

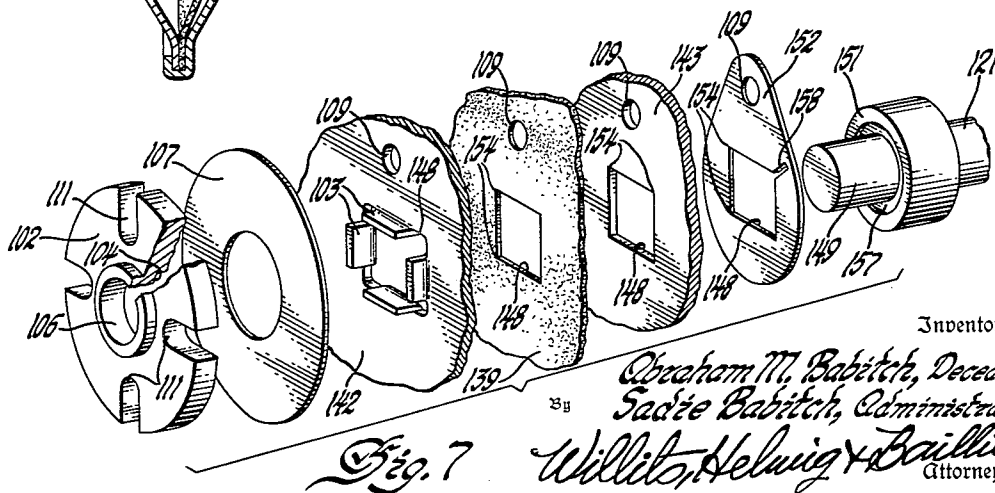
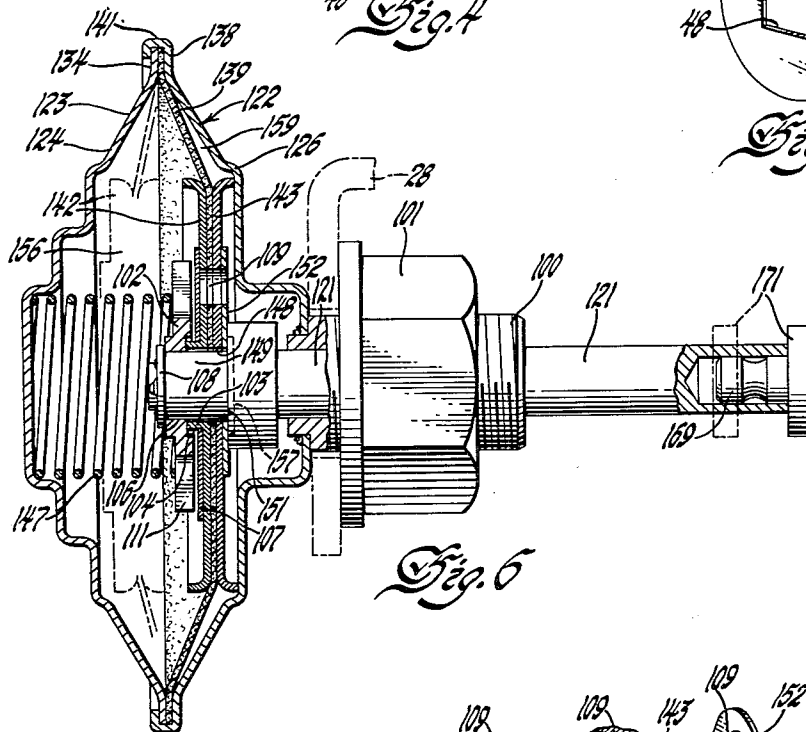
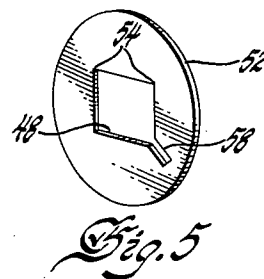
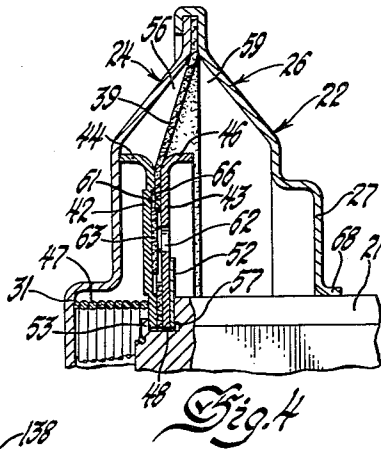
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THROTTLE DASH POT

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2,741,474

THROTTLE DASH POT

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This invention relates to differential pressure chamber or pneumatic devices for resisting or slowing down the rate of movement of other devices in one or more directions. The device is particularly applicable for use as an antistall device for preventing the stalling of automobile or other internal combustion engines when the throttle controlling the engine is suddenly released.

An object of the invention is to provide a simple and reliable antistall device for automobile engines.

Another object of the invention is to provide an antistall device which will consist of a relatively small number of parts which do not require excessive and expensive tooling in the manufacture and assembly thereof and which can be easily installed on an automobile engine either as original equipment or as an accessory to engines already in use.

In the accompanying drawings:

Figure 1 is a fragmentary view of an automobile engine carburetor having an antistall device embracing the principle of the invention associated with and operated by the throttle valve of the carburetor.

Figure 2 is a longitudinal sectional view through the antistall device illustrated by Figure 1. Figure 2 is taken substantially in the plane of line 2—2 on Figure 1 looking in the direction of the arrows thereon.

Figure 3 is a fragmentary view illustrating a portion of the diaphragm and valve structure embraced in the antistall device illustrated by Figures 1 and 2. Figure 3 is taken in the plane of line 3—3 on Figure 2 looking in the direction of the arrows thereon.

Figure 4 is a fragmentary view of the antistall device shown by Figure 2 but with the parts thereof illustrated in a different operative position.

Figure 5 is a perspective view of a metering member or disc embraced in the antistall device illustrated by the preceding figures.

Figure 6 is a longitudinal sectional view illustrating a somewhat different form of antistall device embracing the principles of the invention.

Figure 7 is an exploded perspective view showing how the various parts of the antistall device illustrated by Figure 6 are assembled on the operating shaft of the device.

Referring to Figure 1, there is illustrated at 10 a part of a downdraft carburetor which is adapted to be employed on an automobile or other engine.

The carburetor 10 is provided with a throttle valve having an operating shaft 11 projecting through a coupling 12 by which the carburetor 10 is connected to the inlet manifold for the engine with which the carburetor 10 is employed. The shaft 11 has a flattened end to which is attached an operating lever 13 by which the throttle is operated by a rod 14. One end of the rod 14 is pivotally connected to the lever 13 as is indicated at 16 while the opposite end thereof may be connected through various levers and links to an accelerator pedal or other suitable device for operating the throttle lever 13 from any remote location.

The throttle for the carburetor 10 has a suitable idling

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position in which the throttle is partly open at all times for the purpose of admitting to the engine enough of a charge to maintain the engine in operation at low speed and generally at no load. Such idling position of the throttle for the carburetor 10 is determined by a screw 17 which is adjustably secured in a threaded opening formed in a part 18 of the lever 13. The end of the screw 17 beyond the part 18 is adapted to engage any suitable stop projecting from the casing of the carburetor 10. A suitable spring not shown but generally associated with the rod 14 is adapted resiliently to urge the lever 13 into a position in which the end of the screw 17 will engage the stop referred to.

It will be apparent from the structure disclosed that the throttle valve will be opened when the lever 13 is rotated in a counterclockwise direction by pulling upon the rod 14 and will tend to be closed to idling position when the lever 13 is rotated in an opposite direction by an opposite movement of the rod 14 and into a position in which the screw 17 engages the idling stop referred to.

The lever 13 also is provided with a laterally projecting arm indicated at 19 and the arm 19 is adapted to engage and to operate the actuating shaft 21 of an antistall device indicated generally at 22. The antistall device 22 is provided with a casing 23 through which the shaft 21 projects and which comprises casing sections indicated at 24 and 26. The casing section 26 has an annular end wall indicated at 27 and to the exterior surface of which is welded or otherwise secured a bracket 28. The bracket 28 has an opening through which the shaft 21 projects and has suitable laterally bent parts 29 projecting toward the carburetor 10 and by which parts 29 the antistall device 22 is secured rigidly to the carburetor 10 and in operative relation to the arm 19.

The position in which the antistall device 22 is secured by the bracket 28 with respect to the carburetor 10 is a position in which the axis of the shaft 21 is approximately at a right angle to a radius between the contact point on the arm 19 and the center of the shaft 11 when the throttle-operating lever 13 is in engine idling position.

The casing section 24 comprises an outwardly depressed end part 31, an annular end wall 32 and an inwardly and angularly disposed annular peripheral wall indicated at 33. Peripheral wall 33 terminates in an outwardly disposed flange indicated at 34.

The casing section 26 comprises the outwardly depressed annular wall 27 and inwardly depressed annular wall 36, a sloping peripheral annular wall 37 and an outwardly disposed radial flange 38 which is disposed in directly opposed relation to the flange 34 projecting from the wall 33.

A flexible diaphragm 39 is secured between the flanges 34 and 38 by crimping the outwardly projecting edge of the flange 38 around the flange 34. The crimped edge of the flange 38 is indicated by the numeral 41.

The central part of the diaphragm 39 is reinforced and the movement thereof is limited by a pair of oppositely disposed plates indicated at 42 and 43, each of which is provided with a flanged edge indicated respectively at 44 and 46 and each of which flanged edges is annular in formation and projects in a direction away from the diaphragm 39. The flange 46 is disposed in opposed relation to the annular end wall 36 for limiting the movement of the diaphragm 39 in one direction (Fig. 2) while flange 44 is disposed in opposed relation to an outer peripheral part of the end wall 32 for limiting the movement of the diaphragm 39 in the opposite direction (Fig. 4).

A spring 47 having one end disposed within the depressed end 31 of the casing section 24 and the opposite end abutting the central part of the plate 42, tends resiliently to urge the diaphragm into what might be said to be the expanded position (Fig. 2) of the diaphragm and

casing structure. In the extreme expanded position of the diaphragm 39 the flange 46 of the plate 43 rests upon and abuts the annular end wall 36 of the casing section 26.

The diaphragm 39 is moved toward and away from the expanded position referred to and against the force of the spring 47, by the operating shaft 21 which engages and projects through the central portion of the diaphragm 39 and the central portions of the plates 42 and 43.

The diaphragm 39 and the plates 42 and 43 each are provided with centrally disposed openings therein and all of which openings are indicated by the numerals 48. The openings 48 all are formed in the shape of squares through which project the cylindrically formed and reduced end 49 of the operating shaft 21. The reduced end 49 is formed by an adjacent annular shoulder part 51 of the shaft 21 which is adapted to abut the adjacent surface of a disc-shaped metering member 52 which also is provided with a square opening disposed centrally thereof and indicated by one of the numerals 48.

The metering member 52 is disposed between the shoulder 51 and the adjacent surface of the plate 43. The two plates 42 and 43 are rigidly secured together upon the diaphragm 39 and against the metering member 52 abutting the shoulder 51 by upset metallic portions or staking 53 which is formed at intervals around the periphery of the extremity of the reduced end 49 of the shaft 21.

The openings 48 in the members 52, 43, 39, and 42 are of such size as to slidably fit the reduced end 49 of the shaft 21 with the linear sides of the openings 48 being tangent to the cylindrical surface of the reduced end 49 and engaging the cylindrical surface midway between the ends of the sides. Such construction provides four corner spaces 54 which extend through all of the members 52, 43, 39, and 42 and which on the side of the diaphragm 39 adjacent the casing section 24 communicate with a fluid compartment 56 which is provided by the diaphragm 39 and the casing section 24.

The opposite ends of the corner spaces 54 communicate with an annular recess 57 which is formed in the shaft 21 inside the annular shoulder 51.

In order to provide means for metering the flow of fluid to and from the compartment 56 which may be caused by movement of the diaphragm 39 by the shaft 21 there is formed at one of the corners of the opening 48 in metering member 52 a radial slot (Fig. 2) which is indicated by the numeral 58. The slot 58 at its inner end communicates with the annular recess 57 and the outer end thereof communicates with a compartment 59 formed between the diaphragm 39 and the casing section 26. In so communicating with the compartment 59 the end of the slot 58 projects beyond the peripheral edge of the shoulder portion 51 of the shaft 21.

It will be apparent that movement of the diaphragm 39 by the shaft 21 will cause metered quantities of fluid to flow between the compartments 56 and 59, such quantities being dependent upon the size of the slot 58 which is the smallest and most limiting part of the passage between the two compartments. It will also be apparent that this flow of fluid can be made to occur at any desired rate merely by changing the size of the slot 58 which may be formed in the member 52. It will be observed that the slot 58 is merely an extension of the opening 48 which is formed in the member 52 and that it can be made to relatively exact size by the same punching operation that may be employed in forming the opening 48 in the member 52.

If further will be apparent that the radial slot 58, the annular channel 57 and the corners 54 at all times provide a uniform and continuous opening between the compartments 56 and 59 and that the metering of the flow of fluid between the two compartments in either direction will at all times provide a uniform resistance to the movement of the diaphragm 39.

In order to provide means for increasing the rate of

movement of fluid in one direction between the compartments 56 and 59 there is formed in the plates 42 and 43 and the diaphragm 39 a one-way valve which is indicated generally by the numeral 61 (Fig. 3).

The valve 61 is formed by providing an opening 62 in the plate 43 which is at all times in open communication with the compartment 59. In the closed position of the valve 61 the opening 62 is adapted to be covered by a flap 63 which is formed in the diaphragm 39 by a pair of oppositely disposed arcuate slots indicated at 64. The slots 64 are formed in the diaphragm 39 on opposite sides of the opening 62, and the flap 63 is held in position between the slots by connecting parts of the diaphragm which extend between the slot ends.

The slots 64 communicate with and are disposed within the limits of an annular depression 66 (Fig. 2) which is formed within the surface of the plate 42 on the side thereof adjacent the diaphragm 39. Openings 67 (Fig. 3) are formed in the plate 42 around the central portion of the depression 66 for the purpose of providing open communication between the depression 66 and the expandable and contractable compartment 56.

While assembling the device, it is apparent that it will be necessary to position the plate 43 so that the opening 62 therein will be in the central part of the flap 63 in the diaphragm 39. It is not necessary to locate the plate 42 in any predetermined position with respect to the slots 64 and the opening 62.

The wall 27 of the casing section 26 is flanged outwardly at the central portion thereof as is indicated at 68 and the opening within the flange may be of hexagonal shape for the purpose of fitting and slidably receiving the similarly formed hexagonal surface of the shaft 21.

In the structure disclosed by Figures 1 to 5, the shaft 21 is made of such hexagonal external surface configuration for the purpose of preventing rotation of the shaft and the consequent rotation of any of the assembled parts of the diaphragm structure of the device after such structure has once been properly assembled.

In order to be able to adjust the antistall device 22 after the same has been assembled upon the bracket 28 there is provided at the end of the shaft 21 an adjusting screw 69 having a head 71 which is adapted to be engaged by an arcuate surface 72 which is formed on one side of the arm 19. The screw 69 may be held in any adjusted position with respect to the shaft 21 by a locknut indicated at 73.

Figures 1 and 4 of the drawing illustrate the structure of the antistall device 22 in what might be called a closed throttle or idling position of the engine with which the device is employed. In such position the shaft 21 may be described as being in a retracted position in which the diaphragm 39 and the plates and other parts associated therewith will be moved inwardly in such manner as to reduce to a minimum the size of the compartment 56. In such position the flange 44 of the plate 42 may engage and rest upon the annular end surface 32 of the casing section 24. Also as will be apparent from Figure 4, the spring 47 will be compressed until the convolutions thereof lie closely adjacent one another.

When the throttle is opened or moved away from the idling position of the throttle by pulling upon the rod 14 and rotating the lever 13 in a counterclockwise direction, it will be apparent that the spring 47 will cause the shaft 21 to follow the arm 19 until the diaphragm 39 is in its expanded position. In the extreme expanded position of the diaphragm 39 the flange 46 of the plate 43 will rest upon the annular end wall 36 of the casing section 26. As will be apparent from observing the size and relation of the parts shown in Figures 1 to 5, the flange 46 will rest upon the end wall 36 within a relatively few degrees of rotation of the throttle lever 13 away from the idling position of the throttle. Thereafter during the further opening movement of the throttle, the arm 19 will rotate away from the head 71 of the screw 69 and the throttle will

thereafter continue to operate throughout the normal range of operation without in any way affecting the antistall device 22.

In the structure shown by Figure 4, the valve structure 61 is shown in the position in which the parts thereof will be located at the beginning of the previously described movement of the throttle from idling position to open position. At the beginning of such movement it will be apparent that the initial movement of the diaphragm 39 away from the casing section 24 will cause a slight reduction in pressure in the compartment 56 and this reduction in pressure will cause the flap 63 of the valve 61 to move away from the opening 62 in the plate 43 and into engagement with the adjacent surface of the plate 42 and within the depression 66. Such movement of the flap 63 will permit air to flow from the compartment 59 through the opening 62, through the space between the flap 63 and the plate 43, through the slots 64, into the depression 66 in the plate 42 and surrounding the flap 63 and thence into the chamber 56 through the openings 67. Since these openings form a large and relatively unrestricted passage, it will be apparent that the spring 47 will quickly move the diaphragm into its opposite position in which the flange 46 will be seated upon the end wall 36. The diaphragm 39 therefore will move into the expanded position of the device practically as fast as the throttle lever 13 can be moved away from the idling position of the throttle.

During such opening movement the duct or air passage formed by the slot 58, the channel 57 and the corners 54 also will be open and will aid in the transfer of fluid from the compartment 59 into the compartment 56 to permit the expansion of the bellows 39 into the expanded position referred to.

If the throttle of the engine is suddenly released, then the throttle lever 13 will be rapidly rotated in a clockwise direction and will engage the head 71 of the screw 69 of the actuating shaft 21 of the antistall device 22 with the parts thereof in the position in which such parts are illustrated in Figure 2. Such position of engagement will be several degrees of rotation of the throttle lever 13 prior to the position in which the throttle stop is engaged by the screw 17 and when the throttle is rotated into engine idling position.

As soon as the lever 13 has rotated far enough so that the arm 19 engages the screw head 71 the shaft 21 will tend to move the diaphragm 39 against the compression of the spring 47. It will be apparent that the initial part of such movement will tend instantly to increase the fluid pressure within the compartment 56 and thereupon such increase in fluid pressure will immediately move the flap 63 against the adjacent surface of the plate 43 and in such position as to completely close the opening 62.

The valve 61 therefore will not participate in the transfer of fluid from the compartment 56 to the compartment 59.

The only passage available for such transfer of fluid is the passage provided by the corners 54, the annular channel 57 and the metering slot 58.

In view of the fact that the cross-sectional area of the slot 58 is the limiting factor in the transfer of fluid through such passage and that the difference between the cross-sectional area of the slot 58 and the area of the opening 62 which is exposed by the opening of the valve 61 is great, it will be apparent that the diaphragm 39 will tend to move into a position in which the flange 44 will engage the end wall 32 only at a very slow rate. Such slow rate of movement of the diaphragm 39 will of course be reflected in a correspondingly slow rate of movement of the shaft 21 which in turn will oppose the return of the throttle to engine idling position at any greater rate. Such resistance to the final closing movement of the engine throttle will prevent a violent change in the rate at which the charge to the engine is supplied by the carburetor 10, and hence

will prevent the engine from stalling when the throttle is moved into engine idling position.

The structure shown by Figures 6 and 7 of the drawings is similar to that shown by Figures 1 to 5 except for the fact that the parts forming the valve and metering passage features of the structure are formed in a somewhat different manner.

In Figures 6 and 7, the shaft 121 for operating the antistall device 122 is a cylindrical shaft. In some instances it is considered preferable to employ such a cylindrical shaft to make it difficult or impossible for a wrench to be used on the shaft. It sometimes occurs that wrenches are applied to shafts of this kind and under such circumstances it is possible that sufficient pressure may be applied to the shaft to twist the antistall device entirely out of its adjusted and operative position.

The operating end of the shaft 121 also is formed in a slightly different manner by employing a press fitting studs 169 having a cylindrical head 171 in an axial opening formed in the end of the shaft. The stud 169 may be forced in the opening to any desired extent for the purpose of properly adjusting the position of the shaft 121 relative to the throttle lever 13 of a carburetor such as that illustrated at 10 in Figure 1 and with which the device illustrated in Figures 6 and 7 may be employed.

The shaft 121 is adapted slidably to project through an axial opening formed in a sleeve 100, the reduced end of which may be welded or otherwise secured in an axial opening formed in a casing section 126 of the antistall device 122. A nut 101 engaging the threaded exterior surface of sleeve 100 may be employed for the purpose of fastening the device to a carburetor by the use of a bracket such as that illustrated at 28 in Figure 1.

The casing 123 of the antistall device 122 also comprises a second and oppositely disposed casing section 124, the two being secured together upon a diaphragm indicated at 139 by flanges 134 and 138, the latter being crimped or bent around the former as is indicated at 141. The casing sections 124 and 126 are otherwise similar to the casing sections 24 and 26 illustrated in Figures 1 to 6, and hence will not be further described.

The diaphragm 139 is secured between a pair of plates indicated at 142 and 143 which in turn are disposed between a valve cage indicated at 102 and a metering member or device indicated at 152. The plates 142 and 143, the diaphragm 139 and the metering member 152 all have openings 148 therein and each of which is formed in the shape of a square, these openings being adapted to tangentially fit the cylindrical exterior surface of a reduced end 149 formed on the shaft 121 adjacent a cylindrical shoulder 151, also formed as a part of the shaft 121. Between interior surfaces of the openings 148 and the exterior surface of the reduced end 149 are corners 154 which provide a continuous duct or passage through the diaphragm 139, the end plates 142 and 143 and the metering member 152. The ends of all of the corners 154 adjacent the shoulder 151 also communicate with an annular channel 157 also formed within the shaft 121 and within the annular shoulder 151.

The metering member 152 is provided with an angular slot indicated at 158 which projects across the annular shoulder 151 and provides communication between the channel 157 and the compartment 159 which is formed by the diaphragm 139 and the casing section 126. The opening 148 which is provided in the plate 142 has a plurality of laterally bent flanges indicated by the numerals 103, there being one of these flanges projecting from each side of the opening 148. The flanges 103 project away from the diaphragm 139 and toward the valve cage 102 and into an annular recess 104 which is formed around a cylindrical opening 106 on which the cage 102 is mounted upon the cylindrical end 149 of the shaft 121. The spacers or flanges 103 provide sufficient space between the plates 142 and the cage 102 for an angular valve disc indicated at 107 to be positioned

between the two and to be movable into and out of valve-closing position.

The valve cage 102, the plates 142 and 143, the diaphragm 139, and the metering member 152 are all rigidly secured together on the reduced end 149 of the shaft 121 and against the shoulder 151 by the head of a cap 108 which is operatively secured on the end of the shaft indicated at 149. The plates 142 and 143, the diaphragm 139 and the metering member 152 all are provided with openings which are indicated at 109 and which collectively provide a valve passage or orifice 109 adapted to be controlled by the valve disc 107. The openings 109 also may be employed in assembling the device inasmuch as a rod can be projected through all of these openings for the purpose of properly aligning the parts before they are assembled on the shaft end 149 and against the shoulder 151.

It will be apparent that when the disc 107 is forced against the plate 142 by an increase in pressure in compartment 156, the disc 107 will close the opening 109. The closing of the opening 109 will tend to provide increased resistance to the movement of the diaphragm 139 in such manner as to reduce the capacity of the compartment 156.

It will be apparent, however, that the diaphragm 139 can be so moved to reduce the capacity of the compartment 156 by the provision of the metering passage formed by the corners 154 of the openings 148, the channel 157 and the radial slot 158 which extends across the shoulder 151.

The space provided by the corners 154 will communicate with the compartment 156 through the spaces which are provided at the opposite ends of the flanges 103 and the space provided between the valve cage 102 and the disc 107 when the disc is in its valve-closing position.

In order to provide initial freedom for the flow of fluid between the valve cage 102 and the disc 107 when the disc 107 is in its valve-closing position and to admit air to the adjacent surface of the disc 107 for closing the valve, there is provided a plurality of radially disposed notches indicated at 111 and which are formed inwardly of the periphery of the cage 102 and extend to within a short distance of the spaces provided between the opposite ends of the flanges 103. Under such circumstances the air from the compartment 156 will flow into the metering passage previously described through the radial slots 111.

A spring 147 which is disposed between the central part of the casing section 124 and the valve cage 102 will tend to urge the diaphragm structure into its expanded position and in which position the adjustable head 171 forming the end of the shaft 121 will be in position to be engaged by arm 19 of the throttle of the carburetor 10 when the throttle is released and is rapidly moving toward engine idling position.

The structure disclosed by Figures 6 and 7 is otherwise the same and will operate the same as the structure disclosed by Figures 1 to 5 and the description of operation of the structure disclosed by Figures 1 to 5 likewise will apply to the structure disclosed by Figures 6 and 7.

I claim:

1. A fluid actuated resistance device comprising a casing, a flexible diaphragm extending across said casing and forming in one end of said casing a chamber of variable size, a shaft secured to the central part of said diaphragm for moving said diaphragm for varying the size of said chamber, an opening formed in said diaphragm adjacent said shaft for transferring fluid to and from said chamber, an annular recess on said shaft communicating with said opening and a member disposed between said diaphragm and said recess and having a radially disposed slot formed therein, said slot having one end in open communication with said opening and the other in open communication with said casing on one side of said diaphragm.

2. A pneumatic resistance device comprising a casing, a flexible diaphragm projecting across said casing and forming on one side of said diaphragm and within said casing a closed chamber of variable size, means projecting through an opening formed in said diaphragm for moving said diaphragm for varying the size of said chamber, said opening in said diaphragm being larger than said means to provide a duct through said diaphragm for transferring fluid to and from said chamber, abutment means on said first mentioned means and a metering member disposed between said diaphragm and said abutment means and having a radial slot formed therein, one end of said radial slot being disposed in open communication with said duct and leading outwardly therefrom and providing communication between said duct and the interior of said casing on one side of said diaphragm for metering said fluid transferred to and from said chamber.

3. A pneumatic resistance device comprising a casing, a flexible diaphragm extending across said casing, a shaft projecting through the central part of said diaphragm for moving said diaphragm within said casing, annular shoulder means formed outwardly of said shaft on one side of said diaphragm for moving said diaphragm by said shaft, a metering member disposed between said shoulder means and said diaphragm and comprising a slot extending across said shoulder, a duct formed in said diaphragm and communicating at one end with said slot and at the opposite end with the side of said diaphragm opposite said metering member, and said shoulder having a passage formed therein communicating with said duct and slot.

4. A pneumatic resistance device comprising a casing, a diaphragm secured to said casing and projecting across said casing, a pair of plates engaging opposite central portions of said diaphragm, an annular depression formed in the surface of one of said plates adjacent said diaphragm to permit the movement of said diaphragm toward and away from each of said plates, fluid passage means in said one of said plates between said depression and the interior of said casing, an opening formed in the other of said plates in opposed relation to said depression, and a slot formed in said diaphragm in opposed relation to said depression but in radially spaced relation to said opening.

5. A pneumatic resistance device comprising a pair of casing sections having converging angularly disposed annular peripheral parts terminating in parallel flanges, a flexible diaphragm extending across the casing formed by said sections and secured between said flanges, one of said flanges having extended edge portions crimped about the other of said flanges, a pair of parallel end walls formed in said sections in inwardly disposed relation to said annular peripheral portions, means for moving said diaphragm including a pair of plates engaging the central portion of said diaphragm and disposed on opposite sides of said diaphragm, valve means associated with said plates and said diaphragm for transferring fluid in said casing between the opposite sides of said diaphragm at a rate dependent upon the direction of movement of said diaphragm, and said plates being provided with oppositely disposed peripheral flanges formed at the edges thereof and in opposed relation to said end walls of said casing for limiting the movement of said diaphragm in opposite directions within said casing.

6. A pneumatic resistance device comprising a casing having a flexible diaphragm secured therein and extending thereacross, a pair of plates engaging the central portion of said diaphragm on opposite sides thereof, a depression formed in one of said plates and providing a space for the movement of said diaphragm between said plates, a plurality of openings formed in said one plate in communication with said depression, a plurality of openings formed in said diaphragm in opposed relation to said depression but in laterally spaced relation to an opening in the other of said plates, a spring in said casing

between said casing and said one of said plates for resiliently urging said diaphragm in one direction, shaft means projecting within said casing and attached to the said plates for moving said diaphragm against the force of said spring, and metering means defining a passage between the compartments in said casing formed by said diaphragm.

7. A pneumatic resistance device comprising a casing having a diaphragm secured therein and projecting thereacross, a pair of oppositely disposed plates engaging oppositely disposed surfaces adjacent the central portion of said diaphragm, a fluid metering disc engaging one of said plates and having a radial slot formed therein and with the opposite ends of said slot communicating with the interior of said casing on the opposite sides of said diaphragm, a plurality of registering openings formed in said diaphragm, said plates and said disc for transferring fluid within said casing between the opposite sides of said diaphragm, a valve associated with one of said plates for preventing the flow of fluid in one direction through said openings, valve cage means for securing said valve in position relative to said openings, a central opening in said diaphragm, and a shaft projecting through said plates, said diaphragm opening, said discs, and said valve cage means for operating said diaphragm and for securing said plates, diaphragm, discs, and valve cage means together for operation as a single unit, an annular recess on said shaft communicating with said opening, said fluid metering disc disposed between said diaphragm and said recess whereby one end of said radial slot is in open communication with said central diaphragm opening and the other in open communication with said casing on one side of said diaphragm.

8. A pneumatic resistance device comprising a casing having a diaphragm secured therein and projecting thereacross, a central opening in said diaphragm, a shaft projecting through the central opening of said diaphragm for moving said diaphragm in opposite directions, a plate disposed on one side of said diaphragm for controlling the movement of the central part of said diaphragm, said plate having flanges parallel to said shaft and central opening for receiving said shaft, a valve cage secured on the end of said shaft and against the ends of the said flanges forming a space between said cage and said plate, a plurality of aligned openings formed in said cage, said plate and said diaphragm for transferring fluid within said casing between the opposite sides of said diaphragm, an annular valve disposed between said cage and said plate and around said flanges formed on said plate and axially movable within said space between said cage and said plate for controlling the flow of fluid in one direction through the said aligned openings, an annular recess on said shaft communicating with said opening, and a member disposed between said diaphragm and said recess and having a radially disposed metering passage, said metering passage having one end in open communication with

said central opening and the other in open communication with said casing on one side of said diaphragm.

9. A differential pressure chamber unit comprising a casing, a flexible diaphragm extending across the interior of said casing to form a chamber therein, a shaft attached to the central part of said diaphragm to move the latter and alternatively reduce or enlarge the size of said chamber, said shaft having a shoulder, means surrounding said shaft and defining a passage leading from said chamber and through said diaphragm and along said shaft, said means including a member having a second passage disposed at an angle with said shaft and partially defined by said shoulder, said second passage communicating with said first mentioned passage, and opening through said diaphragm spaced from said shaft, and means forming a one-way valve arranged to control said opening by differential fluid pressures acting on said diaphragm.

10. A pneumatic resistance unit comprising a casing, a flexible diaphragm extending across the interior of said casing to form a chamber therein, the central portion of said diaphragm being interposed between a pair of flanged plates movable with the diaphragm, the flanges of said plates being oppositely disposed to cooperate with the walls of said casing as stop means, a shaft attached to the central part of said diaphragm and to said plates to move the diaphragm and change the size of said chamber, metering means formed with a passage leading through said diaphragm and along said shaft from said chamber, at least one opening through said diaphragm spaced from said shaft, and one-way valve means arranged to control said opening by differential fluid pressures acting on opposite sides of said diaphragm.

11. A differential pressure chamber unit comprising a casing, a flexible diaphragm extending across the interior of said casing forming a chamber therein, a shaft attached to the central part of said diaphragm to move the latter for varying the size of said chamber, said shaft having a shoulder, means associated with said shaft providing a passage leading through said diaphragm along the side of said shaft, and a portion of said passage being disposed at an angle with said shaft and partially defined by said shoulder.

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