

March 11, 1958

J. F. MORSE
ENGINE CONTROL UNIT

2,826,283

Filed Jan. 8, 1957

4 Sheets-Sheet 3

FIG. 4

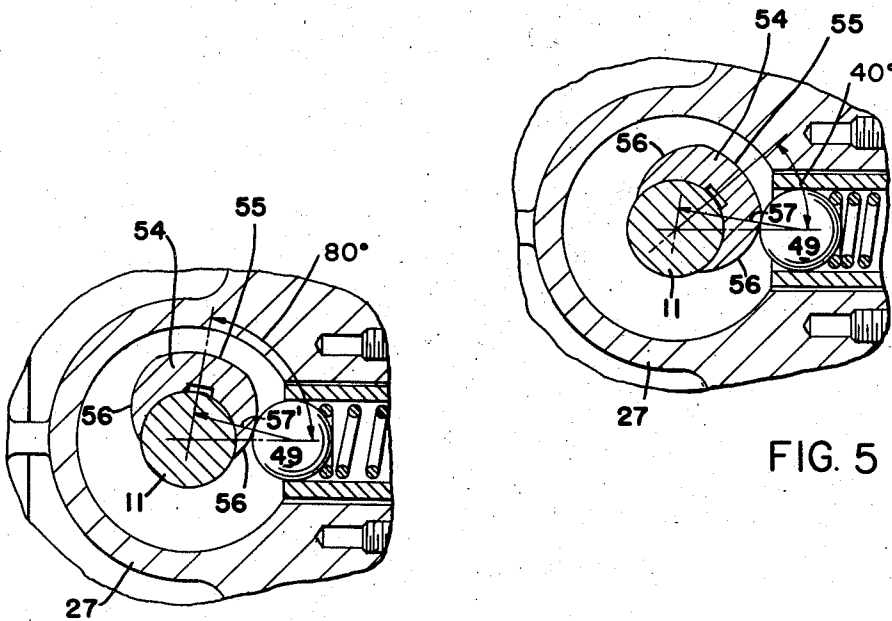
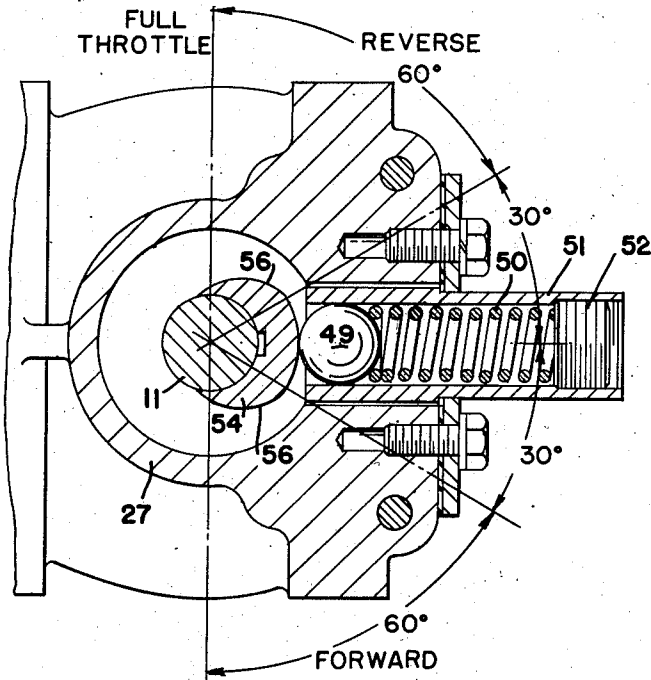


FIG. 5

FIG. 6

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FIG. 7

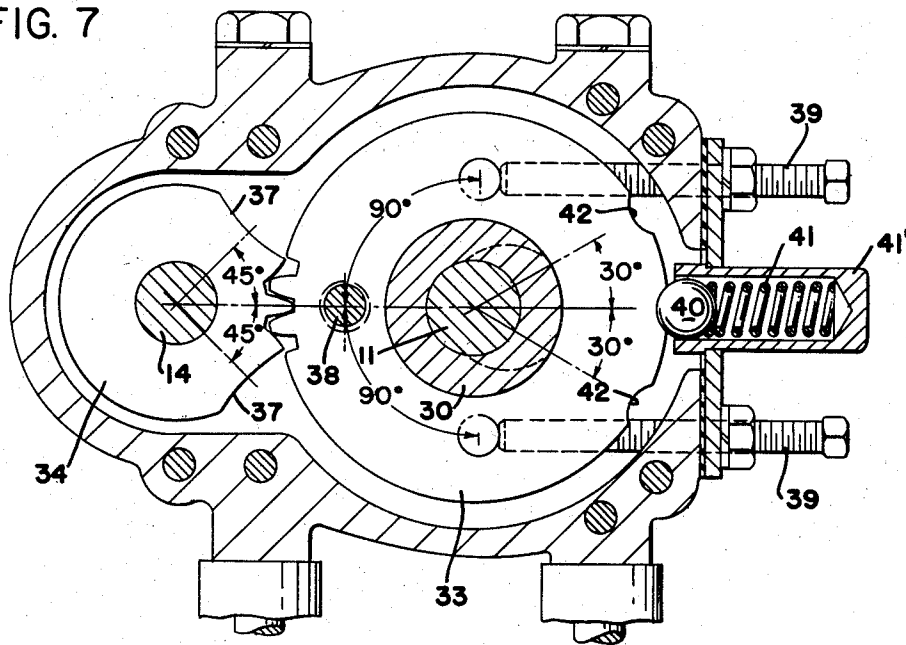
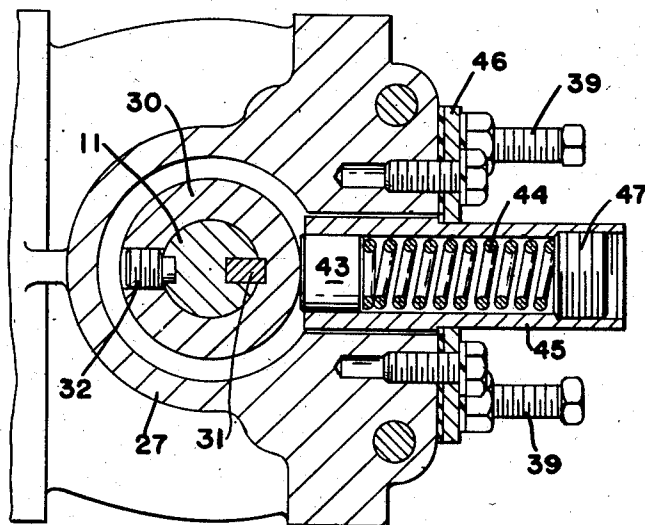


FIG. 8



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2,826,283

ENGINE CONTROL UNIT

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16 Claims. (Cl. 192—096)

This invention relates to a control unit for controlling the clutch and throttle motions of an engine. The control unit of the invention controls the clutch and throttle motions by the movement of a single control shaft, the first part of the movement in either direction serving to engage the clutch, and further movement in the same direction serving to progressively open the throttle.

The improved control unit may be used equally well with diesel engines and gasoline engines. However, it is designed primarily for use with diesel engines of the marine propulsion type having a clutch-controlled hydraulically driven reverse gear for rotating the propeller either in a forward or reverse direction. The control unit will be described herein particularly as applied to a marine diesel engine having a spring loaded mechanical governor which tends to return the throttle to idling position and requires some opposing force to hold the throttle at any open position beyond idle speed.

Certain prior holding mechanisms have consisted of mechanical ratchet latching means to hold the throttle in position, but such mechanisms have a limited number of definite positions, which is a decided disadvantage where absolute synchronization of speeds of twin engines is required, for example. The present control unit has a novel holding mechanism which enables latching the throttle at an infinite number of positions, and the holding force can be adjusted exactly to meet requirements.

Other features of the invention include the provision of a separate brake for holding the throttle setting against movement in either direction due to engine vibration, and positive stops in the control unit for limiting travel of the control shaft in either direction to prevent damage to the governor mechanism by overtravel of the control mechanism.

The improved control unit embodying all of these features is compact and inexpensive to make, and is adapted for dual control, or for operation selectively from pilot house and engine room.

The unit comprises a gear unit having a control shaft driven by suitable means, such as a cable and pulley system from the pilot house, the shaft operating a gear train to transmit motion to both the clutch and throttle, there being a lost-motion connection between the shaft and throttle to allow engagement of the clutch in either forward or reverse position before moving the throttle, and brake means applied to said control shaft for holding it at an infinite number of settings above idle speed.

A preferred embodiment is shown by way of example in the accompanying drawings and described herein. Various modifications and changes in details of construction may be made by way of example without departing from the scope of the invention as defined in the appended claims.

Referring to the drawings:

Fig. 1 is a somewhat schematic view showing the improved control unit connected by push rods to the clutch and throttle levers of a marine diesel engine, said unit being adapted for actuation from a remote point.

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Fig. 2 is an enlarged elevational view of the improved control unit, as on line 2—2 of Fig. 3.

Fig. 3 is an enlarged axial sectional view of said control unit as on line 3—3 of Fig. 1.

Fig. 4 is a cross sectional view on line 4—4 of Fig. 3, showing the control shaft at neutral position.

Figs. 5 and 6 are similar fragmentary views showing different positions of the control shaft.

Fig. 7 is a cross sectional view on line 7—7 of Fig. 3 showing the control shaft at neutral position.

Fig. 8 is a fragmentary cross sectional view on line 8—8 of Fig. 3.

Referring first to Figs. 1 and 2, the control unit indicated generally at 10 has a main drive shaft 11 which is operatively connected by a pull rod 12 to the throttle lever 13 on the governor of a diesel engine outlined in chain lines in Fig. 1. The unit also has a clutch drive shaft 14 actuated by the main shaft 11 and operatively connected to the clutch lever 15 of the engine by a push rod 16.

The means for rotating the main shaft 11 in either direction to operate the clutch and throttle may be a sprocket 17 fixed on the shaft by set screw 17' and operated by a chain 18 which is operatively connected to a remote station such as the pilot house by a cable and pulley system as shown in my Patent No. 2,737,822, or by other suitable motion transfer mechanism. As shown in Fig. 1, the unit 10 may be mounted on the engine by means of a bracket plate 19 or the like. For dual control a second sprocket 17A may be fixed on the shaft (Fig. 3), and for engine room control an operating lever (not shown) may be secured directly on the end of the shaft.

The pull rod 12 is connected to the throttle lever 13 by means of a slot and pin connection indicated at 20 to provide a lost-motion connection allowing the main drive shaft to rotate substantially 30° in either direction before the throttle lever is actuated. After the initial 30° of movement, the next 60° of movement of the main drive shaft in either direction actuates the throttle lever 13 to its full open position, as indicated in chain lines in Fig. 1. The initial 30° of movement of the main drive shaft actuates the clutch lever 15 to engage the reverse gear of the engine in ahead or astern driving position.

As best shown in Figs. 2 and 3, the shafts 11 and 14 of the unit have secured thereon control levers 21 and 22 respectively, which provide adjustable connections with the pull and push rods 12 and 16, respectively. The levers 21 and 22 have slots 23, and clamping bolts 24 attached to the rods extend through the slots 23. The clamping bolts have serrated portions 25 for interfitting the serrations 26 on the levers 21 and 22 for holding the connections at any desired adjusted position. The bolts 24 may have ball joint connections 26' with the pull and push rods 12 and 16. These adjustable connections are highly desirable when installing the control unit in the field, because they enable adjustment to obtain the correct throw of the throttle and clutch control levers without the necessity of drilling special holes in the levers.

Referring to Fig. 3, the control unit includes a gear housing 27 in which the shafts 11 and 14 are journaled. Secured on the hub of the housing adjacent sprocket 17 is a bracket plate 28 to which a compression strut 29 is attached for connecting the housing to the adjacent conduit of a cable and pulley system driving the chain 18. The function of this strut is fully disclosed in my Patent No. 2,737,822.

Within the housing 27 is a sleeve 30 fixed to the shaft 11 by a key 31 and set screw 32. Fixed on the central portion of the sleeve 30 is a mutilated or interrupted gear 33 (Fig. 7), having a toothed peripheral portion meshing with the mutilated gear 34 fixed on the shaft 14 by a set screw 35. The ratio of the gears 33 and 34 is such that 30° rotation of gear 33 will rotate the gear 34 through

45°, which rotates the shaft 14 and the clutch lever 15 45° on each side of neutral, as indicated in Fig. 1. This 90° movement is required to engage the clutch of the reverse gear in its forward and reverse driving positions, in accordance with conventional engine reverse gear construction.

When the main drive shaft is rotated beyond 30° in either direction to actuate the throttle lever 13, the gear 33 can rotate relative to gear 34 because the gear teeth are disengaged, but the clutch drive shaft 14 cannot rotate because one or the other of the arcuate surfaces 37 on gear 34 is in substantial abutment with the outer circumference of gear 33.

A stop stud 38 is secured in gear 33 opposite its toothed portion, and adjustable stop screws 39 are threaded into the housing to abut the stud and positively limit the gear 33 to rotation of substantially 90° on either side of its neutral position, as required. These stop screws prevent damage to the usual stops on the governor mechanism, resulting from overtravel of the actuating mechanism, as by applying excessive force at the pilot house.

Preferably, a detent ball 40, urged against the periphery of gear 33 by a spring 41 housed in a tube 41' is provided to yieldingly hold the gear in neutral, or in the forward and reverse idle positions of the throttle. For this purpose arcuate depressions 42, cooperating with ball 40, are provided 30° apart on the periphery of the gear 33.

In the control of diesel engines there are usually two forces which tend to move the throttle setting if the control is not positively latched in position, as by a ratchet pawl. One of these forces is engine vibration which tends to jiggle the throttle off any given setting. The present control unit is provided with a two-way friction brake which is applied by adjustable spring compression to the main drive shaft 11. Referring to Figs. 3 and 8, this brake comprises a brake shoe 43, preferably of composition material such as Micarta, which is urged radially against one end portion of the sleeve 30 by a spring 44. The shoe and spring are housed in a tube 45 inserted through the cover plate 46 of the housing 27, adjacent to the tube 41'. An adjustment screw 47 in the outer end of the tube 45 abuts the spring 44.

The other force tending to disturb the throttle setting is the tendency of the spring-loaded governor on the diesel engine to return the throttle to idle position from any advanced throttle position, and the force increases as the throttle is advanced toward full open position. To counteract this force, the present control unit provides an adjustable one-way brake which opposes the throttle return at all times and which automatically increases in pressure as the throttle is advanced to balance the opposing force.

Referring to Figs. 3 and 4, the novel one-way brake comprises a hardened steel ball 49 urged radially inward by a spring 50 against the sleeve 30 on the opposite side of gear 33 from brake shoe 43. The ball and spring are housed in a tube 51 inserted through the cover plate 46 of the housing 27, and an adjustment screw 52 abutting the spring 50 is screwed in the outer end of tube 51.

In order to make the ball 49 act as a one-way brake opposing the force of the governor spring for any throttle setting beyond idle in either direction, a cam 54 is formed on the end of sleeve 30 against which the ball abuts. As seen in cross-section in Figs. 4-6, this cam 54 has a central surface 55 curved concentrically with the shaft 11 and extending 60° transversely of the shaft, that is, 30° on each side of the ball when the shaft is in neutral position as in Fig. 4. Thus, as the shaft is rotated 30° in either direction to engage the clutch, the amount of frictional resistance applied by radial pressure of the ball is very small and acts equally in both directions.

However, the center of the curved surfaces 56 of the cam extending beyond the surface 55 through an angle of substantially 60° on either side is eccentric to the center of shaft 11, with the result that as the ball rolls

over either surface 56 it exerts a force in the direction of rotation of the shaft 11 and opposing the tendency of the governor to return the shaft. As shown in Figs. 5 and 6, when the shaft 11 is rotated counterclockwise beyond the 30° angle and the ball 49 contacts one of the cam surfaces 56, a resultant component of force is applied normal to the common tangent of the contacting surfaces in the direction of rotation.

Due to the curve of the cam surface 56, it will be seen by comparing Figs. 5 and 6, that as the angle of rotation increases, the turning movement, applied to shaft 11 by the resultant component represented by the arrows 57 and 57', increases until the total rotation in either direction reaches approximately 90°. In Fig. 5, the amount of rotation counterclockwise from neutral position is shown as 40° and in Fig. 6 it is shown as 80°.

In the operation of the improved control unit, it is apparent from the foregoing description that when the main control shaft 11 is at neutral position, rotation of 30° in either direction will operate the clutch control lever 15 opening the throttle. When the shaft is rotated beyond 30° in the desired direction the throttle will be opened and may be left at any desired position up to full throttle at 90° from neutral. Any tendency of the throttle to return toward idle due to the force exerted by a spring-loaded governor on the engine is opposed by the one-way brake, and the force exerted by its spring is adjustable, while the force applied to the shaft is automatically varied to balance the variation of the force exerted by the governor. The two-way brake 43 affords additional means to hold the throttle setting against jiggling due to vibration to supplement the action of the one-way brake.

Obviously, the improved control unit can be applied to the clutch and carburetor controls of a gasoline engine.

Thus, the novel unit provides a compact and inexpensive control unit which is quickly installed and easily and accurately adjusted, and which has positive means for holding the throttle at an infinite number of adjusted positions against its tendency to move due to the force of the governor spring or to engine vibration.

What is claimed is:

1. A control unit for the clutch and throttle of an engine, having a main drive shaft, a housing journaling said shaft, a cam portion formed on said shaft, a ball frictionally engaging said cam portion, spring means in said housing urging said ball against said cam portion, said cam having a central portion transversely concentric of said shaft, and an eccentric curved surface on each side of said central portion for applying a resultant component of force in the direction of rotation of the shaft as it is rotated to bring the ball into contact with said eccentric curved surface.

2. A control unit having a main drive shaft for operative connection with the clutch and throttle of an engine, a housing journaling said shaft, a cam portion formed on said shaft, a spring-pressed ball mounted in said housing and frictionally engaging said cam portion, said cam portion having a central transversely curved portion concentric with said shaft, for engaging said ball during rotation of the shaft in either direction to engage the clutch of the engine, and said cam having an eccentric curved surface on each side of said central portion for engaging said ball during further rotation, said eccentric curved portions being so constructed and arranged to apply a progressively increasing resultant force component to the shaft in its direction of rotation.

3. A control unit for the clutch and throttle of an engine, having a main drive shaft, a housing journaling said shaft, a cam portion formed on said shaft, a ball frictionally engaging said cam portion, spring means in said housing urging said ball against said cam portion, said cam having a central portion transversely concentric of said shaft, an eccentric curved surface on each side of said central portion for applying a resultant component of force in the direction of rotation

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of the shaft as it is rotated to bring the ball into contact with said eccentric curved surface, and separate friction brake means contacting said drive shaft to prevent rotation of the shaft due to engine vibration.

4. A control unit having a main drive shaft for operative connection with the clutch and throttle of an engine, a housing journaling said shaft, a cam portion formed on said shaft, a spring-pressed ball mounted in said housing and frictionally engaging said cam portion, said cam portion having a central transversely curved portion concentric with said shaft, for engaging said ball during rotation of the shaft in either direction to engage the clutch of the engine, said cam having an eccentric curved surface on each side of said central portion for engaging said ball during further rotation, said eccentric curved portions being so constructed and arranged to apply a progressively increasing resultant force component to the shaft in its direction of rotation, and separate friction brake means contacting said drive shaft to prevent rotation of the shaft due to engine vibration.

5. A control unit for the clutch and throttle of an engine, having a main drive shaft, a housing journaling said shaft, a cam portion formed on said shaft, a ball frictionally engaging said cam portion, spring means in said housing urging said ball against said cam portion, said cam having a central portion transversely concentric of said shaft, an eccentric curved surface on each side of said central portion for applying a resultant component of force in the direction of rotation of the shaft as it is rotated to bring the ball into contact with said eccentric curved surface, and positive stops in said housing for limiting rotation of said shaft in either direction.

6. A control unit having a main drive shaft for operative connection with the clutch and throttle of an engine, a housing journaling said shaft, a cam portion formed on said shaft, a spring-pressed ball mounted in said housing and frictionally engaging said cam portion, said cam portion having a central transversely curved portion concentric with said shaft, for engaging said ball during rotation of the shaft in either direction to engage the clutch of the engine, said cam having an eccentric curved surface on each side of said central portion for engaging said ball during further rotation, said eccentric curved portions being so constructed and arranged to apply a progressively increasing resultant force component to the shaft in its direction of rotation, and positive stops in said housing for limiting rotation of said shaft in either direction.

7. A control unit for the clutch and throttle of an engine, having a main drive shaft, a housing journaling said shaft, a cam portion formed on said shaft, a ball frictionally engaging said cam portion, spring means in said housing urging said ball against said cam portion, said cam having a central portion transversely concentric of said shaft, an eccentric curved surface on each side of said central portion for applying a resultant component of force in the direction of rotation of the shaft as it is rotated to bring the ball into contact with said eccentric curved surface, separate friction brake means contacting said drive shaft to prevent rotation of the shaft due to engine vibration, and positive stops in said housing for limiting rotation of said shaft in either direction.

8. A control unit having a main drive shaft for operative connection with the clutch and throttle of an engine, a housing journaling said shaft, a cam portion formed on said shaft, a spring-pressed ball mounted in said housing and frictionally engaging said cam portion, said cam portion having a central transversely curved portion concentric with said shaft, for engaging said ball during rotation of the shaft in either direction to engage the clutch of the engine, said cam having an eccentric curved surface on each side of said central portion for engaging said ball during further rotation, said eccentric curved portions being so constructed and arranged to apply a progressively

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increasing resultant force component to the shaft in its direction of rotation, separate friction brake means contacting said drive shaft to prevent rotation of the shaft due to engine vibration, and positive stops in said housing for limiting rotation of said shaft in either direction.

9. A control unit having a main drive shaft for operative connection with the clutch and throttle of an engine, a housing journaling said shaft, a throttle control lever secured on said shaft, a clutch operating shaft in said housing, gear means connecting said shafts for operating the clutch shaft only during the first part of rotation of the main shaft in either direction from a neutral position to a throttle idling speed position, stop means in said housing to limit rotation of said main drive shaft in either direction, a cam on said main drive shaft, and spring-biased brake means in said housing frictionally engaging said cam to oppose return rotation in either direction of said main drive shaft to a throttle idling speed position.

10. A control unit having a main drive shaft for operative connection with the clutch and throttle of an engine, a housing journaling said shaft, a throttle control lever secured on said shaft, a clutch operating shaft in said housing, gear means connecting said shafts for operating the clutch shaft only during the first part of rotation of the main shaft in either direction from a neutral position to a throttle idling speed position, stop means in said housing to limit rotation of said main drive shaft in either direction, a cam on said main drive shaft having a central transversely concentric portion and an eccentric portion on each side thereof, and spring-biased brake means in said housing engaging said cam to apply a resultant force component to the shaft in the direction of its rotation as the brake means engages either eccentric portion of said cam.

11. A control unit having a main drive shaft for operative connection with the clutch and throttle of an engine, a housing journaling said shaft, a throttle control lever secured on said shaft, a clutch operating shaft in said housing, gear means connecting said shafts for operating the clutch shaft only during the first part of rotation of the main shaft in either direction from a neutral position to a throttle idling speed position, stop means in said housing to limit rotation of said main drive shaft in either direction, a cam on said main drive shaft having a central transversely concentric portion and an eccentric portion on each side thereof, and spring-biased brake means in said housing engaging said cam to apply a resultant force component to the shaft in the direction of its rotation as the brake means engages either eccentric portion of said cam, said eccentric cam portions being so constructed and arranged as to apply a progressively increasing resultant force component to the shaft in its direction of rotation.

12. A control unit for the clutch and throttle of an engine, said unit having a main drive shaft, a housing journaling said shaft, an eccentric cam portion on said shaft, and spring-biased brake means frictionally engaging said cam portion, said cam portion being so constructed and arranged as to transmit a resultant force component to the shaft in the direction of its rotation when the shaft is rotated a predetermined degree from a neutral position.

13. In combination with an engine having clutch and throttle controls, a control unit for operating said controls having a main drive shaft, lost-motion means connecting said shaft with the throttle control for operating the throttle after a predetermined initial rotation of said shaft in either direction, gear means connected to said shaft for operating the clutch during said initial rotation, a cam on said main drive shaft, and spring-biased brake means in said housing frictionally engaging said cam to oppose return rotation of said shaft in either direction from beyond said initial rotational range.

14. In combination with an engine having clutch and throttle controls, a control unit for operating said controls having a main drive shaft, lost-motion means con-

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necting said shaft with the throttle control for operating the throttle after a predetermined initial rotation of said shaft in either direction, gear means connected to said shaft for operating the clutch during said initial rotation, a cam on said main drive shaft having a central transversely concentric portion and an adjacent eccentric portion on each side thereof, and spring-biased brake means in the housing frictionally engaging said cam, said eccentric portion transmitting a resultant force component to the shaft in the direction of its rotation when the shaft is rotated in either direction beyond said initial rotational range.

15. A control unit having a main drive shaft for operative connection with the clutch and throttle of an engine, a housing journaling said shaft, a throttle control lever secured on said shaft, a clutch operating shaft in said housing, gear means connecting said shafts for operating the clutch shaft only during the first part of rotation of the main shaft in either direction from a neutral position to a throttle idling speed position, a cam on said main drive shaft, and spring-biased brake means in

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said housing frictionally engaging said cam to oppose return rotation in either direction of said main drive shaft to a throttle idling speed position.

16. A control unit having a main drive shaft for operative connection with the clutch and throttle of an engine, a housing journaling said shaft, a throttle control lever secured on said shaft, a clutch operating shaft in said housing, gear means connecting said shafts for operating the clutch shaft only during the first part of rotation of the main shaft in either direction from a neutral position to a throttle idling speed position, a cam on said main drive shaft having a central transversely concentric portion and an eccentric portion on each side thereof, and spring-biased brake means in said housing engaging said cam to apply a resultant force component to the shaft in the direction of its rotation as the brake means engages either eccentric portion of said cam.

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