PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Pneumatic Control Apparatus for Change Speed Gears of Motor Vehicles

We, LANCIA & C. FABRICA AUTOMOBILI-TORINO S.p.A., an Italian Joint Stock Company, of 99, Via Monginevro, Turin, Italy, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a pneumatic control for the change speed gears of motor vehicles.

The improved control apparatus according to the present invention comprises a supply of compressed air, pneumatic motors for controlling the movable components of the change speed gear, conduit means connecting said compressed air supply with said pneumatic motors, pre-selector and control valves respectively interposed in said conduit means for controlling the supply of compressed air to said motors, and a cam controlling the or each said pre-selector valve and actuable by a hand operated lever, the apparatus being characterised in that at least one of said movable components is capable of rectilinear displacement to a central position and two extreme positions, and in that the pneumatic motor controlling the said movable component comprises two cylinders coaxially and oppositely arranged, two plungers movable in said cylinders and securedly fixed to each other, two annular pistons each arranged around one of the said plungers and slidable thereon in sealing contact with the inner walls of their respective cylinders and the surfaces of the plungers, means connecting the plungers to the said one of said movable components for displacing the latter from either one to the other of said positions on displacement of the plungers, and stops on the inward ends both of the cylinders and plungers from their respective pistons, compressed air being fed through two pre-selector valves connected to the outer ends of the cylinders respectively.

Further characteristic features of this invention will be understood from the apended description referring to the accompanying drawings, given by way of example, wherein:—

Figure 1 is a part sectional diagrammatic view of a device according to the invention; and

Figure 2 shows a modification of the embodiment illustrated in Figure 1.

In the drawings, 1 generally denotes a four-speed change speed gear with gears constantly in mesh.

The change speed gear is of a type known *per se* and comprises an inlet shaft 6, an outlet shaft 7 and a secondary shaft 8.

Toothed wheels 9, 10 and 11 are freely rotatable on the shafts 6 and 7 and mesh with toothed wheels 12, 13, 14, respectively, keyed to the secondary shaft 8.

The shafts 6 and 7 have mounted axially displaceably, but not rotatably, thereon sleeves 2 and 3 respectively, which may be coupled with toothed wheels 9, 10 and 11 through dog clutches 15, 16, 17 and 18.

The slidable sleeve 3 is provided with a toothed wheel 19 securely fixed thereto, which can be coupled through a loose toothed wheel 20 to a toothed wheel 21 keyed to the secondary shaft 8 for reverse.

The wheel 20 is freely rotatable but not displaceable on a shaft 20*a* slidable in guides 20*b*. The shaft 20*a* has keyed thereto a grooved disc 20*c* actuated by a fork 20*d*.

Displacement of the sleeves 2 and 3 is effected by means of forks 4 and 5 respectively, which engage grooves 2*a*, 3*a* respectively, formed in the said sleeves.

The forks 4 and 5 are operated by means of pneumatic motors 22, 23, respectively, by which they may be moved between a central

position (shown on the drawing) and two lateral positions for coupling the clutches 15 or 16 and 17 or 18 respectively.

The pneumatic motors 22, 23 are fed through pre-selector valves 24, 25 and 26, 27, respectively.

The translational displacement of the toothed wheel 20 for clutching in reverse is effected through a pneumatic motor 28 fed through a control valve 29.

The pre-selector and control valves are actuated by a cam 30 capable of axial displacement under the action of a hand operated lever 31.

The embodiment of the pneumatic control shown on the drawing is associated with a friction clutch which is likewise pneumatically controlled, and which is provided with a pedal 32 which, on being depressed, allows compressed air to flow through a conduit 33, connected for instance with the service reservoir, to a conduit 34 connected to the pneumatic cylinder 35 actuating the friction clutch through a stem 36.

The pneumatic cylinder 35 actuates a check valve which will be described hereafter and which is adapted to deliver air to a conduit 37 as soon as the clutch is fully released.

The conduit 37 feeds all the pre-selector valves, while the control valve 29 receives air from the conduit 33 directly.

The component parts of the device will now be described in detail.

The pneumatic motors 22, 23 are alike, so that the motor 22 alone need be described. This motor comprises two cylinders 22*a*, 22*b* coaxially and oppositely arranged, and in which two plungers 22*c*, 22*d*, respectively are movable.

The plungers 22*c*, 22*d* extend coaxially from opposite ends of a central body 22*e* to which the fork 4 is securely connected.

Annular piston 22*f*, 22*g* move around the plungers 22*c*, 22*d* in sealing contact with the inner walls of their respective cylinders and the surfaces of the said plungers.

The body 22*e* is provided with stops 22*h*, 22*i* for the pistons 22*f*, 22*g*, respectively. Further stops 22*m*, 22*n*, respectively are provided on the bottom of the cylinders 22*a*, 22*b* for the pistons 22f, 22*g*.

The two cylinders of the pneumatic motor 22 are fed with compressed air from the valves 24, 25 through tubes 38, 39. The cylinders of the pneumatic motor 23 are fed with compressed air from the valves 26, 27 through tubes 40, 41, respectively.

When compressed air is supplied to the two cylinders of the motor 22, the fork 4 occupies the central position shown on the drawing. When compressed air is fed to one cylinder only, such as 22*a*, the body 22*e* is moved away from the cylinder which is being fed, for instance to the right in the case now considered.

The pre-selector valves 24, 25, 26 and 27 and control valve 29, which are all alike, will now be described.

The valve 24 comprises a disc 24*a* biased by a spring 24*b* to its closed position. The valve disc 24*a* is acted upon by a hollow stem 24*c* formed with a drain hole 24*d*.

A spring 24*e* biases the hollow stem 24*c* against the cam 30.

In the position shown on the drawing the valve 24 is open so that its stem 24*c* biases the disc 24*a* downwardly thus removing the latter from its seat. The other valves are similar in construction as mentioned above and will not therefore be described.

The cam 30 comprises a rod capable of rectilinear displacement under the action of the control lever 31 and formed with notches 30*a* adapted to co-operate with the valve stems.

The lever 31 can occupy a neutral position F shown on the drawing, a reverse position R and first, second, third and fourth speed positions indicated by corresponding roman numerals.

The valve 42 comprises a valve disc 42*a* acting as a valve member and biased by a spring 42*b* against its seat. The valve disc 42*a* is acted upon by a hollow stem 42*c* securely fixed to a disc 42*d* actuated through a spring 42*e* by a piston 42*f* acted upon by a rod 42*g* operated by the pedal 32.

The pneumatic cylinder 35 has a piston 35*a* movable therein under the action of the spring 35*b* securely fixed to the rod 36 operating the clutch.

The piston 35*a* has attached thereto a casing 35*c* enclosing a disc 35*d* securely fixed to a stem 35*e* connected with a disc 35*f* serving as a valve member for the above-mentioned check valve.

The pneumatic control operates as follows. When it is desired to change to a forward drive speed, the lever 31 is moved to its position corresponding to the desired speed. This prepares for operation the pre-selector valves required for clutching in the said speed. No compressed air flows as yet, for the valve 42 is in its closed position.

When the friction clutch pedal is depressed air flows from the service reservoir through the conduit 33 and valve 42 to the friction clutch cylinder 35. In the released clutch condition air flows to the conduit 37 and through the pre-selector valves which are open to the motors controlling the change speed gear, thereby effecting the desired speed change. In the three-throw cylinders, the pre-selector valves which are closed or in their drainage position discharge air flowing back from the cylinders, through holes such as 24*d*.

The invention further provides means for positively positioning the movable components 2 and 3 for the forward drive of the change

speed gear, such positioning means being arranged normally to hold the said movable members in their locked positions and to release them as soon as air is delivered for operating the motors actuating the said members.

The positive positioning means comprises two pneumatic cylinders 62, 63 fed through conduits 64, 65, respectively, branched on a pipe 66 connected with the conduit 34 conveying air from the valve 42 to the valve 35*f*.

The cylinders 62 and 63 each co-operate with one of the pneumatic motors 22, 23.

The pneumatic cylinders 62 and 63 are alike, each comprising a piston such as 62*a*, securely fixed to a stem 62*b* the end of which co-operates with notches 22*p* bored in the central casing 22*e* of the associated motor 22.

The notches 22*p* are so arranged that the stem 62*b* extends into said notches under the action of a spring 67 when the central casing is in its extreme right-hand, extreme left-hand or central position.

Upon depression of the friction clutch pedal, air is fed to the cylinder 35 operating the friction clutch and at the same time to the cylinders 62 and 63 for releasing the movable components of the change speed gear. After displacement of the latter, as the friction clutch pedal is lifted again, air is drained from the said cylinders, the stems of which then resume their locked positions. Under these conditions the pneumatic motors are positively blocked, so that the gears of the speed box are likewise held in a positively engaged position.

According to a further aspect of this invention the conduit feeding compressed air to the pre-selector valves has interposed therein a non-return valve 68 arranged to allow compressed air to pass only towards the pre-selector valve. The purpose of this valve will now be explained.

In certain relative positions of teeth of the clutches 15 to 18 of the speed box, the said teeth, on change of speed, abut one another instead of interengaging. On lifting the friction clutch pedal the pneumatic motors are no longer fed with compressed air, so that the teeth of the clutches would not be in a condition for interengagement. The non-return valve 68 causes compressed air to remain in the pneumatic motors which are being fed even after the friction clutch pedal is lifted so that, as soon as the friction clutch starts slipping before engaging, the synchroniser teeth are brought to their correct position for interengagement. It is not essential for the non-return valve 68 to seal tightly, for compressed air need remain in the motor cylinders only up until the interengagement of the synchroniser teeth, which takes place as soon as the clutch pedal is lifted.

According to a further aspect of this invention, a calibrating port 69 is provided in the conduit 37 supplying air to the pre-selector valve for the purpose of slightly throttling air delivery to prevent too sharp displacement of the movable components of the motor cylinder, and hence of the change speed gear, which may cause the synchroniser teeth to strike against one another.

The embodiment shown in Figure 1 is advantageously suitable for remote control of the change speed gear. This may be accomplished by connecting pipes 38, 39, 40, 41 and 43, between pre-selector and control valves and motors of a large cross-section so as to ensure the necessary promptness in operation. However, this is not always convenient, more particularly when the gear box is fairly remote from the pre-selector valves.

In the modification illustrated in Figure 2, in which parts corresponding with those shown in Figure 1 are denoted by the same reference numerals, remote controlled valves 44 to 47 are provided which act as pneumatic repeaters for the positions of the pre-selector valves arranged on the operating lever for the change speed gear. The motor 28 is operated by the control valve 29 direct.

The pipes 38, 39, 40, 41 and 43 therefore feed compressed air for actuating the valves 44 to 47, the pipe 37 supplying compressed air for actuating the pneumatic motors 22 and 23 through the above-mentioned repeater valves.

The pipes connecting the repeater valves to the pneumatic cylinders are denoted by 49 and 52.

The repeater valves are all alike. Therefore, only the valve 44 will be described. This valve comprises a cylinder 44*a* and a piston 44*b* operating through a hollow stem 44*c* a disc 44*d* acting as a valve member. This valve member is biased against its seat by a spring 44*e*. The piston 44*b* is biased against the air pressure by a spring 44*f*.

The embodiment shown in Figure 2 is advantageous in that, as compared with the construction shown in Figure 1, the pipes connecting the change speed gear operating lever with the gear box may be of a reduced cross-sectional area, the operating speed being the same.

The pneumatic cylinders 62 and 63 and non-return valve 68 are not shown in Figure 2 for the sake of simplicity. However, it is clear that such cylinders and valve may be employed in this construction.

It will be understood that embodiments and constructional details may be widely varied from the non-limiting example described and shown without departing from the scope of this invention as defined in the appended claims.

For instance, the friction clutch could be of the conventional control type.

In this case the service reservoir would be connected with the conduit 37 direct. Moreover, the cam 30 could be arranged near to the gear box and be mechanically actuated from the lever 31 through a pull rod.

Alternatively in motor vehicles equipped with a mechanical friction clutch the check valve 35*f* could be controlled from the pedal of the mechanical friction clutch after the pedal has released the clutch, compressed air then flowing from the service reservoir to the pre-selector valves of the change speed gear through the said mechanically actuated valve. This results in a pre-selector pneumatic change speed gear, in which the change of speed is controlled from the pedal of the mechanically operated friction clutch. Since the valves are remotely controlled through a linkage, one pipe only connects the driver's seat with the change speed gear.

Moreover, the cam 30 could be replaced by a rotary disc or drum.

WHAT WE CLAIM IS:—

1. Pneumatic control apparatus for change speed gears on motor vehicles comprising a supply of compressed air, pneumatic motors for controlling the movable components of the change speed gear, conduit means connecting said compressed air supply with said pneumatic motors, pre-selector and control valves respectively interposed in the said conduit means for controlling the supply of compressed air to said motors, and a cam controlling the or each said pre-selector valve and actuable by a hand operated lever, the apparatus being characterised in that at least one of said movable components is capable of rectilinear displacement to a central position and two extreme positions, and in that the pneumatic motor controlling the said movable component comprises two cylinders coaxially and oppositely arranged, two plungers movable in the said cylinders and securely fixed to each other, two annular pistons each arranged around one of the said plungers and slidable thereon in sealing contact with the inner walls of their respective cylinders and the surfaces of the plungers, means connecting the plungers to the said one of said movable components for displacing the latter from either one to the other of said positions on displacement of the plungers, and stops on the inward ends both of the cylinders and plungers for their respective pistons, compressed air being fed through two pre-selector valves connected to the outer ends of the cylinders respectively.

2. Apparatus according to Claim 1, wherein the said cam for actuating the pre-selector and control valves comprises a rod capable of rectilinear movement and having notches co-operating with the valve members of said pre-selector and control valves.

3. Apparatus according to Claim 1, wherein a check valve is interposed in the compressed air supply to the pre-selector and control valves and is actuated by the friction clutch so as to open upon the release of the friction clutch.

4. Apparatus according to Claim 3, wherein the valve member on the said check valve is held in its closed position by spring means and is moved to its open position by a rod engaged by a piston on a pneumatic clutch actuating cylinder when the said piston is forced by compressed air to its unclutched position.

5. Apparatus according to Claim 1, wherein one at least of the said pneumatic motors is operated through repeater valves remotely controlled by the said pre-selector valves.

6. Apparatus according to Claim 1, wherein means are provided for locking the movable components of the change speed gear, said means being arranged normally to hold said components locked and to unlock them as soon as compressed air is delivered for operating the motors actuating the said movable components.

7. Apparatus according to Claim 6 and Claim 1, wherein the said locking means comprises, in association with each movable component of the change speed gear, a compressed air cylinder fed through a pipe including a valve controlled by the clutch pedal, the stem of a piston in the said cylinder being arranged to co-operate, when the cylinder is being fed, with notches formed in the central portions of the movable members of the motor cylinders, and spring means being provided for moving the said stem away from its notch engaging position when the cylinder is not being fed.

8. Apparatus according to Claim 1, wherein a non-return valve is interposed in the pipe supplying compressed air to the said pre-selector valves.

9. Apparatus according to Claim 1, wherein a calibrating port is provided to throttle the pipe supplying compressed air to the said pre-selector valves.

10. Pneumatic control apparatus for change speed gears on motor vehicles, substantially as hereinbefore described with reference to and as shown in Figure 1 of the accompanying drawings.

11. Apparatus according to Claim 11, but modified substantially as hereinbefore described with reference to and as shown in Figure 2 of the accompanying drawings.

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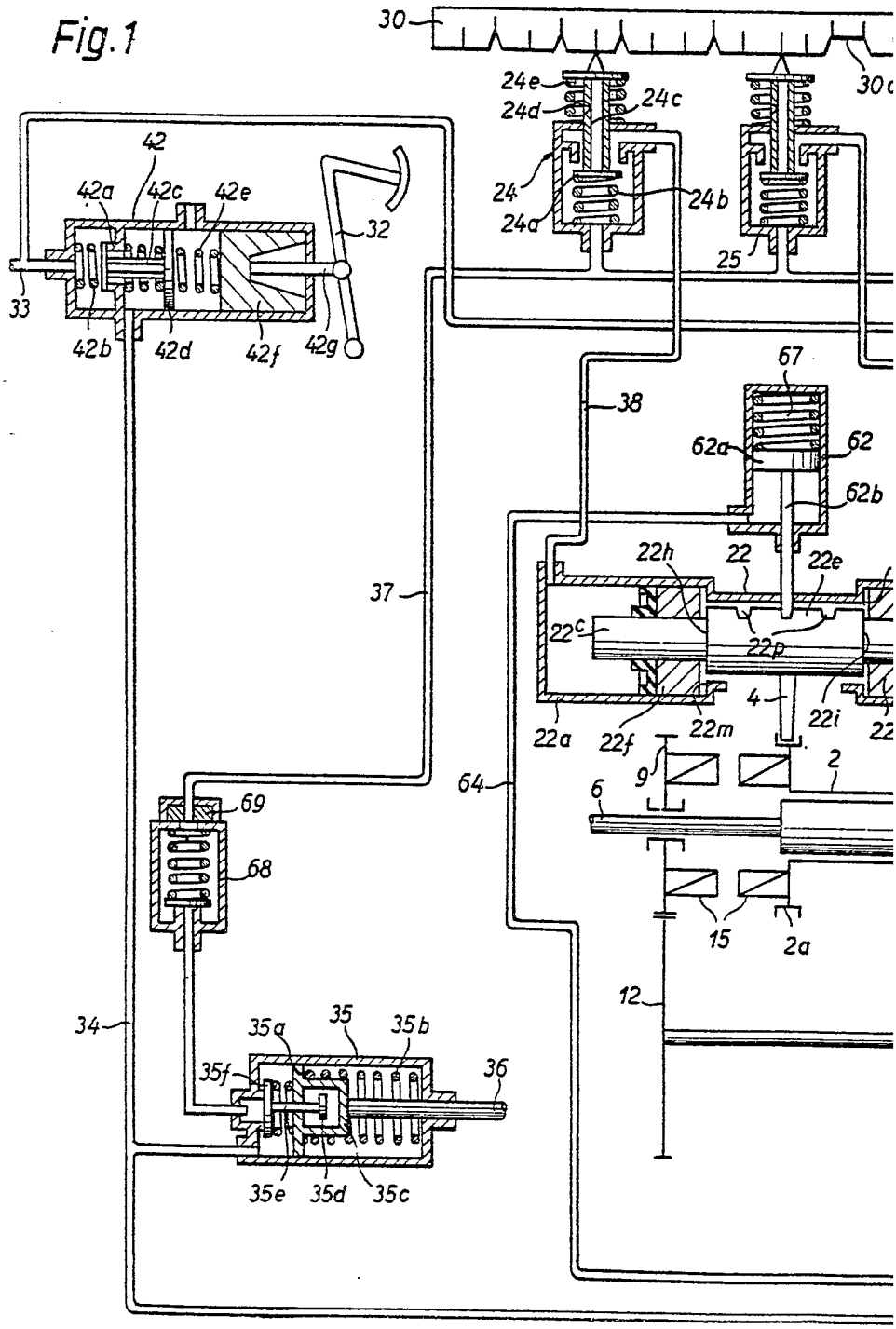
Fig.1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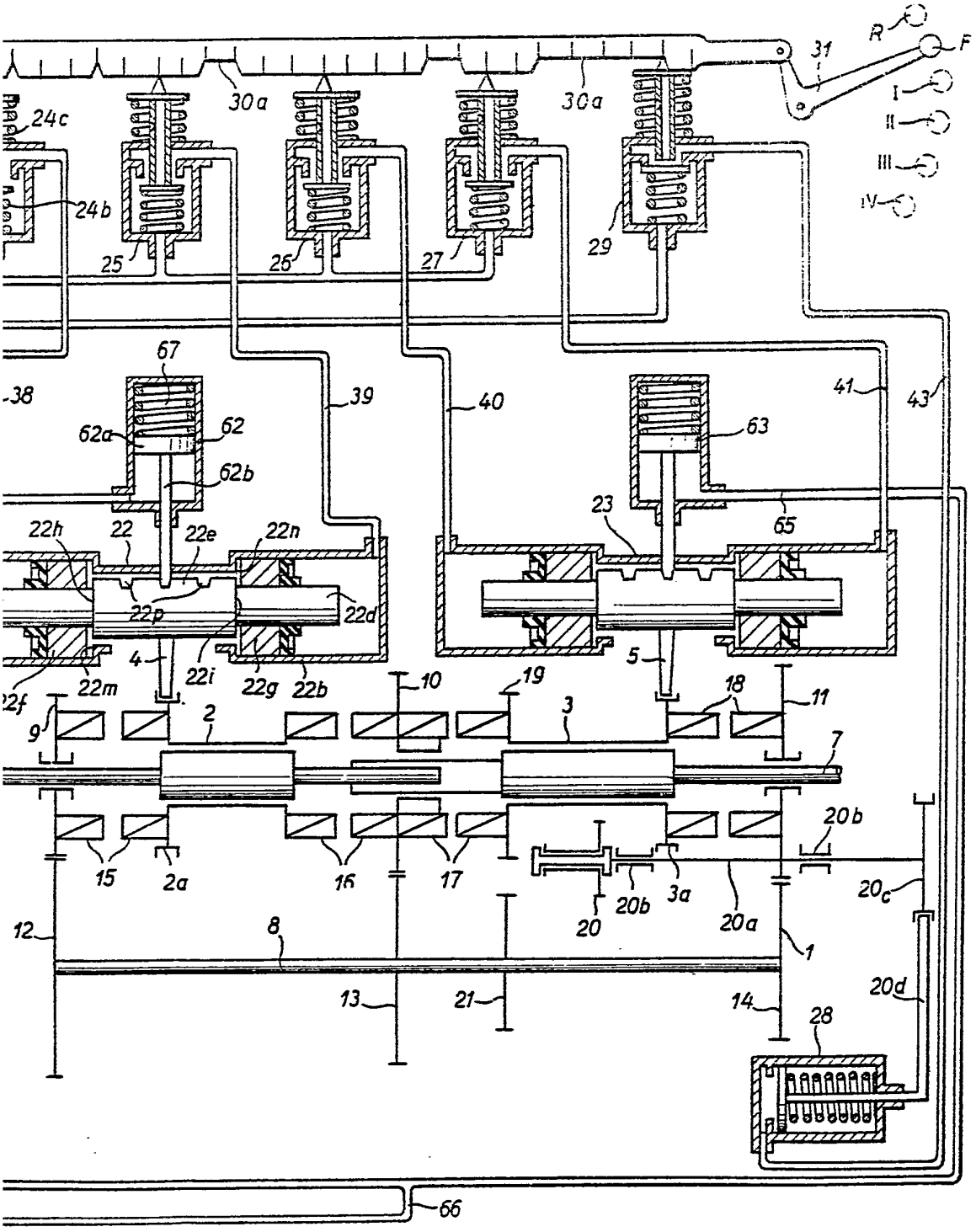

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Fig.1

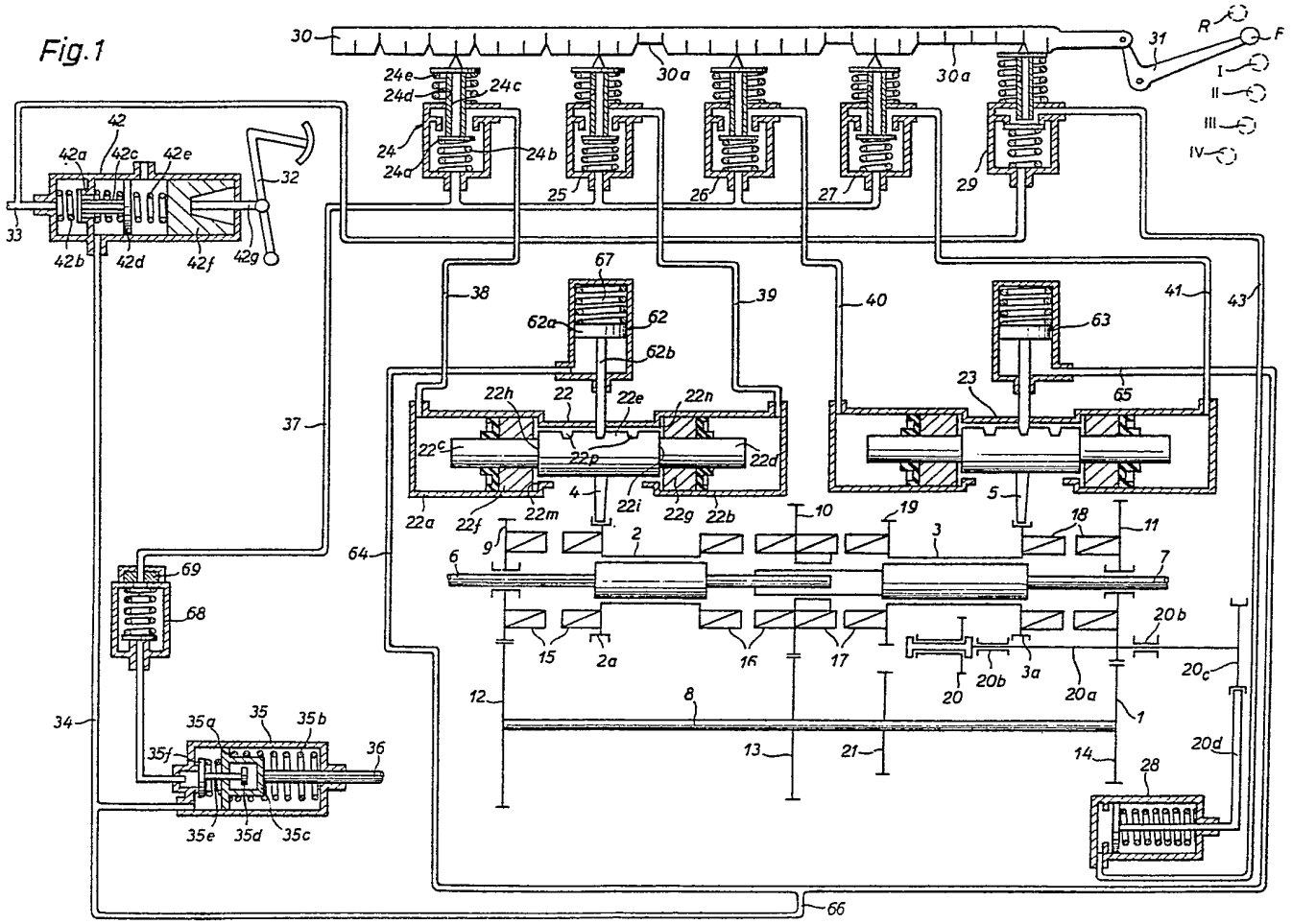
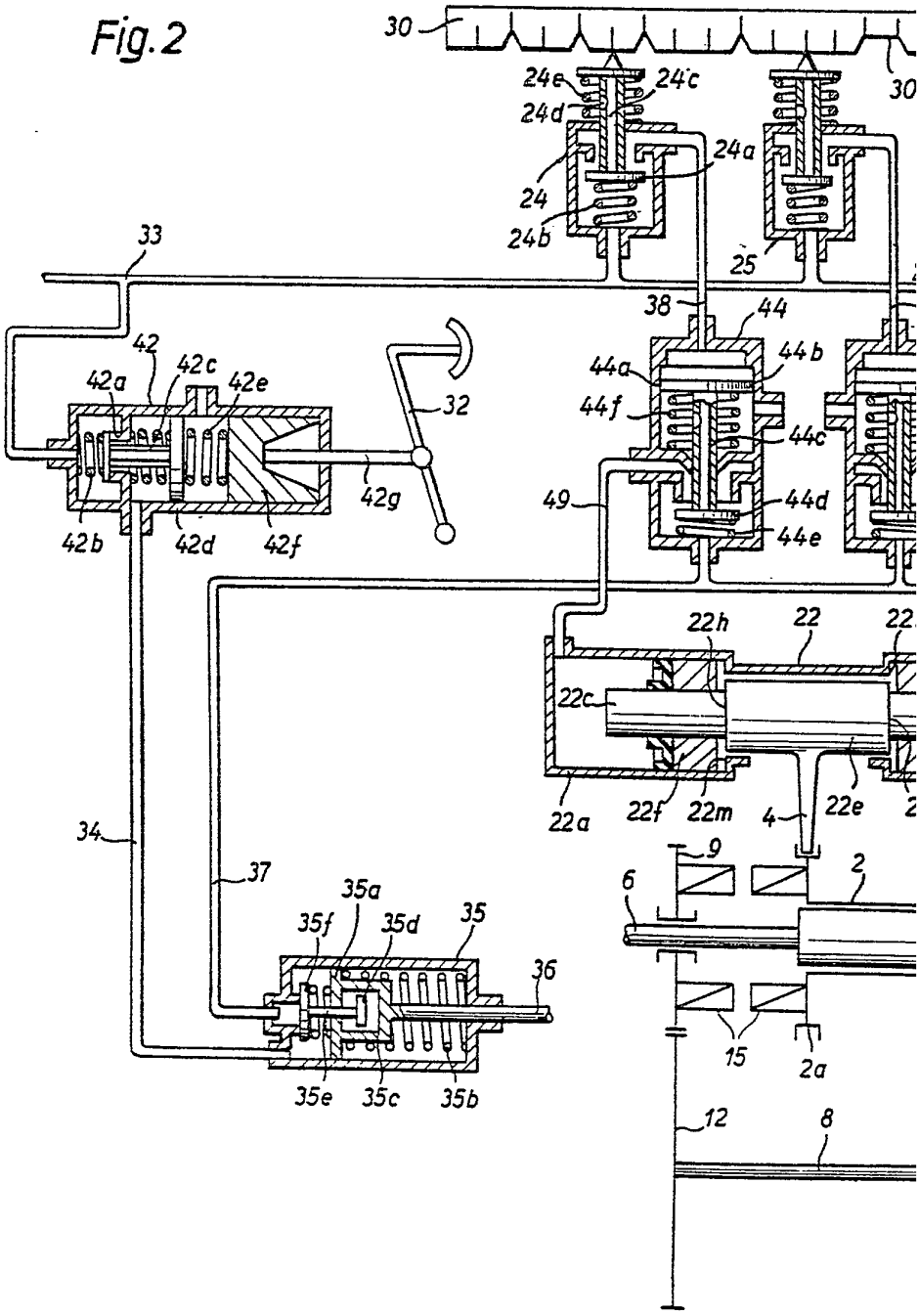


Fig. 2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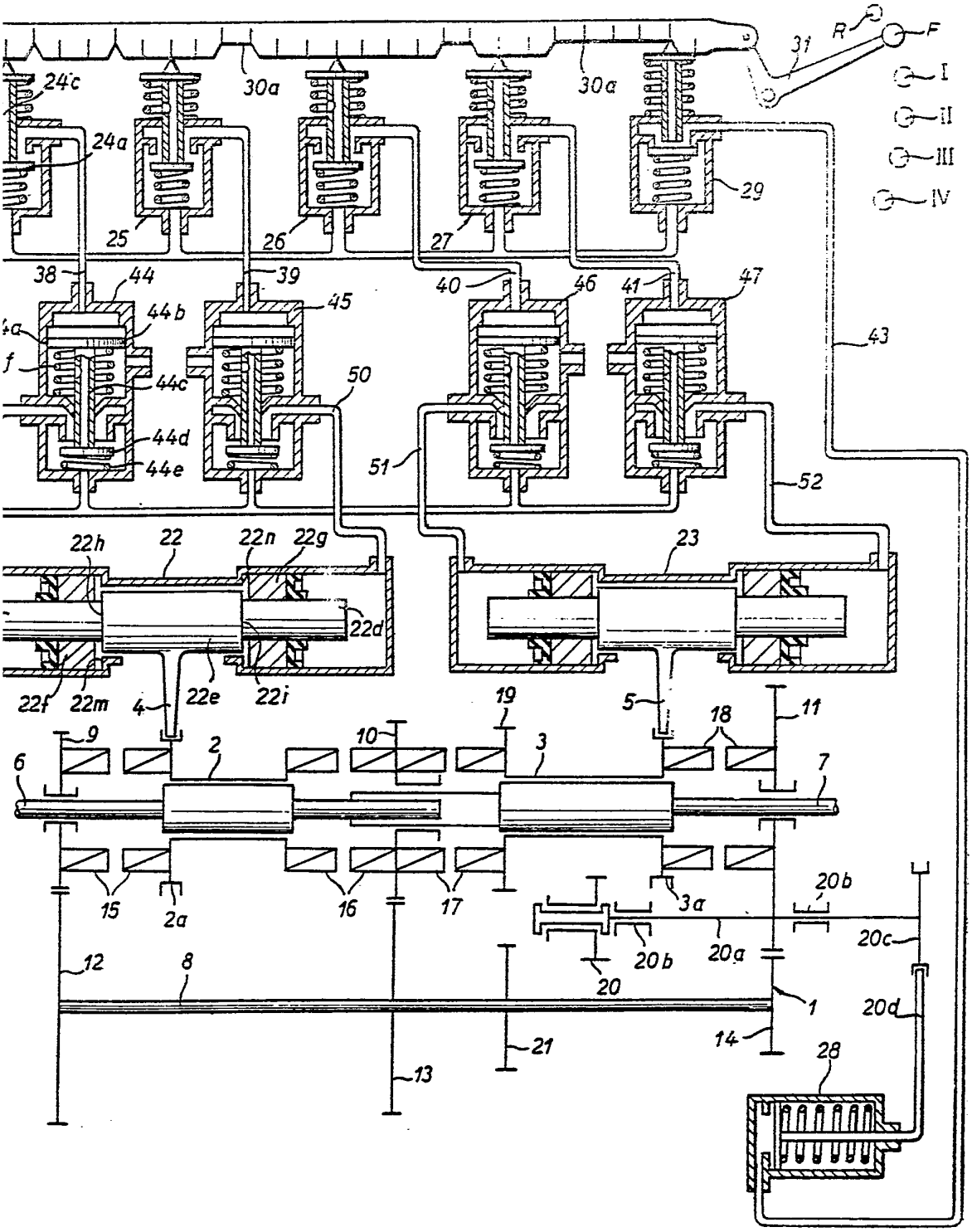
Sheet 2



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Sheet 2

Fig.2