Aug. 16, 1960 J. B. OTTESTAD ET AL 2,949,080

PRESSURE GENERATOR

Filed Jan. 20, 1958 2 Sheets-Sheet 1

FIG. 1.

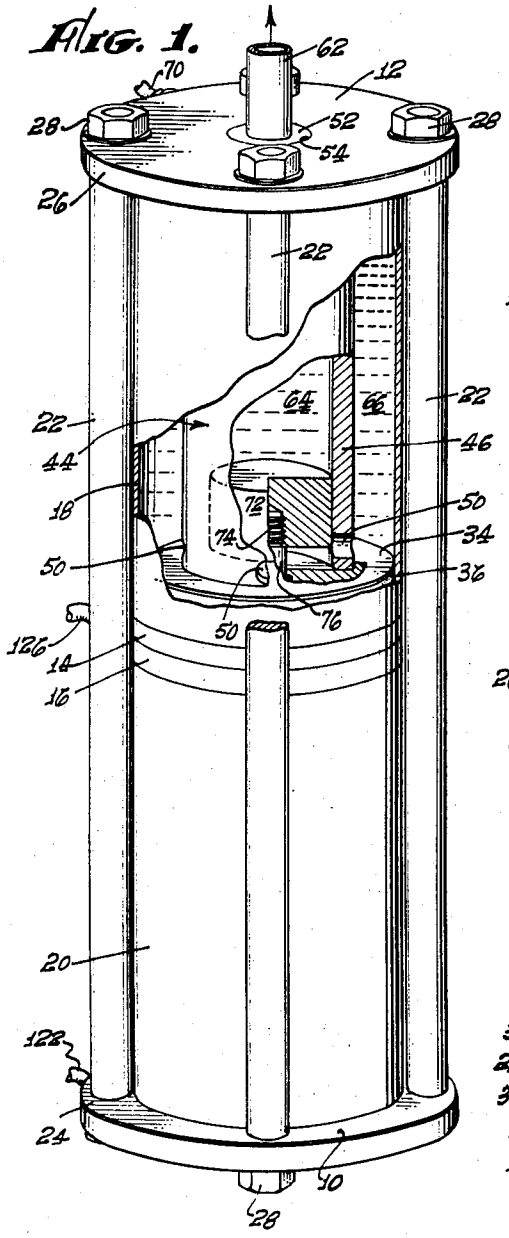


FIG. 3.

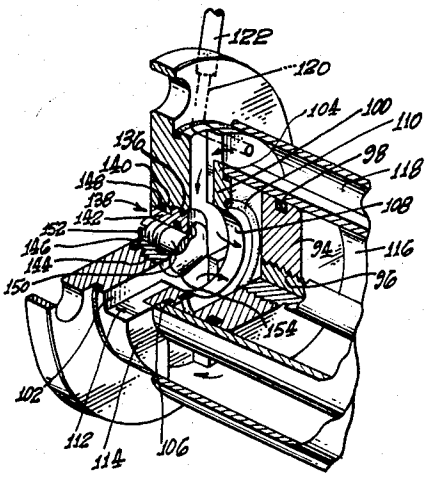
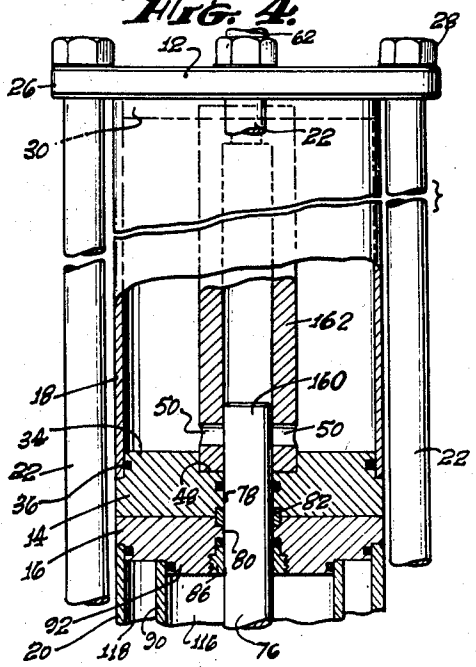


FIG. 4.



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PRESSURE GENERATOR

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FIG. 2.

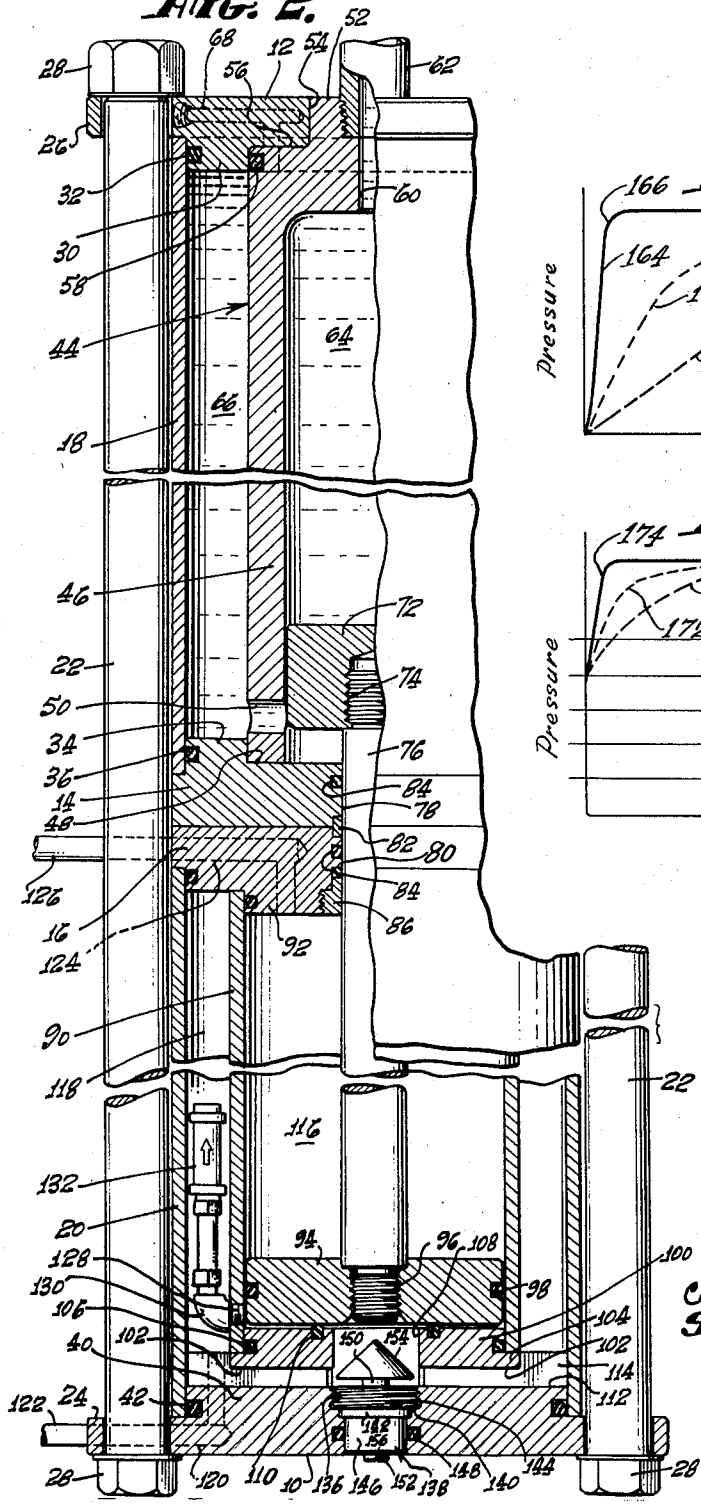


FIG. 5.

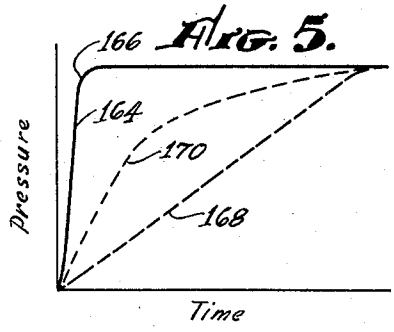
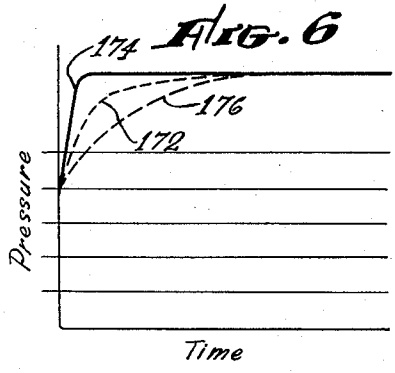


FIG. 6



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PRESSURE GENERATOR

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Filed Jan. 20, 1958, Ser. No. 709,992

16 Claims. (Cl. 103—50)

This invention relates generally to pressure generators; more particularly, it relates to pressure generators for effecting rapid pressure variation.

The pressure generator of the present invention utilizes actuator means for rapidly exerting thrust on plunger means positioned in a cylinder to produce pressure. The actuator means is adapted for very rapid production of thrust, and utilizes features of actuators described and claimed in the copending application of Jack B. Ottestad, Serial No. 617,014, filed October 19, 1957, the copending application of Jack B. Ottestad and Samuel A. Skeen, Serial No. 683,855, filed September 13, 1957, and the copending application of Jack B. Ottestad, Serial No. 690,774 filed October 17, 1957. A preferred embodiment of the present invention utilizes actuator adjustment means for governing the time variation of thrust on the plunger means to predetermine an initial pressure-time pattern.

It is accordingly an object of the present invention to provide a pressure generator capable of very rapid production of high pressure.

An object of this invention is the provision of a pressure generator capable of producing a predetermined pressure-time pattern.

It is an object of this invention to provide a pressure pump which is adjustable for selection of an initial pressure-time output pattern.

An object of the present invention is the provision of a pressure generator which is adjustable for predetermination of the time duration of pressure increase.

Other objects and features of the present invention, as well as many advantages thereof, will become apparent to those skilled in the art from a consideration of the following description, the appended claims, and the accompanying drawings, in which:

Figure 1 is a perspective view, partially in section, of a preferred embodiment of the pressure generator of this invention;

Figure 2 is an elevational view, partially in section of the pressure generator shown in Figure 1;

Figure 3 is a sectional perspective view showing details of a portion of the embodiment shown in Figures 1 and 2;

Figure 4 is a fragmentary elevational view of a modified form of pressure generator according to the present invention; and

Figures 5 and 6 are graphical representations of pressure-time patterns produced by a pressure generator of this invention under certain conditions of operation and adjustment.

Referring to the drawings, and particularly to Figures 1, 2, and 3, a preferred embodiment of the present invention is shown as including base member **10**, an end member **12**, a pump end wall **14**, an actuator end wall **16**, a cylindrical pump housing **18**, and a cylindrical actuator housing or outer cylinder **20**. These parts are secured in clamped relation by tie-bolts **22** to form a housing. The tie-bolts extend through appropriate openings equally spaced about a flange portion **24** of the base member and through similar aligned openings in a flange portion **26** of the end member. The tie-bolts are secured by engagement of their threaded end portions with nuts **28**. Cylindrical pump housing **18** abuts the flange portion **26** and fits closely about a cylindrical section **30** of the end member. Pressure sealing between section **30** and the pump housing is provided by an annular seal **32** disposed in an appropriate groove in the section. The end of the pump housing opposite the end member is fitted about a reduced portion **34** of the pump end wall, and sealing is provided between these parts by an annular sealing element **36**.

A body portion **40** of the base member fits closely within the outer actuator cylinder **20**, the end of which abuts flange portion **24** of the base member. Pressure sealing between the actuator housing and the base member is provided by an appropriate seal **42** disposed in a peripheral groove in the body portion adjacent to the flange portion. The other end of the cylindrical actuator housing is accommodated by actuator end wall **16** in the same manner as pump housing **18** is accommodated by pump end wall **14**, and pressure sealing is similarly provided.

A pump case **44** is coaxial with the pump housing and has the end of its cylindrical portion or pump cylinder **46** seated in a circular recess **48** in the pump end wall. Openings **50** are provided in cylindrical portion **46** near the end thereof. A head portion **52** of the pump case is adapted to fit within an opening **54** in end member **12** and is maintained in clamped relation with the end member by means of mutually engaging shoulders at **56**. A resilient sealing ring **58** in a peripheral groove in the pump case provides pressure sealing. An axial opening **60** in head portion **52** is threaded to accommodate an outlet coupling **62**.

From the foregoing description, it will be understood that cylindrical portion **46** of pump case **44** and pump end wall **14** define a pump chamber **64**. The pump end wall, end member **12**, the pump case and cylindrical pump housing **18** cooperate to define a supply chamber **66**, which is coaxial with the pump chamber. A passage **68** in the end member and a fluid coupling **70** interconnect the supply chamber with a source of fluid (not shown).

A pump piston or plunger **72** is slidably positioned within the pump cylinder **46** of the pump case. A threaded axial opening **74** in the pump piston secures a threaded end portion of a thrust column **76**. The thrust column extends through an opening **78** in the pump end wall and through an aligned opening **80** in the actuator end wall, these openings being maintained in alignment by a concentricity ring **82**, which is seated in adjoining recesses in the two end walls so as to fit closely around the thrust column. A groove **84** within each of the openings **78** and **80** accommodates a sealing member which provides pressure sealing between the thrust column and the end walls. Opening **80** has an enlarged threaded portion within which is secured a thrust column bearing **86**.

An inner actuator cylinder **90** is disposed in coaxial relation with cylindrical actuator housing **20**. The inner cylinder abuts actuator end wall **16** and fits closely about a reduced wall section **92**, which accommodates a pressure sealing ring. An actuator piston **94** is slidably positioned within the inner actuator cylinder and is secured to the thrust column by engagement of its threaded axial opening **96** with a threaded end portion of the thrust column. Pressure sealing between the actuator piston and inner cylinder **90** is provided by an annular seal **98** disposed in a peripheral groove in the piston.

In the modified form of the present invention shown in Figure 4, no pump piston is utilized. An end portion **160** of thrust column **76** serves as a plunger and a cylindrical section **162** of the pump case is adapted to fit the thrust column. In all other respects the modified form is similar to the embodiment shown in Figures 1, 2 and 3.

The pump piston and the thrust column, together with either pump piston **72** or plunger portion **160**, may be considered to constitute piston means slidably positioned in cylinder means comprised of inner actuator cylinder **90** and cylindrical portion **46** of the pump case.

The end of inner actuator cylinder **90** opposite from the actuator end wall secures an orifice plate or wall **100** in wedge-shaped recesses **102** of base member **10** by engaging a flange portion **104** of the orifice plate. A pressure sealing ring **106** is disposed between the cylinder and the orifice plate in an appropriate groove in the plate adjacent to the flange portion. An orifice **108** is defined in the orifice plate and a circular resilient seal **110** is secured as by bonding in a circular groove in the orifice plate, these elements serving purposes which are explained hereinbelow. As shown in Figure 3, the above-mentioned wedge-shaped recesses **102** are defined by four mutually perpendicular radial grooves **112**, which define four wedge-shaped sections **114** of the body portion, and by a circular recess of less depth than the grooves **112**, which is machined in the body portion **40** to produce a wedge-shaped recess on each of the four sections **114**.

It will be observed that the inner cylinder **90**, actuator end wall **16** and the orifice plate cooperate to define a first pressure chamber or actuator chamber **116** and that the actuator housing, the actuator end wall and base member **10** cooperate to define a second pressure chamber or accumulator chamber **118**. The orifice plate and the base member cooperate to define passages between chamber **118** and orifice **108** through the radial grooves **112**. A passage **120** in the base member and a fluid coupling **122** interconnect the second pressure chamber **118** and a source of pressure (not shown). A similar passage **124** in the actuator end wall and an external fluid connection **126** connect the first chamber **116** with another source of pressure (not shown).

A threaded opening **128** in inner cylinder **90** adjacent to the orifice plate secures an elbow coupling **130**, which is joined through appropriate connections with a check valve **132**. The valve communicates directly with the interior of pressure chamber **118**. Means are thereby provided for releasing pressure above a certain value from chamber **116** to chamber **118**, for a purpose which is explained hereinbelow.

A threaded axial opening **136** in the base member accommodates an adjustment assembly **138**. A shoulder **140** is provided in the opening for seating the assembly. Adjustment assembly **37** includes a retainer **142**, an enlarged threaded portion **144** of which secures the assembly in opening **136**. Pressure sealing between the base member and a reduced portion **146** of the retainer is effected by a resilient seal ring **148** disposed in an annular groove within the opening. A threaded bore in the retainer accommodates a threaded shank portion **152** of an adjustment element or needle **150**. Pressure sealing is provided between the retainer and the adjustment needle. The needle is coaxial with orifice **108** and has a conical plug or head **154** which is extended or retracted upon rotation of the needle in the container. A screw slot **156** is provided in the end of shank portion **110** to provide external adjustment means for selectively positioning conical plug **154** relative to the orifice plate **100**.

In operation, the pressure generator hereinbefore described is capable of producing high pressure very rapidly.

To prepare the apparatus for operation, chambers **66** and **64** are filled with fluid which is introduced through passage **68**. In filling chamber **64**, the fluid passes between the pump piston and the pump case, there being no static pressure seal between these members and appropriate clearance being provided between the piston and the case. The chambers **64** and **66** are part of a pressure system which is closed after the chambers are filled.

The actuator portion of the pressure generator exerts thrust on the actuator and pump pistons very rapidly. The method of effecting this sudden action through the coaction of the orifice plate **100**, circular resilient seal **110** and the actuator piston **94** is described in the copending applications mentioned hereinabove. It is briefly discussed herein for convenience in relating it to the pressure generator of the present invention.

A setting pressure is introduced into the actuator chamber through fluid coupling **126** and passage **16** from a source of pressure (not shown). The actuator piston is thereby seated against circular resilient seal **110** to effect a positive pressure seal which isolates chamber **116** from chamber **118**. A high actuating pressure is introduced into chamber **118** through fluid coupling **122** and passage **120** in base member **10**. The actuating pressure acts upon the area of the piston within seal **110** and is predetermined to balance the force of the setting pressure acting upon the larger area on the opposite side of the piston. Piston **94** is thus held in equilibrium. The pressure in chamber **118** is next increased by a pressure differential sufficient to unbalance the forces on the piston and cause movement of the piston from the orifice plate. Seal **110** is thereby disengaged and the high actuating pressure is thus released substantially instantaneously to act upon the area of the piston outside circular seal **110**. A great net force is thus suddenly exerted on the actuator piston and is transmitted to the pump piston **72**. Circular seal **110** is an important element in making possible this extremely rapid production of high force; it is adapted for sudden disengagement from the orifice plate for the purpose of releasing the actuating pressure substantially instantaneously.

In order to prepare the actuator for repeat operation, actuator piston **94** must be re-seated against the orifice plate to re-establish pressure sealing between the piston and the plate by means of resilient circular seal **110**. On re-seating the piston by reducing the pressure in chamber **118** to a value slightly below that in chamber **116**, a pressure approximating the reduced pressure is trapped by circular seal **110** and by seal **98** between the piston and the orifice plate. If this trapped pressure were not relieved, it would tend to oppose the force exerted by the setting pressure on the opposite side of the piston. The opening **128** in the inner actuator cylinder, the elbow coupling **130** and unidirectional check valve **132** provide means for automatically relieving the trapped pressure into chamber **118**. The valve is opened by a predetermined trapped pressure. The pressure is relieved into chamber **118**, because if it were released to the exterior atmosphere the actuating pressure which passes through the orifice to actuate the piston would obviously be released to the atmosphere.

The very rapidly produced high thrust is translated by the pump piston **72** into a high pressure generated in chamber **64** at an extremely high rate. It will therefore be appreciated that the present invention is capable of very rapid or substantially instantaneous production of very high pressure.

Although the fluid in pump chamber **64** may be a gas it is considered preferable to utilize a liquid. The relative incompressibility of liquid results in more rapid attainment of higher pressures. In further discussion herein, it is assumed that liquid is used in the pump chamber.

The output pressure-time pattern at output opening **60** is in accordance with the thrust-time pattern produced on the actuator piston **94**.

In Figure 5 is shown a pressure-time pattern produced in the manner described above. A very rapid pressure rise or surge at **164** is followed by the attaining of maximum pressure at **166**, the elbow of the curve representing the full compression of the fluid against the piston. The maximum output pressure which is produced, and the degree of pressure amplification which is obtained, depend upon the values of the actuating and setting pressures, and upon the ratio of the actuator piston area to the pump piston area. As an example of the pressures which may be obtained, if an actuator pressure of 2,000 pounds per square inch is utilized with an actuator piston area of 4 square inches and a pump area of 1 square inch, an output pressure of 32,000 pounds per square inch is obtainable. The amplification ratio is therefore governed by the ratio between the actuator piston area and the pump piston area. It has been found that maximum pressure is attainable in approximately one-quarter of a millisecond.

An initial pressure other than zero may be selected by establishing such pressure in chamber **64** before activating the actuator. In Figure 6 is shown an initial output pattern **172** where an initial pressure is established.

After maximum pressure is attained, assuming that the external pressure system does not relieve the pressure, the pressure may be maintained for a period dependent upon the rate of leakage of the fluid in chamber **64** past the pump piston **72**. If a pressure seal were provided between the pump piston and the pump case, the output pressure could be maintained by maintaining the actuating pressure against actuator piston **94**. With such a seal, it would be necessary to fill chamber **64** through the outlet opening or in some other manner.

With the pressure generator connected with an external pressure system which provides volume displacement to permit substantial movement of the pump piston, a principal factor governing the initial pressure-time pattern is the degree of restriction upon the release of pressure between chamber **118** and the actuator piston. After disengagement of circular seal **110** by the action of the actuating pressure on the actuating piston, the actuating pressure must be released to the piston through the passages between the base member and the orifice plate and through the orifice. The degree of restriction upon this release is determined by the design of a particular actuator. Utilizing particular pressures in chambers **118** and **116**, the restriction inherent in the design of a particular actuator produces a specific pressure-time envelope.

An important feature of the present invention is the provision of means for adjusting the degree of restriction to release of pressure to the actuator piston. This feature permits selective throttling within the available pressure-time envelope and predetermination of the pattern or duration of output pressure rise. Adjustment needle **150** serves to accomplish this selection and predetermination by adjustment of the net flow area between the orifice plate **100** and plug portion **154** of the adjustment needle, thereby governing the pressure drop across orifice **108** as a function of piston displacement. Adjustment needle **150** is axially adjustable, by means of the screw slot **156** disposed outside the pressure generator, so that head or plug **154** may be selectively positioned relative to the orifice plate to determine the net flow area. Reduction in flow area throttles the actuating pressure and results in increased velocity through the orifice. Increased velocity results in increased pressure drop across the orifice and in greater throttling or limiting effect on the available pressure-time envelope.

In Figure 5 are shown pressure-time curves showing pressure rise patterns for different positions of adjustment needle **150**. Curve **164—166** represents the pressure-time pattern which is produced with the adjustment plug fully withdrawn from the orifice. This curve therefore represents the available envelope within which desired output patterns may be produced by selective throttling by means of adjustment needle **150**. Curve **168** represents the pattern which is produced with plug portion **154** in relatively close proximity to the orifice plate. Intermediate positions of the adjustment plug will produce curves disposed between curve **164** and curve **168**. In Figure 6, curves **174**, **176** and **172** compare respectively to curves **164**, **168** and **172** of Figure 5, and represent the condition where an initial pressure is established in the pump chamber.

From the foregoing description, it will be understood that the adjustment means may be utilized for selection of the initial portion of the pressure-time output pattern of the pressure generator of the present invention. It may also be utilized for predetermination of the time duration or rate of pressure rise to maximum pressure. It has been found that this time duration may be selectively varied between 250 microseconds and 6 milliseconds.

It will be appreciated that the present invention is capable of very rapid or substantially instantaneous production of very high pressures. It will be further appreciated that this invention provides a pressure generator which is externally adjustable to permit predetermination of the initial portion of a pressure-time output pattern and of the time or rate of pressure increase.

The capabilities of the present invention make possible the precise control of the rate of application of pressure for external use. Such control is important in such applications as the testing of pressure gauges, especially the testing of such gauges under surge conditions. An important application is the forming of metal parts. A high controlled rate of pressure application permits the forming of metal at an optimum rate which prevents work-hardening of the metal and therefore precludes splitting or destruction.

Although specific embodiments of the present invention have been described and illustrated in detail, it is to be clearly understood that the same are by way of illustration and example only; it is to be understood that the invention is not limited thereto, as many variations will be readily apparent to those versed in the art and the invention is to be given its broadest possible interpretation within the terms of the appended claims.

The inventors claim:

1. A pressure generator comprising cylinder means, means defining an outlet opening in the cylinder means, piston means slidably positioned in the cylinder means, said piston means having a plunger surface and an actuator surface rigidly interconnected to provide a unitary structure, said plunger surface confronting fluid disposed in the cylinder means, a plate confronting said actuator surface and defining an orifice, a resilient seal element disposed between the actuator surface and the plate for effecting pressure sealing therebetween about said orifice, means for exerting a setting force on said piston means to urge the actuator surface toward said plate to cover the orifice and effect said pressure sealing, and means for establishing an actuating pressure independent of said setting force to act upon a portion of said actuator surface within the resilient seal element to overbalance the setting force and expose an increased area of the actuator surface to the actuating pressure, whereby thrust is exerted on said piston means to produce output pressure in said fluid.

2. A pressure generator comprising cylinder means, means defining an outlet opening in the cylinder means, piston means slidably positioned in the cylinder means, said piston means having a plunger surface and an actuator surface rigidly interconnected to provide a unitary structure, said plunger surface confronting fluid disposed in the cylinder means, a plate confronting said actuator surface and defining an orifice, sealing means disposed between the actuator surface and the plate for effecting

pressure sealing therebetween about said orifice, means for exerting a setting force on said piston means to urge the actuator surface toward said plate to cover the orifice and effect said pressure sealing, means for establishing an actuating pressure independent of said setting force to act upon a portion of said actuator surface within the sealing means to overbalance the setting force and expose an increased area of the actuator surface to the actuator pressure, and an adjustment element selectively positionable relative to said plate for predetermining a net flow area therebetween, thereby providing predetermined restriction to release of said actuating pressure to said actuator surface upon said overbalancing of said setting force to disengage said sealing means, whereby a thrust pattern on said piston means is governed to predetermine a pressure-time output pattern.

3. A pressure generator comprising housing means defining adjacent actuator and pump chambers, a plate defining an orifice at an end of said actuator chamber, an actuator piston positioned within said actuator chamber and confronting the plate, plunger means rigidly connected in a unitary structure with said actuator piston and slidably positioned in said pump chamber, said plunger means being adjacent to fluid in said pump chamber, a resilient seal element positioned between the actuator piston and the plate for effecting pressure sealing therebetween about the orifice, means for applying fluid setting pressure to the piston to exert a setting force urging the piston toward the wall to cover the orifice and effect said pressure sealing, and means for establishing in said second chamber an actuating pressure independent of said setting force to act upon a portion of the actuator piston within said resilient seal element to overbalance said force and expose an increased area of the actuator piston to the actuating pressure, whereby thrust is exerted on said plunger means to produce output pressure in said pump chamber.

4. A pressure generator comprising means defining a pump chamber having an outlet opening, said pump chamber being connected with a fluid pressure system, plunger means positioned within the pump chamber, a thrust column rigidly attached to said plunger means and extending through a wall of the pump chamber, an actuator piston rigidly connected with the plunger means and slidably positioned in an actuator chamber, a plate confronting the actuator piston and defining an orifice at an end of the actuator chamber, a resilient seal disposed between said actuator piston and said plate for effecting pressure sealing therebetween about the orifice, fluid pressure means for exerting a setting force urging the actuating piston toward the plate to cover the orifice and effect said pressure sealing, and means for establishing an actuating pressure independent of said setting force to act upon a portion of the actuator piston within the resilient seal to overbalance said force and expose an increased area of the actuator piston to the actuating pressure, whereby thrust is exerted on said plunger means to produce output pressure in said fluid pressure system.

5. A pressure generator comprising means defining a pump chamber having an outlet opening, said pump chamber being connected with a fluid pressure system, plunger means positioned within the pump chamber, a thrust column rigidly attached to said plunger means and extending through a wall of the pump chamber, an actuator piston rigidly connected with the plunger means and slidably positioned in an actuator chamber, a plate confronting the actuator piston and defining an orifice at an end of the actuator chamber, sealing means disposed between said actuator piston and said plate for effecting pressure sealing therebetween about the orifice, means for exerting a setting force urging the actuating piston toward the plate to cover the orifice and effect said pressure sealing, means for establishing an actuating pressure independent of the setting force to act upon a portion of the actuator piston within the sealing means to overbalance said force and expose an increased area of the actuator piston to the actuating pressure, and an adjustment element selectively positionable relative to said plate for predetermining a net flow area therebetween, thereby providing predetermined restriction to release of said actuating pressure to said actuator piston upon said overbalancing of said setting force to disengage said sealing means, whereby a thrust-time pattern on said plunger means is governed to predetermine a pressure-time output pattern.

6. A pressure pump comprising a pump case having an outlet opening communicating with a pressure system, plunger means positioned within the pump case, actuator housing means including an outer cylinder having closed ends, an inner cylinder coaxial with said outer cylinder and cooperating therewith to define a pressure chamber, a plate defining an orifice at an end of the inner cylinder, means defining at least one passage communicating between said pressure chamber and said orifice, an actuator piston rigidly connected in a unitary structure with the pump piston and positioned within said inner cylinder in confronting relation with said plate, a resilient seal disposed between the actuator piston and the plate for effecting pressure sealing therebetween about said orifice, means for establishing a fluid setting pressure in the inner cylinder to exert a setting force urging the actuator piston toward said plate to cover said orifice and effect said pressure sealing, and means for establishing an actuating pressure in said pressure chamber independent of said setting pressure to act upon a portion of the actuator piston within the resilient seal to overbalance said force and expose an increased area of the actuator piston to the actuating pressure, whereby thrust is exerted on said plunger means to produce output pressure in said pressure system.

7. A pressure generator comprising a pump case having an outlet opening communicating with a pressure system, a thrust column having a plunger portion slidably positioned in the pump case, actuator housing means including an outer cylinder having closed ends, an inner cylinder coaxial with said outer cylinder and cooperating therewith to define a pressure chamber, a plate defining an orifice at an end of the inner cylinder, means defining at least one passage communicating between said pressure chamber and said orifice, an actuator piston attached to said thrust column and positioned within said inner cylinder in confronting relation with said plate, sealing means disposed between the actuator piston and the plate for effecting pressure sealing therebetween about said orifice, means for establishing a setting pressure in the inner cylinder to exert a setting force urging the actuator piston toward said plate to cover said orifice and effect said pressure sealing, means for establishing an actuating pressure in said pressure chamber to act upon a portion of the actuator piston within the sealing means to overbalance said force and expose an increased area of the actuator piston to the actuating pressure, and an adjustment element selectively positionable relative to said plate for predetermining a net flow area therebetween, thereby providing predetermined restriction to release of said actuating pressure to said actuator piston upon said overbalancing of said setting force to disengage said sealing means, whereby a thrust-time pattern on said plunger portion is governed to predetermine an initial pressure-time output pattern.

8. A pressure generator comprising means defining a pump chamber disposed on a first side of a wall, an outlet opening in the pump chamber communicating with a pressure system, a pump piston slidably positioned within the pump chamber, a thrust column rigidly attached to the pump piston and extending through an opening in said wall, an actuator cylinder extending from the wall and cooperating therewith to define a first pressure chamber on a second side of said wall, actuator housing means cooperating with the wall and the actuator cylinder to

define a second pressure chamber, a plate defining an orifice between the first pressure chamber and the second pressure chamber, an actuator piston rigidly attached to the thrust column, said piston being positioned in the first pressure chamber in confronting relation with said plate, a resilient seal positioned between the actuator piston and the plate for effecting pressure sealing therebetween about said orifice, means for establishing a fluid setting pressure in the first pressure chamber to exert a setting force urging said actuator piston toward the plate to cover the orifice and effect said pressure sealing, and means for establishing in the second chamber an actuating pressure independent of said setting force to act upon a portion of said actuator piston within said resilient seal to overbalance said force and expose an increased area of the actuator piston to the actuating pressure, whereby thrust is exerted on said pump piston to produce output pressure in said pump chamber.

9. A pressure generator comprising means defining a pump chamber disposed on a first side of a wall, an outlet opening in the pump chamber communicating with a pressure system, a pump piston slidably positioned within the pump chamber, a thrust column attached to the pump piston and extending through an opening in said wall, an actuator cylinder extending from the wall and cooperating therewith to define a first pressure chamber on a second side of said wall, actuator housing means cooperating with the wall and the actuator cylinder to define a second pressure chamber, a plate defining an orifice between the first pressure chamber and the second pressure chamber, an actuator piston attached to the thrust column, said piston being positioned in the first pressure chamber in confronting relation with said plate, sealing means positioned between the actuator piston and the plate for effecting pressure sealing therebetween about said orifice, means for exerting a setting force urging said actuator piston toward the plate to cover the orifice and effect said pressure sealing, means for establishing in the second chamber an actuating pressure to act upon a portion of said actuator piston within said sealing means to overbalance said force and expose an increased area of the actuator piston to the actuating pressure, and an adjustment needle for restricting the release of the actuating pressure against the actuator piston upon said overbalancing of the setting force to disengage said sealing means, said adjustment needle having a head portion for extension toward said orifice plate to define a net flow area therebetween, a portion of said adjustment needle being threadedly connected with said housing means for positional adjustment, whereby a thrust pattern on said pump piston is governed to predetermine an initial pressure-time pattern in said pump chamber.

10. A pressure pump comprising wall means, a pump cylinder extending from a first side of the wall means and cooperating therewith to define a pump chamber, means defining an outlet opening in the pump chamber, a pump piston slidably positioned in the pump cylinder, a cylindrical pump housing coaxial with the pump cylinder and cooperating therewith and with said wall means to define a fluid supply chamber, means for filling said pump chamber with fluid from said supply chamber, a thrust column rigidly attached to the pump piston and extending through the wall means, an actuator cylinder extending from a second side of the wall means and cooperating therewith to define a first pressure chamber, actuator housing means cooperating with said wall means and the actuator cylinder to define a second pressure chamber, a plate defining an orifice between the first and the second pressure chambers, an actuator piston rigidly attached to said thrust column, said piston being positioned in said first pressure chamber and confronting the plate, a resilient seal between the actuator piston and the plate for effecting pressure sealing therebetween about said orifice, means for establishing a fluid setting pressure in the first pressure chamber to exert a force urging the actuator piston toward the plate to cover the orifice and effect said pressure sealing, and means for establishing in the second chamber an actuating pressure independent of said setting pressure to act upon a portion of said actuator piston within the resilient seal to overbalance said force and expose an increased area of the actuator piston to the actuating pressure, whereby thrust is exerted on said pump piston to produce output pressure in said pump chamber.

11. A pressure generator according to claim 10 and further including an adjustment needle threadedly mounted on said base member, a head portion on the adjustment needle, said head portion being adapted for extension toward said plate to define a net flow area therebetween, and means on the adjustment needle exterior of the pressure generator for selectively positioning said head portion to predetermine said flow area, whereby a thrust-time pattern on said pump piston is governed to predetermine an initial pressure-time pattern in said pump chamber.

12. A pressure pump comprising wall means, a pump cylinder extending from a first side of the wall means and cooperating therewith to define a pump chamber, means defining an outlet opening in the pump chamber, a cylindrical pump housing coaxial with the pump cylinder and cooperating therewith and with said wall means to define a fluid supply chamber, means for filling said pump chamber with fluid from said supply chamber, a pump piston slidably positioned within the pump cylinder, a thrust column attached to the pump piston and extending through the wall means, an actuator cylinder extending from a second side of the wall means and cooperating therewith to define a first pressure chamber, actuator housing means cooperating with said wall means and the actuator cylinder to define a second pressure chamber, a plate defining an orifice between the first and the second pressure chambers, an actuator piston attached to the thrust column, said piston being positioned in said first pressure chamber and confronting the plate, sealing means positioned between the actuator piston and the plate for effecting pressure sealing therebetween about said orifice, means for establishing a setting pressure in the first pressure chamber to exert a force urging the actuator piston toward the plate to cover the orifice and effect said pressure sealing, means for establishing in the second chamber an actuating pressure to act upon a portion of said actuator piston within the sealing means to overbalance said force and expose an increased area of the actuator piston to the actuating pressure, and an adjustment needle for restricting the release of the actuating pressure against the actuator piston upon said overbalancing of the setting force to disengage said sealing means, said adjustment needle having a head portion for extension toward said orifice plate to define a net flow area therebetween, a portion of said adjustment needle being threadedly connected with said housing means for positional adjustment, whereby a thrust pattern on said pump piston is governed to predetermine an initial pressure-time pattern in said pump chamber.

13. A pressure generator comprising means defining a pump chamber disposed on a first side of a wall, an outlet opening in said pump chamber, a pump piston slidably positioned within the pump chamber, a thrust column rigidly attached to the pump piston and extending through an opening in said wall, coaxial outer and inner actuator cylinders, each of the cylinders being closed at a first end thereof by a second side of said wall to define a pressure chamber between the cylinders, a plate defining an axial orifice at a second end of the inner cylinder, a base member closing a second end of the outer cylinder, said base member cooperating with the orifice plate to define at least one passage communicating between said pressure chamber and the orifice, an actuator piston rigidly connected with said thrust column and positioned within the inner cylinder in confronting

relation with said orifice plate, resilient sealing means positioned between the actuating piston and the plate for effecting pressure sealing therebetween about said orifice, means for establishing a fluid setting pressure in the inner cylinder for exerting a force urging the actuator piston toward the plate to cover the orifice and effect said pressure sealing, and means for establishing in the pressure chamber an actuating pressure independent of said setting pressure to act upon a portion of said actuator piston within said resilient sealing means to overbalance said force and expose an increased area of the actuator piston to the actuating pressure, whereby thrust is exerted on said pump piston to produce output pressure in said pump chamber.

14. A pressure generator according to claim 13 and further including an adjustment needle for restricting the release of the actuating pressure against the actuator piston upon said overbalancing of the setting force to disengage said sealing means, said adjustment needle having a head portion for extension toward said orifice plate to define a net flow area therebetween, a portion of said adjustment needle being threadedly connected with said housing means for positional adjustment, whereby a thrust pattern on said pump piston is governed to predetermine an initial pressure-time pattern in said pump chamber.

15. A pressure generator comprising wall means, a cylindrical pump housing abutting the wall means, a pump case disposed coaxially within the pump housing and abutting the wall means, said pump case having a head portion defining an outlet opening, the pump case and the cylindrical pump housing cooperating to define a supply chamber closed by an end member, the pump cylinder having at least one opening for receiving fluid from the supply chamber, an actuator cylinder extending from the wall means and cooperating therewith to define a first pressure chamber on the side of said wall means opposite from the pump chamber, actuator housing means cooperating with the wall means and the cylinder to define a second pressure chamber, a plate defining an orifice between the first pressure chamber and the second pressure chamber, an actuator piston slidably positioned in the actuator cylinder and confronting the plate, a thrust column rigidly interconnecting the pump piston and the actuator piston through the wall means, sealing means positioned between the actuator piston and said plate for effecting pressure sealing therebetween about said orifice, means for establishing in said first pressure chamber a fluid setting pressure for exerting a setting force urging the actuator piston toward the plate to cover the orifice and effect said pressure sealing, and means for establishing in said second pressure chamber an actuating pressure independent of said setting pressure to act upon a portion of said actuator piston within the sealing means to overbalance said force and oppose an increased area of the actuator piston to the actuating pressure, whereby thrust is exerted on said pump piston to produce output pressure in said pump chamber.

16. A pressure generator comprising wall means, a cylindrical pump housing abutting the wall means, a pump case disposed coaxially within the pump housing and abutting the wall means, said pump case having a head portion defining an outlet opening, the pump cylinder and the cylindrical pump housing cooperating to define a supply chamber closed by an end member, the pump cylinder having at least one opening for receiving fluid from the supply chamber, a thrust column attached to the pump piston and extending through an opening in said wall means, coaxial outer and inner cylinders, each of the cylinders being closed at a first end thereof by a second side of said wall means to define a pressure chamber between the cylinders, a plate defining an axial orifice at a second end of the inner cylinder, a base member cooperating with the orifice plate to define at least one passage communicating between said pressure chamber and the orifice, an actuator piston connected with said thrust column and positioned within the inner cylinder in confronting relation with said orifice plate, sealing means positioned between the actuating piston and the plate for effecting pressure sealing therebetween about said orifice, means for establishing a setting pressure in the inner cylinder for exerting a force urging the actuator piston toward the plate to cover the orifice and effect said pressure sealing, means for establishing in the pressure chamber an actuating pressure to act upon a portion of said actuator piston within said sealing means to overbalance said force and expose an increased area of the actuator piston to the actuating pressure, and an adjustment element selectively positionable relative to said plate for predetermining a net flow area therebetween, thereby providing predetermined restriction to release of said actuating pressure to said actuator piston upon said overbalancing of said setting force to disengage said sealing means, whereby a thrust-time pattern on said pump piston is governed to predetermine an initial pressure-time output pattern.

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