

Sept. 14, 1937.

R. O. HARPER

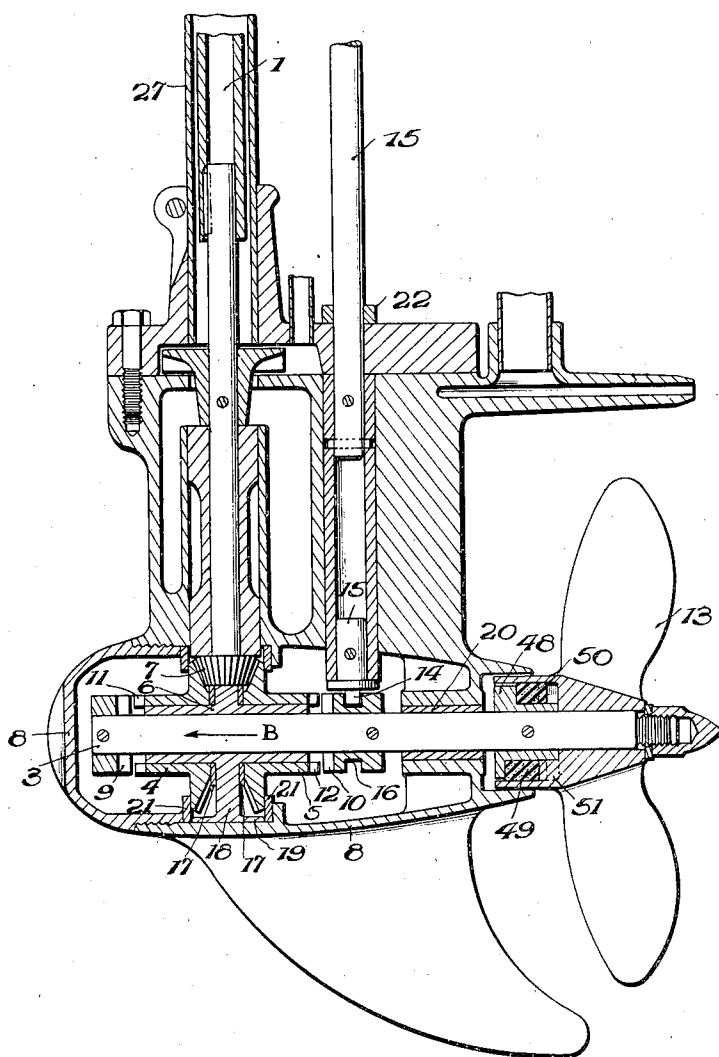
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OUTBOARD ENGINE AND DRIVING AND CONTROL MECHANISM THEREFOR

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3 Sheets-Sheet 1

FIG. 1.



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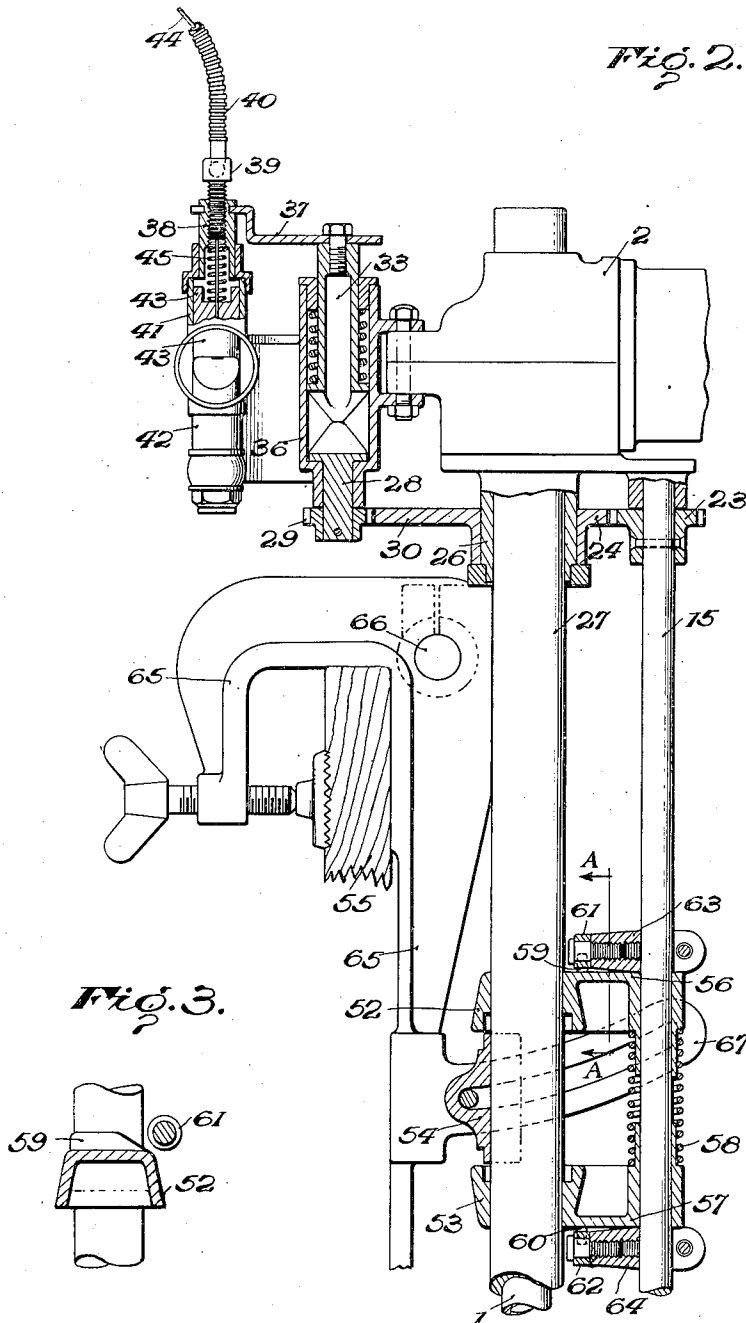
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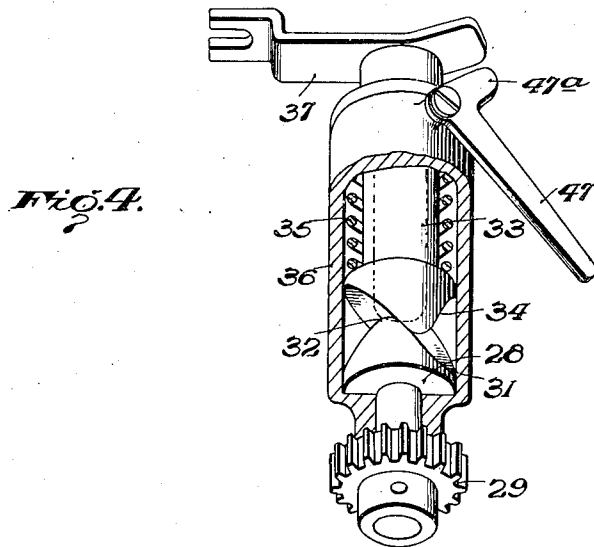
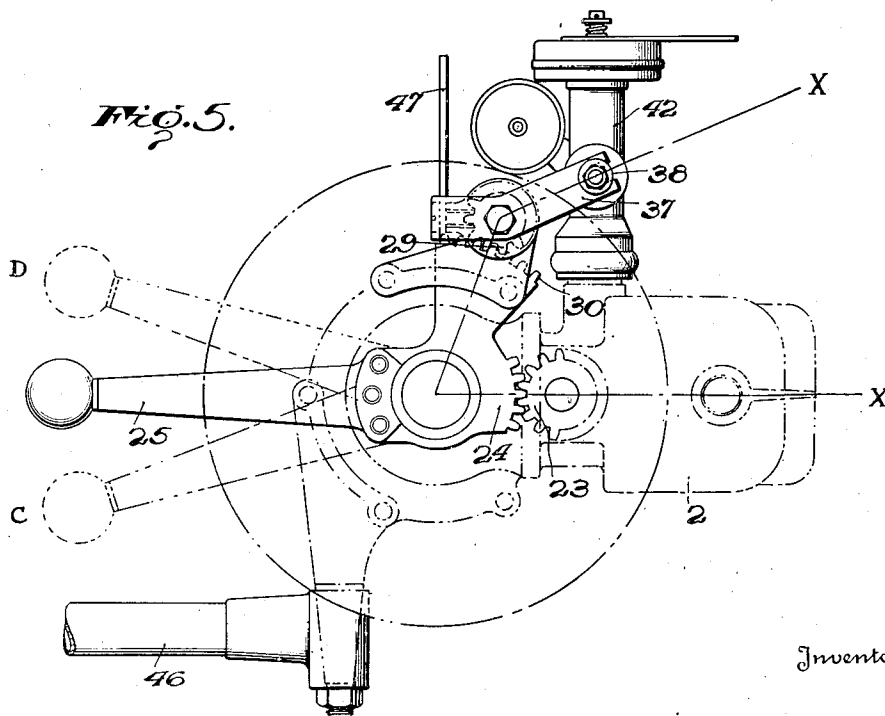
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OUTBOARD ENGINE AND DRIVING AND
CONTROL MECHANISM THEREFORRobert Owen Harper, Manchester, England, as-
signor of one-half to Imperial Chemical In-
dustries Limited, a corporation of Great BritainApplication January 2, 1935, Serial No. 157
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7 Claims. (Cl. 115-17)

This invention relates to outboard engines such as are used for propelling small boats on the water, and also to driving and control mechanism therefor, and it is intended especially for low power engines of this kind.

The object of my invention is to provide outboard engines of the kind referred to with improved mechanism which will enable the engine to drive the propeller in the forward direction and then in the reverse direction without having to stop the engine. A further object of the invention is to provide improved mechanism to enable the engine to be operated independently of the propeller. A still further object of my invention is to provide improved mechanism whereby the usual tilting device associated with this type of engine is automatically locked in a simple and effective manner to prevent the engine unit from tilting during reversal of the drive.

According to my invention, I provide an outboard engine having a forward and reverse gear mechanism, which is actuated by means of a gear change lever connected to means whereby the speed of the engine is automatically reduced to idling speed when the said gear change lever is moved towards the neutral position, in which position the engine driving shaft is entirely disconnected from the propeller shaft. By this means it is possible to transmit a positive drive to the propeller by means of jaw or like positive clutches without imposing any undue strains or damage to the clutch jaws or gear teeth when changing from forward to reverse or vice versa.

Other features of the invention are included in the following description of one method of carrying the same into effect. In order that the invention may be clearly understood reference is made to the accompanying drawings, in which:—

Figure 1 is a vertical section of the lower portion of the engine unit in the plane of the propeller shaft.

Figure 2 is a part sectional elevation of the upper portion of the engine unit and control mechanism, on the line "X—X" of Figure 5.

Figure 3 is a sectional detail on the line "A—A" of Figure 2.

Figure 4 is a part sectional perspective view showing part of the control mechanism.

Figure 5 is a plan view of the upper portion of the engine unit showing the gear change operating mechanism and the tiller arm.

The drive between the vertical power shaft 1, which is coupled to a standard two-stroke outboard motor 2, and the horizontal propeller shaft 3 is effected by means of bevel gearing as shown in

Figure 1. A reversible gear train is provided in known manner by means of two crown wheels 4 and 5, which are free to rotate on the outer surface of a sleeve bearing 6 carrying the propeller shaft 3, and a driving bevel wheel 7 which is secured to the vertical power shaft and is in constant mesh with the crown wheels.

The forward gear and reverse gear and attendant clutch mechanism are accommodated within an underwater housing 8, and in order that the size of this housing shall not be unduly increased (which would detract from the efficiency of the propeller) I arrange the drive from the crown wheels 4 and 5 to be transmitted to the propeller shaft by means of two small jaw or dog clutches 9 and 10 which are secured to the propeller shaft 3. The clutches are located on either side of the crown wheels as shown, and are adapted to engage with corresponding jaws 11 and 12 formed on the rear faces of the crown wheels 4 and 5 respectively.

To engage the forward gear, the propeller shaft 3, together with the propeller 13, is moved axially in the direction of arrow B to move the jaw clutches 10 into engagement with the jaws 12 on the crown wheel 5, the other jaw clutch 9 being at the same time moved out of engagement with the jaws 11 on the crown wheel 4. To engage reverse gear the propeller shaft is moved axially in the opposite direction, and the clutches are so disposed on the propeller shaft that in an intermediate position both clutches are disengaged, and in this neutral position no drive is transmitted to the propeller.

Axial movement of the propeller shaft to operate the gear change is effected by means of a cam-shaped projection 14 at the lower end of a vertical gear change rod 15 located behind and in line with the power shaft 1. The cam-shaped projection is shaped to engage with an annular groove 16 provided in the jaw clutch 10, and when the rod 15 is turned, the cam projection moves the clutches, together with the propeller shaft, in a horizontal direction. It will be seen that when the boat is driven in the forward direction the axial thrust due to the pitch of the propeller tends to keep the jaw clutch 10 in engagement with the crown wheel 5, and, when the reverse gear is engaged, the thrust of the propeller, which is also reversed in direction, tends to keep the jaw clutch 9 in engagement with the crown wheel 4.

The thrust of the propeller as it revolves in either direction is taken by annular thrust blocks 17 located between the front faces of the crown wheels and the supporting portion of the sleeve

bearing 6. The supporting part of the bearing 6 consists of a central annular web 18 carrying a cylindrical flange 19 on its periphery which fits into the underwater housing 8. The flange and also the web are cut away as shown to accommodate the lower end of the power shaft 1 and the driving bevel wheel 7. The propeller shaft is also supported by a water-tight bearing 20, and since the crown wheels revolve on the outer surface of the fixed supporting sleeve 6 the propeller shaft 3 is relieved of their journal and thrust loads. To ensure that the two crown wheels are permanently held in gear with the driving pinion, two further annular thrust blocks 21 are provided which bear on the rear faces of the crown wheels.

The gear change rod 15 is extended upwards from the underwater housing through a water-tight bearing 22 and to its upper end is fitted a small gear wheel 23 which engages with a toothed segment 24 which is connected to a hand operated gear change lever 25, as shown in Figures 2 and 5. The boss carrying the toothed segment is loosely mounted on a bearing 26 which is co-axial with the power shaft casing 27 so that the rotary movement of the lever causes the clutches to be engaged or disconnected through the action of the gear change rod 15. When the gear change lever 25 is moved from the position C, shown in dotted lines in Figure 5, to the position D, the direction of rotation of the propeller is changed from forward to reverse and when the lever is centrally disposed, as shown in full lines, the gear is in neutral and the engine operates independently of the propeller.

Since jaw clutches are used to engage the drive it is essential that when changing from forward to reverse or vice versa, the engine speed should be reduced to a minimum to avoid damaging the clutch jaws or the gear teeth, and this is arranged automatically by a device which is combined with the gear change mechanism. This device consists of a cam member 28 which is rotated by means of a small toothed pinion 29 which engages with a toothed segment 30 formed on the same boss as the segment 24, to which is affixed the gear change lever 25. The cam face formed on the rotatable cam member 28 has a root or hollow portion 31 and a raised portion 32 on either side thereof as shown in Figure 4. Co-operating with this cam member is a slidable member 33 having a cam face 34 of similar contour formed at its extremity. The two cam faces are retained in contact with each other by means of a spring 35, and the slidable member 33, which is prevented from rotating, is suitably guided within the casing 36. Thus, when the raised portions of the two cam faces are in contact with one another, the slidable member 33 is raised to its full extent and any small angular movement of the rotatable member 28 in either direction will cause the slidable member to be lowered.

To the upper end of the slidable member 33 is connected a bent lever 37 having one end forked as shown. This forked end engages a sleeve 38 which is threaded to receive the usual adjustable abutment socket 39 which houses the end of the outer casing 40 of the throttle control Bowden cable. The sleeve 38 is arranged to slide within the throttle chamber 41 of a carburetor 42. One end of the inner Bowden control wire cable 44 passes through the abutment socket 39 and the sleeve 38 and is connected to the throttle valve 43 in the usual manner, the usual light

spring 45 being used to give the necessary bias for closing the throttle valve. The other end of the Bowden wire cable is connected to a hand throttle control mechanism of the well known lever type (not shown on the drawings) and this is mounted in a suitable position on the tiller arm 46.

When the gear change lever is either in the forward or reverse position the raised portion of the cam face 34 of the slidable member 33 rides on the raised portion 32 of the rotatable cam 28 and the sleeve 38 together with the socket 39 supporting one end of the Bowden casing 40 is consequently lifted so that the slack or lost motion of the inner Bowden wire cable 44 is taken up to enable the hand operation of the throttle control to become effective. When, however, the gear change lever is in the neutral position, the cam face 34 of the slidable member rides on the hollow portion 31 of the cam 28 and the sleeve 38 is therefore depressed. The end of the outer Bowden casing 40 is therefore brought nearer to the carburetor 42 thus causing slackness and consequently lost motion of the inner Bowden wire 44 whereby the throttle valve 43 moves into the partly closed or idling position and the hand throttle control is rendered ineffective. Immediately the drive is re-engaged the same mechanism operates to take up the slackness or lost motion of the inner Bowden cable and the throttle valve again comes under the control of the hand control lever and is raised or opened to an extent governed by the said hand control which can then be operated in the ordinary manner.

When it is desired to make the hand throttle control operate the throttle valve 43 while the mechanism is in the neutral position, such as when starting or testing the engine, a hand operated bell crank lever 47 is arranged to keep the automatic throttle control device out of action by engaging the short arm 47a with the lever 37 to lift the sleeve 38, thus reducing the slackness or lost motion of the inner Bowden cable 44. Immediately the gear lever 25 is moved from the neutral position so as to raise the lever 37 clear of the arm 47a the long arm of the bell crank lever falls by gravity and the short arm 47a moves out of engagement with the lever 37, the arrangement being such that a separate hand operation is necessary to reset the lever 47. Alternatively, a catch linked to the gear change mechanism may be arranged to lock the gear change lever in the neutral position and to hold the automatic throttle control sleeve in its uppermost position while the engine is being tested under the control of the hand-throttle lever.

In addition to reducing the engine speed when operating the gear clutch mechanism, we may further reduce wear and shock to the gears and clutches during this operation by incorporating in the driving mechanism a yieldable coupling. This coupling consists of a driving segment 48 which loosely engages with a corresponding resilient rubber segment or buffer 49 adapted to be housed in the propeller boss 50, the propeller 13 being connected to the rubber buffer by means of radial segments as indicated at 51. Alternatively, the vertical driving shaft may be made in two portions and a yieldable coupling introduced at the break to absorb any slight shock to the transmission when changing gear.

The method of mounting the gear change lever and rod previously described ensures that when the whole engine structure is pivoted about the

power shaft to steer the boat in the usual manner, this lever also moves with it and so keeps the gear change mechanism in the same position. The usual tilting of the engine structure, which occurs when the underwater housing or propeller strikes an obstacle while the boat is travelling in a forward direction, can also take place without affecting the control lever or gear engagement. When the drive is changed to reverse the motion of the boat, the whole engine tends to tilt due to the reversal of the traction of the propeller and we may arrange to prevent this automatically by a device cooperating with the gear change rod described above, which locks the engine structure in the vertical position when the gear change lever is moved into the reverse position.

This is accomplished as shown in Figure 2 by two short slidable rings or collars 52 and 53 which are mounted loosely on the power shaft casing 27 one above and one below the usual saddle bearing 54 which is clamped to the stern of the boat 55 and against which the power shaft casing presses when the forward gear is engaged. These collars are conveniently conically shaped on the outside and have annular sockets adapted to fit over the ends of the saddle bearing and thereby lock the engine in position.

The conical collars 52 and 53 have extensions 56 and 57, the end portions of which are bored and mounted slidably upon the gear change rod. A spring 58 is interposed between the extended portions of the collars to keep them normally apart so that the usual tilting arrangement is operable when the gear change lever is in the forward or neutral positions. Inclined planes 59 and 60 are formed on the extended portions 56 and 57 respectively and these inclined planes are acted upon by rollers 61 and 62 carried on radial arms 63 and 64 which are firmly but adjustably affixed to the gear change rod 15.

The arrangement is such that when the gear change lever 25 is moved into the reverse position, the turning of the gear change rod 15 and radial arms 63 and 64 causes the rollers 61 and 62 to contact with the inclined planes 59 and 60 to move the collars 52 and 53 towards one another. The collars are thereby adapted to slide over and embrace the ends of the saddle bearing 54 and in this position the whole engine structure is retained against the supporting bracket 65, thus automatically preventing the tilting arrangement from operating, but leaving the engine free to pivot for steering purposes.

When the gear change lever 25 is moved again from the reverse to the neutral or forward positions this mechanism disengages the sliding collars from the saddle bearing to permit the engine unit to tilt about the pivot point 66 in the usual manner. The usual type of slotted quadrant 67 attached to the bracket 65 is provided to carry the saddle bearing which may thus be adjusted along the slots for the purpose of setting the propeller shaft in a horizontal plane and the bracket 65 at any angle which suits the transom of the boat to which the engine unit is attached.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that I do not limit myself to the specific embodiments thereof, except as defined in the appended claims.

I claim:

1. An outboard engine comprising a power shaft, a propeller shaft, a sleeve bearing support-

ing said propeller shaft, a reversible gear train connecting said power and propeller shafts comprising a bevel gear secured to said power shaft, a pair of crown wheels rotatably mounted on the outer surface of said sleeve bearing and in constant mesh with said bevel wheel, positive clutch members secured to said propeller shaft and adapted to engage with positive clutch members formed on said crown wheels to provide forward or reverse rotation of said propeller shaft, and a gear change lever movable to forward, reverse and neutral positions for axially displacing the propeller shaft to engage or disengage the clutch members, means for controlling the speed of said engine, and means interconnecting the gear change lever and the engine speed control whereby the speed of the engine is automatically reduced during displacement of said gear change lever.

2. An outboard engine as claimed in claim 1 in which the engine is provided with a carburetor having a throttle valve, and the means for automatically reducing the speed of the engine includes a Bowden control cable having an outside casing and a slidable sleeve connected to said casing, said sleeve being movable towards the throttle valve of the engine carburetor when the gear change lever is moved into neutral position to cause slackness and consequent lost motion of the inner Bowden cable whereby the throttle valve connected thereto is automatically moved into partly closed or idling position.

3. An outboard engine as claimed in claim 1 in which the engine is provided with a carburetor having a throttle valve, and the means for automatically reducing the speed of the engine includes a Bowden control cable having an outside casing and a slidable sleeve connected to said casing, said sleeve being movable towards the throttle valve of the engine carburetor when the gear change lever is moved into neutral position to cause slackness and consequent lost motion of the inner Bowden cable whereby the throttle valve connected thereto is automatically moved into partly closed or idling position, and means for moving said slidable sleeve comprising a rotatable member operated by said gear change lever, and a non-rotatable slidable member connected to said slidable sleeve and having a cam face at its extremity which is resiliently pressed into contact with a cooperating cam face provided on said rotatable member.

4. An outboard engine as claimed in claim 1 in which an auxiliary hand operated lever is provided to engage and hold the automatic speed reducing means out of action at will while the gear change mechanism is in the neutral position.

5. An outboard engine as claimed in claim 1, in which an auxiliary hand operated lever is provided to engage and hold the automatic speed reducing means out of action at will while the gear change mechanism is in the neutral position, the auxiliary lever being automatically disconnected when the gear change lever is moved and requiring resetting by a separate hand operation.

6. An outboard engine as claimed in claim 1 in which the engine and propeller shaft are adapted to tilt rearwardly as a unit when the propeller strikes an obstacle on the forward drive and in which locking means are provided for automatically preventing said unit from tilting during reversal of the drive, said locking means comprising a stationary part, a rotatable gear change rod operable by said gear change lever and a slidable collar connected to the tilting unit

and operable by said gear change rod to engage said stationary part to lock the tilting unit thereto when the gear change lever is operated to engage the reverse gear.

- 5 7. An outboard engine as claimed in claim 1 in which the engine and propeller shaft are adapted to tilt rearwardly as a unit when the propeller strikes an obstacle on the forward drive and in which locking means are provided for
10 automatically preventing said unit from tilting during reversal of the drive, said locking means

comprising a stationary part and slidable collars connected to the tilting unit and adapted to engage said stationary part to lock the tilting unit thereto when the gear change lever is operated to engage the reverse gear, said collars being provided with inclined surfaces, a rotatable gear change rod operated by said gear change lever and radial arms attached to said rod and co-operating with said inclined surfaces to operate said sliding collars. 5

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