable in a fixed

core portion 109. A spring 112 tends to separate the movable core element 108 from the stationary core element 109 to withdraw the bell crank lever 105 from contact with the rocker arm 101. The solenoid unit 110 is removable bodily from the housing 100, being contained in a radially directed recess 94' similar to the recess 94 in Figures 1 and 2. When the solenoid is inserted in the recess 94' electrical connection is automatically made with a spring contact 98 in the solenoid circuit, which contact may be conveniently mounted on the bracket 99 carrying the rocker arm shaft 102. Upon energization of the solenoid the movable core 108 will be drawn inwardly against the action of the spring 112 to rotate the bell crank arm in a clockwise direction as seen in Figure 7 and depress the push rod 68', it being understood that the push rod 68' operates an extensible jaw clutch member in the manner illustrated in Figures 1 and 2. The clutch and planetary gear mechanism for rotating the jaw clutch member in the embodiment illustrated in Figures 6 and 7 may be considered as similar in all important essentials to the structure illustrated in Figure 1.

In the embodiment shown in Figures 6 and 7 it may be desirable to incorporate provision for lost motion in the crank arm 103 so that sliding friction or stiffness of the cable 104 will not interfere with the satisfactory operation of the parts by the solenoid. This may be accomplished as shown in Fig. 8 by attaching the cable 104 to a lever 113 pivoted at 114 to a stub crank arm 103' on the shaft 102. A plate or stop 115 on the lever 113 causes the arm 103' and shaft 102 to follow the lever 113 when the latter is moved by the cable 104. However, when the shaft 102 is rotated by the solenoid, the outer end of lever 113 is not compelled to follow the arm 103' and push up slack in the cable 104 since the articulated connection at 114 permits the cable end to remain substantially stationary. The positions assumed by the parts upon operation of the solenoid are shown by broken lines in Fig. 8, the normal or rest positions of these parts being shown in full lines.

The embodiments described herein are to be considered as illustrative only, and not in a limiting sense, as the invention is capable of many modifications. Certain features may be altered and others omitted without interfering with the general results outlined in the objects of the invention. The invention is to be limited only by the prior art and the scope of the appended claims.

I claim:

1. In a starter for internal combustion engines and the like, an extensible jaw clutch member, a coil spring within said member urging said member toward extended position, a fixed sleeve within said member and said coil spring, a push rod extending axially through said member and said sleeve and slidable therein, an abutment on said push rod for retracting said member, a second abutment on said push rod, a spring within said sleeve bearing against said second abutment, said last-named spring exerting a superior force over said first named spring to normally hold said member in retracted position, and means for moving said push rod in opposition to said last-named spring to permit said first named spring to extend said member.

2. In a starter for internal combustion engines and the like, an extensible jaw clutch member having a cavity therein, a fixed cup-shaped sleeve extending within said cavity, a jaw extending spring surrounding said sleeve within said cavity, a push rod slidable axially through openings in the ends of said sleeve and said member, an abutment on the end of said push rod for retracting said member, a spring abutment on said push rod within said sleeve, a push rod retracting spring within said sleeve between the cupped end thereof and said spring abutment, said last mentioned spring overpowering said first-mentioned spring to normally hold said member in retracted position, and means for moving said push rod against said last-named spring to permit said first-named spring to extend said member.

3. In a starter for internal combustion engines and the like, a plurality of separable housing parts, a push rod carried by and disposed axially through one of said housing parts for extending a jaw clutch member on said part, a rocker arm mounted within another of said parts and bearing against said push rod for operating said push rod, a solenoid in said other part having a movable core element for actuating said rocker arm, spring means biasing said core element, a lever for manually operating said push rod independently of energization of said solenoid, and a manipulable member for operating said lever, said housing parts being capable of separation and reunion without dismantling said jaw clutch operating mechanism.

4. In a starter for internal combustion engines and the like, a plurality of separable housing parts, an extensible jaw clutch member on one of said parts, means for normally holding said member in retracted position, a push rod carried by and disposed axially through said part for extending said member against the action of said means, a lever mounted within another of said parts and bearing against the end of said push rod to operate same in one direction, manipulable means for operating said lever, and solenoid means for operating said lever, whereby said member may be extended by manual effort or said solenoid means selectively, said solenoid means including a fixed core element, a movable core element and spring means to bias the latter element with respect to the fixed core element, said movable core element being arranged for actuation of said lever, and said housing parts being capable of separation and reunion without dismantling said jaw clutch operating mechanism.

5. In a starter for internal combustion engines and the like, a generally cylindrical casing comprising a plurality of separable parts united in end-to-end relation, an extensible jaw clutch member on one of said parts, an axial push rod carried by said part for extending said member, an externally accessible recess in another of said parts directed radially into said casing, a solenoid removably secured in said recess, a movable core element in said solenoid, means operable by said core element to engage and depress said push rod, optional mechanical means to depress said push rod independently of energization of said solenoid and a manipulable member extending from said casing for operating said optional means, said housing parts being capable of separation and reunion without dismantling said jaw clutch operating mechanism.

6. In a starter for internal combustion engines and the like, an extensible jaw clutch member, a push rod for extending said member, a bell

crank lever for operating said push rod, a solenoid, a movable core element connected with said bell crank lever and with a movable rod extending from said solenoid, a four bar linkage operable with said rod, and a manually operable push rod engaging said four bar linkage to operate said first-named push rod independently of energization of said solenoid.

7. In a starter for internal combustion engines and the like, an extensible jaw clutch member, a push rod for extending said member, a solenoid device for operating said push rod, a second push rod for operating said solenoid independently of energization of the latter, a cam lever for operating said second push rod, and a manipulable member attached to said cam lever.

8. In a starter for internal combustion engines and the like, a starter casing, an extensible jaw clutch member, a push rod for extending said member, a solenoid device within said casing for operating said push rod, a second push rod for operating said solenoid independently of energization of the latter, said second push rod extending outside of said casing, a cam lever pivoted on the outside of said casing for operating said second push rod, and a manipulable member attached to said cam lever.

9. In a starter for internal combustion engines and the like, an extensible jaw clutch member, a push rod for extending said member, a solenoid, a movable core element in said solenoid, a bell crank lever movable by said core element for operating said push rod, a four bar linkage mounted on an end of said solenoid astride the axis thereof, one of the bars of said linkage having a bifurcated projection extending across said axis, a rod having adjustable screw threaded connection with said movable core element, a collar slidable and rotatable on said rod and having pivotal connection with said bifurcated projection, stop means on the end of said rod to prevent rotation of said rod when said collar is in engagement therewith, resilient means to maintain said engagement, and a manually operable push rod in operative engagement with said four bar linkage.

10. In a starter for internal combustion engines and the like, an extensible jaw clutch member, means for extending said member, a solenoid having a movable core element for operating said means, a rod on said core element extending axially through said solenoid, a collar slidable and rotatable on said rod, means on the end of said rod for limiting the axial and rotative movement of said collar thereon, a four bar linkage on an end of said solenoid and astride said rod, a finger on said linkage engaging said collar, means on said linkage biasing said collar into engagement with said limiting means on said rod, and manual means engaging said linkage and operable through said solenoid mechanism to extend said jaw clutch member independently of energization of the solenoid.

11. In a starter for internal combustion engines and the like, a generally cylindrical starter casing having an extensible jaw clutch member on one end thereof, an axial push rod for extending said member, an externally accessible recess directed radially into said casing, a removable solenoid secured in said recess, a movable core element in said solenoid, a bell crank lever operable by said movable core element to depress said push rod, a four bar linkage connected with said core element to actuate same independently of energization of said solenoid, and a manipulable push rod slidable longitudinally of said casing for operating said linkage.

12. In a starter for internal combustion engines and the like, a solenoid, a movable core element in said solenoid, a bell crank lever operable by said core element to extend an extensible jaw clutch member on said starter, a rod on said core element extending axially of said solenoid, a manipulable push rod directed at right angles to the axis of said solenoid, and means for transferring motions of said push rod to said core element comprising a four bar linkage adapted to be actuated by said push rod, one of said links having a bell crank arm thereon for pivotal engagement with said rod on said core element.

13. In an engine starter having an extensible jaw clutch member, a solenoid operated mechanism for extending said member, said mechanism comprising a generally tubular solenoid body, a movable core element in said solenoid, a bell crank lever pivoted on one end of said body and movable by said core element, a four bar linkage mounted on the other end of said body astride the axis thereof, one of the bars of said linkage having a bifurcated projection extending across said axis, a rod having adjustable screw threaded connection with said movable core element, a collar slidable and rotatable on said rod and having pivotal connection with said bifurcated projection, stop means on the end of said rod to prevent rotation of said rod when said collar is in engagement therewith, and resilient means to maintain said engagement.

14. In a starter for internal combustion engines and the like, a motor housing, a drive housing and a control unit housing all secured together in end-to-end relation, an extensible jaw clutch member carried by said control unit housing, a push rod in said control unit housing for extending said member, said push rod having an end disposed within said drive housing, solenoid actuating means for said push rod contained within said drive housing, an electrical contact on said drive housing for energizing said solenoid, an electrical input connection in said motor housing, said input connection having an electrical contact on said motor housing adapted to engage said first-named contact when said motor housing and drive housing are brought together in assembled relation and a manual push rod carried by said motor housing and having an end projecting into said drive housing in engagement with said solenoid actuating means, whereby said various housing components may be separated and reunited without dismantling said jaw meshing mechanism.

15. In a starter for internal combustion engines and the like, a push rod for extending a jaw clutch member, a rocker arm for operating said push rod, a rocker arm shaft for said rocker arm, a lever on said shaft, a manipulable member for operating said lever, and solenoid means for operating said rocker arm and push rod independently of said manipulable member, said solenoid means comprising a fixed core element, a movable core element, a spring tending to separate said core elements, and a bell crank lever operable by said movable core element to rock said rocker arm to operate said push rod.

16. In a starter for internal combustion engines and the like, a generally cylindrical starter casing having an extensible jaw clutch member on one end thereof, an axial push rod for extending said jaw clutch member, a transverse rocker shaft carrying a rocker arm for depress-

ing said push rod, a lever on said shaft, a pull cable for operating said lever, a bell crank lever providing an optional means to rock said rocker arm, an externally accessible recess directed radially into said casing, a removable solenoid secured in said recess, a movable core element in said solenoid, and means on said core element for engaging said bell crank lever.

17. In a starter for internal combustion engines, a push rod for extending a jaw clutch member, a rocker arm for operating said push rod, a rocker arm shaft for said rocker arm, a lever for operating said rocker arm shaft by manual means, a solenoid device for operating said rocker arm and a lost motion connection between said lever and said rocker arm shaft whereby operation of said rocker arm by said solenoid device does not disturb said manual means.

18. In a starter for internal combustion engines, a push rod for extending a jaw clutch member, a rocker arm for operating said push rod, a rocker arm shaft for said rocker arm, a stub crank arm on said shaft, a lever pivoted on said crank arm, a pull cable attached to said lever for operating said rocker arm, and a solenoid device for operating said rocker arm, said lever being arranged to engage said crank arm to move said rocker arm upon operation of said pull cable, said arrangement being such that movement of said crank arm by said solenoid does not disturb said pull cable.

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