Dec. 25, 1962 J. L. MERCER ETAL 3,070,081

ENGINE STARTER

Filed April 24, 1957

2 Sheets-Sheet 1

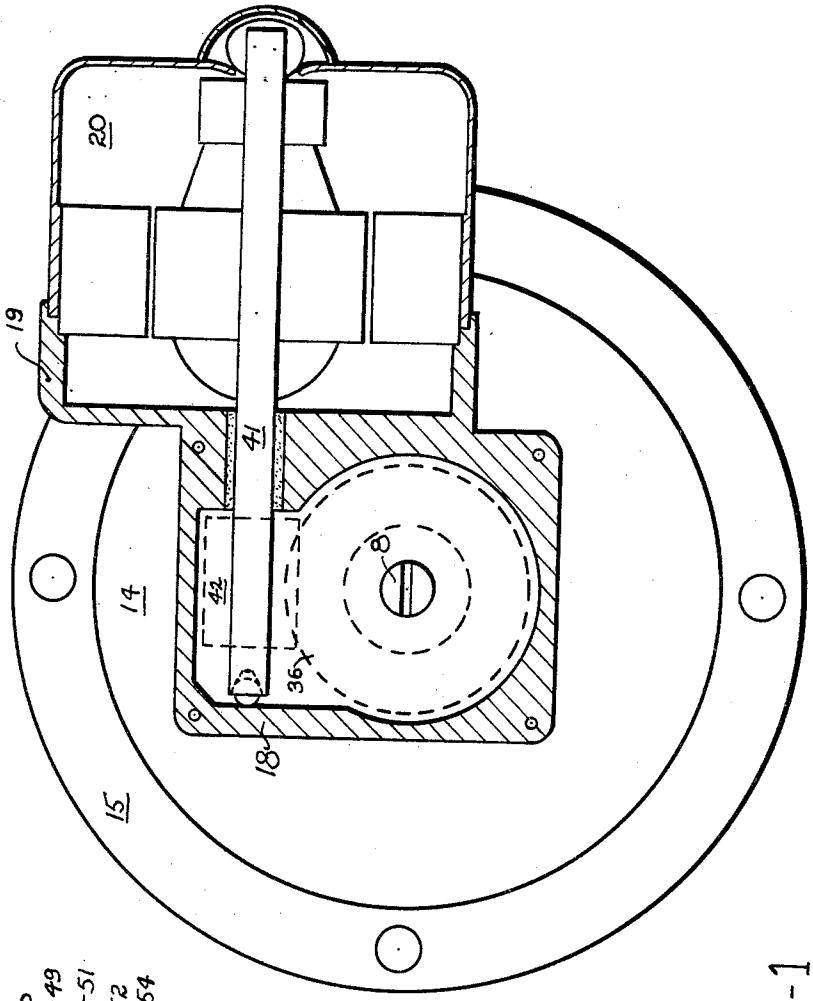


Fig-1

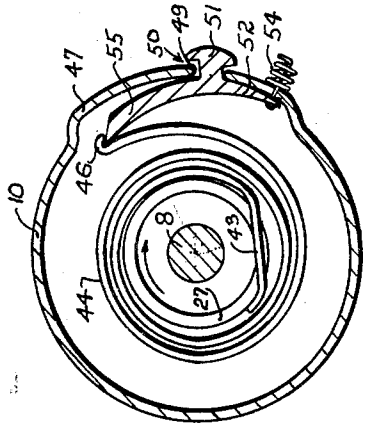


Fig-4

INVENTORS
JOHN L. MERCER
JOHN J. BRUNNER

BY Tom Walker
ATTORNEY

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2 Sheets-Sheet 2

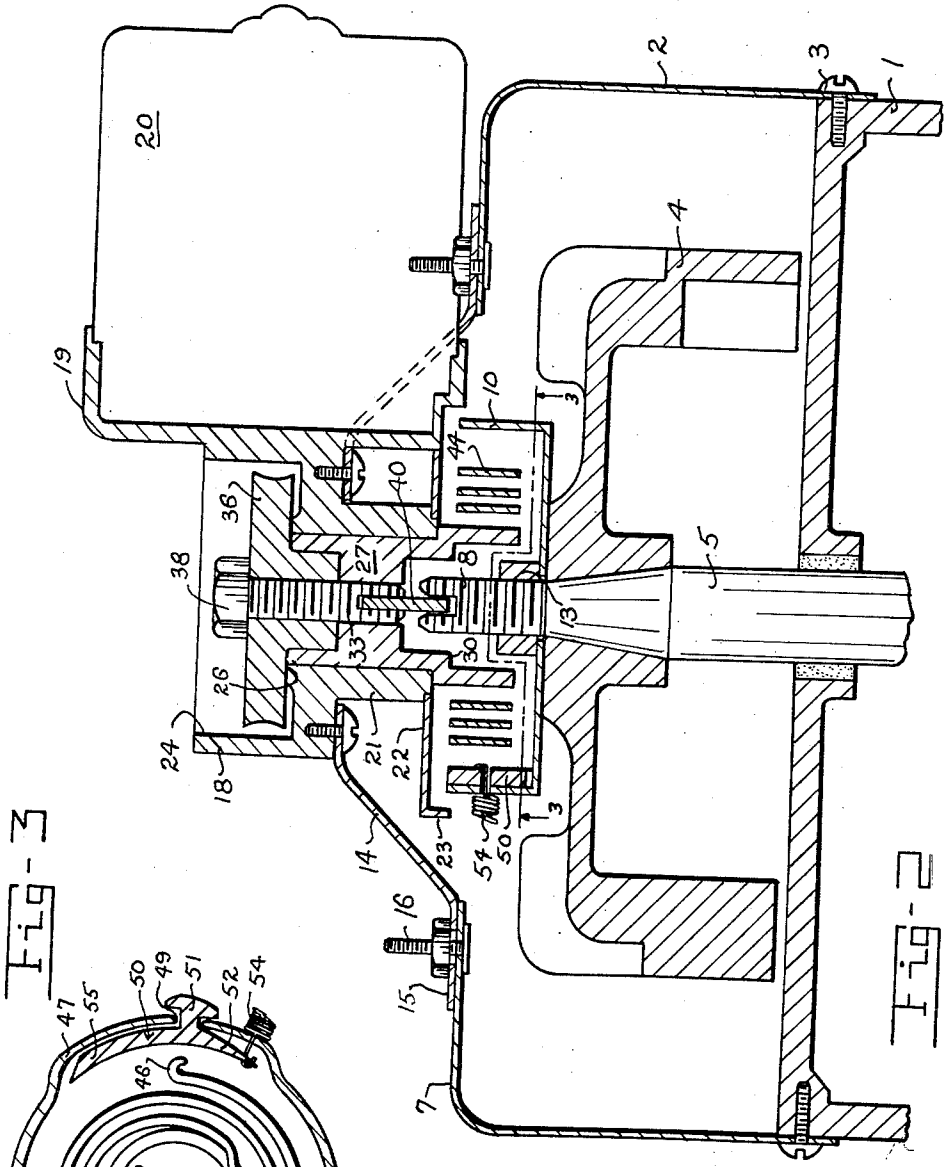


Fig-2

Fig-3

INVENTORS
JOHN L. MERCER
JOHN J. BRUNNER

BY Tom Walker
ATTORNEY

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3,070,081
ENGINE STARTER

John L. Mercer, Crabil Road, and John J. Brunner, 813 E. Southern Ave., both of Springfield, Ohio

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This invention relates to electric starters and more particularly to an improved electric starter for gasoline engines, primarily of the type used on lawnmowers, small tractors, and the like.

Development in the field of starters for small engines has been relatively limited and basic problems remain. For example, the small gasoline engines employed in lawnmowers, tractors, and similar devices are supplied with either a hand operated rope or "recoil" starter. These starters require physical exertion in their operation and many times fail to function properly. Moreover, they are known to kick with consequent danger to the operator.

The present invention provides an electric starter of an improved nature which is particularly applicable for use with small gasoline engines. The improved starter eliminates the disadvantages of the manual starters and is so constructed to simply and effectively function to provide positive and shock free starting of the gasoline engine with which it is associated. Moreover, the construction provided includes means resiliently accommodating engine backfire on starting without any danger whatsoever to the operator or starter mechanism. Embodiment of the invention is economical and structurally simple while the efficiency of the resulting unit is at an absolute maximum.

The object of the invention is to simplify the construction as well as the means and mode of operation engine starters whereby such starters may not only be economically manufactured, but will be more efficient and satisfactory in use, adaptable to a wide variety of applications, and be unlikely to get out of order.

A further object of the invention is to provide an electric starter which is particularly applicable to small gasoline engines such as employed on lawnmowers, tractors, and the like.

A further object of the invention is to provide an improved starter unit having resilient shock absorbent characteristics enabling gentle and safe starting of the engine with which it is connected.

Another object of the invention is to provide an improved electric starter unit which will inherently absorb the effects of engine backfire without damage to the engine or the starter unit.

An additional object of the invention is to provide an improved starter unit having a resilient coupling element driven in a constantly fixed plane for shock absorbing coupling to an engine flywheel in a manner to prevent shock to the engine and starter components and to accommodate engine backfire by contraction.

Another object of the invention is to provide an improved electric starter particularly applicable to small gasoline engines possessing the advantageous structural features, the inherent meritorious characteristics, and the mode of operation herein described.

A further object of the invention is to provide an engine starter possessing the advantageous structural features, the inherent meritorious characteristics and the mode of operation herein mentioned.

With the above and other incidental objects in view as will more fully appear in the specification, the invention intended to be protected by Letters Patent consists of the features of construction, the parts and combinations thereof, and the mode of operation as hereinafter

described or illustrated in the accompanying drawings, or their equivalents.

Referring to the accompanying drawing wherein is shown one but obviously not necessarily the only form of embodiment of the invention,

FIG. 1 is a generally schematic top plan view of the invention as incorporated on a small gasoline engine;

FIG. 2 is a vertical cross-sectional view of a starter such as illustrated in FIG. 1;

FIG. 3 is a cross-sectional view taken on line 3—3 of FIG. 2; and

FIG. 4 is a view similar to FIG. 3, showing the starter in operative position.

Like parts are indicated by similar characters of reference throughout the several views.

The starter is shown in the drawings as applied to a small gasoline engine. Shown in fragmentary fashion is the cast frame 1 of the gasoline engine. In super-imposed relation to the engine frame is a cylindrically formed cover 2 which is peripherally engaged by screws 3 about the upper extremity of the engine frame 1 to form an enclosure for the flywheel 4 fixed adjacent the outer extremity of the engine crankshaft 5. The crankshaft 5 projects through frame 1 in bearing relation thereto and coaxially with cover 2 through a central aperture in its covering wall 7.

A cup-shaped element 10 which has a central aperture in its base freely receives the threaded outer end 8 of the crankshaft so that its base will abut the outer surface of the engine flywheel 4. A lock nut 13 threadedly engaged with the threaded end 8 of the engine crankshaft engages the inner surface of the cup base and clamps it in fixed abutting relation to the flywheel.

An inverted dish-shaped adapter frame 14 is provided with a peripheral flange 15 by which it seats to cover 2 about the aperture therein. The flange 15 is connected to the cover by screws 16. The base of the inverted dish-shaped adapter is thus spaced outwardly of the cover 2 and is provided with a central aperture in coaxial relation to the engine crankshaft. A casting constituting a starter frame 18 seats over the adapter frame 14 and is connected thereto by screws. The frame 18 includes a laterally projecting cup-shaped adapter section 19 accommodating the drive end of an electric motor housing 20.

The frame 18 has a tubular portion 21 which depends through the aperture in the adapter base 14, in coaxial relation to the engine crankshaft and substantially to the open end of the cup-shaped element 10. The depending extremity of this tubular portion 21 of the starter frame 18 is reduced in external diameter to mount a substantially circular element 22 thereabout in parallel spaced relation to the open end of the cup 10. The circular element 22 has a depending peripheral wall 23 which overlaps the peripheral wall of the cup 10 spaced outwardly thereof. The element 22 with its depending wall 23 constitutes a grass guard as provided in a lawnmower embodiment.

Starter frame 18 is provided with a substantial recess 24 in its upper surface opening into the aperture defined by the tubular depending portion 21. The base of this recess is provided with an annular boss 26 defining the internal dimension of the tubular portion 21.

A generally tubular shaft element 27 is contained within the tubular depending portion 21, in bearing relation thereto, having its upper end surface co-planar with the boss 26 in the recess in the starter frame. The shaft 27 is externally expanded immediately below the depending extremity of the tubular portion 21 of the starter frame to provide an external shoulder seating thereto and preventing its movement upwardly of the tubular

bearing portion 21. The lower extremity of the shaft 27 is also internally expanded in stepped fashion at 30 to cup about the outer threaded extremity of the crankshaft 5 and the lock nut 13 in radially spaced relation thereto. The lowermost extremity of the shaft is spaced upwardly from the inner surface of the base of the cup 10.

The shaft 27 is intermediately reduced in internal diameter at 33 to provide a central threaded aperture therein. This provides a cylindrical pocket in the upper end of the shaft 27 which receives the hub of a worm gear 36 which is radially expanded immediately outward of the shaft 27 to have its inner face supported on the end surface of the shaft 27 and the boss 26. The worm gear 36 has a central aperture coaxial with the threaded aperture in the internally reduced portion of the shaft 27. A threaded bolt 38 projects through the central aperture in the worm gear 36 to threadedly engage in the threaded aperture in the shaft 27 until its head abuts the outer surface of the worm gear to clamp it in fixed relation to the shaft 27 for rotation therewith.

The disposition of the threaded bolt 38 provides that it is coaxial with the engine crankshaft 5 and places the adjacent extremities of the crankshaft 5 and the bolt 38 in relatively closely spaced relation. The crankshaft 5 and the bolt 38 are provided with coaxial recesses in their adjacent extremities. A centering pin 40 is disposed between the bolt 38 and crankshaft 5 to have its extremities respectively seat in the respective recesses. The centering pin 40 serves as an alignment device in a manner which is believed obvious.

The drive shaft 41 of the electric motor extends through a bearing in the starter frame 18 to project in spaced adjacent relation to the worm gear 36. A worm 42 is fixed to the shaft 41 to mesh with the worm gear 36 for drive thereof on energization of the electric motor. It will be readily seen that on drive of the worm gear the shaft 27 will also be driven due to the inner connection thereof by the threaded bolt 38.

The depending expanded portion of the shaft 27 which concentrically nests within the cup 10 has a coiled band-type spring 44 secured thereto and coiled to radially expand thereabout. The inner end 43 of the spring 44 is projected through a slot in the wall of the shaft 27 and bent to its peripheral surface so as to be connected and anchored to the shaft 27. The band spring 44 is successively coiled on itself in radially expanding fashion outwardly towards the inner wall of the cup 10 and is provided with an outwardly directed terminal hook extremity 46 of an integral nature.

An arcuate portion 47 of the peripheral wall of the cup 10 is radially expanded to provide an arcuate recess in its inner wall in adjacent relation to the outer periphery of the band spring 44. A cut out or slot 49 is provided in the wall of the cup 10 defining the recess which is spaced more closely to one end of the expanded wall portion than the other.

An arcuate trigger-shaped element 50 is disposed in the arcuate recess. A stud projecting therefrom through the slot 49 has an expanded head 51 outwardly of the expanded wall section. The fit of the stud 51 in the slot 49 and the arrangement of the expansion of the head on the trigger stud is such to allow a pivotal motion of the trigger element 50 in the expanded portion of the cup 10. As indicated, the shorter arm 52 of the trigger element 50 is connected to the cup wall by a spring 54 tending to bias this end inwardly to the wall and bias the longer arm 55 of the trigger 50 to project outwardly of the recess and into the path of the hook 46 on the end of the band spring, in the event of rotation of the shaft 27 in a clockwise direction as shown in FIG. 4 of the drawings.

In the operation of the invention, suitable means are naturally provided to energize the electric motor for starting. Details of such means are not illustrated since they

are not pertinent to the subject invention. Upon energization of the electric motor, the motor shaft drives the worm gear 36 and thereby drives the shaft 27. In the position of rest prior to starting, or after the engine is started, the shaft 27 and the connected band spring 44 are dormant and in free condition. On drive of the shaft 27 the connected band spring 44 is driven in a clockwise direction, as illustrated in FIG. 4 of the drawings, to have its hook extremity 46 engage the end 55 of the trigger 50 in the cup 10 which is normally biased into its path. As the hooked extremity 46 engages the trigger 50, the engagement is quiet and shock-absorbing since the spring contracts and coils about itself to absorb all shock in a quiet resilient fashion. As the trigger 50 is engaged, its connection to the cup 10, and the crankshaft 5 thereby, will cause drive of the crankshaft. When the engine comes up to speed, the cup 10 and trigger 50 will then be rotating faster than the shaft 27 and spring 44 so that the trigger member 50 is thereby advanced relative the hook portion of the band-spring 44. The centrifugal force developed by the engine coming up to speed will cause the trigger 50 to freely pivot in the cup and dispose its hook engaging extremity 55 in the recess 47 in the side of the cup. The motor is then de-energized and shaft 27 and spring 44 comes to rest, the parts being in the position shown in FIG. 3.

In the event that the engine should backfire in starting, there will be a reaction on the band-spring 44 through the trigger element 50 engaging the hook portion thereof. The expanded nature of the coil of the spring 44 will allow it to contract on itself and readily absorb the backfire in a cushioned fashion, subsequent to which the spring will assist in the proper reorientation of the components for correct drive and starting of the engine.

The invention thus provides a highly simplified and effective starter for gasoline engines. This unit is particularly applicable to small engines of the type used on lawnmowers, tractors, and the like but is not intended to be so limited in application. It should be noted that suitable means are provided for de-energizing the electric motor when the engine is brought up to speed and started.

To summarize, the fabrication of the improved electric starter is simple and economical. It eliminates the uncertainties prevalent in the use of manual type starters for small engines and is definitely a positive acting unit. The relatively free and resilient nature of the engaging means for starting the engine as provided herein insures quiet and effective starting with no problems attendant its operation. Also, backfire is readily accommodated without any danger to the components or the operator of the unit.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise but one of several modes of putting the invention into effect, and the invention is therefore claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

Having thus described our invention, we claim:

1. An electric starter for small gasoline engines comprising, drive means, a coiled band connected to and about said drive means, a coupling element, means mounting said element providing for connection thereof to the crankshaft of the engine to be started normally free of said band, said band being normally radially expanded

relative said drive means, mounting means biasing said coupling element to project in the path of said band on actuation of said drive means, means for interengaging said band and said projecting means on actuation of said drive means to provide a drive of said crankshaft through said coupling element and start the engine, said interengaging means automatically disengaging on advance of said engine crankshaft relative said drive means.

2. A starter for gasoline engines including, a cup element having means providing for its fixed engagement for rotation with the crankshaft of an engine, clutch coupling means mounted within the cup to one side thereof, a starter shaft means nesting one extremity in said cup, and a radially coiled resilient clutch element fixed to said shaft means and nesting in said cup, said clutch element having projecting means at its periphery circularly related to said clutch coupling means whereby said projecting means will engage and drive said clutch coupling means to thereby start the engine on drive of said starter shaft and will relatively separate therefrom when the engine is started.

3. An electric starter for gasoline engines comprising, drive means, resilient means connected to and wrapped around said drive means, a housing element for said resilient means connected to the crankshaft of the engine to be started, means on said housing element in the path of movement of said resilient means, and hook means on the periphery of said resilient means interengaging with and driving said means on the housing element on actuation of said drive means, thereby to drive said crankshaft and start the engine, said hook means and said means on said housing element being relatively displaced in response to centrifugal force effects consequent to starting of the engine.

4. In combination with a gasoline engine, a drive shaft having actuating means connected therewith for drive thereof, said shaft being disposed coaxially with the engine crankshaft to place their respective outer ends in adjacent relation, a single resilient element on the adjacent end of said drive shaft having a free extremity, an element on the crankshaft, normally free of said resilient element, in cupping relation to said resilient element and having means biased in the path of the free extremity of said resilient element for drive thereby to start the engine, whereupon said elements will relatively separate.

5. The structure as set forth in claim 4, said means biased in the path of the free extremity of said resilient element constituting a pivoted trigger responsive to centrifugal force when the engine is started to move from the path of said resilient element.

6. In combination with a gasoline engine, a drive shaft including means for drive thereof disposed coaxially with the engine crankshaft with respective ends thereof in adjacent relation, a resilient element on the adjacent end of one of said shafts, a separate relatively rigid element on the other of said shafts in relative concentric relation to said resilient element, biasing means mounted to said relatively rigid element and means movable on said rigid element and normally biased by said biasing means into a path common to said resilient element, drive of said drive shaft producing an engagement of said biased means by said resilient element for drive of the crankshaft through said biased means and said relatively rigid element to which it mounts to start the engine, whereupon said biased means and resilient element will relatively separate automatically.

7. For use in combination with a gasoline engine, a drive shaft including means for drive thereof disposed coaxially with the engine crankshaft with adjacent ends in closely spaced relation, a resilient element on the adjacent end of one of said shafts, a cup having a peripheral recess on the other of said shafts in nesting relation to said resilient element, a pivoted arm connected with said cup in said peripheral recess adjacent to and co-planar with said resilient element, means normally biasing said arm to dispose one end thereof in the path of said resilient element, drive of said drive shaft producing an engagement of said arm by said resilient element to drive the engine crankshaft to start the engine whereupon said elements will relatively separate to their normally free conditions.

8. In a device of the kind described, relatively rotatable driving and driven shafts, said shafts being axially aligned and one end of said driven shaft being received within the adjacent end of said driving shaft, a cup shaped spring housing made fast to said driven shaft and having a portion in concentric surrounding relation to the adjacent end of said driving shaft, interconnecting means to maintain the alignment of said driving and driven shafts, and means respectively positioned on said driving shaft and said spring housing arranged to provide a resilient coupling therebetween on rotation of said driving shaft relative said driven shaft to produce a drive of said driven shaft thereby and to relatively disengage on rotation of said driven shaft at a speed beyond the speed of rotation of said driving shaft.

9. A starter for use in combination with a gasoline engine comprising, normally separated relatively revolvable clutch means including a resilient driving and a driven clutch element, means connected with said driving element for drive thereof said driven element having means for connecting it to the crank shaft of the engine, said driving element having means for resilient engagement said driven element on drive thereof relative the driven element to drive the engine crank shaft to thereby start the engine, said driven element being responsive to starting of the engine to automatically disengage from said engagement means.

10. A starter for use in combination with a gasoline engine comprising, normally separated relatively revolvable clutch means including a driving and a driven clutch element, means for driving said driving element connected therewith, one of said clutch elements being a coiled spring having a hook extremity, the other of said clutch elements having a portion normally biased into a path of movement, common to said hook extremity, one of said clutch elements having means for connecting it to the crank shaft of the engine, the other clutch element being operable on drive thereof to engage said one clutch element to cause interengagement of said biased portion and hook extremity to drive the engine crank shaft to thereby start the engine, said biased portion being responsive to starting of the engine to disengage from said hook extremity of said coiled spring.

11. In a device of the character described, relatively rotatable driving and driven shafts, said shafts being axially aligned, one end of said driven shaft being received within the adjacent end of said driving shaft, a cup shaped spring housing made fast to said driven shaft having a portion in concentric surrounding relation to the adjacent end of said driving shaft, interconnecting means to maintain the alignment of said driving and driven shaft, a coiled spring connected at its inner end to said adjacent end of said driving shaft and having its outer end free, and a pawl carried by said spring housing urged to be engaged by the outer end of said spring for resiliently coupling said driving shaft to said spring housing, said pawl disengaging in response to relative rotation of said driving shaft.

12. An electric starter for gasoline engines comprising, a first clutch element, means connected to said first clutch element for rotation thereof in a fixed plane, coupling means connected in driving relation to an engine crankshaft including a second clutch element normally free of said first element and means biasing said second element into a position for engagement by said first element on rotation thereof to produce a drive of the crankshaft and starting of the engine thereby, said first clutch element being resilient to inherently accommodate and absorb

any shock of starting the said first clutch element being separated from said second clutch element when said second clutch element is driven by said engine.

13. A starter for gasoline engines including, a starter shaft having a resilient coupling element, a trigger, means mounting said trigger providing an operative connection thereof to an engine crankshaft to dispose said trigger in the path of said resilient coupling element, said starter shaft being operable to drive said coupling element to advance and engage said trigger to drive the engine through said crankshaft, said mounting means adapting said trigger for displacement from the path of said coupling element and said trigger being so mounted and oriented with reference to said mounting means to respond to centrifugal force on starting of the engine to displace from the path of said coupling element .

14. A starter including, a first coupling element having means providing its fixed connection to an engine crankshaft, a second resilient coupling element concentric with said first coupling element and normally free thereof, means for rotating said second element, an arm pivoted on said first element engageable by said second element on rotation thereof to drive the engine crankshaft thereby, said second resilient coupling element being released from said first element by the rotation of the engine crank shaft.

15. An electric starter for gasoline engines including, a driving shaft, means connected for energizing said driving shaft, separate clutch means respectively connected to said driving shaft and the crankshaft of a gasoline engine and in relatively disengaged condition when the engine is at rest, said separate clutch means lying substantially in a common plane and arranged to interengage said separate clutch means in response to energization of said driving shaft to start the engine, a portion of said separate clutch means including a concentrically coiled band spring.

References Cited in the file of this patent

UNITED STATES PATENTS

808,946	Reisch	Jan. 2, 1906
1,727,086	Vastano	Sept. 3, 1929
1,972,867	Butler	Sept. 11, 1934
1,986,160	Pomeroy	Jan. 1, 1935
2,266,865	Herrington	Dec. 23, 1941
2,278,547	Herrington	Apr. 7, 1942
2,323,535	Gordon	July 6, 1943
2,486,149	Gorski et al.	Oct. 25, 1949
2,511,908	Forbess	June 20, 1950
2,633,950	Phaneuf	Apr. 7, 1953
2,643,750	Moulton	June 30, 1953
2,756,855	Kloss	July 31, 1956
2,869,682	De Millar	Jan. 20, 1959

FOREIGN PATENTS

436,769	Great Britain	Jan. 17, 1935
815,723	Germany	Oct. 4, 1951