March 20, 1956 H. L. HARTZELL ET AL 2,738,808

SPRING BIASED DIAPHRAGM DEVICE

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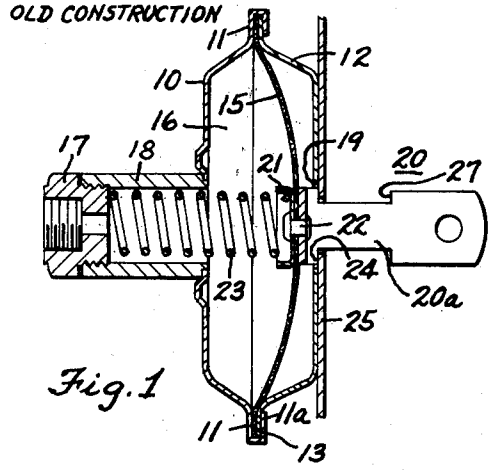



Fig. 1

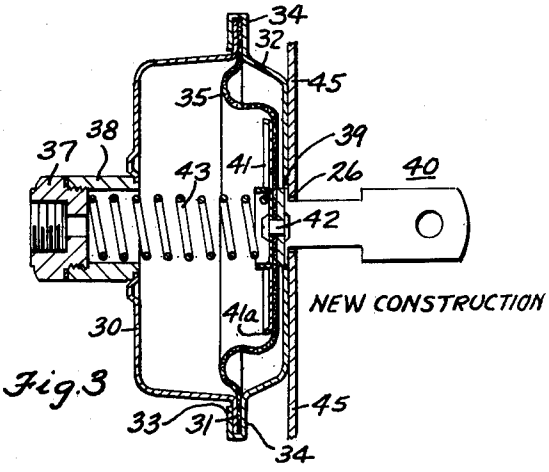



Fig. 3

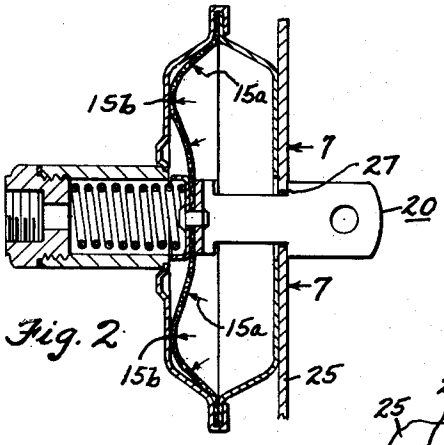



Fig. 2

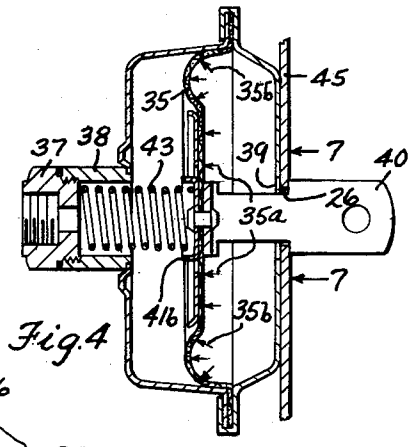



Fig. 4

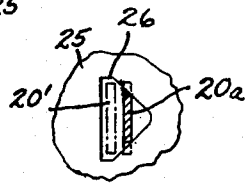



Fig. 7

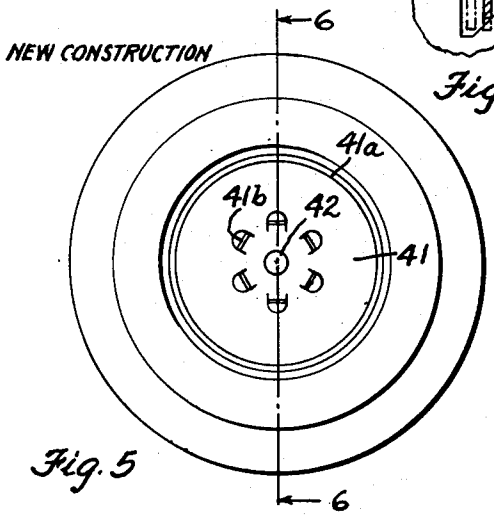



Fig. 5

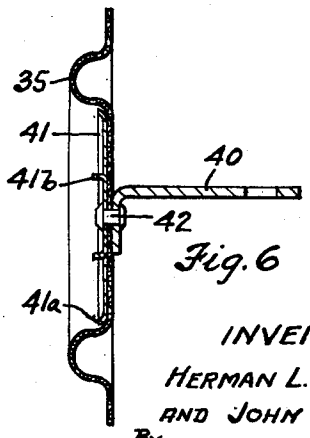



Fig. 6

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# SPRING BIASED DIAPHRAGM DEVICE

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1 Claim. (Cl. 137—790)

This invention relates to fluid pressure responsive devices such as devices operated by the suction of an internal combustion engine to effect a control of a circuit breaker lever carrying plate of the ignition timer of the engine. In the control of ignition timing in accordance with engine suction, it is desirable that the movement imparted to the circuit breaker lever plate be substantially in direct proportion to the amount of engine suction throughout the range of movement of the plate. Suction devices used heretofore provide for connection with the engine intake of a suction chamber enclosed by a metal case and a circular diaphragm, the periphery of which is clamped by the case and the central portion of which is connected with a member for transmitting motion to the circuit breaker plate. Movement of the diaphragm in response to engine suction is opposed by a helical coil spring which offers resistance in proportion to its deflection. The side of the diaphragm external of the suction chamber is exposed to atmospheric pressure. It is desirable that the force corresponding to the difference between atmospheric pressure on one side of the diaphragm and partial vacuum on the other side be opposed by the spring alone so that none of this force be consumed by stretching the diaphragm. To accomplish this it has been the practice to provide sufficient diaphragm material between its peripheral and central portions to eliminate stretching of the diaphragm during its range of movement. In devices used heretofore it has been found that the usable force resulting from the effective pressure differential upon the diaphragm diminishes as the diaphragm approaches the end of its travels in which the spring is additionally compressed with the result that the diaphragm movement is not in direct proportion to engine suction throughout its range of movement.

An object of the present invention is to provide a suction device in which diaphragm movement will be substantially in direct proportion to engine suction throughout the range of movement of the diaphragm. To accomplish this object the present invention provides a diaphragm approaching a piston-like construction and having at the same time such flexibility that the diaphragm is not required to be stretched during its range of movement.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

Figs. 1 and 2 are longitudinal sectional views showing, in a device used heretofore, the position of the diaphragm at the ends of its range of movement.

Figs. 3 and 4 are longitudinal sectional views of a suction device embodying the present invention showing an improved diaphragm in two positions.

Fig. 5 is a side view of an assembly of diaphragm and other parts used in the device shown in Figs. 3 and 4.

Fig. 6 is a sectional view on line 6—6 of Fig. 5.



Fig. 7 is a fragmentary view on line 7—7 of either Fig. 2 or Fig. 4.

Referring to Figs. 1 and 2 showing an old construction device comprising a case including shell members **10** and **12** having flanges **11** and **13** respectively between which the periphery of a diaphragm **15** is gripped by deforming the flange **11** around the flange **13** as indicated at **11***a*. A suction chamber **16** is provided between shell **10** and diaphragm **15** and it is connectible with the engine intake by attaching a pipe to a bushing **17** threaded into a tube **18** attached to shell **10**. Shell **12** is opened to atmosphere through an opening **19** which receives a bar **20** which together with a cup washer **21** is secured by a rivet **22** to the central portion of the diaphragm. A helical coil spring **23** is located between the plug **17** and the washer **21**. The spring **23** is initially compressed so that it urges shoulders **24** of the bar **20** against a mounting bracket **25** used to attach the diaphragm housing to a device to be controlled by engine suction such as an ignition timer. The bar **20** provides a connection between the diaphragm and a rotatable circuit breaker lever carrying plate of the timer. Bracket **25** (Fig. 7) provides a triangular opening **26** through which the widest portion of bar **20** can be passed as indicated at **20'** (Fig. 7) before the diaphragm housing is attached to the bracket **25**. When these parts are properly assembled the narrower portion **20***a* of bar **20** will be located in the narrower portion of the opening **26**. Therefore left movement of the diaphragm as engine suction increases will be stopped when shoulder **27** of bar **20** engages bracket **25** as shown in Fig. 2.

In order that the diaphragm material between its central and peripheral portions will be such that the suction upon the diaphragm will not require it to be stretched it is the practice to lightly crimp flange **11** of shell **10** around flange **13** of shell **12**. Then suction is applied to cause the diaphragm to move left to the limit of its travel as shown in Fig. 2 to tightly crimp flange **11** as shown at **13**. As the diaphragm moves to the position shown in Fig. 2 by applied suction before final crimping of shell flange **11**, the diaphragm pulls away from these flanges. Consequently, after the final crimping of flange **11** none of the suction effect is used in stretching the diaphragm.

As engine suction increases to overcome spring **23** and to cause diaphragm **15** to move to its extreme left position as shown in Fig. 2, the effect of suction substantially decreases. In Fig. 2 the arrows **15A** represent the direction of applied atmospheric pressure. Some of these forces are not parallel to the axis of the spring hence the force components parallel to the spring are less than they would have been if the forces had been parallel to the spring. Furthermore, the diaphragm is drawn into contact at **15B** with shell **10**. As the diaphragm approaches shell **10** the effect in area of the diaphragm substantially decreases with the result that movement of member **20** in response to increase of engine suction does not remain in direct proportion to engine suction but diminishes in proportion to increase of engine suction.

The device embodying the present invention provides a diaphragm **35** of fabric treated with a suitable plastic material such as neoprene which is molded into the form shown in Fig. 6. A rivet **42** secures to the diaphragm a motion transmitting member **40** shaped like member **20**, shown in Fig. 1, and a washer or discs **41** of relatively large diameter having a peripheral flange **41A** to prevent cutting the diaphragm. The washer is provided with a circular row of tangs or fingers **41B** providing a seat for a helical coil spring **43** which is located between the washer **41** and a plug **37**. The plug is threaded into a sleeve **38** attached to a housing shell **30** having a flange **31** which together with the periphery of the diaphragm is forced against a flange **34** of a housing shell **32** by crimping flange **34** about flange **31** as indicated at **33**. This assembly of parts is

assembled with a mounting bracket **45** provided with an aperture **26** like that shown in Fig. 7 for receiving the member **40**. In the manner described with reference to Fig. 3, the bracket **45** provides a stop limiting movement of member **40** in both directions. The opening **26** in bracket **45** and the opening **39** in shell **32** provides for venting the space to the right of the diaphragm **35**.

As engine suction increases to overcome spring **43** to cause movement of the diaphragm **35** toward the extreme left position shown in Fig. 4 the forces representing the difference between atmospheric pressure on the right of the diaphragm and sub-atmospheric pressure to the left of the diaphragm are forces which are nearly all parallel to the axis of spring **43** as indicated by arrows **35A**. The extent to which the differential force is not parallel to spring axis as represented by arrows **35***b* is relatively small in proportion to the total force. Therefore for all practical purposes the diaphragm **35** operates like a piston in response to engine suction so that movement of member **40** to the left is substantially in direct proportion to increase of engine suction. The washer **41** of relatively large diameter maintains the major portion of the diaphragm in a plane at right angles to the axis of spring **43**. The portion included between the clamp peripherally of the diaphragm and the flat central portion thereof provides flexibility sufficient for movement of the diaphragm without stretching. Therefore there is substantially no force consumed in changing the shape of the diaphragm of this flexible portion from that shown in Fig. 3 to that shown in Fig. 4. Therefore the diaphragm of the present device performs a function approaching that of a frictionless piston moving into opposition to a helical coil spring as pressure differential increases.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed as as follows:

A device for effecting mechanical movement in accordance with a fluid pressure differential, the combination comprising; a case, a flexible diaphragm sealingly attached along the peripheral edge to said case and dividing said case into a first and second chamber and forming a movable wall therebetween, said first chamber having one pressure therein and the second chamber being connected with a source of a variable lower pressure, said diaphragm being adapted to move between two extreme positions in response to variations of the pressure within said second chamber, a peripheral annular fold adjacent the peripheral edge of said diaphragm when said edge is attached to said case, a lever attached to the first chamber side of said diaphragm adapted to be moved thereby between limits as defined by stops associated with said lever when said stops engage portions of the case, a disc attached to said diaphragm on the second chamber side having a rounded edge adapted to engage a portion only of said diaphragm and terminating short of said fold, a spring disposed between a wall of the second chamber and said disc for opposing the movement of said diaphragm in response to variations in said pressure, a plurality of centrally disposed fingers integrally formed on said disc for maintaining said spring in position with respect thereto and within said chamber, said diaphragm being adapted to be moved to substantially bottom in said first chamber in one position by said spring when the pressures in said chambers are substantially equal and move to the other extreme position in response to said pressure variation while said fold in the diaphragm diminishes in size and is constantly maintained.




**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 1,790,206 | Farmer | Jan. 27, 1931 |
| 1,999,285 | Davis | Apr. 30, 1935 |
| 2,380,983 | Mock | Aug. 7, 1945 |
| 2,444,163 | Kocmich | June 29, 1948 |
| 2,447,261 | Mock | Aug. 17, 1948 |
| 2,658,526 | Porter | Nov. 10, 1953 |

FOREIGN PATENTS

| | | |
|---|---|---|
| 503,463 | Great Britain | Apr. 6, 1939 |