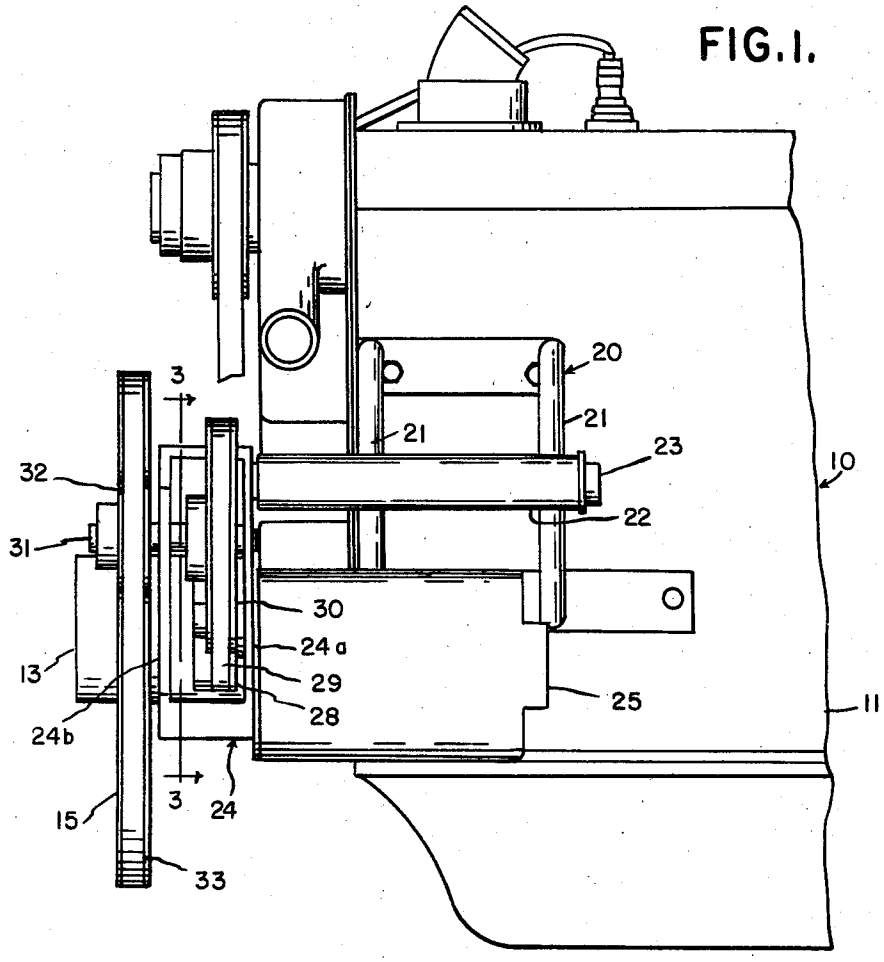
Aug. 4, 1959 S. R. WOOD 2,897,677

INTERNAL COMBUSTION ENGINE STARTER

Filed May 18, 1956 2 Sheets-Sheet 1

FIG. 1.



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FIG.2.

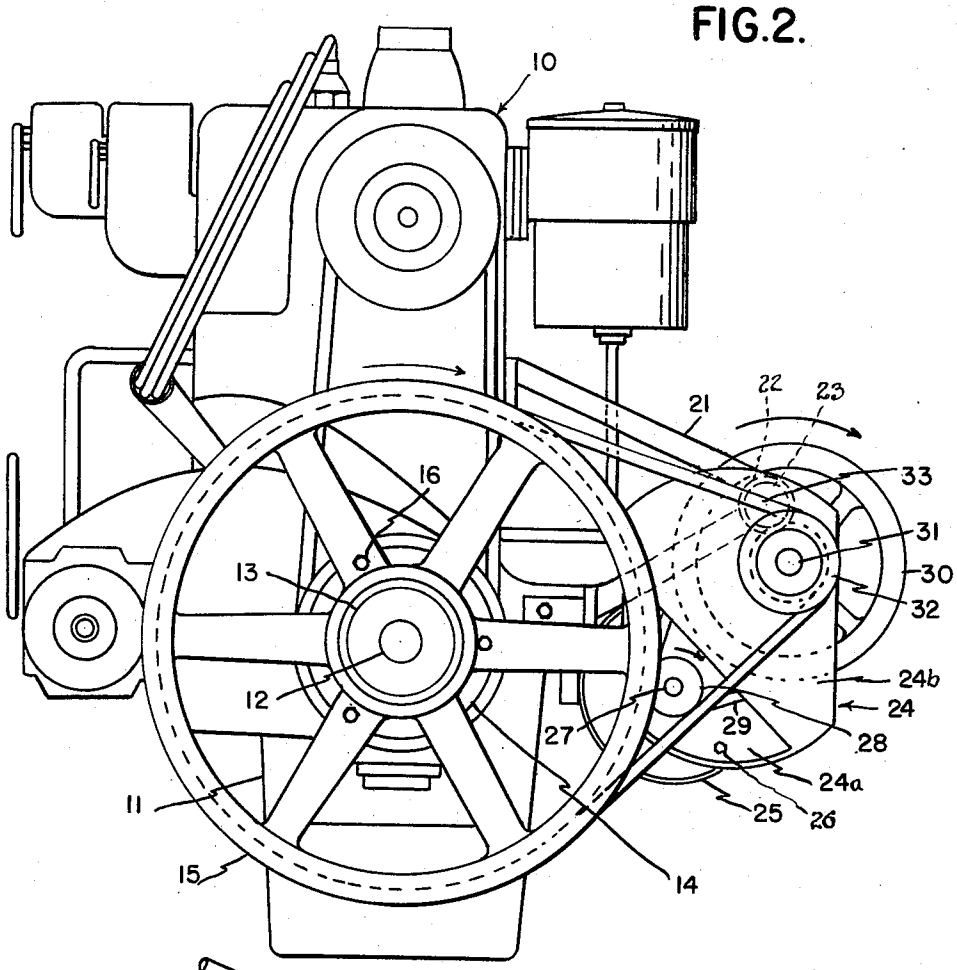
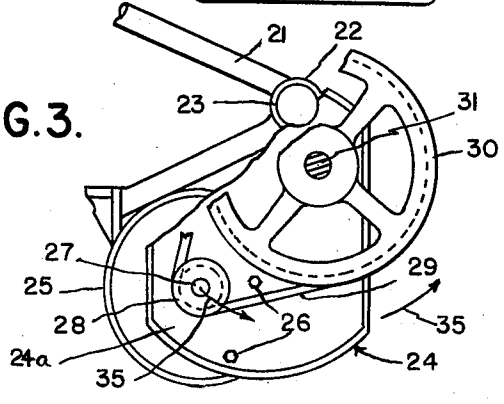


FIG.3.



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INTERNAL COMBUSTION ENGINE STARTER

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11 Claims. (Cl. 74—8)

This invention relates to internal combustion engine starters, and more particularly to electric motor driven, pulley and belt speed reduction starting mechanisms preferably adapted to small engines utilized for air conditioning and refrigerating units and the like.

The type of relatively small air conditioning equipment, refrigerating condensing units, and other equipment operated by small internal combustion engines, for use in buildings where quietness is desired, require compact, smooth and quietly operating starters. In addition, such starters should be adapted for quick engagement with and disengagement from the crankshaft, be of simplified and inexpensive construction, so as to reduce maintenance and repair costs, and be so constructed that when the starter is not in use, it will apply no bending stresses on the crankshaft which tends to cause engines to labor and bearings to wear.

Starters heretofore in use generally comprise more expensively machined gearing and more complicated engaging mechanisms than are economically practical.

An object of the present invention is to provide internal combustion engines with a simplified starter mechanism by constructing a belt and pulley starting arrangement connected to the crankshaft.

Another object of the invention is to provide an improved starter for internal combustion engines by pivotally mounting a starting mechanism on the engine and operably connecting it to the engine crankshaft in such a manner that substantial bending stresses on the crankshaft will only be applied during the starting operation.

A further object of the invention is to construct an improved starting mechanism for engines by providing a starting motor permanently connected to the engine crankshaft in such a manner that torque reaction of the motor will act to positively drive the crankshaft only during the starting operation.

A still further object of the invention is to provide a dependable engine starting mechanism by constructing a belt and pulley starter connected to the crankshaft and driven by a motor mounted in such a way that motor torque reaction supplies the proper belt tension required to turn the crankshaft.

For a more complete understanding of the present invention reference may be had to the accompanying drawings illustrating a preferred embodiment of the invention in which like characters refer to like parts throughout the several views, and in which

Fig. 1 is an elevational side view of a preferred type of internal combustion engine embodying my improved starter,

Fig. 2 is an elevational end view of the engine and starter, and

Fig. 3 is a fragmentary sectional view taken substantially on the line 3—3 of Fig. 1.

An internal combustion engine 10 is illustrated as having a crankcase 11 in which operates a crankshaft having a stub shaft 12 extending preferably from the flywheel end of the engine 10. An overrunning clutch mechanism

13 of conventional construction is mounted on the stub shaft 12 and is preferably operable to seize the shaft when rotated in a clockwise direction as seen in Fig. 2. The clutch mechanism is supported in a clutch housing 14 to which a clutch pulley 15 is secured by bolts 16 or other means.

A bracket assembly 20 is preferably secured to the engine as shown in Fig. 1 and comprises a pair of spaced V-shaped supports 21. A pivot bearing 22 is secured, preferably by welding, at the apex of the supports 21. A pivot shaft 23 is rotatably supported in the bearing 22 and to one end is secured a mounting frame 24, comprising spaced side plates 24*a* and 24*b*. An electric starting motor 25 is secured to the plate 25*a* by bolts 26 or other means and has a drive shaft 27 extending into the space between the side plates. A driving pulley 28 is secured to the shaft 27 by any suitable means and operates through a drive belt 29 to rotate a large pulley 30 secured to a countershaft 31. The countershaft 31 is rotatably supported by the side plates 24*a* and 24*b* as shown, one end extending forward to which is secured a small pulley 32 disposed in the same plane as the clutch pulley 15. A belt 33 operably connects pulleys 15 and 32 as shown.

Thus the arrangement of pulleys and belts constitutes a speed reduction means operably connecting the motor 25 with a crankshaft extension or stub shaft 12, and the motor operating clockwise as seen in Fig. 2, effects a clockwise rotation of the clutch 13 to seize the stub shaft 12, imparting rotation to the crankshaft for starting the engine 10. Pulley rotation is illustrated in Fig. 2 by the directional arrows.

Since the frame 24, motor 25, and their associated pulleys 29, 30 and 32, mounted in said frame 24, are pivotally suspended on the shaft 23, the torque reaction of the motor 25, when in operation, tends to rotate the entire assembly counterclockwise about the pivot shaft 23; that is in the direction indicated by arrow 35 in Fig. 3. This effects a tensioning on the belt 33, for achieving the desired grip on the clutch pulley 15 to rotate the crankshaft against the engine cylinder compression. When the engine 10 starts, the overrunning clutch 13 disengages.

After the starting motor 25 is turned off, the tension on the belt 33 decreases, taking the major portion of the bending stress or load off the crankshaft. Due to the off-center position of the motor 25 with relation to the pivot shaft 23, the motor 25 and frame 24 will tend to swing to the right under the weight of the motor, thus retaining the belt 33 in position and preventing undesirable vibration, but this pull is, to all practical purposes as far as the crankshaft is concerned, nominal and insufficient for positive actuation of the pulley 15, the only effective load tension being supplied by torque reaction when the motor 25 is operated.

Although I have described but one embodiment of the invention, it will be apparent to one skilled in the art to which my invention pertains that various changes and modifications may be made without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. In a starter mechanism for an internal combustion engine having a crankshaft and a driven element operatively connected with said said crankshaft, a support, said starter mechanism comprising a frame structure pivotally mounted on said support, a starter motor carried by said frame structure, a driving element mounted in said frame structure and operatively connected with said motor, and a belt drivingly connecting said driving and driven elements, the axis of said driving element being located relative to the axis of the motor and the frame structure pivot to utilize the torque of said motor when activated for moving said frame structure in a

direction effecting separation of the driving element axis from the axis of said driven element whereby to apply tension on said belt.

2. In a starter mechanism for an internal combustion engine having a crankshaft and a driven element operatively connected with said crankshaft, a support, said starter mechanism comprising a frame structure pivotally mounted on said support, a starter motor carried by said frame structure, a speed reduction means mounted in said frame structure and comprising driven and driving pulleys, a belt operatively connecting said driven pulley with said motor, and a second belt drivingly connecting said driving pulley with said crankshaft driven element, said second belt being tensioned in operative drive relation with said driving pulley and crankshaft driven element by the torque of said motor only when said motor is activated.

3. In a starter mechanism for an internal combustion engine having a crankshaft and a driven element operatively connected with said crankshaft, a support, said starter mechanism comprising a frame structure pivotally mounted on said support, a starter motor carried by said frame structure, a speed reduction means mounted in said frame structure and comprising driven and driving pulleys, a belt operatively connecting said driven pulley with said motor, and a second belt drivingly connecting said driving pulley with said crankshaft driven element, said second belt being tensioned in operative drive relation with said driving pulley and crankshaft driven element by the torque of said motor only when said motor is activated to apply positive driving tension on said second belt to positively operate said crankshaft driven element.

4. In a starter mechanism for an internal combustion engine having a crankshaft and a driven element operatively connected with said crankshaft, a support, said starter mechanism comprising a frame structure pivotally mounted on said support, a starter motor carried by said frame structure, a speed reduction means mounted in said frame structure and comprising driven and driving pulleys, a belt operatively connecting said driven pulley with said motor, and a second belt drivingly connecting said driving pulley with said crankshaft driven element, said second belt being tensioned in operative drive relation with said driving pulley and crankshaft driven element by the torque of said motor only when said motor is activated to cause said frame structure carrying said driving pulley to move about its pivotal mounting in a direction away from said crankshaft, thereby applying tension to said second belt to subject said crankshaft to bending stresses normal to the crankshaft axis, said stresses being automatically relieved when the aforesaid belt tension is reduced on deactivating said starter motor.

5. In a starter mechanism for an internal combustion engine having a crankshaft and a driven element operatively connected with said crankshaft, a support, said starter mechanism comprising a frame structure pivotally suspended from said support, a starter motor carried by said frame structure, a driving element mounted in said frame structure and operatively connected with said motor, and a belt drivingly connecting said driving and driven elements, said motor having a torque reaction only on being activated to apply positive driving tension on said belt, and the weight of said motor when deactivated applying a nominal tension on said belt to maintain same in connection with said driving and driven elements.

6. In a starter mechanism for an internal combustion engine having a crankshaft and a driven element operatively connected therewith, a support, a frame structure pivotally carried by said support on a hinge axis parallel to the engine crankshaft axis, a starter motor mounted on said frame structure and on an axis parallel to and offset from the aforesaid hinge axis, said motor having a torque reaction operable only on activation of said motor to induce pivotal movement of said frame structure, means operably connecting said motor with said driving element, and a second means operably connecting said driving element with said driven element, the aforesaid torque-induced movement of said frame structure being operable to apply variable positive driving friction only to said second means.

7. In a starter mechanism for an internal combustion engine having a crankshaft and a driven element operatively connected therewith, a support, a frame structure pivotally carried by said support on a hinge axis parallel to the engine crankshaft axis, a starter motor mounted on said frame structure and on an axis parallel to and offset from the aforesaid hinge axis, said motor having a torque reaction operable only on activation of said motor to induce pivotal movement of said frame structure about the aforesaid hinge axis, a driving element carried by said frame structure, means operably connecting said motor with said driving element, and a second means operably connecting said driving element with said driven element, the aforesaid torque-induced movement of said frame structure being operable to apply variable positive driving friction only to said second means, said driven element comprising a pulley, said driving element comprising a lay shaft rotatably carried by said frame structure and on an axis parallel to and offset from the aforesaid hinge axis, a driving and a driven pulley mounted on said lay shaft, said motor having a drive shaft and a pulley mounted thereon, said first means comprising a belt connecting said motor drive shaft pulley in fixed frictional relationship with said lay shaft driven pulley, said second means comprising a belt connecting said lay shaft driving pulley with said driven element pulley and in variable frictional relationship therewith dependent on the degree of movement induced by torque of said motor on said frame structure, said pulleys and belts being arranged in speed reduction relationship.

8. In a starter mechanism for an internal combustion engine having a crankshaft and a driven element operatively connected therewith, a support, a frame structure pivotally suspended by said support, a starter motor mounted on said frame structure and having a torque reaction tending only on activation of said motor to swing said frame structure in one direction, and a driving element carried by said frame structure and operatively connected with said motor and with said driven element, the aforesaid torque-induced tendency to swing of said frame structure being operable to apply variable positive driving connection only between said driving and driven elements and dependent on the degree of torque of said motor.

9. In a starter mechanism for an internal combustion engine having a crankshaft and a driven element operatively connected therewith, a support, a frame structure pivotally suspended by said support on a hinge axis parallel to the engine crankshaft axis, a starter motor mounted on said frame structure and on an axis parallel to and offset from the aforesaid hinge axis, said motor having a torque reaction tending only on activation of said motor to swing said frame structure in one direction, a driving element carried by said frame structure, means operably connecting said motor with said driving element, and a second means operably connecting said driving element with said driven element, the aforesaid torque induced tendency to swing of said frame structure being operable to apply variable positive driving friction only to said second means and dependent on the degree of torque of said motor.

10. In a starter mechanism for an internal combustion engine having a crankshaft and a driven element operatively connected therewith, a support, a frame structure pivotally suspended by said support on a hinge axis parallel to the engine crankshaft axis, a starter motor mounted on said frame structure and on an axis parallel to and

offset from the aforesaid hinge axis, said motor having a torque reaction tending only on activation of said motor to swing said frame structure in one direction, a driving element carried by said frame structure, means operably connecting said motor with said driving element, and a second means operably connecting said driving element with said driven element, the aforesaid torque-induced tendency to swing of said frame structure being operable to apply variable positive driving friction only to said second means and dependent on the degree of torque of said motor, said driven element comprising a pulley, said driving element comprising a lay shaft rotatably carried by said frame structure and on an axis parallel to and offset from the aforesaid hinge axis, a driving and a driven pulley mounted on said lay shaft, said motor having a drive shaft and a pulley mounted thereon, said first means comprising a belt connecting said motor drive shaft pulley in fixed frictional relationship with said lay shaft driven pulley, said second means comprising a belt connecting said lay shaft driving pulley with said driven element pulley and in variable frictional relationship therewith dependent on the degree of swing induced by the torque of said motor on said frame structure, said pulleys and belts being arranged in speed reduction relationship.

11. In a starter mechanism for an internal combustion engine having a crankshaft and a driven element operatively connected therewith, a support, a frame structure pivotally suspended by said support on a hinge axis parallel to the engine crankshaft axis, a starter motor mounted on said frame structure and on an axis parallel to and offset from the aforesaid hinge axis, said motor having a torque reaction tending only on actuation of said motor to swing said frame structure in one direction, a driving element carried by said frame structure, means operably connecting said motor with said driving element, and a second means operably connecting said driving element

with said driven element, the aforesaid torque-induced tendency to swing of said frame structure being operable to apply variable positive driving friction only to said second means and dependent on the degree of torque of said motor, said driven element comprising a pulley, said driving element comprising a lay shaft rotatably carried by said frame structure and on an axis parallel to and offset from the aforesaid hinge axis, a driving and a driven pulley mounted on said lay shaft, said motor having a drive shaft and a pulley mounted thereon, said first mentioned means comprising a belt connecting said motor drive shaft pulley in fixed frictional relationship with said lay shaft driven pulley, said second means comprising a belt connecting said lay shaft driving pulley with said driven element pulley and in variable frictional relationship therewith dependent on the degree of swing induced by the torque of said motor on said frame structure, said pulleys and belts being arranged in speed reduction relationship, said second belt constructed and arrange to hold said suspended frame structure away from its rest position in a direction opposite to the aforesaid torque-induced tendency to swing of said frame structure.

References Cited in the file of this patent

UNITED STATES PATENTS

1,254,320	Fitzgerald	Jan. 22, 1918
1,319,066	Grob	Oct. 21, 1919
1,882,088	Leyvastre	Oct. 11, 1932
1,997,571	Billon et al.	Apr. 16, 1935
2,292,536	McCabe et al.	Aug. 11, 1942
2,760,377	Critchfield	Aug. 28, 1956

FOREIGN PATENTS

657,784	Great Britain	Sept. 26, 1951
895,706	France	Apr. 11, 1944