United States Patent

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[33] **Great Britain**
[31] **4,175/68**

[54] **GEAR CHANGE MECHANISMS**
5 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **137/596.2,** 137/636.2, 73/473
[51] **Int. Cl.** **F16k 11/18,** G05g 13/00
[50] **Field of Search** 192/3.5; 74/471, 473; 137/596, 596.1, 596.2, 636.2, 609, 595

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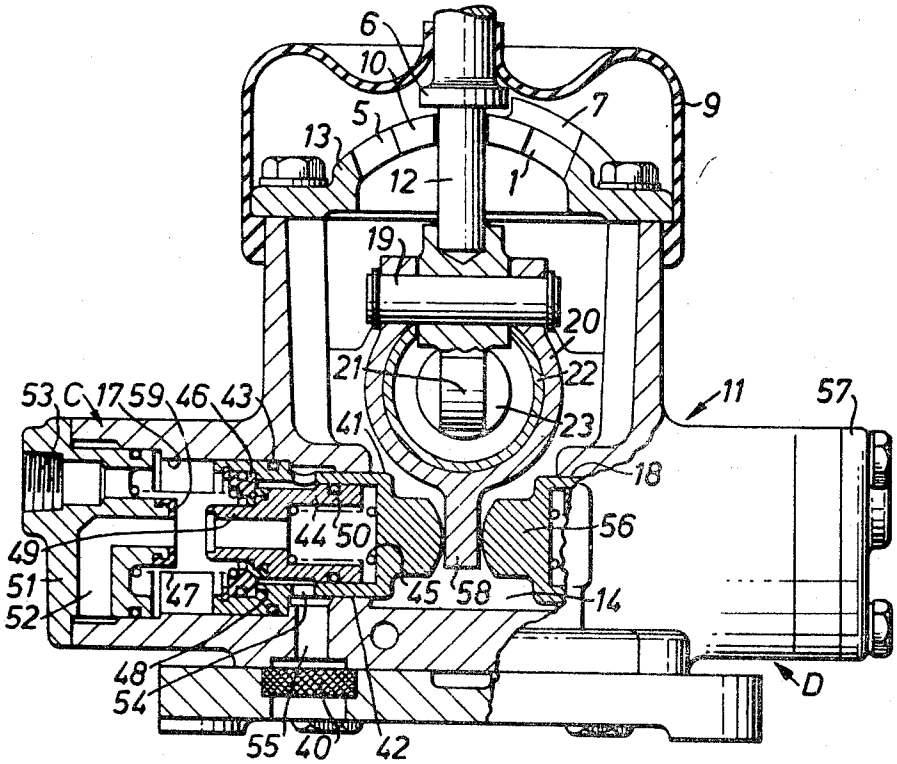
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ABSTRACT: A manual control device for a fluid-pressure actuated gear change mechanism, said device comprising a hand lever, movable in at least two directions in a valve housing containing at least four valves, and a casing adapted to be secured to a gearbox and housing at least four cylinders, each of said cylinders being connected via one of said valves to a source of pressure fluid; wherein movement of the hand lever to a position to select a gear is effective to exhaust the pressure fluid from at least one of the cylinders and the pressure fluid acting on pistons in the remaining cylinders being effective to select the said gear and to maintain the hand lever in the selected bar position.



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FIG. 1.

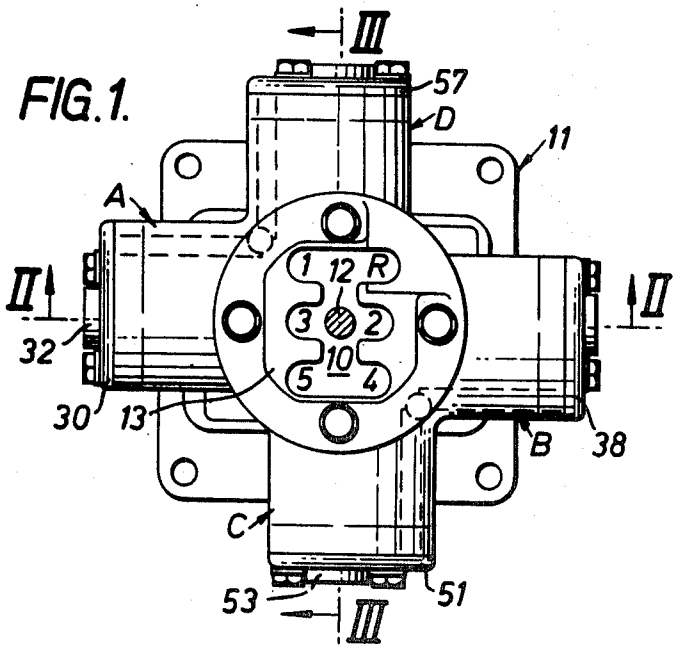
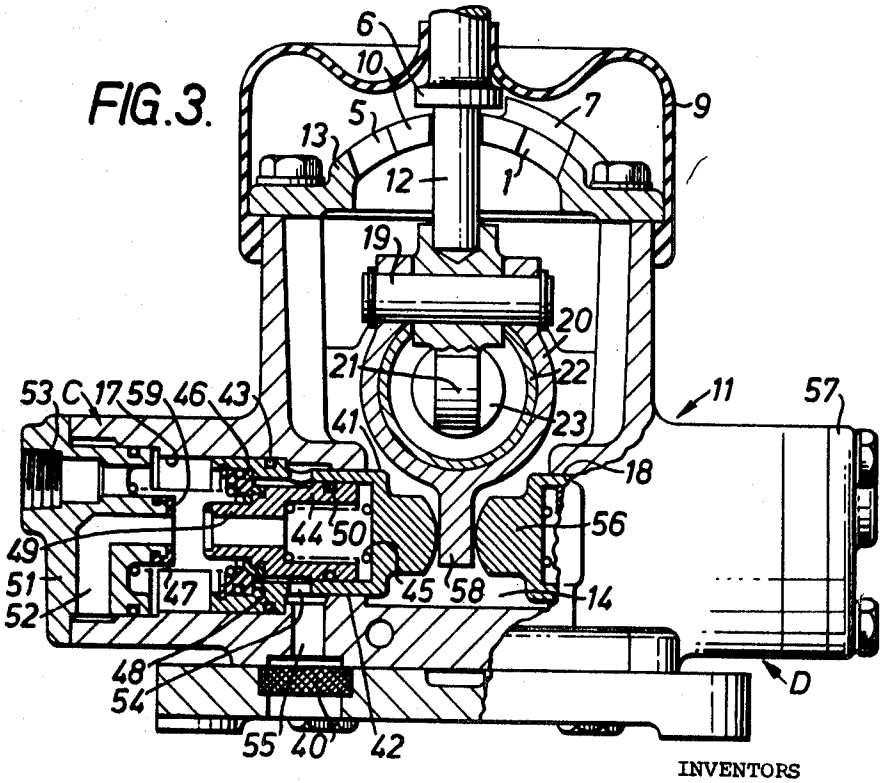


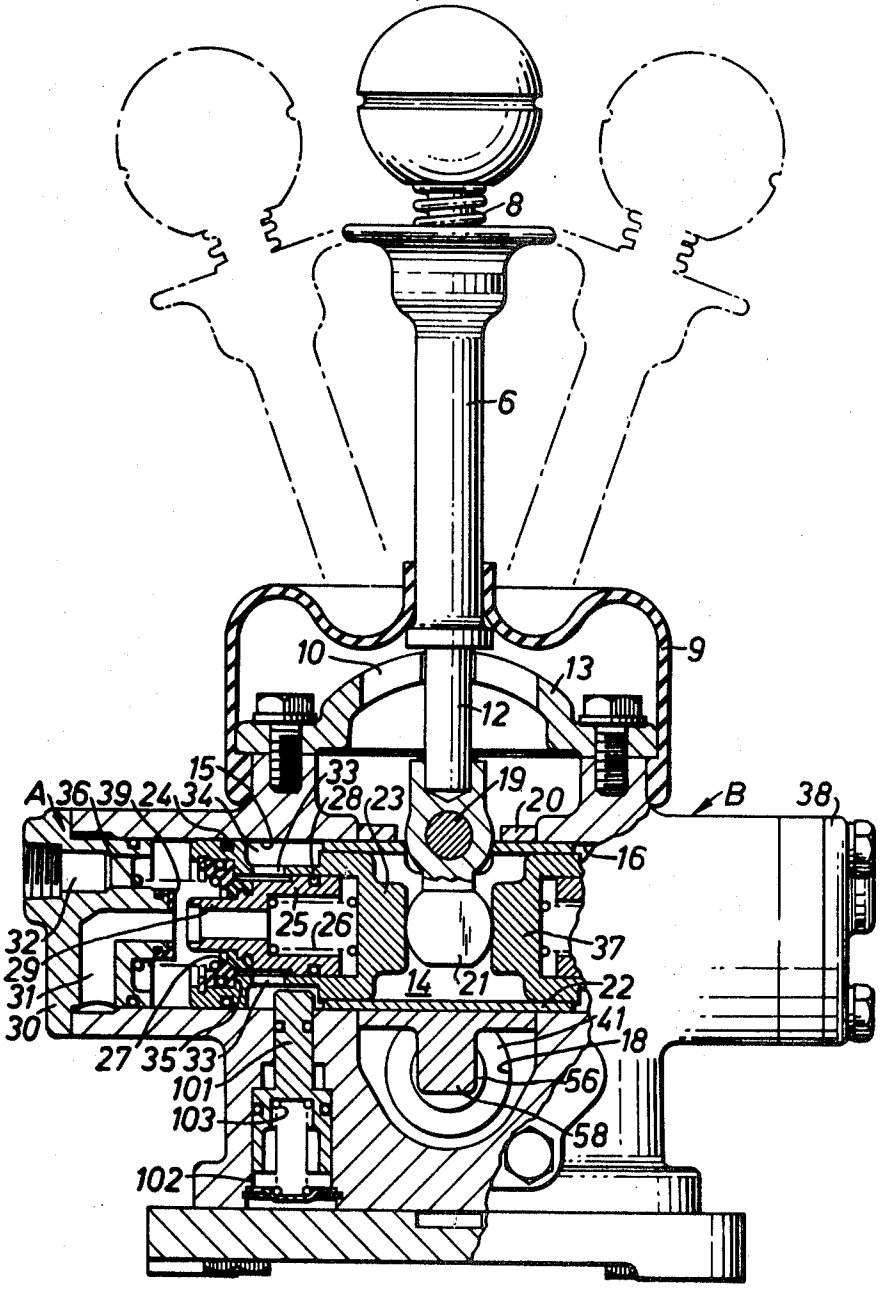
FIG. 3.



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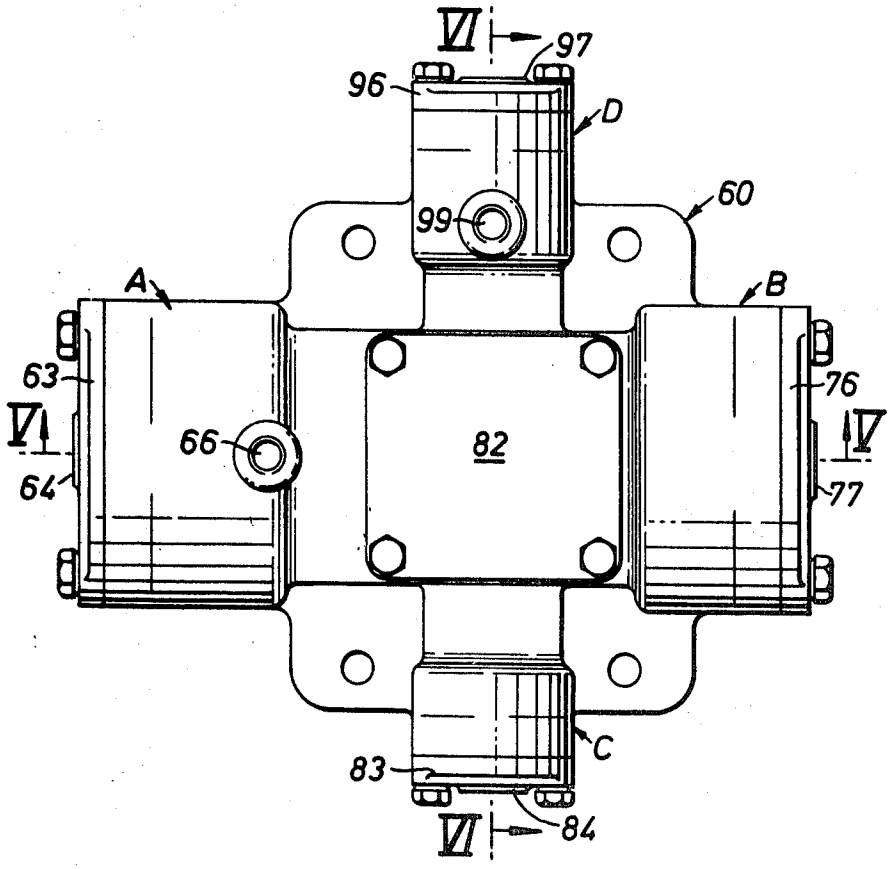
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FIG. 2.



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FIG. 4.



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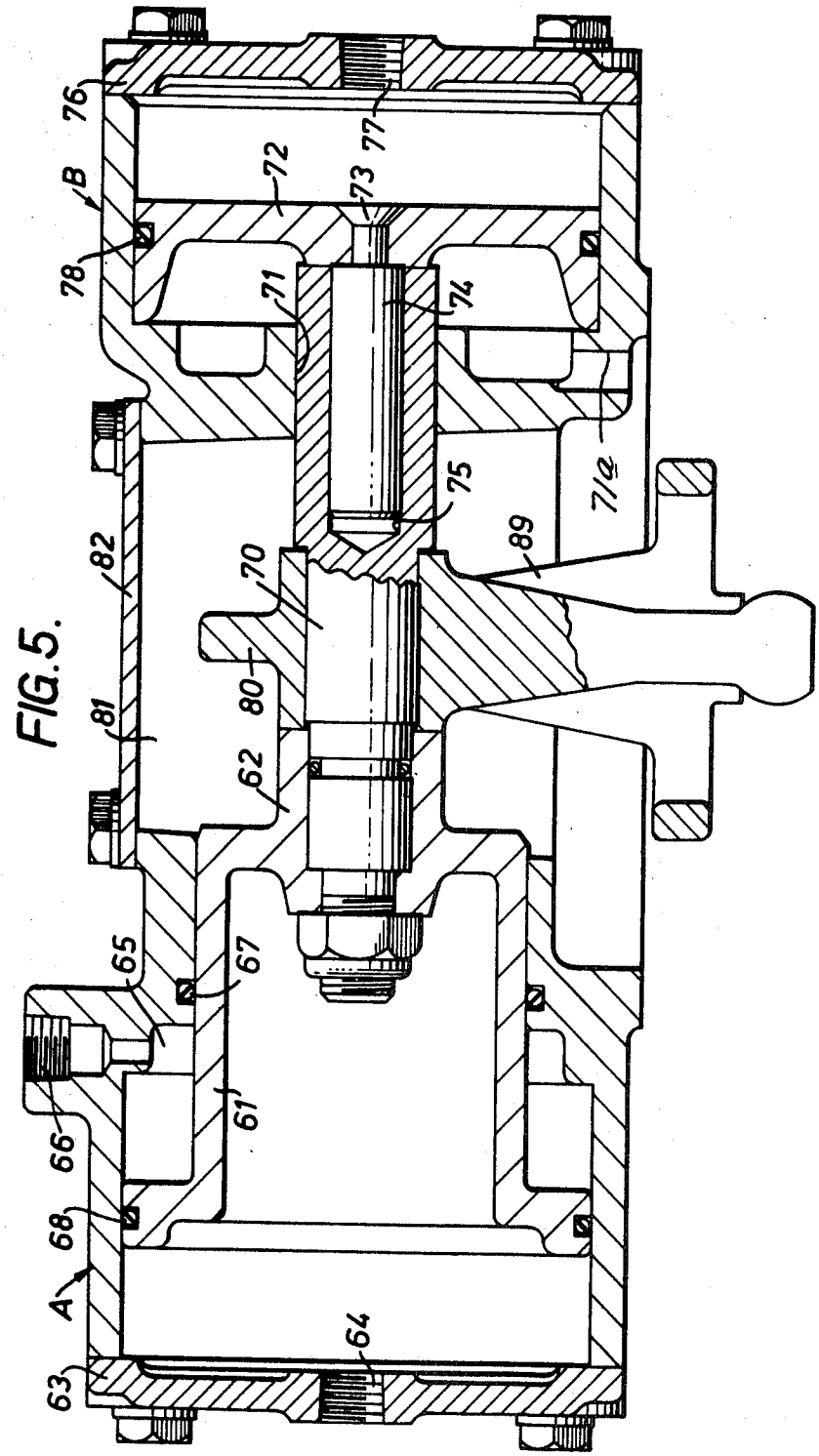
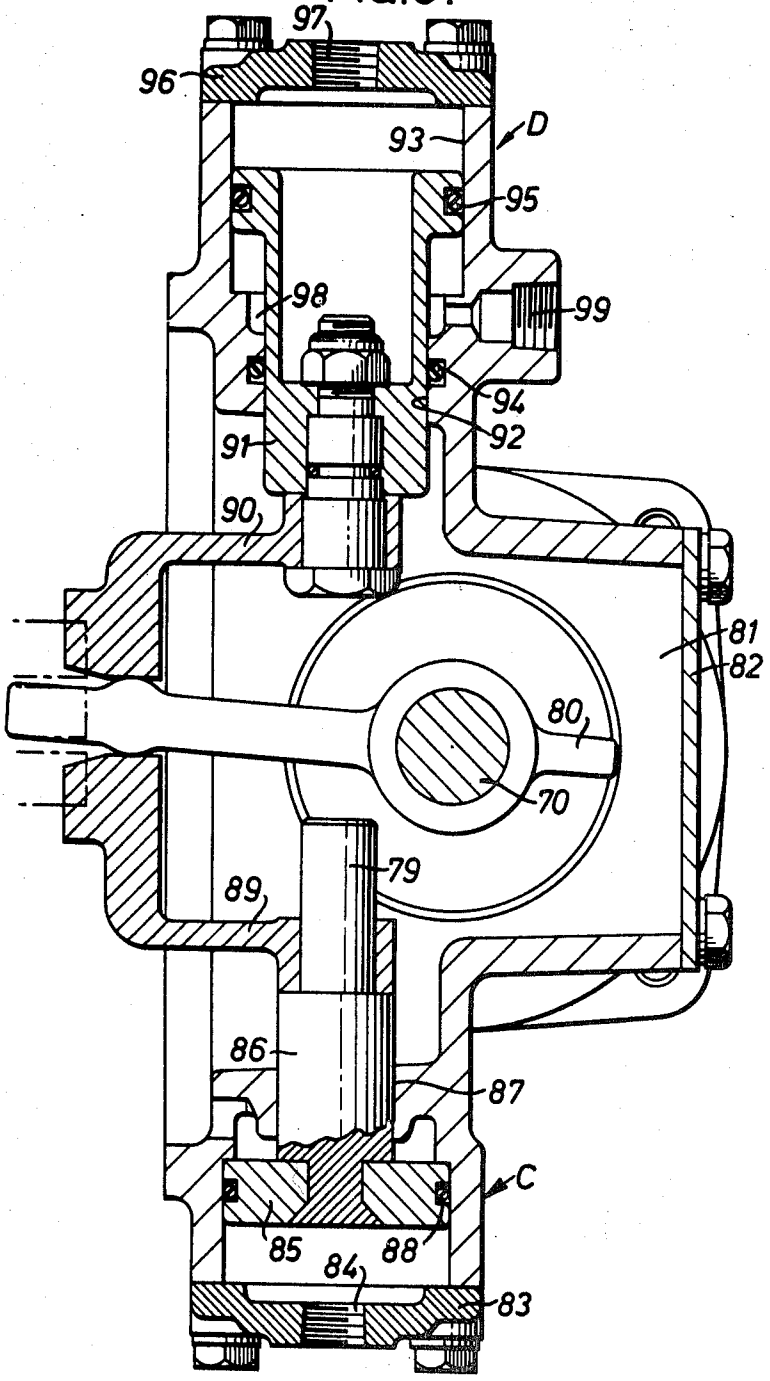


FIG. 5.

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FIG. 6.



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GEAR CHANGE MECHANISMS

This invention relates to the manual control of fluid pressure actuated gear change mechanisms.

According to the invention, there is provided a manual control device for a fluid-pressure actuated gear change mechanism, said device comprising a hand lever, movable in at least two directions in a valve housing containing at least four valves, and a casing adapted to be secured to a gearbox and housing at least four cylinders, each of said cylinders being connected via one of said valves to a source of pressure fluid; movement of the hand lever to a position to select a gear being effective to exhaust the pressure fluid from at least one of the cylinders and the pressure fluid acting on pistons in the remaining cylinders being effective to select the said gear and to maintain the hand lever in the selected gear position.

Preferably, the valves are arranged in pairs, the valves of each pair being on a common axis and each valve including a piston arranged to bear against a member formed on or connected to the hand lever or an extension thereof. When only four valves are provided, the two axes are desirably at right angles to each other with one axis vertically above the other.

The hand lever is preferably mounted for pivotal movement in one direction about a shaft provided in the valve housing and for pivotal movement in a second direction about a sleeve located in bores housing the upper two valves.

The cylinders are also desirably arranged in pairs with the cylinders of each pair on a common axis. In the case of four cylinders, the two axes are preferably at right angles to each other.

According to a preferred embodiment, each of the cylinders contains a piston operatively connected to a gearbox striker, operation of the hand lever to a selected gear position being effective to cause at least one of the pistons to move the gearbox striker to select the selected gear in the associated gearbox.

The invention will now be further described, by way of example, with reference to the accompanying drawings in which:

FIG. 1 is a plan view of one example of a valve housing for use in the manual control device according to the present invention;

FIG. 2 is a section on line II—II in FIG. 1;

FIG. 3 is a section on line III—III in FIG. 1;

FIG. 4 is a plan view of one example of a casing for the cylinders used in the manual control device according to the invention;

FIG. 5 is a section on line V—V in FIG. 4; and

FIG. 6 is a section on line VI—VI in FIG. 4.

Referring first to FIGS. 1 to 3 of the drawings, the manual control device comprises a valve housing **11** which is designed to be normally mounted below the floor of a vehicle on a baseplate above the engine. A hand or gear lever **12**, corresponding to the lever of a conventional manually operated gearbox is arranged to project through the floor of the vehicle and is mounted in the housing in a manner to be hereinafter described. The housing is closed at its upper side by a cover **13** forming the conventional 'gate' and the gear lever extends through the 'gate' in the normal manner. The 'gate' comprises a main slot **10** in which the gear lever is located for neutral and three branch slots extend from each side of the main slot. Four of the branch slots extend from the ends of the main slot on each side and the remaining two branch slots extend from the center of each side of the main slot. The branch slots provide for gear selection and thus provide five forward gear (indicated respectively as **1**, **2**, **3**, **4** and **5**) and one reverse gear (indicated as R) positions.

The valve housing is formed with a central chamber **14** from which two pairs of bores **15**, **16** and **17**, **18** depend. The bores of each of the pairs are on a common axis and the two axes are disposed in planes at right angles to each other. One pair **15**, **16** of the bores is located above the other pair **17**, **18**. The gear lever **12** is pivotally mounted on a shaft **19** in the central chamber **14** above the upper pair of bores **15**, **16** and an extension **20** of the gear lever below the shaft **19** is mounted around a cylindrical sleeve **22** the ends of which are received in the ends of the bores **15**, **16**. The axes of the shaft **19** and sleeve **22** are disposed in planes at right angles to each other so that the gear lever **12** is capable of pivotal or rockable movement in the direction of the main slot **10** and in the direction of each of the branch slots of the 'gate.'

Each of the bores **15**, **16** contains a valve, the valve in bore **15** (hereinafter referred to as valve A) comprising a piston **23**, the head of which is slidably received in the cylindrical sleeve **22**. The outer end of the piston skirt is of increased diameter and is in sliding engagement with the wall of the bore **15**. A seal **24** is provided between this increased diameter portion and the bore wall. A valve member **25** is provided in the piston **23** and is urged by a spring **26** against a valve seat **27** secured to the inside of the piston **23** adjacent its outer end. A seal **28** is provided between the inside of the piston **23** and the valve member **25** which desirably is hollow and is provided with a tubular extension **29** extending through the valve seat **27**. The end of the bore **15** remote from the sleeve **22** is closed by a plug **30** having a port **31** connected to a source of pressure fluid and a second port **32** connected by a fluid line to the cylinder casing in a manner to be hereinafter described. The piston skirt is provided with a number of bores **33** leading to a chamber **34** formed between the piston **23** and wall of bore **15** and an exhaust port (not shown) leads from the chamber **34** to atmosphere.

The valve in the other bore **16** of the upper pair is identical to valve A and this valve will hereinafter be referred to as valve B. This other bore contains a piston **37** and is closed by a plug **38** having two ports connected to the pressure fluid source and cylinder casing.

A lug **21** is formed on the hand lever **12** below the shaft **19** and this lug is arranged to lie substantially on the axis of the cylindrical sleeve **22**. The pressure fluid source acts on the pistons **23**, **37** in the two upper bores **15**, **16** to force the piston crowns or extensions formed on the piston crowns against the lug **21** when the gear lever **12** is in its neutral position. In this position, the valve members **25** are urged onto their seatings by the associated springs. The valve seats **27** need not be secured to the pistons **23**, **37** but may if desired be forced against a step **35** formed on the inside of each piston by a spring **36** the other end of which bears against the associated plug **30**, **38**.

Each of the bores **17**, **18** of the lower pair also contains a valve, the valve in the bore **17** (hereinafter referred to as valve C) comprising a piston **41** slideably mounted in a reduced diameter portion **42** of the bore **17** at one end thereof. The outer end of the piston skirt is of increased diameter and sealingly engages with the wall of the major unreduced diameter portion of the bore **17**, a seal **43** being provided between the increased diameter portion of the piston and the bore wall. A valve member **44** housed within the piston **41** bears, by means of a spring **45**, against a valve seat **46** which is urged by a spring **47** against a step **48** formed on the piston **41**. An extension **49** of the valve member passes through the valve seat **46** and the valve member is desirably hollow. A seal **50** is provided between the valve member **44** and the inside of the piston wall. The end of the bore **17** is closed by a plug **51** against which the valve seat spring **47** bears. The plug **51** is provided with two ports **52**, **53** connected by fluid lines respectively to the pressure fluid source and gearbox The piston skirt is provided with a number of bores **54** and the bore **17** is provided with an exhaust port **55** leading to atmosphere via a filter **40**. Except for the increased diameter portion, a clearance is provided between the piston skirt and the major portion of the bore wall.

The valve in the other bore **18** of the lower pair is identical to valve C and this valve will be referred to as valve D. The other bore **18** contains a piston **56** and is closed by a plug **57** having ports connected to the pressure fluid source and gearbox.

Formed below the extension **20** of the gear lever **12** which fits around the cylindrical sleeve **22** is a lug **58** arranged to lie substantially on the axis of the lower bores **17, 18**. The pressure fluid source acts on the pistons **41, 56** in the two lower bores **17, 18** to force the pistons against steps formed by the reduced diameter portions of the lower bores and to hold the piston crowns or extensions formed thereon against this lower lug **58** when the gear lever **12** is in the center of the main slot **10** in the 'gate.' In this position the valve members of valves C and D are urged against their respective valve seats by the associated springs.

The ports leading from valves A to D each lead to an associated cylinder, hereinafter referred to respectively as cylinders A, B, C and D, the four cylinders being formed in a cylinder casing or housing **60** (FIG. **4**) adapted to be mounted on top of the gearbox in place of the conventional mechanical gear shift unit.

Turning now to FIGS. **4** to **6** of the accompanying drawings, the cylinder A is stepped the outer end being of larger diameter than the inner end. A stepped piston **61** is reciprocably mounted in the cylinder and an extension **62** formed on the crown of the piston is arranged to project beyond the inner end of the cylinder when the piston is at one end of its stroke. The outer end of cylinder A is closed by a cover **63** except for a port **64** connected by a fluid line to the port **32** of valve A. A further step **65** is provided in the cylinder wall of a diameter greater than the inner end but less than the outer end and a port **66** is provided in this portion of the cylinder leading to the pressure fluid source. Seals **67, 68** are provided between the piston and cylinder walls.

Secured to the crown extension **62** is one end of a shaft **70** the other end of which extends through a bore **71** into cylinder B the diameter of which is equal to the diameter of the outer end of cylinder A. A piston **72** is reciprocably received in the cylinder B and is secured by a screw **73** to a pin **74** which is slidably housed in a socket **75** provided in the other end of the shaft **70**. Cylinder B is closed at its inner end except for the bore **71** in which the shaft **70** is slidable and a vent port **71***a*. The outer end of cylinder B is closed by a cover **76** having a port **77** connected by a fluid line to valve B. A seal **78** is provided between the piston and cylinder walls.

A gearbox striker **80** is pivotally mounted on the shaft **70** intermediate its ends and is adapted to be connected in the usual manner to the selector forks in the gearbox. The gearbox striker is located in a chamber **81** which is closed at the top by a cover **82**.

Cylinder C is closed at one end by a cover **83** having a port **84** connected by a fluid line to port **53** of valve C and the cylinder houses a piston **85** secured to a shaft **86** which extends through a bore **87** in the other end of the cylinder. A seal **88** is provided between the piston and cylinder walls. An arm **89** is slidably mounted on the shaft **86** and is arranged to contact one side of the gearbox striker **80**.

The other side of the gearbox striker **80** is contacted by a second arm **90** which is secured to the first arm and to a stepped piston **91** reciprocably mounted in cylinder D. Cylinder D is also stepped and the smaller step portion **92** slidingly engages the wall of the piston **91** adjacent the crown. The edge of the piston skirt is of increased diameter to engage slidingly with the larger step portion **93** of the cylinder. Seals **94, 95** are provided between the piston and cylinder walls and the larger end of the cylinder is closed by a cover **96** having a port **97** connected by a fluid line to valve D. A further step **98** is provided in the cylinder wall between the larger and smaller steps and a port **99** is provided in said cylinder wall at this point leading to the pressure fluid source.

The operation of the control device according to the invention will now be described and it will be assumed that the gear lever **12** is initially in the center of the main slot **10**.

When it is desired to select 1st gear, the gear lever **12** is first moved to one end of the main slot opposite branch slots **1** and R. The gear lever **12** pivots on the cylindrical sleeve **22** and the lug **58** below the sleeve acts on the piston **41** in valve C to force it towards the plug **51** at the end of the bore **17**. When the piston has travelled a predetermined distance, the valve member extension **49** engages a valve seat **59** on the port **52** connected to the fluid pressure source and cuts off the supply of fluid to the bore **17** and hence to the cylinder C. Further movement of the piston **41** brings the valve seat **46** out of engagement with the valve member **44** and the fluid pressure in cylinder C is thus exhausted via ports **84** and **53** through bores **54** to exhaust port **55** and hence to atmosphere.

Cylinder D is still pressurized and the piston **91** in this cylinder is therefore forced towards cylinder C the second arm **90** moving the gearbox striker **80** and hence the first arm **89**. The first arm **89** in turn forces the piston **85** in cylinder C away from cylinder D to expel the pressure fluid from said cylinder C through valve C to atmosphere.

First gear can now be selected by moving the gear lever **12** into the branch slot **1** by pivoting said lever on the shaft **19**. When this occurs, the upper lug **21** on the gear lever forces the piston **37** in valve B towards the plug **38** at the end of the bore. Again, the valve member extension **29** engages a valve seat **39** on the port **31** connected to the fluid pressure source and the valve seat **27** on the piston **37** breaks contact with the valve member **25** to connect cylinder B to atmosphere through valve B.

Since cylinder A is still pressurized, the piston **61** in this cylinder is forced towards cylinder B and the piston **72** in cylinder B is forced by the connected shaft **70** to expel the pressure fluid from cylinder B through valve B to atmosphere. The gearbox striker **80** which is mounted on the shaft **70** also moves to select first gear in the associated gearbox. At the same time, valve A forces its piston **23** against the upper lug **21** on the gear lever **12** to maintain said lever in the first-gear branch slot **1**.

When it is desired to return to neutral or to engage 2nd gear, the gear lever **12** must first be moved out of the branch slot **1**. The upper lug **21** on the gear lever **12** forces the piston **23** in valve A back to its former position and releases the force on valve B. Since the valve member **25** is hollow, the inside of the piston **37** in valve B is acted on by the fluid pressure source from port **31** so that the piston **37** follows the movement of the gear lever lug **21**. When the gear lever **12** has been returned to the main slot **10**, the valve member of valve B is again in engagement with the valve seat on the piston **37** and out of engagement with the valve seat on the port **31**.

Cylinder B is therefore again pressurized but since this cylinder has a diameter equal to the largest step of cylinder A which is at the same pressure a further force is required to return the cylinders to the central or neutral position. This force is provided by the pressure fluid source which enters cylinder A through the port **66** in the intermediate step portion **65**. This pressure acts on the larger step of the piston **61** in cylinder A and is effective, together with the force on the piston **72** in cylinder B to return the gearbox striker **80** to the neutral position. In this position, the piston **72** in cylinder B bears against the inner end of said cylinder.

The gear lever **12** is then moved to its central position in the main slot **10**. The piston **41** in valve C follows the movement of the lug **58** in a similar manner to the piston **37** in valve B and when the gear lever **12** is again in its central position, cylinder C is reconnected to the fluid pressure source via ports **52** and **53** in valve C. The force of pressure fluid on the piston **85** in cylinder C, assisted by the force of pressure fluid on the step of the piston in cylinder D which is supplied from the port **99** in the intermediate step portion **98** in said cylinder D, is effective to return the gearbox striker **80**, via the arms **89, 90** to its central position. Again, in this position, the piston **85** in cylinder C bears against the inner end of said cylinder.

If neutral is desired the gear lever **12** may be left in this position. However, if second gear is desired, the gear lever is moved into the gear branch slot **2** which is on the opposite side of the main slot **10** from the gear branch slot **1**. In this case valve A is acted on by the gear lever upper lug **21** and cylinder A is connected to atmosphere via ports **64** and **32**, bores **33**,

chamber 34 and its exhaust port. Since the piston 72 in cylinder B is already at the end of its cylinder it cannot act on the piston 62 in cylinder A. However, the pressure fluid from the port 66 in the intermediate step portion 65 in cylinder A acts on the piston 61 to force it to the end of said cylinder A. The shaft 70 moves with the piston and slides partially out of the pin 74 connnected to the piston 72 in cylinders B and the gearbox striker 80 moves with the shaft 70 to select second gear. The gear lever 12 is maintained in the branch slot 2 by the piston 37 in valve B.

Third gear is selected by first running the gear lever 12 to the central position in the main slot 10 facing both the second and third gear branch slots. When this occurs, valve A again connects cylinder A to the pressure fluid source and the pressure fluid acting on the whole area of the piston 61 in cylinder A returns the piston and hence the gearbox striker 80 to the neutral position, the shaft 70 sliding back to receive the pin 74 connected to the piston 72 in cylinder B. Third gear is then selected by moving the gear lever into the third gear branch slot 3 when the valve B opens cylinder B to atmosphere and third gear is selected as for first gear.

When it is desired to select fourth gear from third gear, the gear lever 12 must first be returned to the main slot 10, when the gearbox striker 80 is returned to neutral as with first gear, and then moved to the end of the main slot opposite branch slots 4 and 5. This movement causes valve D to open cylinder D to atmosphere

Since the piston 85 in cylinder C is already bearing on the end of the cylinder it cannot act on the piston 91 in cylinder D. However, the pressure fluid supplied from the port 99 in the intermediate step portion 98 in cylinder D acts on the stepped portion of the piston 91 in cylinder D to move said piston away from cylinder C to expel the pressure fluid in cylinder D through valve D to atmosphere. The second arm 90 moves with the piston in cylinder D and, since the first arm 89 is connected to the second arm 90, said first arm 89 also moves sliding along a reduced diameter portion 79 of the shaft 86 and moving the gearbox striker 80 therewith.

Fourth or fifth gear can now be selected by moving the hand lever into branch slots 4 or 5, the operation being the same as for second and third gears respectively.

When it is desired to reengage neutral or to change to a lower gear, the gear lever is first moved from the gear branch slot 4 or 5 to the main slot 10 and then to the central position in the main slot. The first movement has the same operation as for moving the gear lever 12 out of the second or third gear branch slots 2 or 3 but as regards the second movement, the valve member in valve D again seats on the valve seat in the piston 56 and cuts off cylinder D from atmosphere while at the same time reconnecting the pressure fluid source to cylinder D. The pressure fluid acting on the whole area of the piston 91 in cylinder D returns said piston, against the action of the pressure fluid on the piston step, to its former position. The second arm 90 returns the gearbox striker 80 to its neutral position and the first arm 89 slides back on the portion 79 until it abuts the step formed by the remainder of shaft 86.

Movement of the gear lever 12 is opposed by the air pressure loading behind the valve pistons so that a baulk is provided in either direction when the gear lever is moved from its central neutral position. This gives a good indication as to which gear position is about to be engaged and also prevents a rapid movement from say first to fourth gears instead of from first to second.

Reverse gear is selected in a similar manner to first gear except that cylinder A instead of cylinder B is connected to atmosphere. Means are desirably provided to prevent reverse gear from being selected accidentally. These means may comprise a tube 6 mounted on the gear lever 12 which is arranged to abut against a baulk 17 on the gate cover 13 when reverse gear is to be selected. This baulk may be overcome by lifting the tube 6 against the action of a spring 8 so that it clears the baulk 7.

The exhaust ports in the valve housing are preferably provided with filters 40 to prevent the ingress of dirt etc. into the valves. Moreover, a cover 9 of flexible material such as rubber or plastics is desirably provided over the gate cover, the gear lever 12 and tube 6 extending through the cover in the normal way.

The valve housing preferably includes clutch interlock means whereby a gear position cannot be engaged until the clutch pedal of a vehicle fitted with the device is depressed. The clutch interlock means desirably comprises a piston 101 slidably received in a cylinder 102 in the valve housing 10 and normally urged by a spring 103 to project into the upper bore 15 to prevent movement of the pistons in valves A and B. When the clutch pedal is depressed, the clutch piston 101 is forced out of the bore 15 against the action of spring 103 so that the required gear may be selected.

We claim:

1. A manual control device for a fluid-pressure actuated gear change mechanism, said device comprising a housing containing at least four valves arranged in opposing pairs, each valve including a piston; a hand lever mounted in said housing, said hand lever being movable in at least two directions and being engageable with said valve pistons; a casing adapted to be secured to a gearbox and having at least four cylinders, said cylinders being arranged in pairs and each cylinder having a piston and at least one fluid port; and pressure fluid lines connecting each of said cylinders to a respective valve; each of said pistons in the valve housing containing a valve member arranged to engage a valve seat on the piston in one position of the valve and to engage a second valve seat in a second position of the valve when said piston is engaged and displaced by the hand lever, the valve member in said second position connecting the associated cylinder to atmosphere via the respective pressure fluid connecting line, and said hand lever being movable to engage a valve piston in order to select a gear in said gearbox and being held in said gear-selected position by pressure fluid acting on the opposing valve piston of the pair.

2. A device as claimed in claim 1, the valves of each pair lying on a common axis and the two axes being disposed in planes that are at right angles to each other with one axis arranged vertically above the other.

3. A device as claimed in claim 1, in which the casing contains four cylinders arranged in pairs, the cylinders of each pair lying on a common axis.

4. A device as claimed in claim 3, in which the two axes are disposed in planes that are at right angles to each other.

5. A device as claimed in claim 3, in which the piston in each cylinder is arranged to act on a gearbox striker, whereby operation of the hand lever to a selected gear position is effective to cause at least one of the pistons to move the gearbox striker to select the selected gear in the associated gearbox.