

March 2, 1971

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3,566,711

GATE PLATE INTERLOCK

Filed June 10, 1969

6 Sheets-Sheet 1

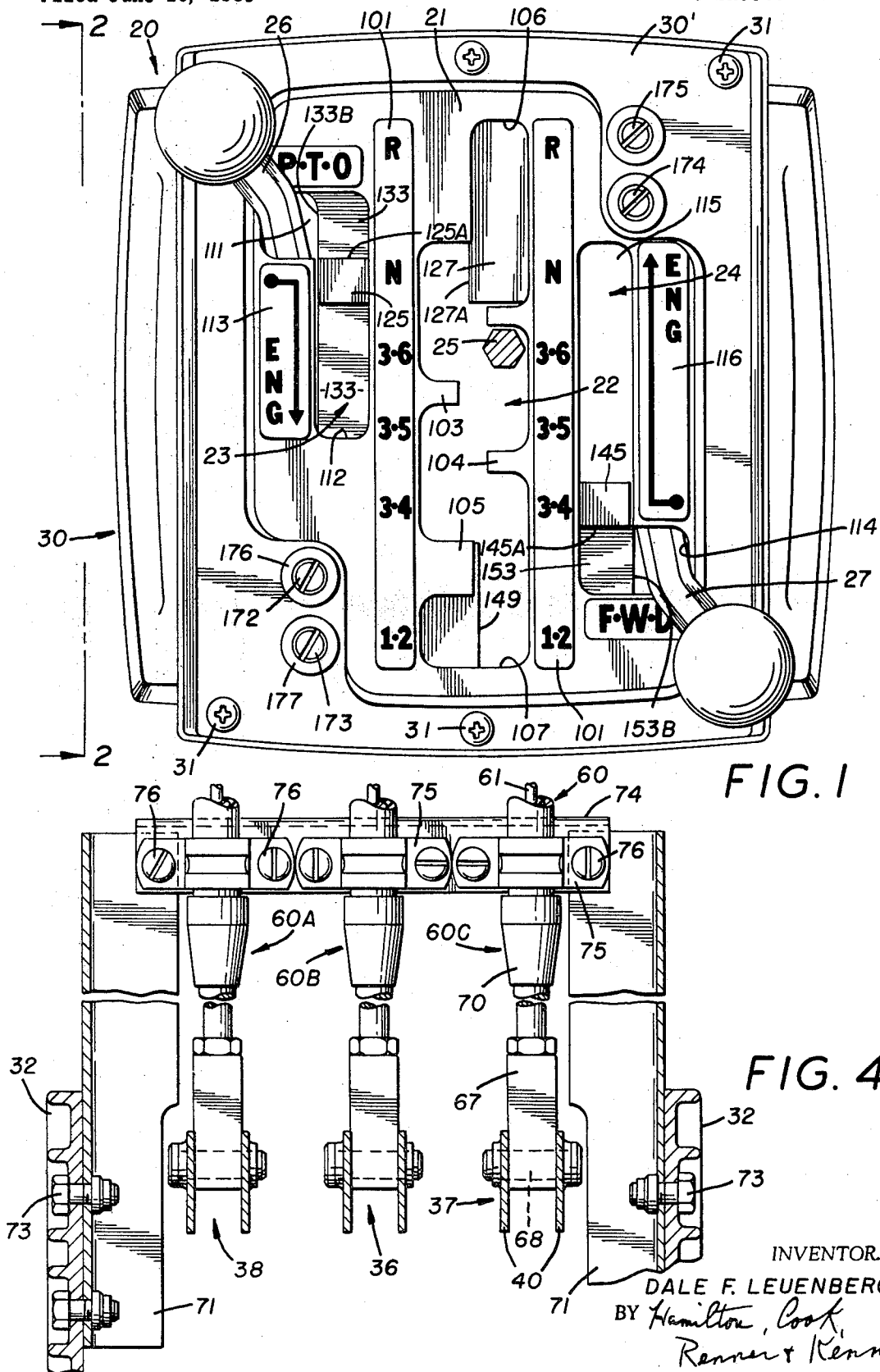


FIG. 1

FIG. 4

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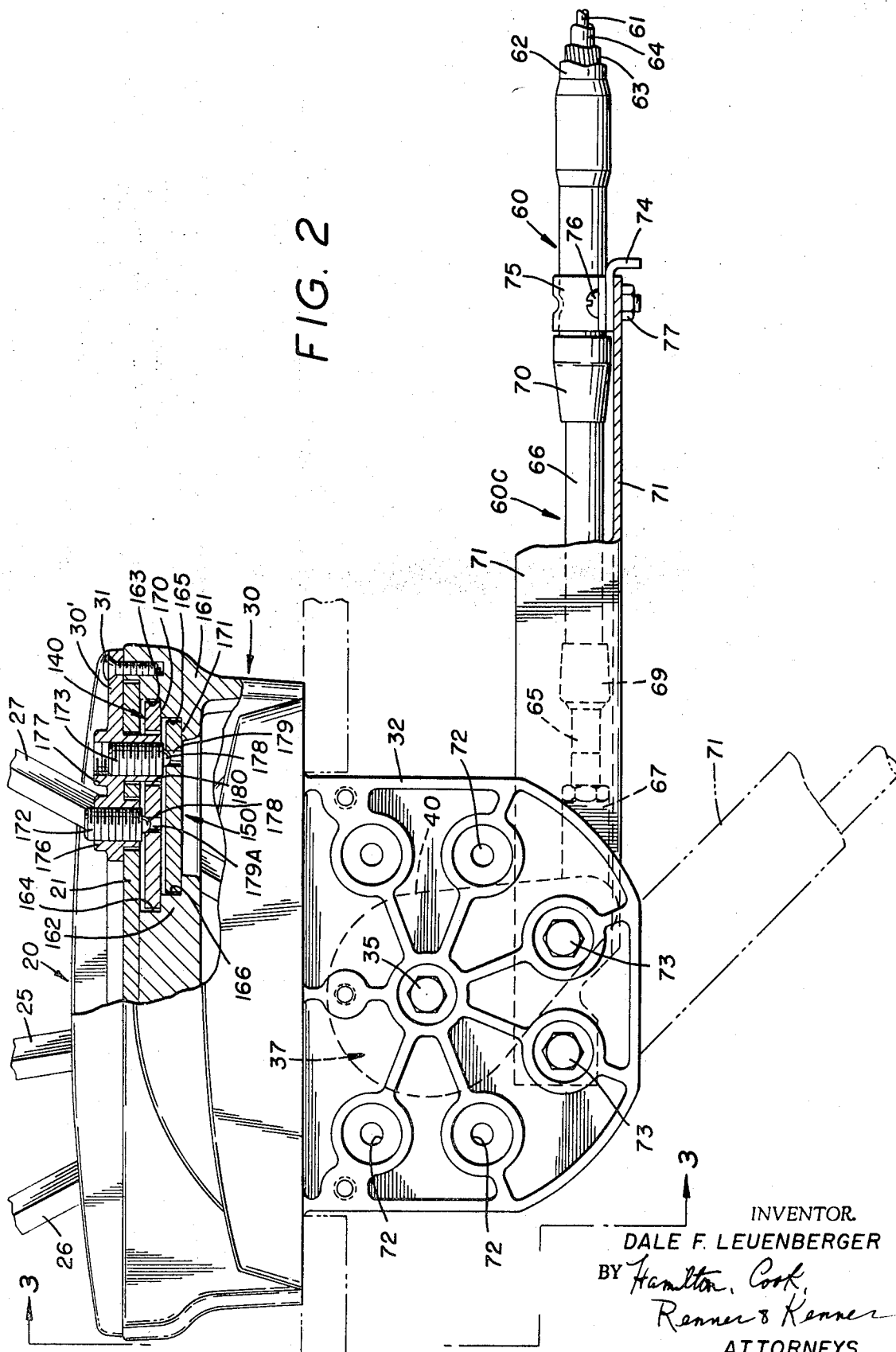
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FIG. 2



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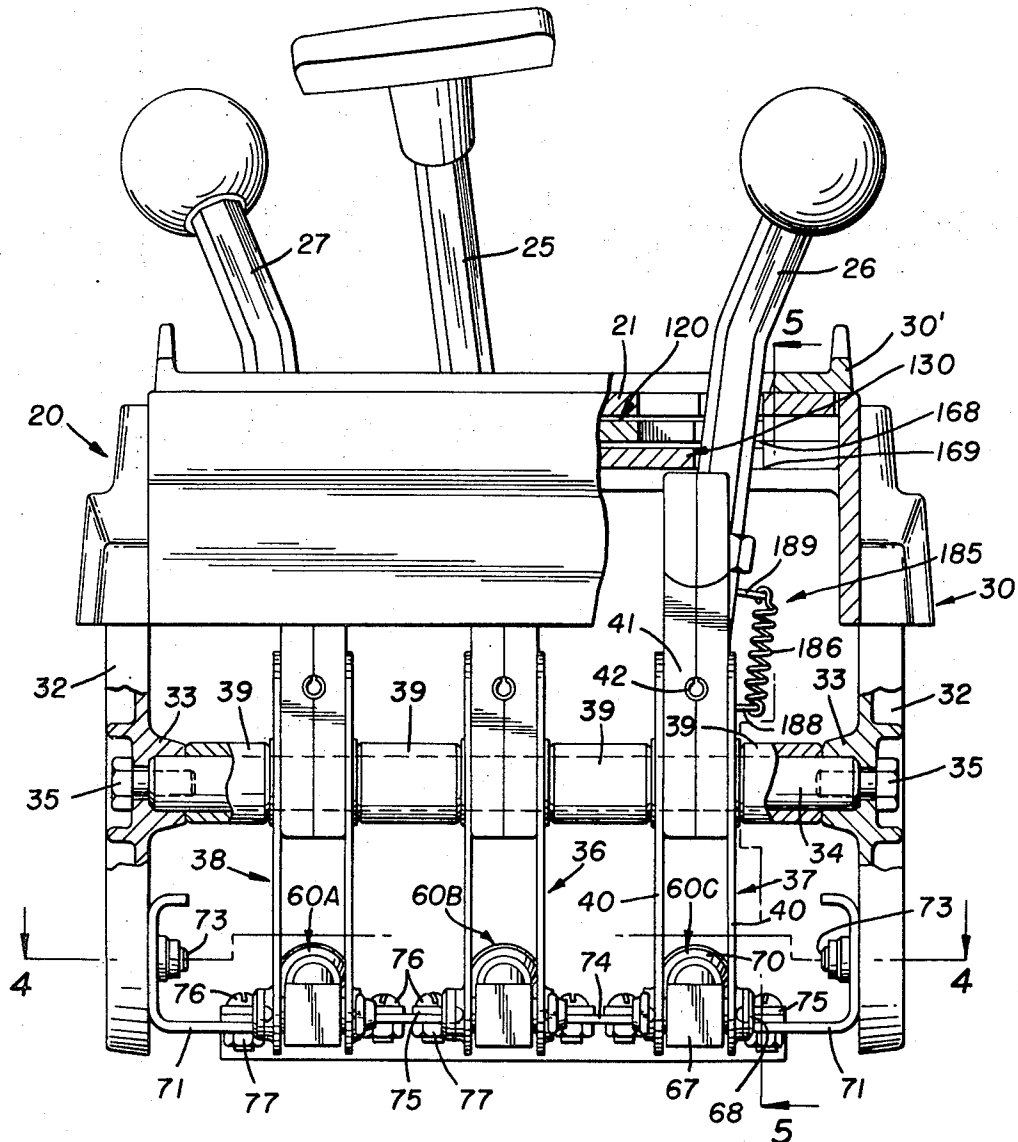


FIG. 3

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GATE PLATE INTERLOCK

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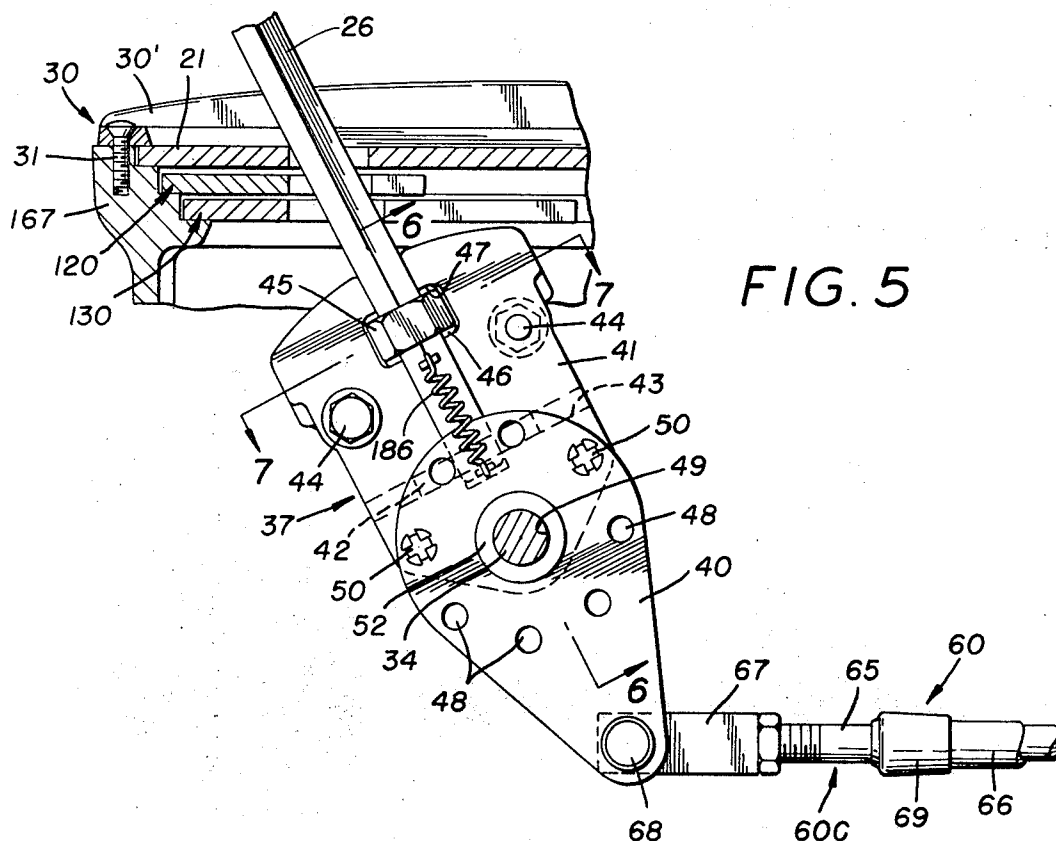


FIG. 5

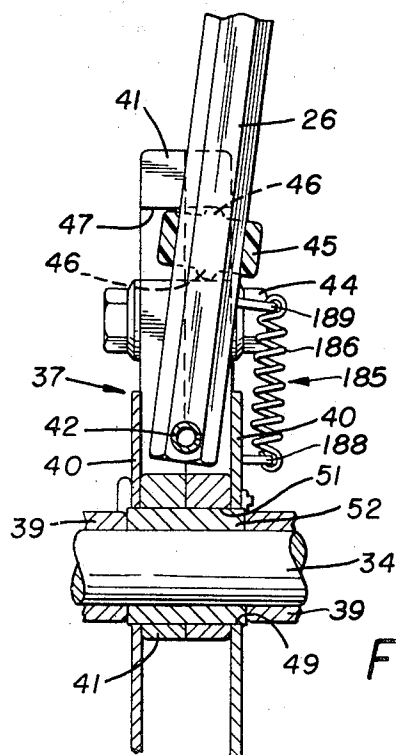


FIG. 6

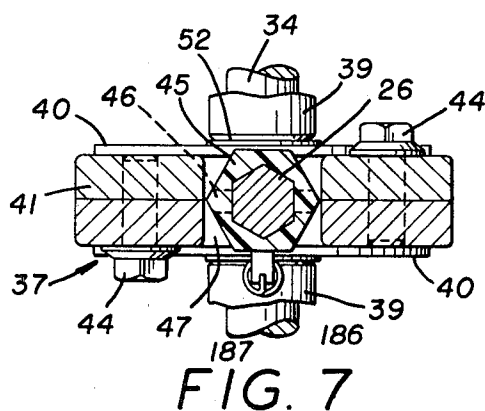


FIG. 7

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GATE PLATE INTERLOCK

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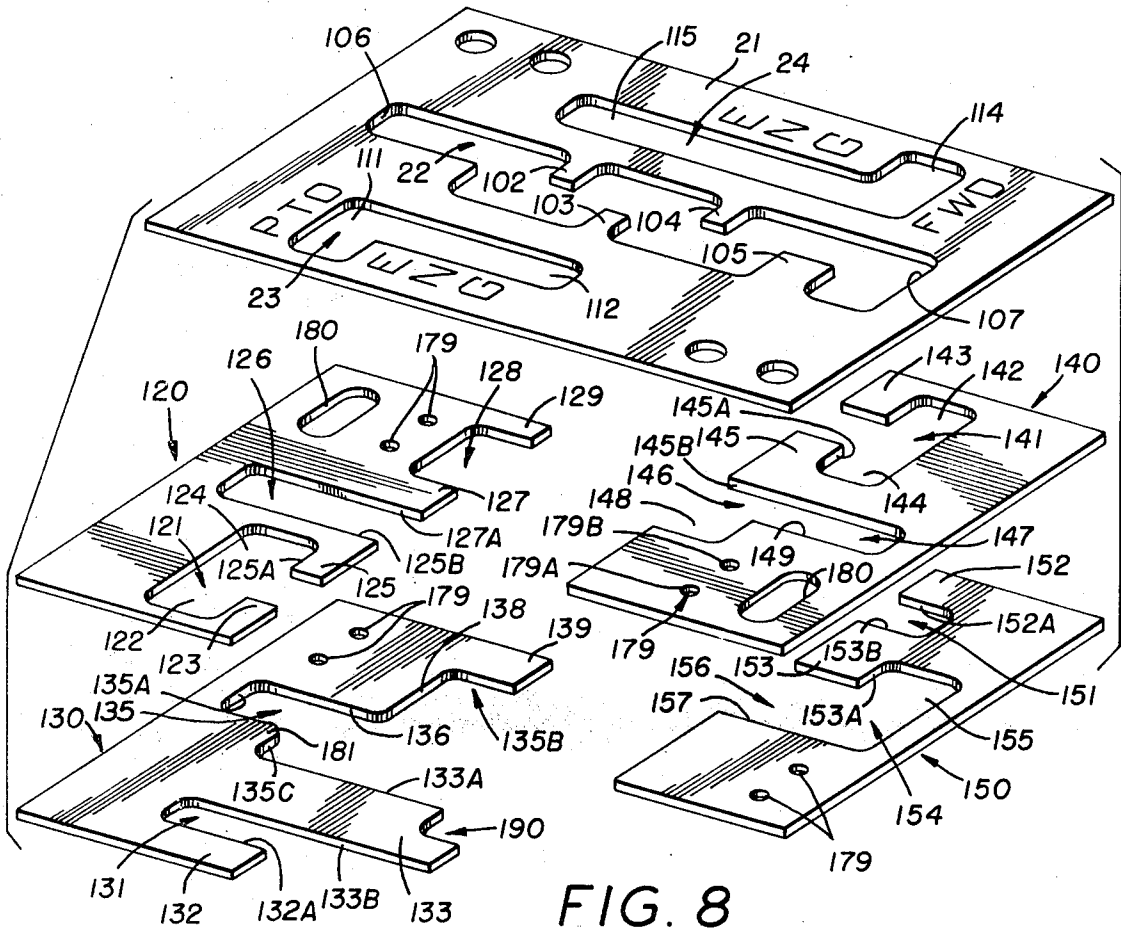


FIG. 8

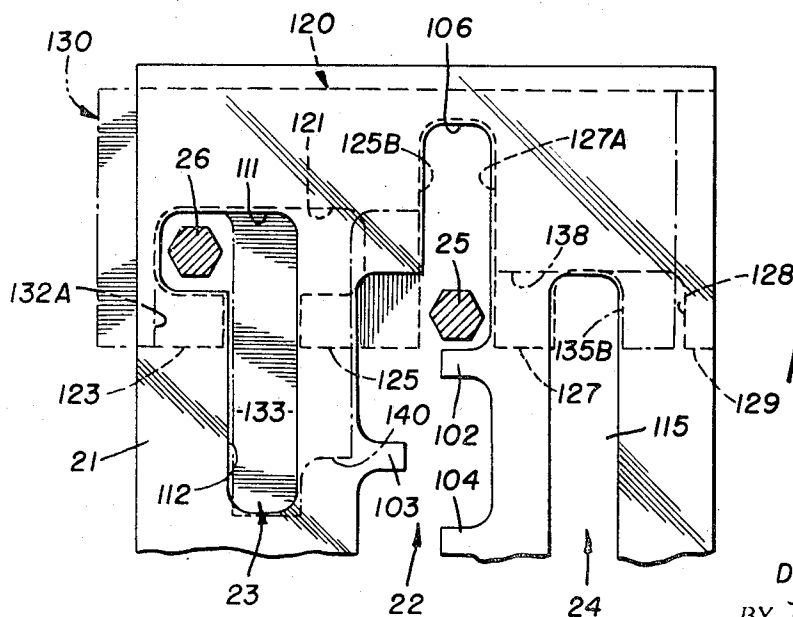


FIG. 9

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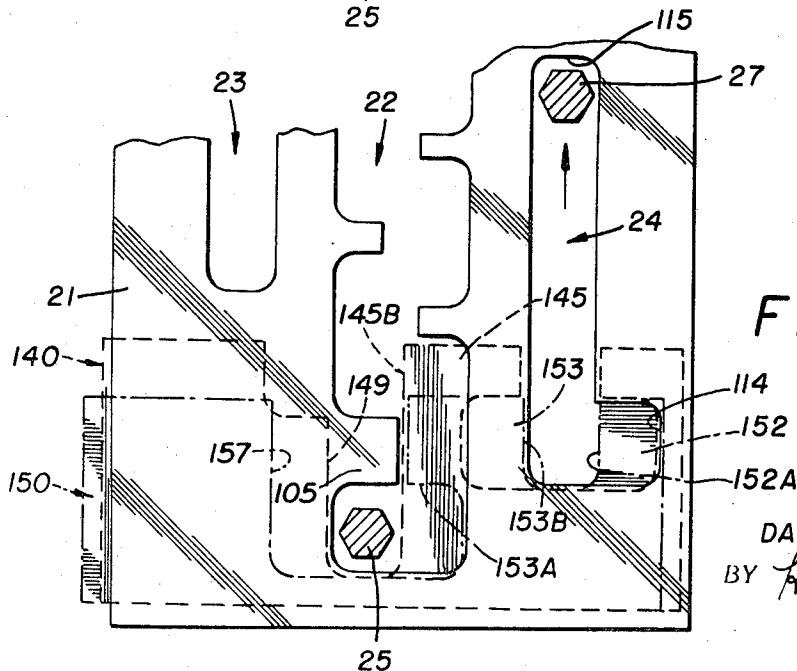
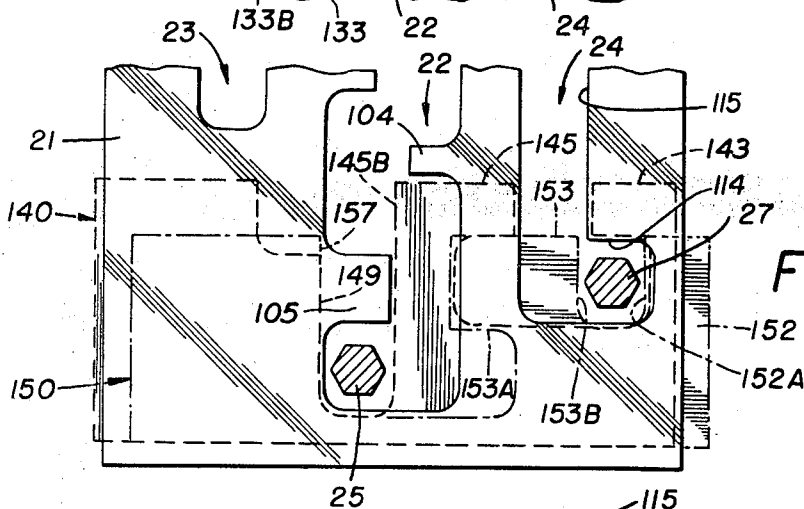
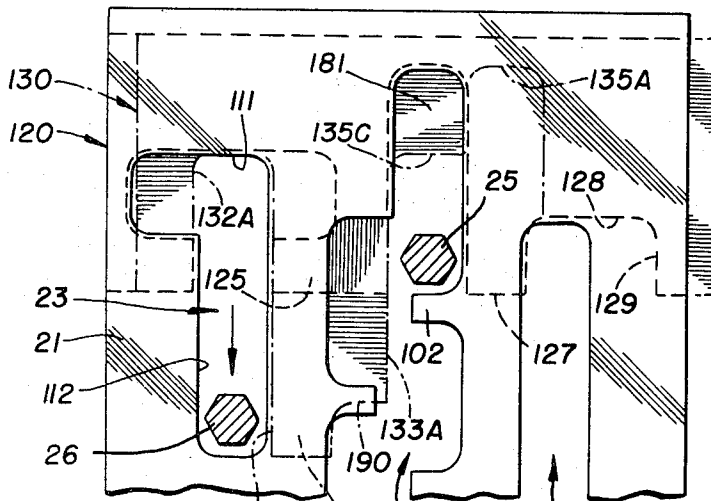
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GATE PLATE INTERLOCK

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6 Sheets-Sheet 6



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GATE PLATE INTERLOCK

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Int. Cl. G05g 5/08

U.S. Cl. 74—483

8 Claims

ABSTRACT OF THE DISCLOSURE

A device for assuring the fail-safe coordination of at least two control systems. A plurality of slidable locking plates are positioned with respect to the gate plate of a control box and are shaped so that effective operation can be achieved only through a selective and sequential movement of the two control levers which, in turn, provides selective and sequential movement of the locking plates.

BACKGROUND OF THE INVENTION

This invention relates to an apparatus for assuring the fail-safe coordination of a plurality of controls. Where two controls are involved, for example, the subordinate control can be actuated only after the master control has been set in a position which is proper for the safe or desired operation of the subordinate control and conversely, the subordinate control can, at times, prohibit movement of the master control.

In devices where a plurality of controls must be sequentially operated for proper actuation, all too often such sequential operation depends solely upon the skill and attention of the operator. While reliance on the human element is sometimes satisfactory, often due to negligence or mere human frailties, the operator will attempt to energize the subordinate control before the master control is in the proper position, or vice versa.

A prime example of such controls is found in many motor vehicles such as tractors, jeeps and the like which are provided with auxiliary controls in addition to the normal transmission control. Typical of the accessories requiring auxiliary controls are power take-off systems for actuating devices somewhat remote from the vehicle, and/or front wheel drive systems. It is inherent with these accessories that their safe operation is possible only when the vehicle's transmission is in a certain range. For example, power take-off units should be energized only when the vehicle is at rest with the transmission in the neutral range; similarly, front wheel drive features should be employed only when the transmission is in the low gear ranges. Accordingly, the auxiliary controls employed to regulate accessories such as these should preclude their actuation except when the transmission is operating within the proper range.

Most vehicles equipped with such auxiliary controls to operate these, or other accessories, provide no means to assure that such subordinate controls will be actuated only when the transmission, or master, control is in a proper position. Thus again, proper actuation of sequentially actuated controls has heretofore, been the responsibility of the operator. It is evident that any errors by the operator might do damage to the controls as well as to other portions of the vehicle, nearby property or people.

SUMMARY OF THE INVENTION

It is therefore a primary object of the present invention to provide an apparatus which assures the fail-safe coordination of a plurality of control systems.

It is another object of the present invention to provide an apparatus, as above, which will prohibit engagement of a subordinate control, such as a power take-off unit,

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unless a master control, such as a transmission lever, is in the proper position.

It is still another object of the present invention to provide an apparatus, as above, which can prohibit movement of a master control until a subordinate control has been disengaged.

It is a further object of the present invention to provide an apparatus, as above, which is completely mechanical and fail-safe.

These and other objects, which will become apparent from the following specification, are accomplished by means hereinafter described and claimed.

In general, an apparatus constructed according to the concept of the present invention comprises a gate plate for a control box having at least two slots or guideways therein for directing passage of control levers there-through in a primary, or longitudinal, direction to actuate control cables attached thereto. The guideways also allow a certain amount of secondary, or lateral, movement to actuate a plurality of slidable locking plates.

The locking plates are provided with various shaped openings or slots therein which can be selectively aligned or misaligned with each other and with the slots of the gate plate through their sliding action. The locking plates are further designed so that certain misalignments will prohibit the movement of at least one of the control levers until such time that another control lever has been moved to align the slots of the locking plates with a particular slot of the gate plate to create a free passageway for the previously locked control lever along the primary direction of its guideway.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of the control box embodying the principles of the present invention showing a gate plate for a transmission and two auxiliary controls, the auxiliary, or subordinate, control lever being shown locked in a disengaged position and the transmission, or master, control lever being free to move throughout the entire forward driving range;

FIG. 2 is a partially broken away, partially sectioned side elevation taken substantially along line 2—2 of FIG. 1;

FIG. 3 is a partially broken away, partially sectioned end elevation taken substantially along line 3—3 of FIG. 2;

FIG. 4 is a sectional view taken substantially along line 4—4 of FIG. 3;

FIG. 5 is a sectional view taken substantially along line 5—5 of FIG. 3;

FIG. 6 is an enlarged sectional view taken substantially along line 6—6 of FIG. 5;

FIG. 7 is an enlarged sectional view taken substantially along line 7—7 of FIG. 5;

FIG. 8 is an exploded perspective view of a typical gate plate and locking plates embodying the concepts of the present invention;

FIG. 9 is a partial top plan view similar to FIG. 1 with the components of the subject control sequentially positioned in response to movement of the master control lever from the position depicted in FIG. 1 to the position depicted herein, the gate plate being shown in solid lines, the upper locking plate being shown entirely in broken lines, and the lower locking plate shown entirely in chain dotted lines;

FIG. 10 is a top plan view similar to FIG. 9 with the first subordinate control lever actuated sequentially from the position depicted in FIG. 9;

FIG. 11 is a top plan view similar to FIG. 9 but depicting a different area of FIG. 1 and with the components of the subject control sequentially positioned in

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response to movement of the master control lever from the position depicted in FIG. 1 to the position depicted herein, the gate plate also being shown in solid lines, the upper locking plate being shown entirely in broken lines, and the lower locking plate also being shown entirely in chain dotted lines; and,

FIG. 12 is a top plan view similar to FIG. 11 with the second subordinate control lever actuated sequentially from the position depicted in FIG. 11.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A control box embodying the principles of the present invention is indicated generally by the numeral 20 in FIG. 1. Control box 20 is depicted as having a gate plate 21 which, in the embodiment shown, has a transmission guideway slot 22, a power take-off guideway slot 23 and a front wheel drive guideway slot 24. Movably received within each of the gate plate guideways 22, 23 and 24 are control levers 25, 26 and 27 respectively. As will hereinafter be evident, the selection and exact shape of these particular guideway slots is not critical to the present invention, the transmission, power take-off, and front wheel drive controls being shown merely as typical examples of a master and two subordinate controls chosen to describe the invention herein.

The gate plate 21 is clamped to the upper side of a control box housing 30 as by a plurality of screws 31 or other fastening means extending through a housing frame 30' and into housing 30. As is best seen in FIGS. 2 and 3, the lower sides of housing 30 present laterally spaced spider-like mounting flanges 32. Extending between the mounting flanges 32 and into hub portions 33 formed therein is an axle member 34 which is secured to the mounting flanges, as by bolts 35. Axle 34 serves as the axis about which control levers 25, 26 and 27 and their respective mounting assemblies 36, 37, and 38 can pivot, levers 25, 26 and 27 moving in a primary direction longitudinally through slots 22, 23 and 24. As shown in FIG. 3, the mounting assemblies 36, 37 and 38 are maintained in a spaced relationship by annular spacer members 39 mounted on axle 34.

The control lever mounting assemblies 36, 37 and 38 are identical in structure so that the description thereof can be limited to one assembly, for example, the power take-off control lever mounting assembly 37 shown in FIG. 5. Mounting assembly 37 comprises actuator plates 40 which embrace a split retainer 41. The lower end of the hexagonally shaped control lever 26 is received within retainer 41, the lever having a pin 42 passing through the bottom thereof which is rotatably received in a bearing 43 formed when the two halves of retainer 41 are fastened together as by the bolts 44. As such, the lever can be pivoted around the pin in a secondary direction transverse to the direction of its primary, or longitudinal, movement. The lever is shown in FIG. 6 as having been swung in the lateral, or secondary, direction.

Encasing lever 26 is a hexagonal frictional detent washer 45 having nipple-like protrusions 46 which frictionally engage the inner surface of a recess 47 formed within retainer 41. Detent washer 45 serves, along with other structures to be hereinafter described, as a friction means to insulate the levers from vibration.

The actuator plates 40 are provided with a plurality of bores 48 which are circumferentially spaced about a central bore 49. Bores 48 are oriented such that selective pairs thereof can receive the screw connecting means 50 to fasten the plates 40 to the retainer 41 while maintaining the central bore 49 of the plate 40 in register with a bore 51 in retainer 41, the aligned bores 49 and 51 receiving a bushing 52 rotatably mounted on axle 34. The plurality of bores 48 provides the mounting assembly 37 with a selective versatility of mounting angles and heights. In the example shown in FIG. 5, the retainer 41 and actuator plates 40 are in alignment. However, it is evident

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that by choosing a different pair of bores 48, the angularity in either direction could be varied through a wide range.

The result of the above-described mounting is that the control lever 26 is capable of dual movement, primary movement about the axis of axle 34 and secondary movement about the axis of pin 42. Primary movement of the control lever 26 moves the actuator plate 40 but secondary movement of the control lever 26 can be effected without movement of the actuator plate 40. This interrelation between the movement of the control lever and the responsive movement of the actuator plates is utilized to actuate the interlock mechanism disclosed in the preferred embodiment of the subject invention, as is hereinafter more fully described.

Movement of the mounting assembly 37 about axle 34 causes the lower end of the mounting assembly, as seen in FIG. 5, to transmit mechanical motion, by the application of either tensile or compressive forces, to actuate a standard push-pull cable indicated generally by the numeral 60. The push-pull cables 60 may be of any conventional construction having a core 61 slidable within a casing 62 formed of a sheath of wires 63 continuously laid, in the form of a long pitch helical coil, about the radially outer surface of a plastic tube 64 which extends the full length of casing 62.

One end of the core 61 is connected to a control rod 65 which telescopes within one end of a sleeve 66 and which is also threaded into a coupler 67 that is swingably connected, as by pin 68, to the mounting assembly so that movement of the control levers 25, 26 and 27 in the primary direction will effect corresponding movement to the cores in each of the respective cables 60A, 60B and 60C. In the exemplary environment with which the subject control is disclosed, push-pull cable 60A is operatively connected to a front wheel drive mechanism, push-pull cable 60B is operatively connected to the transmission and push-pull cable 60C is operatively connected to a power take-off mechanism.

Resilient sealing sleeves 69 and 70 may be provided at the joint between the sleeve 66 and the control rod 65 and at the joint between the sleeve 66 and the casing 62, respectively, to maintain the interior of the cable 60 as clean and dry as possible.

In order conveniently to mount the cable 60, two cable hangers 71, L-shaped in cross section, are provided, one hanger 71 being mounted to each of the mounting flanges 32 of housing 30. To provide mounting versatility, the mounting flanges 32 are provided with a plurality (six shown) of mounting bores 72 selective pairs of which can be aligned with two bores in hangers 71 to be fastened by bolts 73 as shown in FIG. 2. This feature adds further versatility to the unit by permitting, as shown in the chain lines of FIG. 2, the cable hangers 71 to be oriented in a selective plurality of directions, as may be occasioned by the location of the remote device to be controlled by cables or as may be required by the space requirements in the location where the control 20 is mounted.

The actual mounting of the cables 60 to the hangers 71 is best shown in FIGS. 2 and 4. An L-shaped cable support 74 spans the distance between the two hangers 71 and is provided with suitable bores so that one or more of the cables 60 can be fastened thereto by the use of brackets 75 secured by bolts 76 and nuts 77.

Turning now to the interlock mechanism, as previously described and as best shown in FIGS. 1 and 8, gate plate 21 contains two or more, and, as shown, three guideway slots 22, 23 and 24 in which control levers 25, 26 and 27 are movable. On each side of the transmission guideway slot 22 is a numbered and lettered transmission guide 101 which, in this instance, indicates that the transmission under discussion is "automatic," having six forward speeds embodied in four ranges, a neutral (N) and a reverse (R) position. Guideway slot 22 is shown as including four stop lugs 102, 103, 104 and 105 which impede

movement of the master, the direct longitudinal or transmission, control lever 25 in its primary direction and serve to provide places in which to register lever 25 in neutral, the 3-6 gear range, the 3-5 gear range, and the 3-4 gear range, respectively. The upper end wall 106 of slot 22, as seen in FIG. 1, serves as the registry point for the reverse range and the lower end wall 107 as the stop point for the 1-2 gear range. It is thus evident that if one would desire to shift the transmission lever 25 longitudinally from the 3-6 position shown in FIG. 1 to, for example, the 1-2 gear range at point 107, he would be forced to move lever 22 in a snake-like fashion employing not only the primary but also the secondary permissive movement features previously described.

The power take-off guideway slot 23 may be located generally in the upper-left portion of gate plate 21, as seen in FIG. 1, and has the configuration of an inverted L to provide at least two basic positions: the disengaged position, the lever 26 being located in the short leg 111 of the L; and, the engaged position, the lever being located in the long leg 112 remotely of the short leg 111. The engaged position is designated by the letters "ENG." on plate 113.

The front wheel drive guideway slot 24 may be located generally toward the lower-right portion of gate plate 21, as seen in FIG. 1, and is also L-shaped to provide a disengaged position in the short leg 114 of the L and an engaged position in the long leg 115 of the L. Again, the engaged position is designated by a guide plate 116 bearing the letters "ENG." Like the transmission lever 25, both power take-off lever 26 and front wheel drive lever 27 utilize their dual movement capability when being moved from disengaged to engaged position.

Located beneath the gate plate 21 so as to be cooperatively positionable with at least a portion of the transmission guideway slot 22 and, preferably, the entire power take-off guideway slot 23, as will hereinafter be explained, is an upper power take-off locking plate 120 and a lower power take-off locking plate 130. As is best shown in FIG. 8, the upper plate 120 includes a T-shaped slot 121 having a left-hand branch 122 bounded on one side by a tab portion 123 and a right-hand branch 124 bounded by a blocking edge portion 125A on tab 125. A deep recess 126 has its two sides defined by a throw edge portion 125B on tab 125 and a throw edge portion 127A on lug 127. Lug 127 also bounds one side of a larger U-shaped recess 128 bounded on its other side by tab portion 129.

The lower power take-off locking plate 130 has a deep slot 131 laterally bounded by the long tab 132 having throw edge portion 132A, and by the blocking edge portion 133B on lug 133.

The locking plate 130 also has an irregularly outlined recess 135 comprised of a deep bay portion 135A, a shallow bay portion 135B and a bay portion 135C of intermediate depth. The intermediate bay portion 135C is bounded on one side by a blocking edge portion 133A on lug 133 and is adjacent the deep bay portion 135A that is bounded by edge 136 generally parallel to and spaced apart from the blocking edge portion 133A. The shallow bay portion 135B is adjacent the deep bay portion 135A on the side opposite the intermediate bay portion 135C and is bounded by surface 138 and tab member 139.

Located beneath gate plate 21 so as to be cooperatively positionable with at least a portion of the transmission guideway slot 22 and the front wheel drive guideway slot 24 is an upper front wheel drive locking plate 140 and a lower front wheel drive locking plate 150. Upper plate 140 includes a T-shaped slot 141 having a branch 142 bounded on one side by a hook 143 and a branch 144 bounded on one side of a blocking edge portion 145A on hook 145. A recess 146 has a long leg 147 and a contiguous short leg 148. Long leg 147 is bounded on one side by throw edge portion 145B on hook 145 and on the other side by throw edge portion 149.

The lower, front wheel drive, locking plate 150 has a

slot 151, the sides of which are defined by a throw edge portion 152A on tab 152 and a throw edge surface 153B on tab 153. A blocking edge portion 153A on tab 153 also defines one boundary of an L-shaped recess 154 having a short leg 155 and a longer leg 156 bounded on the longer side by surface 157.

The locking plates 120, 130, 140 and 150 are mounted in such a fashion that they are capable of a sliding movement only in a direction parallel to the secondary direction in which the various control levers are movable. For example, as shown in FIG. 2, locking plates 140 and 150 are supported between longitudinally spaced steps 161 and 162 presented from the housing 30. In this manner plate 140 is restrained against movement in a direction parallel to that of the primary movement of the control levers by the vertical stop shoulder 163 of steps 161 and by the spaced, substantially parallel stop shoulder 164 of steps 162. Similarly, plate 150 is restrained by stop shoulder 165 of steps 161 and by stop shoulder 166 of steps 162. While not shown in great detail, plates 120 and 130 are similarly mounted on steps, such as those designated by numeral 167 in FIG. 5. Thus the plates 120, 130, 140 and 150 are prohibited from moving in a direction parallel to the longitudinal orientation of guideways 22, 23, and 24.

As will hereinafter become evident, however, the locking plates must be capable of movement in a direction parallel to the lateral movement of the control levers. To this end, the steps also present shelves on which the locking plates are slidable. The shelves for locking plates 120 and 130 are best shown in FIGS. 3 and 5, the end of plate 120 being slidable (left to right, as viewed in FIG. 3) on shelf 168 and plate 130 slidable on shelf 169.

As best shown in FIG. 2, locking plates 140 and 150 are slidably mounted on similar shelves 170 and 171, respectively.

Since the locking plates are slidably mounted it is important to keep them from moving accidentally due to any possible vibratory movement of the vehicle. Accidental translation of the locking plates may be prevented by a plurality of spring biased detents 172, 173, 174 and 175. As best shown in FIG. 2, the detents are threaded through bosses 176 and 177 in the frame 30' of housing 30 that extend through the gate plate 21 and present a spring biased plunger nose 178 selectively receivable in one of a plurality of lock holes 179 located in plates 120, 130, 140 and 150. As shown in FIG. 2, plate 140 is being held in place by detent 172, plunger nose 178 resting in lock hole 179A. If it is desired to slide plate 140 to a new position, such a movement overcomes the biasing force of the spring loaded plunger nose 175 and the plate 140 is free to move. However, at its new position, plate 140 would be again held in place as the nose 178 is received in lock hole 179B, also located in plate 140. Plate 120 is secured against accidental translation in a similar fashion by detent 173.

Plates 130 and 150 are also held in place by detents 174 and 175 respectively. However, since plates 130 and 150 are lower locking plates, the detents 174 and 175 must pass through the upper plates 120 and 140, respectively. To accommodate access of detents 174 and 175 to plates 130 and 150, the upper plates 120 and 140 are provided with apertures 180.

The operation of the above-described device will now be set forth in detail. With respect to the power take-off and transmission controls, it is the objective of the device described herein to make it impossible for one to actuate the power take-off mechanism unless the transmission control is in the neutral range.

As shown in FIG. 1, the plates are oriented such that the transmission lever 25 is permitted to move within the entire forward drive range, lever 25 being shown in the 3-6 driving range and positioned in proximity to stop lug 102. The reverse and a portion of the neutral range are blocked out by lug 127 of upper locking plate 120. The power take-off lever 26 is shown in the short leg 111 of

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the guideway 23—i.e., with the power take-off disengaged—and with the entire long leg 112 of slot 23 being blocked by the longer leg of lug 133 on lower locking plate 130 and with the blocking edge portion 125A on tab 125 of the upper locking plate 120 being positioned across the long leg 112 of guideway 23 at the juncture thereof with short leg 111.

While levers 25 and 26, and plates 120 and 130, are in the abovedescribed positions, it is not possible for the power take-off lever 26 to be moved from the disengaged position in leg 111 to the engaged position in leg 112. If, for example, the operator would attempt to engage the power take-off system with the master control lever 25 in any of the forward drive ranges, secondary movement of subordinate control lever 26 against throw edge portion 133B would slide lower plate 130 to the right, as seen in FIG. 1, thus clearing the lug 133 from leg 112 of guideway slot 23; however, movement of the subordinate control lever 26 in the primary direction would be prohibited by the blocking edge portion 125A of lug 125 on upper locking plate 120.

In order to free the subordinate power take-off lever 26 for engagement, the master transmission lever 25 must be moved from the position shown in FIG. 1, around stop lug 102, and to the right-hand neutral range (as seen in FIG. 9). This movement brings lever 25 against throw edge portion 127A so that the secondary movement of lever 25 slides the upper plate 120 to the right and thereby removes tab 125 from the path of the subordinate power take-off lever 26. Now the operator is able to move lever 26 in its secondary direction to slide locking plate 130 out of its path, and then down (as seen in FIG. 10) into leg 112 of guideway 23 to engage the power take-off mechanism.

As the movement of subordinate lever 26 along its secondary direction slides locking plate 130 to the position shown in FIG. 10, a flange 181 that delineates the difference between the depth of the deep bay 135A and the intermediate bay 135C substantially blocks the reverse range of guideway 22. Flange 181 does not, however, totally block the reverse range, because, in the event that the gearing of the power take-off mechanism would not mesh, it is highly desirable to be able to adjust the position of the power gears in the transmission to facilitate engaging the power take-off. By being able to jiggle the master control lever 25 slightly into the reverse range this result is effected.

Once the subordinate control lever 26 has been moved in the primary direction to engage the power take-off, the cooperative interaction of the edge portion 133B, leg 112 of guideway 23 and the control lever 26 maintains edge portion 133A cooperatively juxtaposed with the stop lug 102 so that the transmission control lever 25 is restricted against movement into the forward drive range. The transmission control lever 25 will, therefore, only be able to move into the forward range after the subordinate control lever 26 is returned to leg 111 of guideway 23—the resulting secondary movement of control lever 26 engaging the lever 26 against throw edge portion 132A to withdraw the blocking edge portion 133A from its cooperative interaction with guideway 22.

Turning now to a description of the interrelation between the front wheel drive and transmission controls, it is the objective of the device described herein to make it impossible for one to engage the front wheel drive accessory unless the transmission control lever 25 is in the low gear, or 1-2 drive range, between stop lug 105 and end wall 107.

With the transmission lever 25 in the 3-6 drive position, as shown in FIG. 1, the front wheel drive lever 27 is locked in the disengaged position delineated by the short leg 114 of guideway 24. Were the operator to attempt to engage the front wheel drive by movement of lever 27 into leg 115 without the control lever 25 properly positioned, he would be able to slide the bottom locking plate

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150 to the left (as seen in FIG. 1) by contact of the subordinate control lever 27 with the throw surface 153B on tab 153. However, he would be prohibited from moving lever 27 in its primary direction due to the presence of the blocking edge portion 145A on the hook 145 of locking plate 140.

Therefore, in order for the front wheel drive lever 27 to be freely movable along leg 115 of guideway 24, the transmission lever 25 must first be moved from the position shown in FIG. 1 to that shown in FIG. 11. In so doing, lever 25 will contact throw edge 149 of plate 140 so that movement of the master control lever 25 in a secondary direction will slide locking plate 140 to the left (as seen in FIG. 11). This movement of plate 140 removes blocking hook 145 from guideway 24. Now the operator is able to move lever 27 in a secondary direction within leg 114 and then in a primary direction along leg 115 to engage the front wheel drive (FIG. 12).

Movement of the subordinate control lever 27 in a secondary direction along leg 114 of guideway 24 brings lever 27 into engagement with the throw edge portion 153B on tab 153 and slides the locking plate 150 to the left as viewed in the drawings—i.e., from the position depicted in FIG. 11 to the position depicted in FIG. 12. This sliding movement of locking plate 150 positions the blocking edge portion 153A on tab 153 in cooperative interaction with guideway 22 to restrict the master control lever 25 against movement in a primary direction out of the low, "1-2," drive range (FIG. 12). This restriction of the master control lever 25 to the low, 1-2, drive range can be cleared only when the subordinate control lever 27 is returned to the short leg 114 of guideway 24. Return of control lever 27 to the short leg 114, and the attendant movement of the lever 27 in its secondary direction therealong, brings lever 27 against the throw edge portion 152A on tab 152 to slide locking plate 150 to the right, as viewed in the drawings, and thereby withdraw the blocking edge portion 153A from its cooperative interaction with guideway 22.

In order to assure that the guideway 22 for the master control lever 25 will remain clear when the subordinate control levers 26 and 27 are positioned to disengage the accessories operated thereby, it has been found highly desirable biasingly to retain the subordinate control levers 26 and 27 in the short legs 111 and 114 of their respective guideways 23 and 24. A biasing system indicated generally by the numeral 185 in FIG. 3 may be employed. Biasing system 185 is shown as consisting of a spring 186 mounted between an eyelet 188 on the plate 40 and an eyelet 189 on the control lever 26. Although not shown, a similar system can be utilized with respect to lever 27.

The operation of the subordinate control levers to actuate power take-off and front wheel drive accessories and their interrelation with the primary transmission control lever have been separately described to point out that they are separate systems capable of operation independently of each other. Such being the case, it should be evident that a control system could be supplied with any number of subordinate controls to be used in combination with one or more master controls and the requisite number of locking plates without departing from the spirit of the present invention. However, it should also be evident that when more than one subordinate control is provided in the same gate plate within the same housing independently to interrelate with a master control, the respective locking plates must also have recesses, tabs, and the like in the proper position not only to interlock but also to permit interference free operation of controls when the prescribed conditions for their operation is satisfied.

For example, no matter which of the two positions the upper power take-off locking plate 120 is in, the U-shaped recess 128 will always maintain the front wheel drive guideway 24 in an open position. Similarly, the shallow bay portion 135B of recess 135 in lower plate 130 serves to perform the same function.

An additional example of conditions that must not be overlooked is represented by the recess 190 in tab 133. Recess 190 is provided so that should lower locking plate 130 be inadvertently moved to the right when the master control lever 25 is in the "3-4" range, the tab 133 will not cooperatively interact with stop lug 104 to prevent movement of the master control lever from the "3-4" range into the "3-5" range and even on to neutral. Although the biasing system 185 operatively connected to subordinate control lever 26 will normally preclude this result, a fail-safe interlock requires assurance that the master control lever 25 will have proper access to a throw edge portion on locking plate 130 (in this situation, edge portion 132A) so that the plate 130 may be translated, by secondary movement of lever 25 within guideway 22, to clear that guideway for movement of the master control lever 25 in its primary direction.

It should now be evident that if control units having master and subordinate levers are provided with an interlock system embodying the concept of the present invention, fail-safe operation will be assured—thus substantially improving the control art and otherwise accomplishing the objects of the invention.

What is claimed is:

1. A fail-safe interlock for a control comprising, a housing, a gate plate secured to said housing, at least master and subordinate control levers mounted within said housing for movement through a primary direction and a secondary direction laterally of said primary direction, individual guideways in said gate plate for each said control lever, said guideways delineating the range of said primary and secondary directions, at least first and second locking plates movably mounted in said housing, each said locking plate having a throw portion and a blocking portion, the blocking portion on said first plate positionable in cooperation with the guideway for said subordinate control lever to restrict the movement of said subordinate control lever along its primary direction, the throw portion of said first locking plate positioned to be engaged by secondary movement of said master control lever at a predetermined position along the range of its primary movement, engagement of said master control lever with the throw portion of said first locking plate moving said first locking plate to eliminate the cooperative interaction of the blocking portion thereon with the guideway for said subordinate control lever, the blocking portion on said second locking plate positionable in cooperation with the guideway for said master control lever to restrict said master control lever to predetermine movement along its primary direction, the throw portion on said second locking plate positioned to be engaged by secondary movement of said subordinate control lever at a predetermined position along the range of its primary movement, engagement of said subordinate control lever with the throw portion of said second locking plate moving said second locking plate to eliminate the cooperative interaction of the blocking portion thereon with the guideway for said master control lever.

2. A fail-safe interlock according to claim 1 wherein said first locking plate has a second throw portion positioned to be engaged by secondary movement of said master control lever at a predetermined position along the range of its primary movement, engagement of said

master control lever with said second throw portion of said first locking plate moving said first locking plate to position the blocking portion thereof in cooperative interaction with the guideway for said subordinate control lever to restrict movement of said subordinate control lever along its primary direction.

3. A fail-safe interlock according to claim 1 wherein said second locking plate has a second throw portion positioned to be engaged by secondary movement of said subordinate control lever at a predetermined position along the range of its primary movement, engagement of said subordinate control lever with said second throw portion of said second locking plate moving said second locking plate to position the blocking portion thereof in cooperative interaction with the guideway for said master control lever to restrict movement of said master control lever along its primary direction.

4. A device for assuring the fail-safe coordination of remote control systems having at least two controls comprising, a control lever for each control, a gate plate having guideway slots therein slidably receiving and directing said control levers, said guideway slots adapted to allow movement of said control levers both in a primary direction to actuate the remote control systems and in a secondary direction, and a plurality of locking plates operatively positioned with respect to said gate plate and shaped to selectively prohibit the movement of said control levers through the guideway slots, said locking plates being slidable in the secondary direction so that movement of said control levers in the secondary direction through said guideway slots can selectively slide said locking plates.

5. A device according to claim 4 wherein said locking plates are fixed from movement in the primary direction selectively to prohibit the movement of said control levers through the guideway slots in the primary direction.

6. A device according to claim 4 wherein said locking plates are positioned below said gate plate and have at least one slot therein to be selectively aligned or misaligned with said guideway slots.

7. A device according to claim 4, wherein a first of said control levers operates a transmission control having a neutral, drive and reverse range, and a second of said control levers operates a power take-off system, said locking plates being shaped so that said second control lever cannot be moved within its said guideway slot in the primary direction for engagement unless said first control lever is in the neutral range.

8. A device according to claim 4 having a transmission control lever, a power take-off control lever, and a front wheel drive control lever, said power take-off and front wheel drive control levers being capable of actuation independently of each other but dependent upon the position of said transmission control lever.

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