Sept. 13, 1949. R. R. ROBINSON ET AL 2,481,783

STARTING MECHANISM FOR INTERNAL-COMBUSTION ENGINES

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FIG. 1

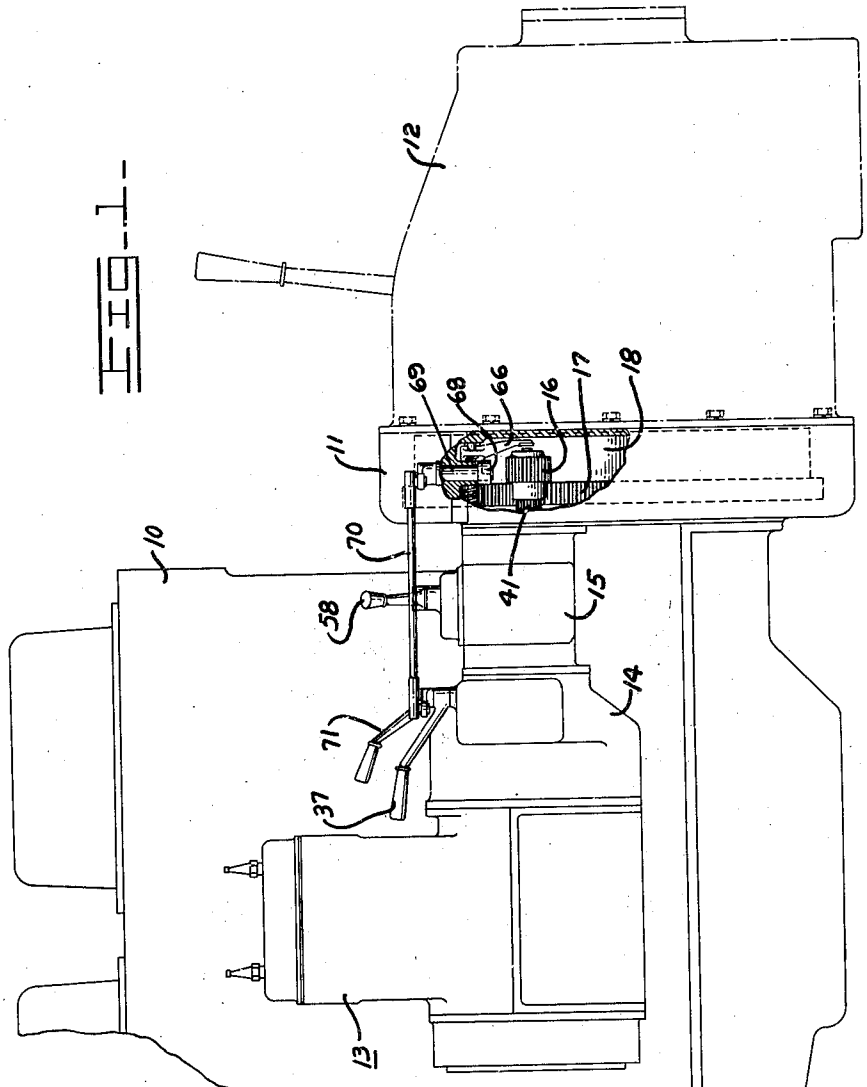
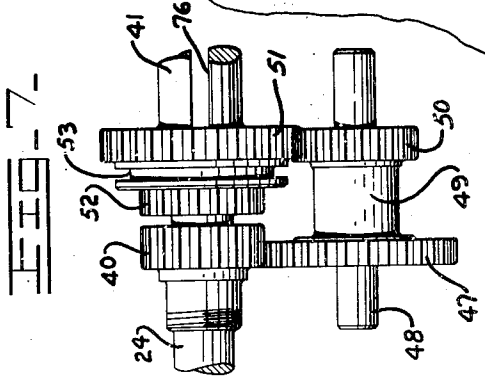


FIG. 2



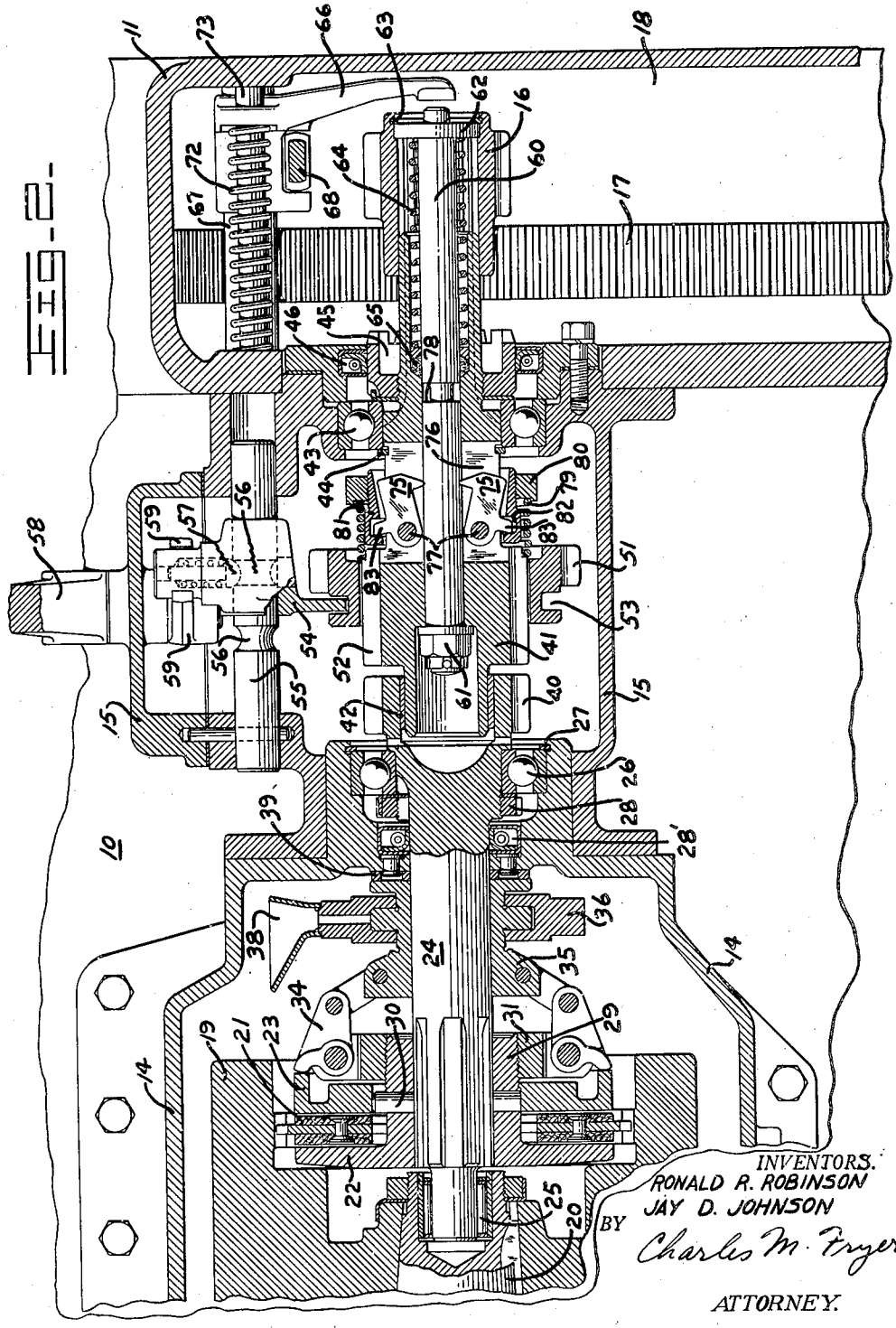
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FIG-2-



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Fig. 3.

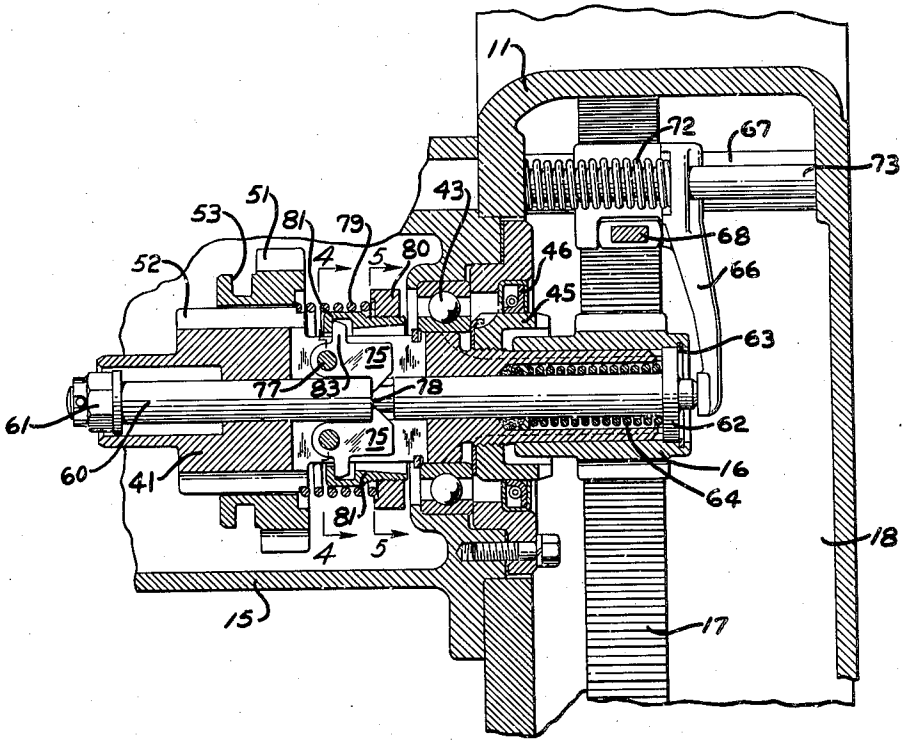


Fig. 4.

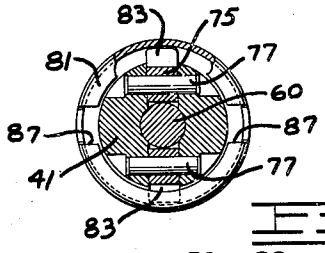


Fig. 5.

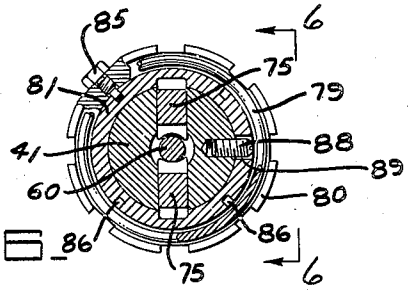
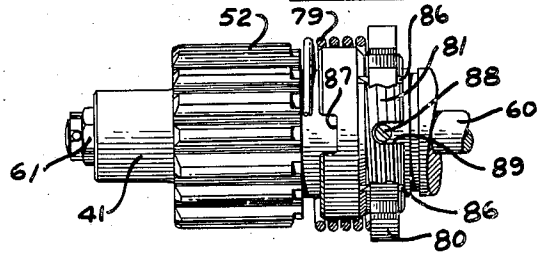


Fig. 6.



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2,481,783

STARTING MECHANISM FOR INTERNAL-COMBUSTION ENGINES

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8 Claims. (Cl. 74—6)

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The present invention relates to starting mechanism for internal combustion engines and particularly to the construction of starting pinion latching mechanisms and the arrangement of such mechanisms with relation to certain parts of a starting engine and the internal combustion engine which it is employed to start.

Patent No. 2,076,954 to Lewis for "Engine" which issued on April 13, 1937, discloses a starting mechanism of the general type to which the present invention pertains. This patent discloses a primary engine having a smaller starting engine mounted alongside it and a driving connection including a pinion gear adapted to mesh with a ring gear on the flywheel of the primary engine. Latching mechanism is also disclosed for holding the pinion gear in mesh with the ring gear during starting of the primary engine and this latching mechanism extends beyond the pinion and ring gears and projects to the rear of the primary engine flywheel housing. This arrangement of starting mechanism has been found to have certain disadvantages. One such disadvantage is that the presence of the latching mechanism beyond the flywheel housing interferes with the convenient positioning of other auxiliary apparatus conventionally located adjacent said housing. For example, in marine engines an electric generator is often so positioned and great inconvenience is caused by the presence of the latching mechanism in this position. Another disadvantage of the arrangement mentioned is that lubrication of parts positioned beyond the flywheel housing is difficult and must be accomplished by making special provision for lubrication.

It is an object of the present invention to overcome the disadvantages mentioned above and other disadvantages of previous structures and to provide a compact positively operating starting mechanism for internal combustion engines. A further object of the invention is to provide a starting mechanism which includes a starting engine and a pinion gear driven thereby for engagement with a gear on the engine to be started and a latching mechanism for holding the pinion gear in mesh with the gear on the engine with said latching mechanism located between the starting engine and said gear. A still further object of the invention is the provision of a starting mechanism of the character described which includes a latching mechanism disposed in a bath of lubricant. Further and more specific objects and advantages of the invention are made apparent in the following detailed specification.

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The invention is described and illustrated herein in its application to a primary engine of the compression ignition type and a startng engine of the spark ignition type. It is to be understood, however, that this disclosure is merely illustrative of the principles of the invention which is readily adaptable to other types of primary engines and other types of starting engines or motors than those herein shown.

In the drawings:

Fig. 1 is a fragmentary view in side elevation of a primary engine and a starting engine therefor with parts broken away to show the normal relationship of the pinion and ring gears by means of which starting motion is imparted to the primary engine;

Fig. 2 is an enlarged vertical central section through a portion of the clutch housing of the starting engine, the transmission housing thereof and a portion of the flywheel housing of the primary engine illustrating details of construction of the starting and latching mechanism;

Fig. 3 is a fragmentary section similar to Fig. 2 illustrating the position of certain parts when the pinion gear is in mesh with the ring gear;

Fig. 4 is a sectional view taken on line 4—4 of Fig. 3;

Fig. 5 is a sectional view taken on line 5—5 of Fig. 3;

Fig. 6 is a side elevation of a portion of the latching mechanism shown in Fig. 3 as viewed from the line 6—6 of Fig. 5; and

Fig. 7 is a fragmentary plan view illustrating details of the transmission gearing shown in Fig. 2.

In Fig. 1 of the drawings a conventional internal combustion engine of the compression ignition type is shown at 10 as provided with a flywheel housing 11 and a conventional transmission case 12. On one side of the block of the engine 10 is secured a starting engine 13 which is provided with a clutch housing 14 and a transmission case 15 through which power is transmitted for rotating a pinion 16 which is adapted to be brought into mesh with a ring gear 17 on a flywheel 18 of the primary engine 10.

The manner in which power is transmitted from the starting engine 13 to the pinion 16 is best illustrated in Fig. 2 wherein the clutch housing 14 is shown as enclosing a flywheel 19 secured to the end of a shaft 20 which is the crank shaft of the starting engine 13. The flywheel 19 has a recessed end which carries the driving plate 21

of a clutch. The driven plates of this clutch are shown at 22 and 23 and are mounted on a clutch shaft 24. The clutch shaft 24 is supported at one end in a pilot bearing 25 received within a recessed end of the crank shaft 20 and at the other end by a bearing 26 received in the clutch housing where it is held in place by a snap ring 27 and a nut 28 threaded on the clutch shaft 24 as shown. An oil seal 28' is preferably disposed around the shaft 24 to prevent the passage of oil between the transmission case 15 and the clutch housing 14.

The driven plate 22 of the clutch is splined to the shaft 24 for rotation therewith and the driven plate 23 is mounted on a hub 29 of the driven plate 22 but held against relative rotation with relation to the plate 22 by means of a pin 30. A spider 31 is threaded to the hub 29, and carries toggle links 34 which are connected with a conventional slide collar assembly 35 which is slidably mounted on the shaft 24 and operates upon sliding movement to effect engagement or release of the clutch in the usual manner for controlling rotation of the clutch shaft 24. The slide collar assembly 35 includes a flange embraced by a shifting fork 36 and this fork is controlled through conventional mechanism, not shown, by a lever 37 which, as shown in Fig. 1, is mounted on the exterior of the clutch housing. An oil reservoir 38 is shown on the fork 36 for supplying lubricant to its connection with the slide collar assembly. When the clutch is disengaged the slide collar assembly moves to the right as viewed in Fig. 3 and abuts a brake plate 39 secured to the inside of the clutch housing which compels it and the clutch shaft to come to rest.

One end of the clutch shaft 24 projects into the transmission case 15 and terminates in a gear 40. A transmission shaft 41 extends through the transmission case and is supported at one end by a pilot bearing 42 within a recessed end of the shaft 24, and at its other end by a bearing 43 supported in the transmission case. The bearing 43 is held in place by a snap ring 44 received in a groove in the transmission shaft and a castellated nut 45 threaded on the same shaft. A seal ring 46 surrounds the nut 45 to prohibit the flow of oil between the transmission case and the flywheel housing 11.

Power may be transmitted from the clutch shaft 24 to the transmission shaft 41 through a gear transmission which is illustrated in Figs. 2 and 7. This transmission is constructed to transmit power to the transmission shaft at two different ratios. For low speed transmission the gear 40 on the clutch shaft 24 meshes with a gear 47 rotatable on a counter shaft 48. The counter shaft is supported in the transmission housing by conventional means, not shown. The gear 47 is carried by a hub 49 which also carries a gear 50 adapted to mesh with a gear 51 which has a slidable driving connection with the shaft 41. This slidable driving connection includes a gear 52 formed integrally with the shaft 41 and having externally formed teeth in registry with teeth formed internally of the gear 51 to provide what is in effect a splined connection. By sliding the gear 51 to the left, as viewed in Fig. 2 its internal teeth will also register with the teeth of gear 40 on the clutch shaft 24 thus connecting the clutch shaft and transmission shaft 41 for high speed or direct transmission of power from the former to the latter. The same movement of the gear 51 which establishes the high speed drive disables the low speed drive by moving the gear 51 out of mesh with the gear 50 on the counter shaft 48.

In order to effect movement of the gear 51 between its high and low speed positions it carries a shifting groove 53 engaged by a shifting fork 54 slidable on a guide shaft 55. The shaft 55 has two notches as illustrated at 56 which are engageable by a spring pressed detent, shown in dotted lines in Fig. 2, at 57 to hold the fork in either its high or low speed position. The fork is slidable along the shaft 55 by a manually operable lever 58, see also Fig. 1, which controls a shifting member which has finger 59 embracing a part of the fork 54.

One end of the transmission shaft 41 extends into the flywheel housing 11 of the primary engine and is splined for sliding reception of the internally splined pinion 16. The transmission shaft is concentrically bored throughout its length for the sliding reception of a latch pin 60 which has a nut 61 fixed to one end and which is connected at its other end, by an integral flange or collar 62, with the pinion 16. The collar 62 rests against a shoulder in the bore of the pinion and is held in place therein by an internal snap ring 63. The splined end of the transmission shaft 41 has an enlarged bore for the reception of an expansible spring 64 which surrounds the latch pin 60 and which bears against the collar 62 at one end and against the inner end of the enlarged bore at the other end through the medium of a packing gland 65 which permits sliding movement of the latch pin 60 but forms a seal against the passage of oil from the transmission case to the flywheel housing. The spring 64 normally urges the pinion 16 toward its outermost position which is limited by the nut 61 on the latch pin 60 and which is the position illustrated in Fig. 2 wherein the pinion is not in mesh with the ring gear 17.

When the power of the starting engine is to be transmitted to the ring gear for starting the primary engine, the pinion is moved into mesh with the ring gear by sliding along its splined connection with the shaft 41 so that it assumes the position illustrated in Fig. 3. The pinion may be moved to this position by a finger 66 slidably mounted on a shaft 67 and engageable by a lever 68, which is carried by a pin 69 shown in Fig. 1, and controlled by a connecting link 70 and a manually operated lever 71 mounted on the exterior of the clutch housing 14. The finger 66 is normally urged to the retracted position shown in Fig. 2 by a spring 72 which surrounds a shaft 73, and a portion of the finger 66 embraces the shaft to prevent rotation of the finger relative to the shaft 67 by which it is principally guided. Thus, when the lever 71 is operated to advance the finger 66 into contact with the end of the latch pin 60 and to move the pinion into mesh with the ring gear, as shown in Fig. 3, the spring 72 immediately returns the finger 66 to the normal position shown in Fig. 2 so that the pinion may return to its normal position under influence of its spring 64 as soon as it is permitted to do so.

When the starting engine has been started and the desired gear ratio selected on the transmission mechanism, the pinion 16 is meshed with the ring gear 17 of the primary engine and the clutch of the starting engine is then engaged to impart driving motion to the pinion and, through its connection with the ring gear, to start the primary engine.

It is desired that the pinion gear remain in mesh with the ring gear until the primary engine has been started and brought up to sufficient speed under its own power to assure its continued operation. In order to retain the pinion in mesh with the ring gear during this period of time, and against the pressure of the spring 64 which tends to return it to its normal position, a pair of pawls 75 are pivotally supported within a diametrically disposed slot 76 in the transmission shaft 41 by pins 77, the arrangement of which in the shaft are best illustrated in Figs. 2 and 4. The pawls 75 are engageable with a peripheral groove 78 when the latch pin and pinion 16 are moved to the position illustrated in Fig. 3. In this position the pawls 75 prevent the return of the pinion to its normal position under influence of its spring 64. The pawls 75 are constantly urged toward their latching position by an expansible spring 79 which seats at one end against a shoulder formed in the teeth of the gear 52. The other end of the spring 79 engages a nut 80 which is threaded on the exterior of a cage 81 which surrounds the shaft 41 and is interiorly grooved as at 82 to receive fingers 83 on the pawls 75. Through these connections, the spring 79 urges the pawls about their pivots 77 toward the engaged position illustrated in Fig. 3. The pawls 75 are of sufficient size to act effectively as governor weights upon rotation of the shaft 41 by which they are carried. Consequently, when the primary engine has been started and attains a predetermined desired speed, it will impart speed to the pinion 16 and shaft 41 sufficient to throw the pawls 75 outwardly about their pivots by centrifugal action, and against the tension of the spring 79, with the result that the latching engagement of the latch pin 60 will be released and the pinion will return to the normal position of Fig. 2 under influence of spring 64. The tension of the spring 79 which regulates the speed necessary to disengage the pawls 75 may be adjusted by rotation of the nut 80 and a shouldered set screw 85 is carried by said nut as shown in Fig. 5 for engagement with any one of the plurality of notches 86 in the outer periphery of the cage 81.

To enable assembly of the cage 81 over the projecting finger 83 of the pawls 75, the end of the cage is notched as indicated at 87 in Fig. 4 so that it may be slipped over the pawl fingers and then rotated ninety degrees so that the fingers will assume an effective position within the groove 82. The cage is held in its proper position by a set screw 88 (see Figs. 5 and 6) threaded into the shaft 41 and projecting into a slot 89 in the cage which prevents rotation of the cage on the shaft but permits its necessary endwise movement.

With the construction described the entire latching mechanism which retains the pinion 16 in mesh with the ring gear on the flywheel of the primary engine is disposed within the transmission case which contains a bath of lubricating oil for lubrication of the transmission parts. Consequently, the latching mechanism is always adequately lubricated without the provision of special lubricating means. Furthermore, this arrangement positions the latching mechanism between the starting engine and the flywheel of the primary engine so that it does not project to an undesirable location as in previous structures.

The starting mechanism will operate in the manner herein described whether the transmission is adjusted for high speed or low speed and the lever 58 is manipulated before the starting engine clutch is engaged to establish whichever gear ratio is deemed desirable for each starting operation.

We claim:

1. Starting mechanism which comprises in combination a primary engine to be started and a starting engine associated therewith, a first gear on the primary engine, a second gear adapted to be driven by the starting engine, a shaft supporting said second gear for axial movement into meshing engagement with the first gear, a grooved latch pin slideable in said shaft and engaged with the second gear, and latch pawls pivotally carried by said shaft and engageable with the groove in said latch pin to retain the second gear in mesh with the first gear.

2. Starting mechanism which comprises in combination a primary engine to be started and a starting engine associated therewith, a first gear on the primary engine, a second gear adapted to be driven by the starting engine, a shaft supporting said second gear for axial movement into meshing engagement with the first gear, a grooved latch pin slideable in said shaft and engaged with the second gear, latch pawls pivotally carried by said shaft and engageable with said latch pin groove to retain the second gear in mesh with the first gear and resilient means normally urging the second gear away from its meshed position.

3. Starting mechanism which comprises in combination a primary engine to be started and a starting engine associated therewith, a first gear on the primary engine, a second gear adapted to be driven by the starting engine, a shaft supporting said second gear for axial movement into meshing engagement with the first gear, a grooved latch pin slideable in said shaft and engaged with the second gear, latch pawls pivotally carried by said shaft and engageable with said latch pin groove to retain the second gear in mesh with the first gear, said latch pawls being arranged for centrifugally impelled releasing movement upon rotation of the shaft, and resilient means for preventing such movement until the shaft attains a predetermined speed.

4. Starting mechanism which comprises in combination with a primary engine to be started and a starting engine associated therewith, a gear on the primary engine, a pinion gear driven by the starting engine, means to move the pinion gear into and out of mesh with the gear on the primary engine, said means including a circumferentially grooved latch pin movable with said pinion gear and extending toward the starting engine and latch means interposed between the starting engine and the gear on the primary engine and engageable with said latch pin groove for holding said gears in mesh.

5. Starting mechanism which comprises in combination with a primary engine to be started and a starting engine associated therewith, a ring gear on the flywheel of the primary engine, a pinion gear driven by the starting engine, means for moving said pinion gear axially into mesh with the ring gear, said means including a circumferentially grooved latch pin carried by and movable with said pinion gear and extending toward the starting engine and latch means interposed between the starting engine and the ring gear and engageable with said latch pin groove for holding said gears in mesh.

6. Starting mechanism which comprises in

combination with a primary engine to be started and a starting engine associated therewith, a ring gear on the flywheel of the primary engine, a pinion gear driven by the starting engine, means for moving said pinion gear axially into mesh with the ring gear, power transmission means between the starting engine and the pinion gear, a lubricant retaining case inclosing said transmission means, and latch means including a part connected with the pinion gear and extending into said case for holding said gears in mesh.

7. In starting mechanism wherein a starting engine drives a pinion gear to be meshed with a ring gear on a primary engine, a bored shaft supporting the pinion gear for axial sliding movement into and out of mesh with the ring gear, a circumferentially grooved latch pin connected with the pinion gear and slidably disposed in the bore of said shaft, and latch means carried by the shaft and engageable with the latch pin groove for retaining the pinion gear in mesh with the ring gear.

8. In starting mechanism wherein a starting

engine drives a pinion gear to be meshed with a ring gear on a primary engine, a bored shaft supporting the pinion gear for axial sliding movement into and out of mesh with the ring gear, a grooved latch pin connected with the pinion gear and slidably disposed in the bore of said shaft, and latch means carried by the shaft and engageable with the groove in the latch pin for retaining the pinion gear in mesh with the ring gear, said latch means being arranged for centrifugally impelled releasing movement when the shaft attains a predetermined speed.

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