March 27, 1934. H. J. DE N. McCOLLUM ET AL 1,952,767

VACUUM POWER CLUTCH MECHANISM

Original Filed Feb. 17, 1931

FIG. 1.

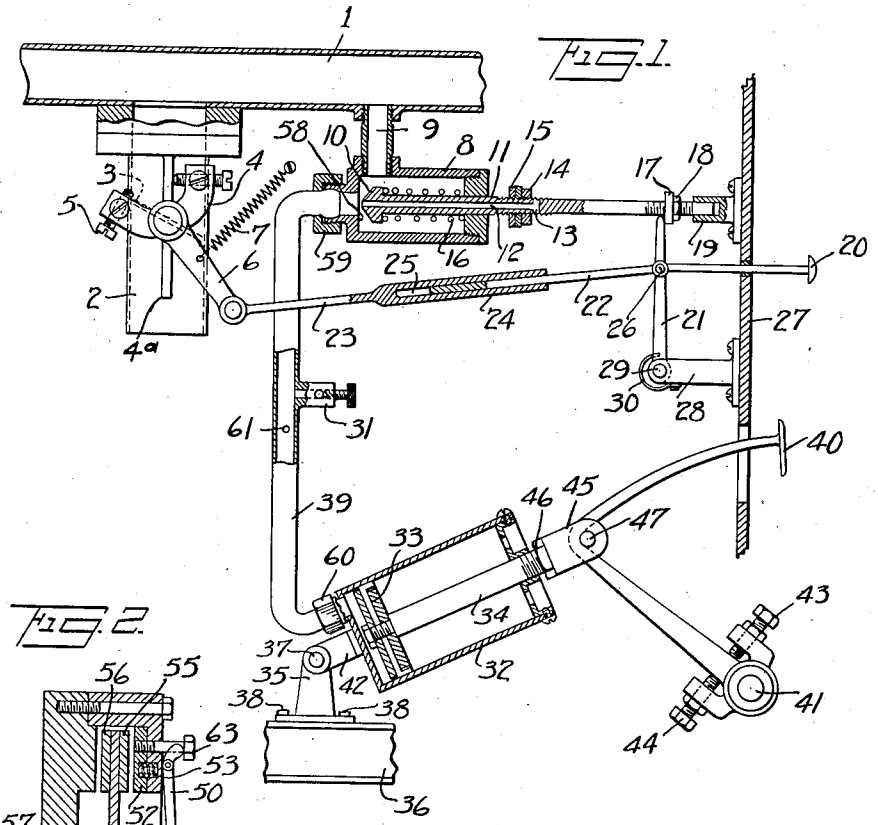


FIG. 2.

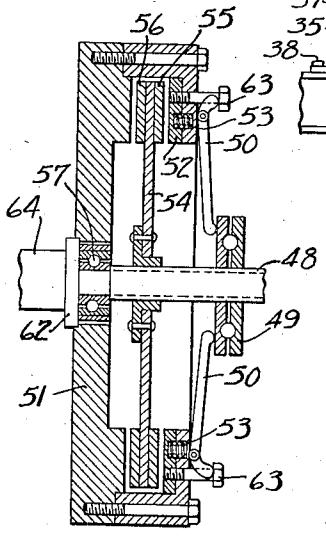
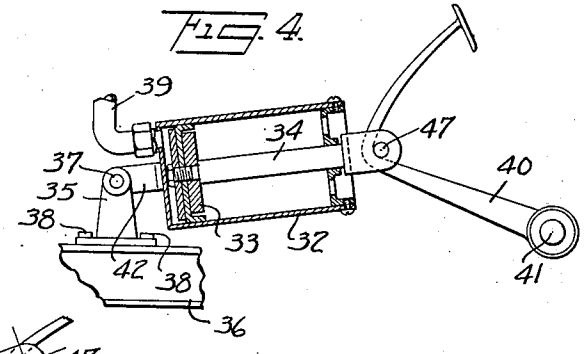


FIG. 4.



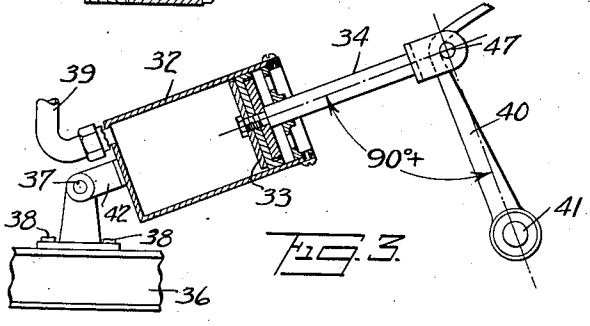


FIG. 3.

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VACUUM POWER CLUTCH MECHANISM

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Renewed September 26, 1933

7 Claims. (Cl. 192—.01)

Our invention relates to improvements in vacuum power clutches and the objects of our improvements are, first, to provide a mechanism of the simplest possible construction, second, to provide a mechanism of the greatest reliability at a minimum cost of construction. Third, to provide a mechanism with a minimum cost of installation. Fourth, to provide a mechanism satisfactorily meeting all the requirements of a power operated clutch. Fifth, to provide a mechanism giving true "free wheeling" in all gears including reverse. Sixth, to provide a mechanism in which the engine can be used as a brake in all gears including reverse. Seventh. To provide simple, mechanical and automatically operating means for permitting a rapid initial movement of the clutch-engaging mechanism and compelling a subsequent slower rate of movement during the completion of the clutch engagement, this being technically known as a "two-stage" mechanism.

By the term "free wheeling" above used, we mean a free rolling or coasting movement of the car under the influence of gravity, or of the car's momentum, without the transmission of such motion to the motor, which may be then throttled down to a low speed of rotation.

We attain these objects by the mechanism illustrated in the accompanying drawing in which like numbers represent the same parts throughout and in which—

Fig. 1 shows a sectional view of the mechanism, Fig. 2 a detailed sectional vew of the clutch, and Figs. 3 and 4 show parts of the mechanism in different positions of angularity of the clutch lever.

Throughout the drawing like reference characters indicate like parts. Referring to Fig. 1, the parts of a standard form of motor car therein illustrated comprise the following: the intake manifold 1, to which the carburetor 2 is connected, the usual butterfly valve of such carburetor being shown at 3, and the throttle lever at 6, the usual stop arms 4 and 5 on the shaft of the valve cooperating with the stop rib 4a on the carburetor and the tension spring 7 normally holding the carburetor throttle in the position shown for idling the motor. A section of the floor board is shown at 27, through which projects the accelerator operating pedal 20 which, in the arrangement shown, has its other end pivoted at 26 to the accelerator link 22 and also to the lever 21 which is fulcrumed at 29 to the bracket 28, carried by the foot board. The accelerator link 22 telescopes into the sleeve 24 carried by the throttle operating link 23, the parts being so proportioned that when the pedal or button carried by 20 is in its position of rest, as shown, and the motor is idling, there will be a gap 25 between the end of link 22 and the bottom of the interior of sleeve 24, this constituting a lost motion connection between the accelerator link 22 and the throttle.

40 represents the clutch pedal lever mounted on the clutch operating shaft 41 and angularly adjustable with reference thereto by means of the setscrews 43 and 44. A portion of the chassis or engine subframe is indicated at 36.

A pneumatically operated clutch-controlling mechanism of the class disclosed in our co-pending application Serial No. 503,767 is also shown in Fig. 1, our present invention comprising certain further improvements thereon. This apparatus comprises a cylinder 32 containing piston 33, having piston rod 34 and a hinged mounting on the chassis 36 by means of the pedestal 35, bolted to 36, as indicated at 38, 38, to which pedestal lug 42 on the closed end of cylinder 32 is pivoted at 37. The free end of the piston rod 34 has a fork 45 screwed thereon and held in any position of adjustment by lock nut 46. Pivot 47 connects piston rod 34 to clutch lever 40. There is therefore here created a pneumatically expansible and contractile unit hinged to a fixed support and to said clutch lever 40, and said unit is connected to the intake manifold 1 by means of the conduit 39 opening at one end into the closed end of cylinder 32, and at the other end, through the valve port 58, into the valve casing 8, which latter is connected by conduit 9 to the manifold 1. In said casing is the plunger valve 10 carried by stem 11 projecting through one end of the casing and having the locking nuts 17 and 18 on its projecting portion which are in the path of movement of the free end of lever 21. The end of stem 11 is nested in the guide 19 carried by the footboard 27. A spiral compression spring 16 surrounds valve 8 and is confined between the right hand end of the valve casing and the head of the valve. 12 is an axial bore extending through the valve and stem to a point in the latter exterior of casing 8, where there is a port 13 opening to the atmosphere. 14 and 15 are locking nuts for controlling the effective area of opening of air inlet 13. The usual pipe connections for joining conduit 39 (which would usually be a flexible copper pipe) to valve and cylinder are shown at 59 and 60.

An air leakage port 61 in conduit 39 has a very small fixed cross sectional area, and 31 repre-

sents an adjustable air inlet device connected to the interior of said conduit.

30 is a semicircular spring anchored on bracket 28 and having its free end engaging a notch in the surface of lever 21 and so stressed as to normally tend to swing lever 21 in a clockwise direction on its fulcrum or pivot 29 and maintain all parts shown in Fig. 1 in the position there illustrated, the suction valve 8—10 being then open so that the manifold suction has pulled piston 33 to the closed end of cylinder 32, and thereby pulled the clutch lever 40 into the position producing complete disengagement of the clutch.

The preferred proportion of the parts is such as will produce the results illustrated in Figs. 3 and 4 where the angle between the straight lines passing through the axis of clutch shaft 41 and through the axis of pivot pin 47, and the straight line also passing through axis of pin 47 and that of pivot pin 37, equals or slightly exceeds 90 degrees when the clutch is in fully engaged position (as indicated in Fig. 3) and approximates 180 degrees when the clutch is in fully disengaged position as indicated in Fig. 4.

As the result of this arrangement, whenever the suction valve 10 is closed the volume of air that will thereafter flow at a uniform rate into said cylinder 32 through ports 13 and 61, or through 61 and adjustable valve 31 (or through so many of them as may have been left open) will permit piston 33 to travel toward the open end of cylinder 32 at a substantially uniform rate of speed under the action of the clutch springs, and consequently, as a result of the relative angularities of lever 40 and piston rod 34 above described, such initial uniform movement of piston 33 will produce at first a relatively rapid clockwise rotation of clutch shaft 41 which will gradually decrease in speed as the clutch lever approaches the position of complete clutch engagement shown in Fig. 3. The described arrangement of air inlet ports forms a convenient and controllable means for applying a substantially constant resistance to movement of piston rod 34 toward clutch lever 40, not sufficient, however, to overcome the pull of the clutch springs.

Referring to Fig. 2 there is there shown a standard form of clutch which has been employed in a widely used make of motor cars, and which is particularly adapted to cooperate with our above described invention, as the engaging and disengaging movements of the clutch surfaces are extremely small. 51 is the flywheel bolted to a flange 62 on the end of the engine crank shaft 64 and carries part of a ball bearing set 57, the other ball race of which is fast on transmission shaft 48, which carries clutch disc 54, having annular clutch linings 55 and 56. Throwout bearing 49 transmits pedal pressure to throwout fingers 50, which engage the heads of bolts 63, 63, set in the annular pressure plate 52, and pull the latter away from clutch lining 55 against the resistance of springs 53, 53.

As shown in Fig. 2 the face of clutch disc 54 is flat throughout its entire diameter and the linings 55 and 56 which are fastened to said clutch disk are made of the least compressible form of clutch lining material such as the moulded type and the clutch actuating mechanism is so designed as to allow complete engagement and disengagement of the clutch with the least possible motion of the clutch pedal. With the parts in the positions shown in Fig. 1 and the motor idling, the valve 10 is held off its seat 58 by the torsion spring 30, and the consequent pull of lever 21, transmitted through nut 17 and valve stem 11, against the action of the compression spring 16. This connects the cylinder 32 with the intake manifold 1 by means of the passageways 9 and 39 and the vacuum in the cylinder 32 to the left of the piston 33 causes the piston 33 to be held in the position shown. The clutch pedal is adjusted by means of the threaded fork 45, piston rod 34 and lock nut 46 and the adjustments 43 and 44 so that with the piston in the position shown, the clutch is just completely disengaged. This is the position for "free wheeling" or coasting, changing gears and idling while in gear with the car at a standstill. To start the car from a standstill the transmission is put in gear and the pedal plunger 20 depressed to a point depending upon the speed of starting desired. The first motion of the accellerator takes up the lost motion of the gap 25 and at the same time allows valve 10 to seat by the action of the spring 16 disconnecting the cylinder from the intake manifold. The air vent 12 with the adjustable opening 13 allows air to enter the cylinder 32 allowing the clutch to engage with a speed depending upon the adjustment of the opening 13, the diameter of the cylinder 32, the angularity of the clutch pedal arm and the pressure of the clutch springs. The necessity of adjusting the mechanism so that the clutch is just fully disengaged when the piston is against the bottom of the cylinder as shown in Fig. 1 is due to the fact that it is necessary to have the clutch start to engage a very short time after the plunger 20 has been depressed. This allows any desired amount of clutch slipping for proper starting and accellerating at any speed in any gear including reverse. The fact that full engagement and disengagement of the clutch is obtained with a minimum of movement of the clutch pedal and piston 33 allows a minimum opening of the air vent 13 with consequent slow engagement of the clutch makes possible maximum smoothness of starting and all other conditions of operation. This minimum movement of the clutch pedal and piston 33 also provides for maximum rapidity of clutch disengagement, preventing the car from "running up" on the engine when the accellerator is released with the car in motion and in gear. The adjustable air vent 31 can be used in place of the air vent shown at 12 and 13 Fig. 1 if desired. The object of the lost motion gap 25 in the throttle rod 22, 23, and 24 is to allow the engagement of the clutch while the throttle is in the idling position and the motor idling, for the purpose of "idling along" with the car and for using the engine as a brake in any gear including reverse. While the use of this mechanism with a flat clutch plate is preferred, it can be used in connection with the spring type or crimped type of clutch plate by taking advantage of the angularity of the clutch pedal arm and piston rod as shown in Figs. 3 and 4 which show the clutch pedal in the fully engaged and disengaged positions respectively. It will be seen by referring to Fig. 4 that a very small motion of the piston will give a comparatively large motion to the clutch pedal arm allowing a more rapid first motion of same to compensate for the larger motion of the clutch pedal arm when using the spring or crimped type of clutch plate or in the multiple disk type. This rapid first motion of the clutch pedal arm allows the clutch to move rapidly up to a partially engaged position and to more slowly com-

plete the engagement, permitting of a smooth start without unnecessary slipping of the clutch. Although the poppet valve is the preferred form due to the fact that it requires no lubrication, is simpler of construction and more reliable, is practically free from wear and gives the most perfect seal, yet any other suitable form of valve can be used, and even if the poppet form of valve be retained, it is not necessary that the air inlet passageway shown in the drawing as consisting of the axial bore 12 should remain in that particular location, since it might be moved to either side of the valve axis.

The type of flat-disk, short-coupled clutch shown in Fig. 2 is especially adapted for use in the particular arrangement of pneumatic power units herein shown and above described. The engaging and disengaging movements of pressure ring 52 are very slight, and the resistance of springs 53, 53, to disengaging movement thereof is considerable, but the multiplied leverages produced by clutch fingers 50, 50, and by clutch lever 40 overcome that resistance under the pull of piston 33, which is preferably of a diameter larger than is usual in apparatus of this type. The piston stroke, however, can be made shorter than is usual, because of the short travel of the clutch ring 52, and consequently the volumetric displacement of the piston is of about the standard amount and the intake manifold suction will therefore pull it back through the full stroke as quickly as in other arrangements, and so clutch disengagement will not be unduly delayed.

When the operation is reversed and air is admitted to cylinder 32 to permit engagement of the clutch a slight initial movement of piston 33 to the right, looking at Fig. 4, permits a considerable angle of clockwise swinging of clutch lever 40, because of the nearly flat condition of the toggle joint 41, 40, 47, 34, 42 and 37 then obtaining. Consequently clutch ring 52 then quickly moves to the left (Fig. 2) and squeezes the parts 55, 54, 56 (the clutch elements carried by the transmission shaft 48) against the interior face of the fly wheel 51 (which is rotated by the motor).

Thereafter the further movement of clutch ring 52 is slight and slow because the suction drag of piston 33 on the rising clutch lever 40 increases rapidly in effect with every degree of the latter's swinging motion to the right and upward, as indicated in Fig. 3. This final motion, however, merely creates slowly increased compression of clutch linings 55 and 56 and the consequent increase of clutch friction or gripping action.

The disengaging action of the clutch is so quick and the clutch engaging action so rapid and smooth in character that the lost motion mechanism 23—24 in the throttle connection can sometimes be dispensed with entirely.

Various changes could be made in the details of construction herein shown and described as affording the preferred embodiment of our invention, without departing from the underlying novel principles of construction of the same as above explained. Thus, other forms of apparatus constituting a pneumatically expansible and contractile power-operated unit might be substituted for the cylinder and piston shown, and other means for guiding the power-driven end of piston rod 34 along a substantially straight line might be used in place of the rigid connection of said piston rod to a piston sliding in a cylinder which swings about a fixed pivot, as here illustrated. Such changes of form, but not of substance, so far as the mode of operation and results obtained are concerned would still leave such modified construction within the definition of the appended claims.

Having now fully described our invention, what we claim is:

1. In a pneumatic power-developing attachment for operating motor car clutches the combination, with a clutch actuating lever and spring means normally tending to close the clutch, of a pneumatically expansible and contractile unit hinged at one extremity to a fixed support and to said lever at the other, the parts being so proportioned that the angle between the straight line connecting the axes of said hinges and the straight line which passes through the fulcrum of said lever and through the axis of the hinge connecting it to said unit approximates 90 degrees when the clutch is in closed position, and approximates 180 degrees when the clutch lever is at the limit of its clutch opening movement.

2. An apparatus such as defined in claim 1 combined with means for permitting a substantially uniform rate of flow of air into said unit during the clutch closing movement of said lever.

3. An apparatus such as defined in claim 1 combined with a clutch assembly comprising a flat pressure ring adapted to be moved by said lever and having a minimum limit of clearance movement after disengagement from its cooperating friction element; whereby in the clutch engaging operation, a prompt initiation of contact between the clutch element is assured, followed by a retarded gradual increase of pressure and consequent friction between the said elements.

4. In a pneumatic clutch-operating apparatus for motor cars comprising a vacuum operable unit operatively connected to a clutch-actuating member, and a conduit connecting said unit with the intake manifold of the motor car, the combination, with said above described apparatus, of a valve for controlling passage of a fluid through said conduit comprising a casing having one port connected to said manifold and a second port connected to said unit and a valve plunger adapted to open and close said last mentioned port and having a stem which extends through said casing wall, said valve and stem having an axially located bore extending from said valve face to a point in said stem exterior of said casing and having at that point an opening to the atmosphere; whereby, when said valve is seated communication from said unit to said manifold will be closed but communication from said unit to the atmosphere will be maintained through said valve bore.

5. In a pneumatic power-developing attachment for operating motor-car clutches the combination with a clutch actuating lever which extends in an approximately horizontal direction when at the limit of its clutch opening movement and swings upward to approximately a vertical position when completing the clutch closing movement, and spring means normally tending to move said lever in a clutch closing direction, of a pneumatic expansible and contractile unit hinged to a fixed support at one of its extremities and to said lever at the other, the parts being so proportioned that the angle between straight lines connecting the axes of said hinges and the straight line which passes through the fulcrum of said lever and through the axis of the hinge connecting it to said unit approximates ninety degrees when the clutch is in clutch clos-

ing position and one hundred eighty degrees when the said clutch lever is at the limit of its clutch opening movement.

6. In a pneumatic power-developing attachment for operating motor-car clutches the combination with a clutch-actuating lever which extends in an approximately horizontal direction when at the limit of its clutch opening movement and swings upward to approximately a vertical position when completing the clutch closing movement, and spring means normally tending to move said lever in a clutch closing direction, of a pneumatically expansible and contractile unit hinged to a fixed support at one of its extremities and to said lever at the other, the parts being so proportioned that the angle between straight lines connecting the axes of said hinges and the straight line which passes through the fulcrum of said lever and through the axis of the hinge connecting it to said unit approximates ninety degrees when the clutch is in closed position and approximates one hundred and eighty degrees when the said clutch lever is at the limit of its clutch opening movement.

7. In a pneumatic clutch-operating apparatus for motor cars comprising a vacuum-operable unit operatively connected to a clutch-actuating member, and a conduit connecting said unit with the intake manifold of the motor car, the combination, with said above described apparatus, of a valve for controlling passage of a fluid through said conduit comprising a casing having one port connected to said manifold and a second port connected to said unit and a valve body sliding in said casing and adapted to open and close communication between said unit and manifold and having a portion extending through said casing wall, in which said valve body there is a longitudinal passageway extending to a point exterior of said casing so as to be open to the atmosphere at such point, while its other end is in communication with the said vacuum unit; whereby communication from said unit to said manifold can be closed and direct communication from the atmosphere to said unit alone will be thereupon established through said passageway.

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