Sept. 18, 1951 J. PALFI 2,568,359

STARTING DEVICE FOR INTERNAL-COMBUSTION ENGINES

Filed Oct. 24, 1949 4 Sheets-Sheet 1

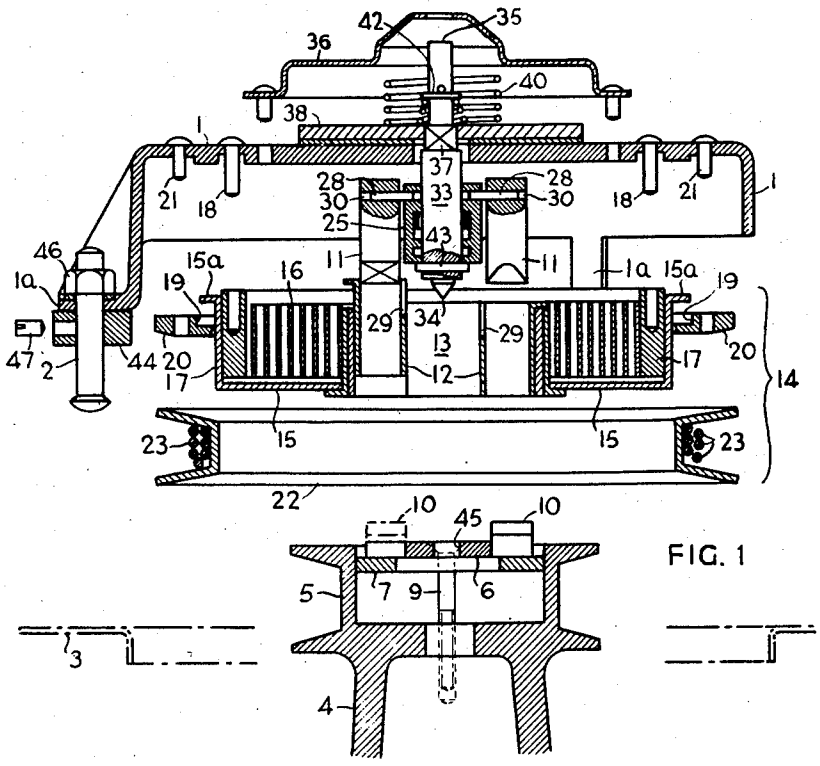


FIG. 1

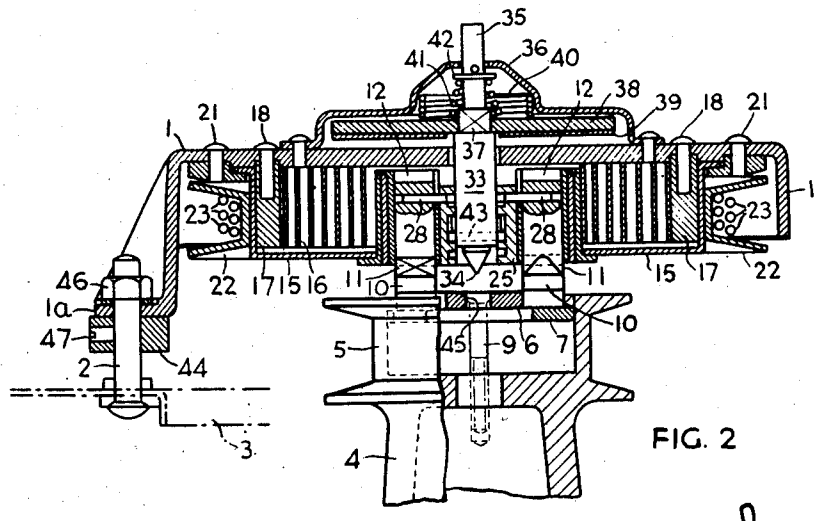


FIG. 2

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Sept. 18, 1951 J. PALFI 2,568,359

STARTING DEVICE FOR INTERNAL-COMBUSTION ENGINES

Filed Oct. 24, 1949 4 Sheets-Sheet 2

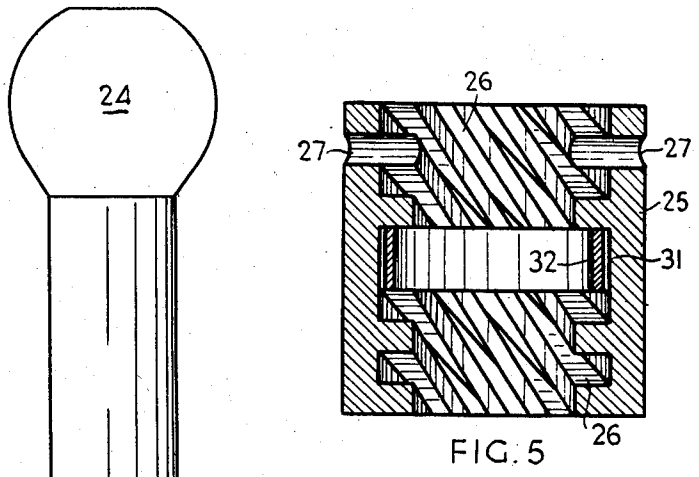


FIG. 5

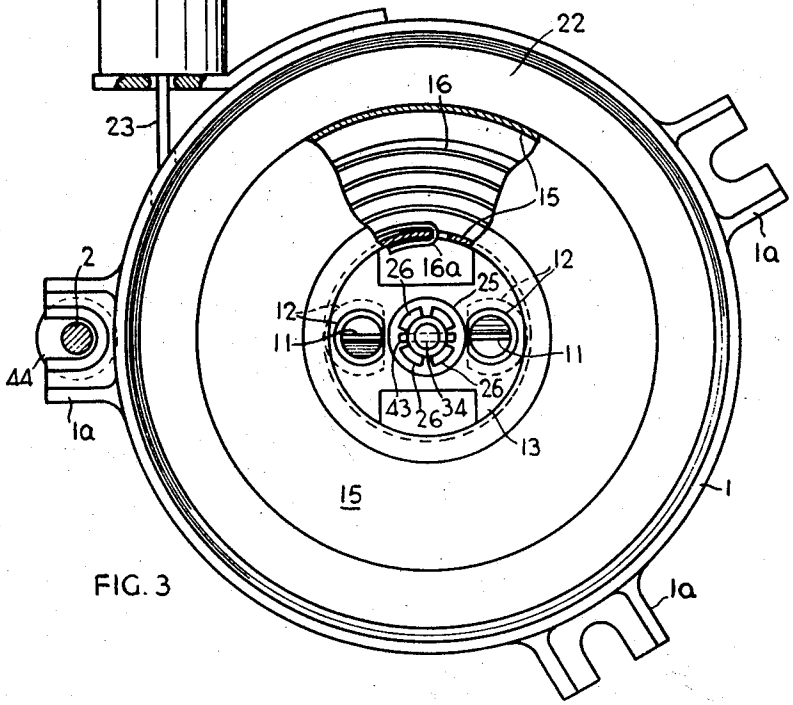


FIG. 3

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Sept. 18, 1951 J. PALFI 2,568,359

STARTING DEVICE FOR INTERNAL-COMBUSTION ENGINES

Filed Oct. 24, 1949 4 Sheets-Sheet 3

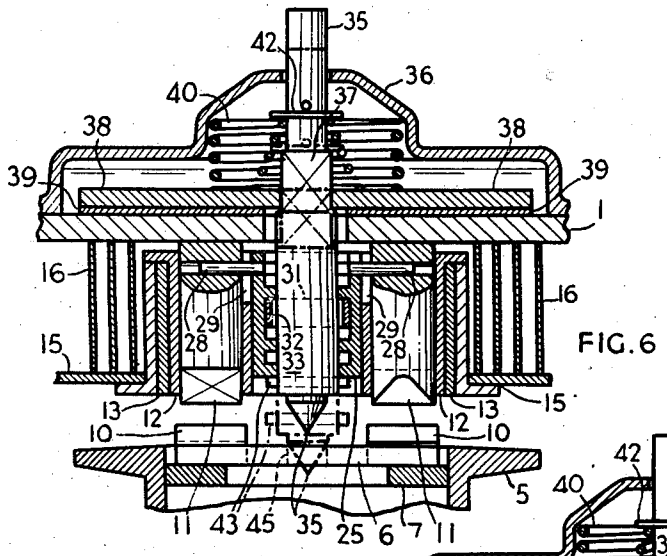


FIG. 6

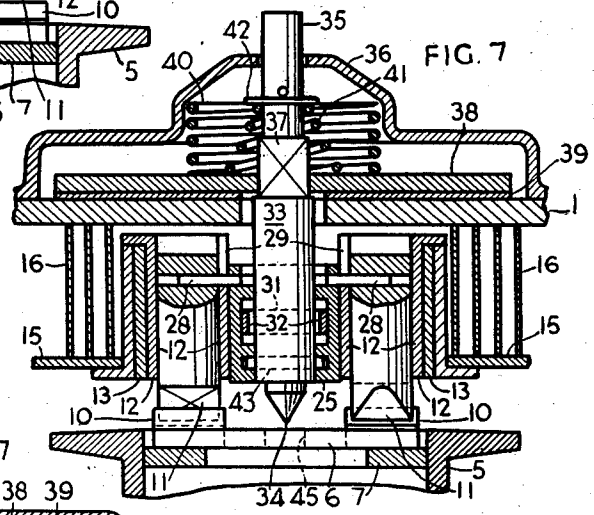


FIG. 7

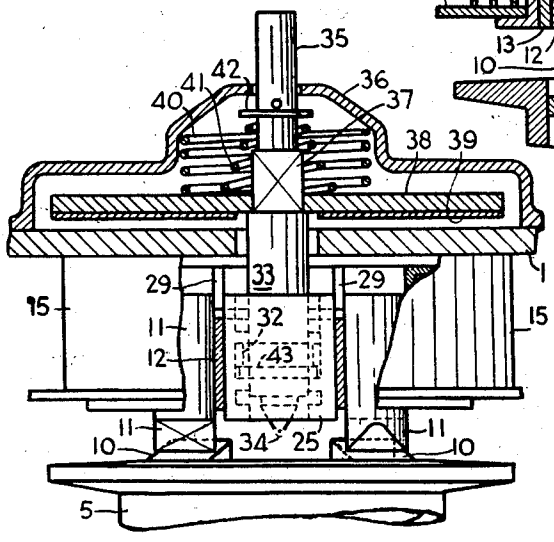


FIG. 8

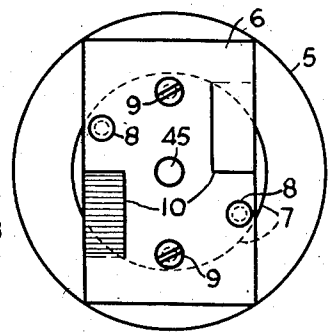


FIG. 4

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Sept. 18, 1951 J. PALFI 2,568,359

STARTING DEVICE FOR INTERNAL-COMBUSTION ENGINES

Filed Oct. 24, 1949 4 Sheets-Sheet 4

FIG. 9

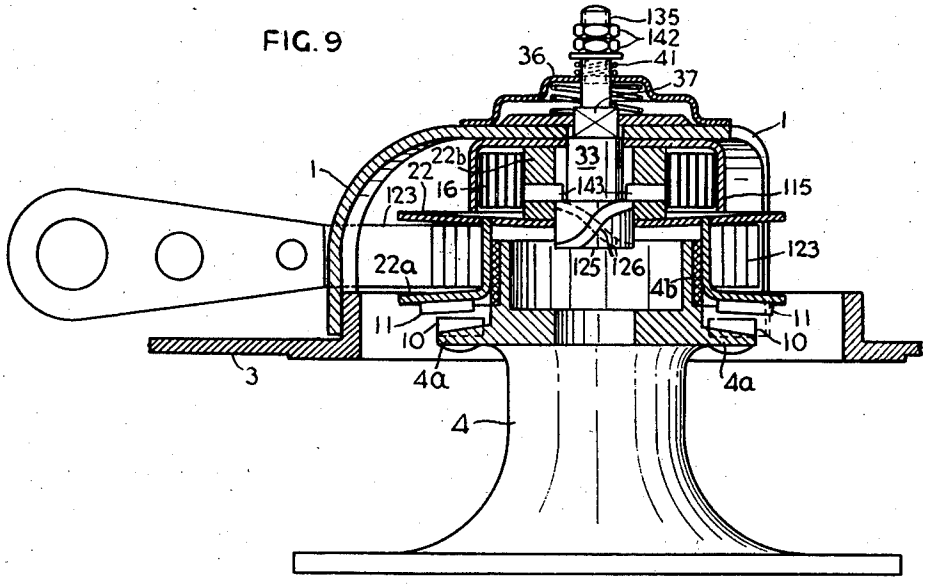
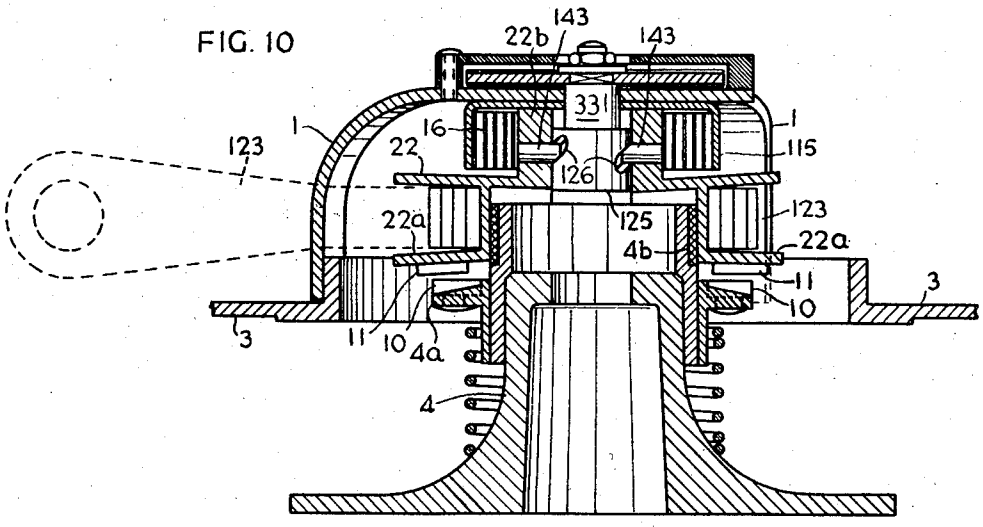


FIG. 10



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UNITED STATES PATENT OFFICE

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STARTING DEVICE FOR INTERNAL-COMBUSTION ENGINES

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Application October 24, 1949, Serial No. 123,251
In Great Britain October 25, 1948

10 Claims. (Cl. 123—185)

1

This invention concerns starting devices for internal combustion engines of the kind commonly known as pull starters in which a drum having a flexible cord or tape wound thereon and provided at its free end with a hand grip is mounted coaxially with the engine shaft and in driving connection therewith. By pulling the cord or tape, the drum is rotated to start the engine.

It is an object of the present invention to provide a construction of pull starter which is compact and robust and which is automatically disengageable from the engine shaft on which it is mounted both when the engine starts or when is runs backwards after a mis-fire.

It is another object of the invention to provide a construction of pull starter which is particularly, although not exclusively, applicable to small horse-power engines of the kind frequently employed for driving chain saws or outboard boat propulsion units.

Another object of the invention is the provision of a pull starter which is readily detachable for inspection and servicing purposes and which can be easily remounted on the engine.

With these and other objects in view the invention consists essentially in the provision, in a pull starter, of a disengageable driving connection between the drum and the engine shaft in combination with automatic feed and retraction mechanism for engaging or disengaging the said driving connection according to the direction of rotation of the drum.

The drum is conveniently provided with a return spring which is operative to rewind the cord or tape after each starting operation.

In order that the invention may be more clearly understood, alternative constructions in accordance therewith will now be described, by way of example only, with reference to the accompanying drawings in which—

Fig. 1 is an exploded view, in axial cross-section, of a preferred construction of a pull starter;

Fig. 2 is an axial section showing the parts of Fig. 1 assembled and with the dogs in engagement during a starting operation;

Fig. 3 is an underplan of the pull starter assembly;

Fig. 4 is an end view of the engine shaft, or its extension, showing the arrangement of the dogs thereon;

Fig. 5 is an enlarged sectional view of the cam feed nut of Fig. 1;

Figs. 6–8 are fragmentary axial sections, on

2

a larger scale showing the parts in successive relative positions with the coacting dogs seen in elevation for clarity of representation, and

Figs. 9 and 10 illustrate two alternative constructions of pull starter according to the invention.

Throughout the drawings, like parts carry similar reference numerals.

In the construction illustrated in Figs. 1–8, the starter mechanism is mounted in an inverted dished housing 1 which is supported by pillar bolts 2 on the engine casing or frame 3. The engine crankshaft, or an extension thereof, is indicated at 4 (Figs. 1 and 2) and terminates within the starter housing 1 in a pulley 5 which can be used as an emergency drum for a pull cord or tape in the event of failure of the starter mechanism. This pulley 5 is hollow and has a dog plate 6 of rectangular shape secured thereto. The dog plate 6 is recessed into the outer face of the pulley 5 and is located centrally with respect to the axis of the engine shaft 4 by means of a locating ring 7 riveted at 8 to the plate 6 (Fig. 4) the outer rim of the ring 7 being a snug fit within the hollow pulley 5. The dog plate 6 and locating ring 7 are held in place by screws 9 which are threaded into the wall of the shaft 4.

Two tongues 10 are bent up from the dog plate 6 to constitute the driven dogs on the engine shaft.

A pair of driving dogs 11 are slidably mounted in sleeves 12 held in the boss 13 of a rotary drum assembly generally indicated at 14 in Figs. 1 and 2. The rotary drum assembly 14 comprises a hollow annular spring casing 15 accommodating a clock-type return spring 16 having its inner end anchored at 16a (Fig. 3) to the casing 15 whilst its outer end is anchored to a stationary bearing ring 17 secured to the starter housing 1 by screws or rivets 18. The bearing ring 17 has an external diameter such that the spring casing 15 is an easy running fit thereover. The free edge of the casing 15 is turned over to form a flange 15a which is loosely accommodated in an annular recess 19 in the adjacent face of a keep ring 20 which is secured by screws or rivets 21 to the housing 1. The keep ring thus functions to locate the spring casing 15 in the axial direction on the fixed bearing ring 16 so that the casing 15 is free to rotate thereon without axial displacement. An annular deep-flanged pulley 22 is secured on the outer surface of the spring casing 15, and in the groove is wrapped the starting cord 23, the free end of which terminates in a hand grip 24 (Fig. 2). The arrangement is

such that, when the cord 23 is pulled the pulley 22 is rotated and with it the casing 15 which carries round the driving dogs 11 in their sleeves 12. The whole assembly 14 thus rotates about the axis of the engine shaft 4.

Within an axial bore through the boss 13 slides a cam feed nut 25 (see in particular Fig. 5) having a four-start quick pitch cam thread 26 formed therethrough. Adjacent its inner end, the cam feed nut 25 has two radial bores 27 (Fig. 5) formed at diametrically opposite points through the wall thereof. In each bore is secured a pin 28 which projects outwards through a slot 29 in the adjacent wall of a respective sleeve 12 to engage in a similar bore 30 in the corresponding driving dog 11. The nut 25 and the two driving dogs 11 are thus constrained to move axially in unison. At a convenient point below the level of the bores 27, a recess 31 is formed in the internal wall of the cam feed nut 25. Into this recess is inserted a spring ring 32 which acts as a stop for the nut in a manner described below.

Through the nut passes a reaction spindle 33 having a conical tip 34 at its one end and being reduced in diameter at its other end 35 to form a spigot projecting through a cover 36 riveted to the housing 1. Between the main body portion of the spindle 33 and the reduced diameter spigot part 35 is a squared portion 37 which engages in a correspondingly squared hole in a friction brake disc 38 located within the cover 36. On the side adjacent the housing 1, the friction disc 38 carries a friction lining 39, and a helical compression spring 40 is mounted between the cover 36 and the friction disc 38 to urge the friction lining 39 into contact with the surface of the housing 1. A similar and smaller compression spring 41 is mounted within the spring 40 between an abutment collar 42 on the spigot part 35 of the spindle 33 and the opposed surface of the friction disc to urge the spindle 33 outwards through the cover 36. This action maintains a transverse pin 43 secured in the spindle 33 adjacent the base of the conical head 34 in engagement with the inner end surface of the cam feed nut 25.

In use, the housing 1 is roughly aligned with the engine shaft 4 and feet 1a spaced around the rim thereof are engaged over the pillar bolts 2 to rest on platform nuts 44 screwed thereon. The latter are then adjusted to ensure parallelism between the axes of the drum assembly 14 and the engine shaft 4. To ensure coincidence of these axes, the spigot portion 35 of the spindle 33 is manually depressed to force the conical head 34 into a hole 45 in the centre of the dog plate 2 (see Fig. 6, dotted line position). When the starter mechanism has thus been correctly aligned, nuts 46 are tightened on the bolts 2 to clamp the feet 1a of the housing 1 on to the platform nuts 44. The latter may be locked on the bolts 2 by means of grub screws such as 47 (Figs. 1 and 2). The starter is then ready for use, the parts being in the positions shown in Fig. 6.

To start the engine, the hand grip 24 (Fig. 3) is pulled to unwind the cord 23 from the drum 15. The latter begins to rotate on the stationary bearing ring 17, axial displacement being prevented by the engagement of the flange 15a with the retaining ring 20. As the drum 15 rotates, the nut 25 rotates with it, being constrained to do so by the pins 28 which project radially outwards therefrom into the pawls 11. The spindle 33, however, is prevented from rotation by the engagement of the squared portion 37 with the friction disc 38 whose friction lining is pressed by the spring 40 against the outer face of the housing 1. At the same time, the spindle 33 is outwardly biased by the spring 41 so that the pin 43 bears against the inner end of the nut 25. Hence, as the nut rotates relatively to the spindle 33, the pin 43 enters the cam thread 26 in the nut, and the spindle moves axially outwards until the shoulder at the inner end of the square portion 37 bears against the inner surface of the disc 38. Further travel of the spindle 33 is then opposed by the spring 40, and the nut 25 begins to move inwards by virtue of the reaction of the pin 43 on the flanks of the cam thread 26.

As the nut 25 moves axially inwards towards the engine shaft 4, it carries the dogs 11 with it by reason of the connecting pins 28, and with continued movement these dogs become projected sufficiently to engage the driven dogs 10 on the engine shaft (see Fig. 7). When this driving engagement occurs, the thrust between the dogs 10, 11 is sufficient to prevent any further forward feed of the dogs 11 and hence of the nut 25. The reaction at the pin 43 as rotation of the drum 15 continues thus produces an axially outward thrust which is sufficient to overcome the pressure of the spring 40 and the disc 38 is moved outward to disengage the friction lining 39 from the housing 1 (Fig. 8). Frictional resistance to rotation of the shaft 33 is thereby removed, and the shaft, together with the disc 38, rotates freely with the drum 15. The friction torque of the disc 38 does not, therefore, oppose the pull of the cord 23 during the starting operation.

Under certain fortuitous conditions, it would be possible, in the absence of any provision to the contrary, for the driving dogs 11 to be fed forward far enough prior to their engagement with the driven dogs 10 for their tips to foul the plate 6. This is prevented by the engagement of the pin 43 with the spring 32 in the nut 25, the recess 31 accommodating the spring being located so as to ensure that the pin 43 makes contact with the said spring before the driving dogs 11 are advanced too far.

When the driving dogs 11 engage the driven dogs 10 (see Fig. 7) no further axial movement thereof, and hence of the cam feed nut 25, takes place. Continued rotation of the casing 15 by the pulley 22, however, causes an outward thrust to be exerted on the pin 28 by the cam threads 26, and the spindle 33 is displaced axially until the shoulder at the base of the squared portion 37 engages the edges of the square aperture in the friction disc 38. Continued exertion of the outward thrust forces the friction lining 39 away from the housing 1 until the frictional torque is reduced to a value equal to the tangential component of thrust exerted on the pin 43 by the flanks of the cam thread 26 in the nut 25. Thereafter the pin 33 rotates with the casing 15, and the cord 23 is relieved of the tension which would have been required to overcome the full frictional torque of the lining 39 on the housing 1 under the pressure of the spring 40.

When the engine fires, the driven dogs 10 overrun the driving dogs 11, and the latter are forced axially outwards up the sloping backs of the driven dogs. This axial movement is accommodated by the clearance space between the back of the friction disc 38 and the inner face of the cover 36, the whole nut and spindle assembly 25, 33 moving with the dogs 11 in the boss 13 of the casing 15. This movement is shown commencing in Fig. 8 and completed in Fig. 2. When this oc-

curs, the hand grip is released, and the spring 16 rotates the casing 15 backwards, and with it the dogs 11 and the nut 25. This causes a reversal of the axial component of thrust between the pin 43 and the cam threads 26 in the nut, and permits the spindle 33 to move axially inwards under the action of the spring 40. The friction lining 39 is thus again forced against the outer surface of the housing 1, and the parts are restored to their initial positions in which the dogs 11 are fully retracted (Fig. 6).

If the engine backfires while it is being started, the reverse rotation imparted to the nut 25 releases the thrust of the spindle 33 against the underside of the disc 38. The lining 39 thereupon instantly grips the housing 1 to lock the spindle 33 so that the nut 25 runs up on the pin 43 to withdraw the dogs 11 out of engagement with the driven dogs 10. The necessary axial thrust to overcome the friction between the two sets of dogs is provided partly by the outward thrust of the spring 41 on the spindle 33 and partly by the momentarily high value of friction between the spindle flats 37 and the edges of the square hole through the friction disc 38, owing to the rapid reverse acceleration of the engine shaft.

It will thus be seen that the mechanism is self-protecting against damage due to backfire, and can accordingly be of relatively light construction. Moreover, the assembly is easily detachable from the engine by releasing the nut 46 without disturbing the adjustment of the platform nuts 44, so that inspection and servicing may readily be effected with a minimum of idle time of the engine.

In both the alternative forms of the invention shown in Figs. 9 and 10, the starter mechanism is mounted in an open housing 1 bolted to the engine frame or casing 3 around the projecting end of the engine crankshaft 4 or an extension thereof. This shaft 4 is provided, within the starter housing 1, with a flange 4a carrying a number of driven dog clutch teeth 10, which project outwards away from the engine. Beyond this ring of teeth 10 the shaft 4 is extended to form a plain journal bearing 4b for the pulley 22 on which the starting tape 123 is wound. This pulley 22 is free to rotate and to slide axially on the journal bearing 4b and is provided, on the flange 22a thereof which faces towards the engine, with a number of driving dog clutch teeth 11 corresponding to the number of the teeth 10 on the shaft 4. The pulley 22 has an extension on its outer side in the form of a boss 22b around which is wrapped a coil return spring 16 having its outer end anchored to the wall of a cup 115 which is fixed within the housing 1. The pulley 22 and its boss 22b together with the parts attached thereto, constitute the rotary drum of the starter, and the return spring 16 is operative to rotate the drum in the sense for winding on the starting tape 123, and is also operative to bias the drum in the axial direction to separate the driving and driven dog clutch teeth 11, 10 respectively.

The boss 22b surrounds a short stub spindle 33 which is also located in the starter housing 1 coaxially with the drum. The inner end of this stub spindle 33 is provided with a short cam head 125 in the circumferential face of which are formed two quick-pitch cam grooves 126. These cam grooves are of a size to be engaged by a pair of diametrically opposed feed pins 143 which project radially inwards from the boss 22b and constitute axial feed members therefor.

In the form of starter illustrated in Fig. 9, when the parts are at rest (as shown), the feed pins 143 rest against the outer edge of the cam head 125 on the stub spindle 33. The outer end of the latter projects through the end wall of the housing 1 and is provided, beyond a shoulder, with a reduced squared portion 37 which engages with a correspondingly squared hole in a friction disc 38 bearing against the outer surface of the housing 1. The squared section 37 of the spindle 33 is of a length sufficient to allow for small axial movement thereof relatively to the friction disc 38. Beyond this squared portion 37, the stub spindle 33 is reduced in diameter to terminate in a screw threaded extension 135 which accommodates a pair of lock nuts 142 which serve as an adjustable abutment for a short coil compression spring 41 surrounding the reduced end of the spindle. The inner end of this spring bears on the outer end surface of a dished cover 36 secured to the starter housing 1 and enclosing the friction disc 38, the spring 41 tending to pull the stub spindle 33 outwards and so to hold the cam head 125 thereon in contact with the feed pins 143. Within this cover 36 is located the coil compression spring 40 one end of which bears against the friction disc 38 whilst the other bears against the inner end surface of the cover 36.

In operation, when the engine is to be started, the flexible tape 123 is pulled to rotate the pulley 22, and as the drum 22, 22b begins to rotate, the diametrically opposed pins 143 enter the quick-pitch cam grooves 126 in the head 125 under the influence of the spring 41. The spindle 33 is free to move axially with respect to the friction disc 38 sufficiently to ensure the proper engagement of the feed pins 143 with the cam grooves 126. Further rotation of the drum 22, 22b thus causes the pins 143 to run down the quick-pitch cam, the torsional reaction on the stub spindle 33 during this movement being taken by the friction disc 38 which ensures that the stub spindle 33 is sufficiently firmly held against rotation. Consequently, the drum 22, 22b is displaced axially to bring its dog clutch teeth 11 into engagement with the coacting driven teeth 10 on the engine shaft 4. Further pulling of the starting tape 123 thus causes rotation of the engine shaft to effect starting of the engine.

When the dog clutch teeth 10, 11 are fully engaged, no further axial displacement of the drum 22, 22b can take place, and there is developed between the feed pins 143 and the outer flanks of the quick-pitch cam grooves 126 an axial thrust which tends to force the spindle 33 outwards. The spindle is so proportioned that when this occurs the shoulder at the inner end of the squared section 37 engages the friction disc 38 around the square hole therein and tends to lift it against its compression loading spring 40 out of engagement with the surface of the starter housing 1. By so doing, the friction which tends to prevent the rotation of the stub spindle 33 is substantially reduced and an equilibrium condition is set up between the thrust on the quick-pitch cam grooves 126 derived from the drag exerted by the friction disc 38 and the pressure of the loading spring 40 on the friction disc. Under these conditions, the stub shaft 33 can thus be rotated with the drum and the engine shaft 4 without excessive drag being transmitted to the starting tape 123 during the engine starting period.

While the drum 22, 22b is thus rotated to start

the engine, the spiral return spring 16 is wound up to provide the necessary energy for rewinding the starting tape when the latter is released. The spring 16 is also distorted axially and thus exerts an outward axial thrust on the drum tending to disengage the dogs 10, 11. This thrust is small compared with the friction between the dogs 10, 11 and is not sufficient to cause disengagement thereof during the starting period.

If the engine fires correctly, and before the flexible tape 123 is released, the dog clutch teeth 10 on the shaft 4 overrun the dog clutch teeth 11 on the drum. The back faces of these teeth are chamfered off so that the teeth 11 ride up on the teeth 10 and the drum 22, 22b is thrown out of engagement, the spindle 33 and friction disc 38 moving axially therewith as a unit against the compression loading spring 40. Immediately the tape 123 is released, the coil spring rotates the drum and, since the spindle 33 is, in the intervals between the engagement of the dogs 10, 11 intermittently held by its friction disc 38 against rotation, the pins 143 on the drum run back up the cam grooves 126 so that the spindle 33 and drum 22, 22b move axially towards each other until the dog teeth 10, 11 are completely disengaged and the pins 143 in the drum have passed out of engagement with the cam grooves 126. The coil spring 16 is then free to complete the rewinding of the starting tape 123 and the parts are thus returned to their original positions ready for the next starting operation.

Should the engine misfire and start to run back, the drum 22, 22b is jerked back against the starting pull and begins to rotate in the opposite direction. This reverses the direction of the axial thrust exerted by the feed pins 143 on the cam grooves 126 so that the stub spindle 33, which is initially held stationary by inertia, moves axially inwards for a sufficient distance to allow the friction disc 38 to re-engage fully, under the action of its loading spring 40, the outer surface of the housing 1 and to hold the spindle 33 against rotation. Further backward rotation of the drum thus causes the pins 143 to run up the cam grooves 126 and throw the dogs 10, 11 out of engagement. The starting tape 123 can then be released to be wound on the pulley 22 by the spiral spring 16 and the parts are ready for the next operation.

In the alternative construction of Fig. 10, the feed pins 143 remain at all times in engagement with closed ended quick-pitch cam grooves 126a in the cam head 125 of the stub spindle 33. The outer end of the spindle 33 is squared at 37a to receive a double-sided friction disc 138 which is firmly locked on the spindle 33. The disc 138 is enclosed by a flat cover plate 136 the inner surface of which is just clear of the outer surface of the friction disc 138 when the latter is in frictional engagement with the co-acting surface on the housing 1. When there is no axial thrust in either direction on the spindle 33, the friction disc 138 is free to run between the opposed surfaces on the housing 1 and on the cover plate 136. So long, however, as the drum 22, 22b is being rotated relatively to the stub spindle 33 the engagement of the pins 143 in the cam grooves 126a maintains a resultant axial thrust on the stub spindle 33 in one or other direction, and the friction disc 138 is consequently held against the respective surface to oppose rotation of the stub spindle 33.

The dog clutch teeth 10 on the engine shaft are mounted on a sleeve 48 which is keyed to the shaft 4 so as to rotate therewith but which can slide axially thereon against the thrust of a compression spring 49 which urges the dogs 10 towards the drum 22, 22b.

In the operation of this construction, the initial pull on the tape 123 causes the feed pins 143 to exert an outward axial thrust on the outward walls of the cam grooves 126a. The inertia of the stub spindle assembly initially tends to hold it against rotation with the pins 143 so that it is moved axially outwards to cause the friction disc 138 to engage the inner surface of the cover plate 136. Thereafter the spindle 33 is fractionally held against rotation by the friction disc 138, and continued rotation of the drum 22, 22b causes the pins 143 to run down the quick-pitch cam grooves 126a so as to bring the dogs 11 on the drum into engagement with the dogs 10 on the sleeve 48.

When the dogs 10, 11 are fully engaged, the feed pins 143 reach the ends of the cam grooves 126a and there is no further axial thrust exerted on the spindle 33 to maintain the friction disc 138 in frictional engagement with the inner surface of the cover plate 136. The resistance of the spindle 33 to rotation is thus substantially reduced, and further pulling of the starter tape 123 causes rotation of the drum 22, 22b without any noticeable drag being exerted thereon by the friction disc 138.

If the engine fires correctly the dogs 10 on the sleeve 48 are thrown out of engagement with the dogs 11 on the drum 22, 22b as the sleeve 48 moves axially towards the engine against the pressure of its engagement spring 49. Release of the tape 123 thus enables the drum 22, 22b to be rewound by its spiral spring 16 and the parts return to their initial position ready for the next starting operation.

If the engine misfires, the drum 22, 22b tends to be rotated backwards to rewind the tape 123 and the feed pins 143 immediately bear on the inward walls of the cam grooves 126a so that an axially inward thrust is exerted on the stub spindle 33. The friction disc 138 is thus brought into sufficiently tight engagement with the outer surface of the housing 1 to check the stub spindle 33 against rotation and the feed pins 143 run up the cam grooves 126a to pull the dogs 11 on the drum 22, 22b out of engagement with the dogs 10 on the sleeve 48. The parts are thus returned to their initial positions ready for the next starting operation.

The frictional surface area may be increased if necessary by the substitution of a multi-plate clutch for the single friction disc 38 or 138 described above and the forces operating this clutch can be increased by decreasing the pitch angle of the cam threads or grooves 26, 126, 126a respectively.

What I claim is:

1. A pull starter for an internal combustion engine comprising a housing, a drum mounted in the housing coaxially with the engine shaft and having the starting belt wound thereon, a driving clutch component mounted on the drum for rotation therewith, a coacting driven clutch component on the engine shaft, and co-operating cam and follower feed elements, the one rotatable with the drum and positively connected to the driving clutch component and the other having limited freedom of axial displacement under the influence of the axial component of reaction between the feed elements during a starting operation, and friction means for restraining rotation of the said other feed element relative to a fixed

part of the mechanism for effecting axial feed displacement of the driving clutch component on rotation of the drum.

2. A pull starter for internal combustion engines having a casing, an axially engageable and disengageable driving connection between the drum and the engine shaft, co-operating relatively rotatable cam feed elements for effecting axial engagement and disengagement of the said connection on rotation of the drum in the starting and the reverse direction respectively, a frictional torque reaction member operatively associated with one cam feed element for yieldable engagement with the casing, the said one cam feed element being displaceable at a predetermined value of axial reaction between the cam feed elements for automatically disengaging the friction member from the casing when the driving connection between the drum and engine shaft is fully engaged

3. A pull starter for internal combustion engines comprising a drum, a spindle mounted coaxially with the drum, co-operating cam and follower elements on the spindle and the drum respectively, a frictional torque reaction member slidably but non-rotatably connected to the spindle, spring means for biasing the torque reaction member into frictional engagement with a fixed surface on the starter frame, and an abutment on the spindle for axial engagement with the friction member in the sense for opposing the spring bias under the influence of the axial reaction between the cam and follower members during a starting operation.

4. A pull starter for an internal combustion engine comprising a housing, a drum journalled in the said housing coaxially with the engine shaft for rotation without axial displacement, a tension element wound on the drum for effecting driving rotation thereof, a driving clutch component mounted on the drum for sliding displacement relative thereto in the axial direction, a coacting driven clutch component on the engine shaft, and co-operating cam and follower feed elements the one slidably but non-rotatably received coaxially within the drum and positively connected to the driving clutch component and friction means for restraining rotation of the other feed element relative to a fixed part of the frame.

5. A pull starter as claimed in claim 1 comprising a spindle mounted coaxially with the drum, co-operating cam and follower elements on the spindle and the drum, a friction member slidably but non-rotatably connected to the spindle, spring means for biasing the friction member into frictional engagement with a fixed surface on the mechanism, and an abutment on the spindle for axial engagement with the friction member in the sense for opposing the spring bias.

6. A pull starter as claimed in claim 4 wherein the frictionally restrained feed element comprises a spindle extending coaxially through the drum and a friction member slidably but non-rotatably engaged therewith, spring means for urging the friction member into engagement with a fixed surface on the housing, and a stop formation on the spindle for engagement with the friction member in the opposite sense during a clutch-engaging feed operation.

7. A pull starter as claimed in claim 6 including a spiral return spring mounted within the drum for rotating it in the direction opposite to the direction of rotation of the engine shaft on release of the tension element.

8. A pull starter for internal combustion engines comprising a housing embracing the free end of the engine shaft, a drum slidably journalled on the said shaft end and having the tension element wound thereon, axially engageable and disengageable driving and driven clutch components rigidly secured on the drum and on the engine shaft respectively, and co-operating cam and follower feed elements the one mounted on the drum and the other having limited freedom of axial displacement under the influence of the axial component of reaction between the feed elements during a starting operation, and friction means for restraining rotation of the said other feed element relative to a fixed frame part for effecting axial displacement of the drum in the direction for engaging the clutch components on rotation thereof by the tension element and in the direction for disengaging the clutch components on reverse rotation of the drum.

9. A pull starter as claimed in claim 8 wherein the frictionally restrained feed element comprises a spindle located coaxially within the drum, a friction member slidably but non-rotatably engaged with the spindle, spring means for urging the friction member into frictional contact with a fixed surface, and abutment means on the spindle for limiting the freedom of relative sliding movement thereof with respect to the friction member in the direction for moving the said member out of contact with the fixed surface.

10. A pull starter as claimed in claim 8 wherein the frictionally restrained feed element comprises a spindle located coaxially within the drum, a friction member rigidly secured thereon, and opposed coacting fixed surfaces located with clearance on opposite sides of the friction member, in combination with a stop formation at each end of the cam surface on the said feed element to positively limit the amount of axial feed displacement of the drum.

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