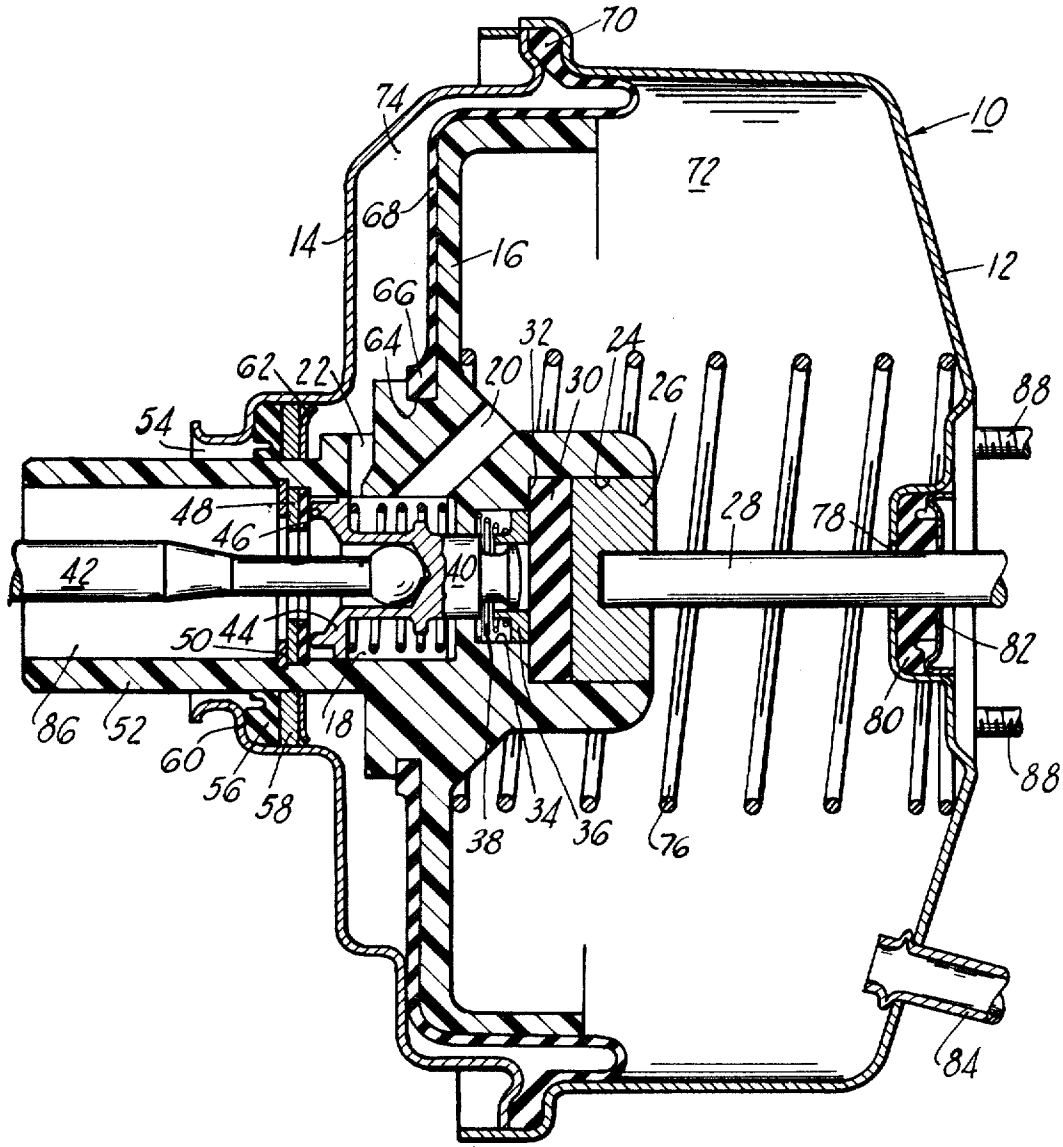
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REACTION MECHANISM

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REACTION MECHANISM

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Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

ABSTRACT OF THE DISCLOSURE

A reaction means between an operator-operated valve means and a force transmitting means of a servomotor including a pressure responsive element to proportionally vary the area of a reaction force transmitting device on the operator-operated valve means.

This invention relates to power brake units for motor vehicles and particularly to brake booster mechanisms incorporating "feel" of application of the brake.

It is desirable in power brake booster mechanisms to provide a structure by which there is an apparent feel of the degree of application of the brakes of the vehicle that the operator may have more accurate control over the brake effort applied to the vehicle, and thereby the rate of deceleration of the vehicle. To accomplish this, it has become the general practice to utilize the hydraulic pressure developed in the master cylinder during a brake application for application to a member that transmits pressure to a manually operated element that is under the control of the operator of the vehicle and feel the pressure developing in the master cylinder and thereby have a sense of feeling of the brake effort applied to the wheels of the vehicle. The amount of "feel" that is transmitted from the master cylinder to the foot of the operator through the reaction system of the power brake unit is only a small portion of the total brake effort applied at the wheels of the vehicle.

Numerous reaction systems have been proposed in the prior art by which the operator of the vehicle is given a sense of feeling the full power of the brake application. Some of these have used hydraulically operated plungers that have their area proportioned to the area of the brake fluid displacement member that operates in the master cylinder so as to provide a proportionate brake "feel" while others have used diaphragms with opposite sides exposed to pressure differentials to obtain the desired brake "feel" and still others have utilized mechanical level components to obtain a proportioned brake "feel" to the foot of the operator of the vehicle.

It is an important object of the present invention to provide a novel type brake booster mechanism wherein a body of deformable material is provided to receive reaction pressure from the master cylinder with the deformation of the body transferring the reaction forces to a manual control member.

Another object of the present invention is to provide clearance in the reaction structure so that the reaction structure would not be forced into the deformable member when the associated control mechanism is actuated to bring an associated servomotor into operation.

Another object of the present invention is the provision of a new and improved reaction structure of the above described type which does not produce a rapid build-up and reactive force upon the control structure of the servomotor.

It is a still further object of this invention to place

a deformable member between a force transmitting member and a movable wall within a cavity in said movable wall such that said deformable member may extrude into an opening upon being forced by said force transmitting member, which cavity is provided with a means to vary the area of extrusion in accordance with a pressure exerted on said deformable member by said force transmitting member to automatically vary the proportion of "feel" imparted to an operator of the servomotor.

Further objects and advantages of the present invention will be apparent from the following description of the accompanying drawing in which a servomotor is shown in cross section.

With reference to the drawing, a servomotor construction **10** has been provided which greatly reduces the number of parts that have heretofore been thought necessary within such a servomotor; so that the design is the epitome of simplicity, and has greatly reduced a manufacturing cost of a fluid pressure servomotor. The housing of the servomotor **10** is formed by means of a front and rear shell stampings **12** and **14**, respectively, which are assembled according to principles set forth in Patent No. 3,083,698 assigned to the common assignee.

According to further principles of the present invention the power driven element **16** of the servomotor **10** is formed by a single cast or molded part which is so arranged or constructed as to provide the necessary valve chamber **18** and fluid passages **20** and **22** as well as a cavity **24** for the reception of a plunger **26** operatively connected to a force transmitting member **28** and a deformable disk **30** between the plunger **26** and the shoulder **32** of the cavity **24**. As may also be seen the cavity **24** is stepped down as at **34** to provide an extrusion cavity in which I have inserted a ring **36** that is biased by means of a heavy spring **38** to abut on the deformable member **30**.

The ring **36** is appropriately located to slidably receive a reaction plunger **40** formed on one end of a connecting member for a valve control rod **42**. The connecting member is formed at the end opposite that of the reaction plunger into a valve poppet **44** that cooperates with a valve seat **46** held to the one piece plastic movable wall **16** by means of a washer **48** and a retaining member **50**. As may be readily observed the retaining member **50** fits within an appropriate groove in a tubular extension **52** of the plastic movable wall **16**, which extension is slidably mounted through a rear opening **54** in the rear shell **14**, as by means of a seal **56** and bearing **58** held against a shoulder **60** of the opening **54** by means of a spring retainer **62**. The one piece plastic movable wall **16** is provided with a groove **64** into which a beaded portion **66** of a diaphragm **68** is snapped into place with the diaphragm **68** having a further beaded peripheral edge **70** held between the juncture of the shells **12** and **14** so that the servomotor **10** is divided into two variable volume chambers **72** and **74**. In absence of a pressure differential across the wall **16** and diaphragm **68**, a spring **76** positioned between the rear shell **12** and the plastic movable wall **16** holds the wall in the rearmost position shown.

The force transmitting rod projects through the forward shell **12**. However, the opening **78** in the forward shell **12** is sealed by means of an annular seal **80** held therein by a spring retainer **82**.

The servomotor shown is designed to be operated by a pressure less than atmosphere, which pressure is directed thereto from an engine intake manifold for an associated vehicle (not shown) by means of the proper conduit that is sealingly joined with an inlet **84** in the forward shell **12**. However, it is not beyond the skill of the art to utilize a unit such as I have proposed with a system having the power source a fluid pressure greater

than atmosphere. It would merely mean that the inlet **84** could be open to atmosphere and an opening **86** in projection **52** could be connected to a high pressure source. For the pressure different than that of the power source being introduced through inlet **84** we have provided the tubular projection **52** of the wall **16** with the central opening **86** to feed atmospheric pressure into the appropriate section of the servomotor **10** upon scheduling theerof by displacement of poppet **44** from the seat **46** described hereinafter in greater detail.

In operation the operator of a vehicle will depress the brake pedal to cause inward movement of the control rod **42** to move the poppet **44** off the valve seat **46**, initially with the peripheral edge of the connecting member closing off communication between passages **20** and **22**. After the initial movement the poppet **44** is moved to the position whereby the reaction plunger **40** abuts the deformable member **30** and the peripheral sides of the poppet **44** have been placed between the passages **20** and **22** to prevent communication of chamber **72** and **74**. At this time the central opening **86** of the tubular projection **52** is open by means of passage **22** to the variable volume chamber **74**. Since the pressure in variable volume chamber **72** is less than atmosphere, and since the pressure in the variable volume chamber **74** is atmosphere or greater, as the case may be, depending upon to what the central opening **86** is communicated, the movable wall **16** and diaphragm **68** will tend to compress the spring **76** to drive the force transmitting member **28** outwardly of the shell **12**.

Normally, a master cylinder (not shown) is connected to the forward portion or forward shell **12** by means of bolts **88** so that the force transmitting rod will tend to displace a fluid from the master cylinder to associated wheel cylinders (not shown) for a vehicle to apply the vehicle's brakes. As the force in the master cylinder builds up, the movement of the rod **28** is resisted to impart a force in the opposite direction to the deformable member **30**. At first the deformable member **30** will extrude through the opening in the ring **36** to abut upon the reaction plunger **40** to tend to drive the control rod **42** in the opposite direction of actuation of the poppet **44**, aforementioned.

If, the reaction force on the force tranmsitting member **28** is great enough to overcome the spring **38** it will also tend to drive the ring **36** rearwardly by extruding over the total opening area of the extrusion cavity **34**. As seen, the ring **36** is provided with rearwardly facing projections that cooperate with the reaction plunger **40** to direct the extrusion forces on the ring **36** through the reaction plunger **40**, thereby increasing the proportion of reaction forces acting on the control rod **42** due to the increased extrusion area.

It will thus be seen that the initial opening of the valve **44** will have little or no resistance; whereas "feel" imparted to the control rod **42** will immediately begin upon a small area of the reaction plunger **40** when the movable wall **16** begins to traverse the servomotor **10** to compress the springs **76**. At a predetermined force on rod **28** the area upon which the deformable member **30** operates on the reaction plunger **40** is materially increased to [provided] *provide* an operator of the vehicle with a very high "feel" in that ring **36** moves inwardly of cavity **34**.

While the invention has been described in considerable detail, I do not wish to be limited to the particular construction shown and described; and it is my intention to cover hereby all novel adaptations, modifications and arrangements thereof which come within the practice of those skilled in the art to which the invention relates.

I claim:

1. For use with a servomotor mechanism having a power device, means controlling said power device, force transmitting means operatively connected to said power device, said force transmitting means including a confined deformable member arranged for variable extrusion to proportionally vary the reaction on said means controlling said power device upon actuation of said power device, and force responsive means operatively arranged in said power device including a control member, a ring operatively arranged to be spaced from and surround said control member, and a spring between said power device and said ring to maintain said ring spaced from said control member and abutting said deformable member such that said ring may be moved to abut said control member to change the area of contact for said deformable member on said control member to automatically delay the changeover from a minimum feel proportion to a maximum feel proportion.

2. A force applying mechanism, comprising:

a fluid pressure operated motor having a pressure responsive unit therein;

a force applying member operatively connected with said pressure responsive unit effective for transmission of force from said pressure responsive unit and arranged to receive reaction force in proportion to the force exerted by the pressure responsive unit;

an operator-operated control member;

follow-up control valve mechanism actuated by the control member having a normal off position balancing pressure in said motor and being movable from said off position by actuation of said control member to establish differential pressure in said motor to move said pressure responsive unit thereby;

a coherent generally solid deformable force transmitting mass in a condition of controlled volumetric confinment between said force transmitting member and control member, said pressure responsive unit and said control member effective to transmit thereby reaction forces from said force applying member to said pressure responsive unit and to said control member in a [proportion] ratio, said force transmitting mass having a predetermined volume in the relaxed state of the mass such that said control member does not contact said mass until said control valve mechanism is moved from said off position; and

pressure responsive means operatively connected to said pressure responsive unit, said pressure responsive means slidably receiving a stepped down projection of said control member and normally spaced from a shoulder on said control member and movable towards the shoulder to vary said [proportion] ratio of reaction forces applied to said pressure responsive unit and said control member as said pressure responsive unit strokes.

3. A force applying mechanism according to claim **2** wherein said pressure responsive means includes a spring biased ring operatively arranged to be spaced from and surround said control member and contact said control member when said force transmitting member has applied a reaction force to said mass that is greater than said spring.

4. A force applying mechanism, comprising:

a fluid pressure operated motor having a pressure responsive unit therein;

a force applying member operatively connected with said pressure responsive unit effective for transmission of force from said pressure responsive unit and arranged to receive reaction force in proportion to the force exerted by the pressure responsive unit;

an operator-operated control member;

follow-up control valve mechanism actuated by the control member having a normal off position balancing pressure in said motor and being movable from said off position by actuation of said control member to establish differential pressure in said motor to move said pressure responsive unit thereby;

a coherent generally solid deformable force transmitting mass in a condition of controlled volumetric confinement between said force transmitting member

and control member, said pressure responsive unit and said control member effective to *proportionally* transmit thereby reaction forces from said force applying member to said pressure responsive unit and to said control member [in a proportion ratio], said force transmitting mass having a predetermined volume in the relaxed state of the mass such that said control member does not contact said mass until said control valve mechanism is moved from said off position; and

pressure responsive means including a spring biased ring operatively arranged to be spaced from and surround said control member and contact said control member when said force transmitting member has applied a reaction force to said mass that is greater than said spring.

5. For use with a servomotor mechanism having a power device, means controlling said device, force transmitting means operatively connected to said power device, said force transmitting means including a deformable member arranged for variable extrusion to proportionally vary the reaction on said means controlling said power device upon actuation of said power device, and a ring surrounding and receiving one end of said means controlling said power device and located in the path of movement of said means controlling said power device and engageable therewith on a given axial movement of said means controlling said power device, and spring means holding said ring in a position to transfer a portion of reaction forces from said force transmitting means into said power device, said spring means being collapsible upon a predetermined reaction force to cause said ring to engage said means controlling said power device whereupon a greater proportion of reaction forces are transmitted to said means controlling said power device.

6. For use with a servomotor mechanism having a power device, means controlling said power device, force transmitting means operatively connected to said power device, said force transmitting means including a confined deformable member arranged for variable extrusion to proportionally vary the reaction on said means controlling said power device upon actuation of said power device, and a ring surrounding and receiving one end of said means controlling said power device and located in the path of movement of said means controlling said power device and engageable therewith on a given axial movement of said means controlilng said power device, and spring means for regulating the position of said ring with respect to said means controlling said power device to permit a change in area for said deformable member in its extrusion to increase the proportion of reaction on said means controlling said power device.

7. For use with a servomotor mechanism having a power device, means controlling said power device, force transmitting means operatively connected to said power device, said force transmitting means including a deformable member arranged for variable extrusion to proportionally vary the reaction on said means controlling said power device upon actuation of said power device, and pressure responsive means operatively connected to said power device, said pressure responsive means slidably and internally receiving a stepped down projection of said means controlling said power device and normally spaced from a shoulder on said means controlling said power device and movable towards the shoulder to vary the ratio of reaction forces on said means controlling said power device as said power device strokes.

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