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(54) **Displacement control valve for use in a variable displacement compressor**

Ventil zur Hubregelung zur Verwendung in einem Kompressor mit veränderlicher Fördermenge

Soupape de contrôle de déplacement pour utilisation dans un compresseur à capacité variable

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Description

Background of the invention:

[0001] The present invention relates to a displacement control valve for use in a variable displacement compressor which is included in, for example, a vehicle air conditioner.

[0002] As such a variable displacement compressor, there has been a type having a piston. In the manner known in the art, the compressor of the type comprises a crank chamber, a suction chamber, and a discharge chamber. The piston has a piston stroke controlled in response to the pressure in the crank chamber. Therefore, the compressor has a displacement which is variable and determined in accordance with the piston stroke.

[0003] For making the displacement be variable, a displacement control valve is assembled to the variable displacement compressor to control the piston stroke. Various displacement control valves have been known in the art.

[0004] Referring now to Fig. 7, description will be made as regards an example of the conventional displacement control valves. The shown displacement control valve monitors the pressure in the suction chamber by means of a bellows 1 and opens/closes a ball valve 2 depending on the monitored suction chamber pressure so as to adjust the amount of gas introduced into the crank chamber from the discharge chamber. This is a bellows valve structure of a so-called internal control type.

[0005] On the basis of the bellows valve structure of this type, an electromagnetic actuator 3 is further disposed over the ball valve 2 so that an electromagnetic force is exerted on the ball valve 2. Thus, the operation point of the bellows valve, i.e. the pressure control point of the suction chamber, can be changed according to the current amount supplied to the electromagnetic actuator 3.

[0006] However, in the displacement control valve shown in Fig. 7, since the ball valve 2 is subject to the discharge chamber pressure, the suction chamber pressure control point changes, as shown in Fig. 8, depending on discharge chamber pressures Pd1, Pd2, Pd3, ... even if the current amount fed to the electromagnetic actuator 3 is constant. Accordingly, the suction chamber pressure control point can not be determined univocally relative to the current amount fed to the electromagnetic actuator 3, so that a control method becomes complicated for optimally controlling the discharge displacement of the compressor.

[0007] According to the structure shown in Fig. 7, there should be an upper limit in suction chamber pressure. For example, in Fig. 8, the suction chamber pressure can not be controlled over 3.7kg/cm^{2}G.

[0008] During the normal running of the vehicle, the pressure in the suction chamber is controlled across 2kg/cm^{2}G so that no problem is raised. On the other hand, during acceleration of the vehicle, the discharge displacement may be reduced for enhancing the acceleration performance. In this case, the discharge displacement is reduced while the pressure in the suction chamber increases. When the pressure in the suction chamber increases up to 3.7kg/cm^{2}G, the discharge displacement is controlled to keep this pressure. Accordingly, depending on the vehicle operating condition, the required minimum displacement can not be achieved to given a serious influence onto the vehicle running performance.

[0009] From DE 197 16 089 A1 a displacement control valve for use in a variable displacement compressor comprising a suction chamber, a crank chamber and a discharge chamber is known. The displacement control valve comprises a valve casing defining a communication passage for communicating the discharge chamber with the crank chamber, a valve member placed in the communication passage, and moving means for moving the valve member. The valve member has a first and second surface. A solenoid chamber is-provided which receives the pressure of the crank chamber as rear pressure against the valve member.

[0010] Therefore, it is an object of the present invention to provide a displacement control valve which makes it possible to determine the suction chamber pressure control point univocally relative to the current amount fed to an electromagnetic actuator and which makes it possible to forcibly keep the required minimum displacement of the variable displacement compressor in the state wherein no current is fed to the electromagnetic actuator.

[0011] Such an object is solved by a displacement control valve according to the independent claim 1.

[0012] Preferred developments are given in the dependent claims.

Fig. 1 is a longitudinal sectional view showing the overall structure of a variable displacement compressor;

Figs. 2A and 2B are longitudinal sectional views of a displacement control valve according to a first embodiment of the present invention, wherein Fig. 2A shows the state of a normal operation of the compressor while Fig. 2B shows the state of the minimum displacement of the compressor;

Fig. 3 is a graph showing a pressure control characteristic of the displacement control valve shown in Figs. 2A and 2B;

Fig. 4 is a longitudinal sectional view of a displacement control valve according to a second embodiment of the present invention;

Fig. 5 is a longitudinal sectional view of a displacement control valve according to a third embodiment of the present invention;

Fig. 6 is a longitudinal sectional view of a displacement control valve according to a fourth embodiment of the present invention; Fig. 7 is a longitudinal sectional view of a conventional displacement control valve; and

Fig. 8 is a graph showing a pressure control characteristic of the displacement control valve shown in Fig. 7.

Description of the Preferred embodiments:

[0013] Referring to Fig. 1, description will at first be made as regards a variable displacement compressor including a displacement control valve according to a first embodiment of the present invention.

[0014] The shown compressor is used for a vehicle air conditioner and comprises a tubular casing 31, a front housing 32 closing one axial end of the casing 31, and a cylinder head 34 attached to the other axial end of the casing 31 via a valve plate assembly 33. The casing 31, the front housing 32 and the cylinder head 34 are fixed together by means of bolts 35.

[0015] The casing 31 is integrally provided with a cylinder block 36 therein. A shaft 37 axially extends at the center of the casing 31. The shaft 37 is rotatably supported by the front housing 32 and the cylinder block 36.

[0016] A pulley 38 is rotatably supported on the front housing 32. The pulley 38 is driven by an engine of the vehicle. A ring-shaped armature 41 is supported on an outer end of the shaft 37 via a rubber member 39 so as to be movable axially.

[0017] The armature 41 confronts an axial end surface of the pulley 38 and is controlled to be attached to or detached from the pulley 38 by means of an electromagnetic attracting unit 42. Specifically, when the electromagnetic attracting unit 42 is energized, the armature 41 is attracted and attached to the pulley 38 by an electromagnetic force, so that the torque of the engine is transmitted to the shaft 37. On the other hand, when the energization to the electromagnetic attracting unit 42 is stopped, the armature 41 is detached from the pulley 38 by a restoring force of the rubber member 39, so that the torque of the engine is not transmitted to the shaft 37.

[0018] A crank chamber 43 is defined between the front housing 32 and the cylinder block 36. In the crank chamber 43, a rotor 44 is fixed on the shaft 37. A swash plate 46 is coupled to the rotor 44 via a hinge mechanism 45. The hinge mechanism 45 renders variable an inclination of the swash plate 46 relative to an axis of the shaft 37. The swash plate 46 rotates together with the rotor 44.

[0019] A plurality of pistons 47 engage with peripheral portions of the swash plate 46 via shoes, respectively. The pistons 47 are received in corresponding cylinder bores 48 formed in the cylinder block 36 so as to be axially slidable. When the swash plate 46 rotates, each of the pistons 47 makes a reciprocating motion in the corresponding cylinder bore 48 with a stroke determined by an inclination of the swash plate 46.

[0020] The cylinder head 34 is formed with a suction chamber 51 along its peripheral portion and with a discharge chamber 52 at the center thereof. Between the suction chamber 51 and the discharge chamber 52 is connected a known refrigeration circuit.

[0021] The valve plate assembly 33 is provided with suction holes 53 and discharge holes 54 for establishing communication of the cylinder bores 48 with the suction chamber 51 and the discharge chamber 52, and with valve mechanisms for those holes.

[0022] When the shaft 37 rotates, the pistons 47 make the reciprocating motion in the cylinder cores 48, respectively. Following the reciprocating motion of the pistons 47, refrigerant gas in the refrigeration circuit is sucked into the cylinder bores 48 from the suction chamber 51 and discharged into the refrigeration circuit from the discharge chamber 52.

[0023] The compression displacement of the variable displacement compressor depends on the stroke of the pistons 47 determined by the inclination of the swash plate 46. For controlling the inclination of the swash plate 46, a displacement control valve 10 is further provided in a control valve chamber 55 formed in the cylinder head 34.

[0024] The control valve chamber 55 communicates with the crank chamber 43, the suction chamber 51 and the discharge chamber 52 via passages 56, 57 and 58, respectively. Further, the suction chamber 51 communicates with the crank chamber 43 via a narrow passage 59.

[0025] Referring now to Figs. 2A and 2B in addition, the displacement control valve 10 will be described.

[0026] The displacement control valve 10 adjusts the pressure in the crank chamber 43 so as to control the stroke of the pistons 47. The displacement control valve 10 comprises a valve casing 11 and a bellows 12 disposed in the valve casing 11. The inside of the bellows 12 is under vacuum and provided with a spring.

[0027] The displacement control valve 10 further comprises a guide 13 receiving a lower end (in the figures) of the bellows 12 and disposed in a cavity of the valve casing 11 so as to be movable, a spring 14 for biasing the guide 13 upward (in the figures), an adjusting screw 15 forming a part of the valve casing 11 and adjusting the expansion/ contraction amount of the bellows 12, a transfer rod 16 engaging at its one end with an upper end (in the figures) of the bellows 12 and supported by the valve casing 11 so as to be movable, a valve member 18 engaging with the other end of the transfer rod 16 so as to open/close a communication passage 17 between the discharge chamber 52 and the crank chamber 43 depending on the expansion/contraction of the bellows 12, and an electromagnet assembly comprising an electromagnetic coil 21 and a core 24 for generating an electromagnetic force urging the valve member 18 in a valve closing direction via a plunger 19 and a transfer rod 20. A combination of the electromagnetic coil 21, the core 24, the plunger 19 and the transfer rod 20 is referred to as an externally biasing mechanism.

[0028] The communication passage 17 comprises an inlet portion 17a communicated with the discharge chamber 52 through the passage 58, a plurality of outlet portions 17b communicated with the crank chamber 43 through the passage 56, and an intermediate portion 17c between the inlet portion 17a and the outlet portions 17b. The intermediate portion 17c is formed with a valve seat 17d radially extended.

[0029] The valve member 18 has a first surface 18a facing the valve seat 17d and a second surface 18b facing a rear chamber 25 provided as a recessed portion at the bottom of the core 24. When the first surface 18a rests on the valve seat 17d, the communication passage 17 is closed. When the first surface 18a is apart from the valve seat 17d, the communication passage 17 is opened. The second surface 18b is arranged to receive the pressure of the crank chamber 43 via the rear chamber 25 and a pressure introducing passage 22 which is made to the valve casing 11. Crank chamber pressure receiving areas of the first surface and the second surfaces 18a and 18b are set equal to each other when the first surface 18a of the valve member 18 rests on the valve seat. Further, a circumference surface 18c of the valve member 18 is supported by the valve casing 11 so as to be movable with a gap therebetween set to be minimum.

[0030] The valve casing 11 has a plurality of lateral holes 11a. The adjusting screw 15 has a through hole 15a. Each of the lateral holes 11a and the through hole 15a communicates the cavity of the valve casing 11 with the suction chamber 51 through the passage 57 and the control valve chamber 55. Therefore, the cavity of the valve casing 11 is subjected to the pressure of the suction chamber 51.

[0031] Referring now to Fig. 3 in addition, the description will be made as regards an operation of the displacement control valve 10.

[0032] Since no electromagnetic force is generated in the state where the electromagnetic coil 21 is not energized, there is no force urging the valve member 18 in the valve closing direction in a pressure balanced state. Thus, although the bellows 12 is contracted when the pressure in the suction chamber 51 is high, since the valve member 18 is biased upward (in the figures) by means of the spring 14, the valve member 18 is constantly opened. If the compressor is activated in this state, the gas in the discharge chamber 52 is constantly introduced into the crank chamber 43 to increase a pressure differential between the crank chamber 43 and the suction chamber 51, so that the compressor is kept at the minimum displacement.

[0033] The biasing force of the spring 14 is set to be small, for example, smaller than an electromagnetic force generated by a current value i0(A) supplied to the electromagnetic coil 21. Thus, the valve member 18 can be closed in a current region of i0(A) or greater.

[0034] Assuming that the compressor is activated in the state where the pressures are balanced under 6kg/cm^{2}G and that the current amount supplied to the electromagnetic coil 21 is adjusted to a current value i3(A) for controlling the pressure in the suction chamber 51 to be 2kg/cm^{2}G, since an electromagnetic force generated by the electromagnetic coil 21 is greater than the biasing force of the spring 14, the valve member 18 is closed. Thus, the pressure in the crank chamber 43 is lowered to be equal to the pressure in the suction chamber 51. Therefore, the compressor is kept at the maximum displacement, and the pressure in the suction chamber 51 is gradually lowered. As the pressure in the suction chamber 51 is lowered, the bellows 12 is expanded to cause a lower end (in the figures) of the guide 13 to abut the adjusting screw 15, so that a function of the spring 14 is lost. At this time, the pressure in the crank chamber 43 applied to the valve member 18 is canceled at the sides of the first and the second surfaces 18a and 18b, and the pressure in the discharge chamber 52 does not work in an axial direction of the valve member 18. Accordingly, the valve member 18 is open/close controlled depending on the electromagnetic force and the pressure in the suction chamber 51 applied to the bellows 12. Specifically, when the pressure in the suction chamber 51 is lowered to 2kg/cm^{2}G, the bellows 12 is expanded to move the valve member 18 in a valve opening direction. Therefore, the gas in the discharge chamber 52 is introduced into the crank chamber 43 to increase a pressure differential between the crank chamber 43 and the suction chamber 51, so that the discharge displacement is reduced. Following this, when the pressure in the suction chamber 51 increases, the bellows 12 is contracted to move the valve member 18 in the valve closing direction. Accordingly, the pressure in the crank chamber 43 is lowered to reduce a pressure differential between the crank chamber 43 and the suction chamber 51, so that the discharge displacement increases.

[0035] In this fashion, the opening degree of the valve member 18 is adjusted to converge the pressure in the suction chamber 51 to a given value, so that the discharge displacement is controlled. Accordingly, as shown in Fig. 3, the pressure control point of the suction chamber 51 is univocally determined by a value of current supplied to the electromagnetic coil 21. If the current value is set to be zero in this state, the bellows 12 is expanded to cause the valve member 18 to be fully open. Thus, since a pressure differential between the crank chamber 43 and the suction chamber 51 highly increases, the minimum displacement is realized. Even if this increases the pressure in the suction chamber 51 up to greater than 3.5kg/cm^{2}G in Fig. 3 to contract the bellows 12, since the valve member 18 is urged upward (in the figures) by the spring 14 to be constantly opened, the compressor is kept at the minimum displacement.

[0036] Turning to Fig. 4, the description will be directed to a displacement control valve according to a second embodiment of the present invention. Similar parts are designated by like reference numerals. In the displacement control valve, the pressure introducing passage 22 is made to penetrate the valve member 18 in the upward and downward direction of the figure.

[0037] Turning to Fig. 5, the description will be directed to a displacement control valve according, to a third embodiment of the present invention. Similar parts are designated by like reference numerals. In the displacement control valve, the valve member 18 is slidably fitted in the intermediate portion 17c of the communication passage 17. In the manner known in the art, the inlet portion 17a of the communication passage 17 is opened or closed in response to movement of the valve member 18 in the upward and downward direction in the figure.

[0038] Turning to Fig. 6, the description will be directed to a displacement control valve according to a fourth embodiment of the present invention. Similar parts are designated by like reference numerals. Also in the displacement control valve, the pressure introducing passage 22 is made to penetrate the valve member 18 in the upward and down ward direction of the figure.

[0039] While the present invention has thus far been described in connection with a few embodiments thereof, it will readily be possible for those skilled in the art to put this invention into practice in various other manners. For example, the bellows may expands/contracts in response to a pressure in at least one of the suction chamber and the crank chamber.

Claims

1. A displacement control valve (10) for use in a variable displacement compressor comprising a suction chamber (51), a crank chamber (43), and a discharge chamber (52),
said displacement control valve (10) comprising:

    a valve casing (11) defining a communication passage (17) for communicating said discharge chamber (52) with said crank chamber (43) to conduct gas from said discharge chamber (52) to said crank chamber (43),
    a valve member (18) placed in said communication passage (17) and movable along said communication passage (17) in a predetermined direction for adjusting a substantial opening degree of said communication passage (17), and
    moving means (12, 16, 19, 20, 21, 24) for moving said valve member (18) in said predetermined direction,
    said valve member having a first surface (18a) controlling the passage opening and a second surface (18b) facing a rear chamber (25) as a recessed portion at the bottom of a core (24)

    characterized by :
    pressure applying means (22) for applying gas pressure to said first and said second surfaces (18a, 18b) in common.

2. A displacement control valve as claimed in claim 1, wherein said communication passage (17) has said valve seat (17d) facing said valve member (18) in said predetermined direction, said communication passage (17) being closed when said valve member (18) rests on said valve seat (17d), said communication passage (17) being opened when said valve member (18) is apart from said valve seat (17d), said first and said second surfaces (18a, 18b) have pressure receiving areas which are substantially equal to each other for receiving said gas pressure when said valve member (18) rests on said valve seat (17d).

3. A displacement control valve as claimed in claim 1 or 2, wherein said valve member (18) is fitted in said communication passage (17) to be slidable in said predetermined direction, said communication passage (17) being opened or closed in response to movement of said valve member (18) in said predetermined direction.

4. A displacement control valve as claimed in anyone of claims 1-3, wherein said communication passage (17) has an inlet portion (17a) for communicating with said discharge chamber (52), an outlet portion (17b) for communicating with said crank chamber (43), and an intermediate portion (17c) therebetween, said valve member (18) being placed in said intermediate portion (17c) so as to direct said first surface (18a) towards said outlet portion (17b) of the communication passage (17) said pressure applying means (22) having a pressure introducing passage (22) which is connected to said outlet portion (17b) and is for applying gas pressure in said outlet portion (17b) to said second surface (18b).

5. A displacement control valve as claimed in claim 4, wherein said pressure introducing passage (22) is made in said valve casing (11).

6. A displacement control valve as claimed in claim 4, wherein said pressure introducing passage (22) is made in said valve member (18).

7. A displacement control valve as claimed in anyone of claims 1-6, wherein said moving means comprises a pressure sensitive member (12) contained in said valve casing (11) for causing deformation thereof in response to a pressure in at least one of said suction chamber (51) and said crank chamber (43) to urge said valve member (18) in a valve opening direction, and an externally biasing mechanism (19, 20, 21) coupled to said valve casing (11) for generating a biasing force in response to an external signal to apply said biasing force to said valve

member (18) in a valve closing direction, said pressure sensitive member (12) is movable in said predetermined direction, said displacement control valve (10) further comprising a spring (14) disposed between said pressure sensitive member (12) and said valve casing (11) for urging said pressure sensitive member (12) in said valve opening direction.

Patentansprüche

1. Verdrängungssteuerventil (10) zur Verwendung in einem Kompressor mit variabler Verdrängung, der eine Ansaugkammer (51) aufweist, eine Kurbelkammer (43) und eine Auslaßkammer (52),

   wobei das Verdrängungssteuerventil (10) aufweist:

   ein Ventilgehäuse (11), das einen Verbindungsdurchlaß (17) zur Verbindung der Auslaßkammer (52) mit der Kurbelkammer (43) bildet, um Gas von der Auslaßkammer (52) zur Kurbelkammer (43) zu leiten,
   ein Ventilbauteil (18), das in dem Verbindungsdurchlaß (17) angeordnet und entlang des Verbindungsdurchlasses (17) in einer vorbestimmten Richtung bewegbar ist, zur Einstellung eines wesentlichen Öffnungsgrades des Verbindungsdurchlasses (17), und
   eine Bewegungsvorrichtung (12, 16, 19, 20, 21, 24) zur Bewegung des Ventilbauteils (18) in die vorbestimmte Richtung,
   wobei das Ventilbauteil eine erste Oberfläche (18a) hat, die die Durchlaßöffnung steuert, und eine zweite Oberfläche (18b), die einer hinteren Kammer (25) als ein Ausnehmungsabschnitt am Boden eines Kerns (24) gegenüberliegt,

   gekennzeichnet durch,
   eine Druckaufbringungsvorrichtung (22) zur gemeinsamen Aufbringung eines Gasdruckes auf die ersten und zweiten Oberflächen (18a, 18b).

2. Verdrängungssteuerventil gemäß Anspruch 1, wobei der Verbindungsdurchlaß (17) den Ventilsitz (17d) besitzt, der dem Ventilbauteil (18) in der vorbestimmten Richtung gegenüberliegt, wobei der Verbindungsdurchlaß (17) geschlossen wird, wenn das Ventilbauteil (18) auf dem Ventilsitz (17d) verbleibt, wobei der Verbindungsdurchlaß (17) geöffnet wird, wenn das Ventilbauteil (18) von dem Ventilsitz (17d) entfernt ist, wobei die ersten und zweiten Oberflächen (18a, 18b) Druckaufnahmeflächen haben, die im wesentlichen zueinander gleich sind, um den Gasdruck aufzunehmen, wenn das Ventilbauteil 818) auf dem Ventilsitz (17d) verbleibt.

3. Verdrängungssteuerventil gemäß Anspruch 1 oder 2, wobei das Ventilbauteil (18) in dem Verbindungsdurchlaß (17) eingepaßt ist, um in der vorbestimmten Richtung verschiebbar zu sein, wobei der Verbindungsdurchlaß (17) in Reaktion auf die Bewegung des Ventilbauteils (18) in der vorbestimmten Richtung geöffnet oder geschlossen wird.

4. Verdrängungssteuerventil gemäß einem der Ansprüche 1 bis 3, wobei der Verbindungsdurchlaß (17) einen Einlaßabschnitt (17a) zur Verbindung mit der Auslaßkammer (52) hat, einen Auslaßabschnitt (17b) zur Verbindung mit der Kurbelkammer (43), und einen Zwischenabschnitt (17c) dazwischen, wobei das Ventilbauteil (18) in dem Zwischenabschnitt (17c) angeordnet ist, um die erste Oberfläche (18a) auf den Auslaßabschnitt (17b) des Verbindungsdurchlasses (17) zu richten, wobei die Druckaufbringungsvorrichtung (22) einen Druckeinführungsdurchlaß (22) besitzt, der mit dem Auslaßabschnitt 17b verbunden ist und zur Aufbringung eines Gasdruckes in dem Auslaßabschnitt (17b) auf die zweite Oberfläche (18b) dient.

5. Verdrängungssteuerventil gemäß Anspruch 4, wobei der Drukkeinführdurchlaß (22) in dem Ventilgehäuse (11) hergestellt ist.

6. Verdrängungssteuerventil gemäß Anspruch 4, wobei der Drukkeinführdurchlaß (22) in dem Ventilbauteil (18) hergestellt ist.

7. Verdrängungssteuerventil gemäß einem der Ansprüche 1 bis 6, wobei die Bewegungsvorrichtung ein Druckfühlbauteil (12) aufweist, das in dem Ventilgehäuse (11) enthalten ist, um eine Deformation davon in Reaktion auf einen Druck in wenigstens einer Kammer der Ansaugkammer (51) und der Kurbelkammer (43) hervorzurufen, um das Ventilbauteil (18) in eine Ventilöffnungsrichtung zu drängen, und einen externen Vorspannmechanismus (19, 20, 21), der mit dem Ventilgehäuse (11) gekoppelt ist, um eine Vorspannkraft in Reaktion auf ein externes Signal zu erzeugen, um die Vorspannkraft auf das Ventilbauteil (18) in eine Ventilschließrichtung aufzubringen, wobei das Druckfühlbauteil (12) in der vorbestimmten Richtung bewegbar ist, wobei das Verdrängungssteuerventil (10) des weiteren eine Feder (14) aufweist, die zwischen dem Druckfühlbauteil (12) und dem Ventilgehäuse (11) angeordnet ist, um das Druckfühlbauteil (12) in die Ventilöffnungsrichtung zu drängen.

Revendications

1. Soupape de commande de déplacement (10) destinée à être utilisée dans un compresseur à capacité variable comprenant une chambre d'aspiration

(51), une chambre de manivelle (43) et une chambre de décharge (52),
cette soupape de commande de déplacement (10) comprenant :

un carter de soupape (11) définissant un passage de communication (17) pour faire communiquer la chambre de décharge (52) avec la chambre de manivelle (43) de manière à conduire le gaz de la chambre de décharge (52) vers la chambre de manivelle (43),
un élément de soupape (18) placé dans le passage de communication (17) et pouvant se déplacer le long de ce passage de communication (17) dans une direction prédéterminée, pour régler un degré d'ouverture important du passage de communication (17), et
des moyens de déplacement (12, 16, 19, 20, 21, 24) pour déplacer l'élément de soupape (18) dans la direction prédéterminée,
cet élément de soupape comportant une première surface (18a) commandant l'ouverture du passage et une seconde surface (18b) venant en face d'une chambre arrière (25) réalisée sous la forme d'une partie en creux dans le fond d'un noyau (24),

caractérisée par
un moyen d'application de pression (22) pour appliquer la pression de gaz en commun à la première surface (18a) et à la seconde surface (18b).

2. Soupape de commande de déplacement selon la revendication 1,
dans laquelle
le passage de communication (17) comporte le siège de soupape (17d) venant en face de l'élément de soupape (18) dans la direction prédéterminée, le passage de communication (17) étant fermé lorsque l'élément de soupape (18) repose sur le siège de soupape (17d), le passage de communication (17) étant ouvert lorsque l'élément de soupape (18) est écarté du siège de soupape (17d), la première surface (18a) et la seconde surface (18b) comportant des surfaces de réception de pression qui sont essentiellement égales l'une à l'autre, pour recevoir la pression de gaz lorsque l'élément de soupape (18) repose sur le siège de soupape (17d).

3. Soupape de commande de déplacement selon la revendication 1 ou 2,
dans laquelle
l'élément de soupape (18) est adapté dans le passage de communication (17) pour pouvoir glisser dans la direction prédéterminée, ce passage de communication (17) étant ouvert ou fermé en réponse au mouvement de l'élément de soupape (18) dans la direction prédéterminée.

4. Soupape de commande de déplacement selon l'une quelconque des revendications 1 à 3,
dans laquelle
le passage de communication (17) comporte une partie d'entrée (17a) destinée à communiquer avec la chambre de décharge (52), une partie de sortie (17b) destinée à communiquer avec la chambre de manivelle (43), et une partie intermédiaire (17c) entre les deux, l'élément de soupape (18) étant placé dans la partie intermédiaire (17c) de manière à diriger la première surface (18a) vers la partie de sortie (17b) du passage de communication (17), le moyen d'application de pression (22) comportant un passage d'introduction de pression (22) qui est relié à la partie de sortie (17b) et sert à appliquer la pression de gaz régnant dans la partie de sortie (17b), à la seconde surface (18b).

5. Soupape de commande de déplacement selon la revendication 4,
dans laquelle
le passage d'introduction de pression (22) est formé dans le carter de soupape (11).

6. Soupape de commande de déplacement selon la revendication 4,
dans laquelle
le passage d'introduction de pression (22) est formé dans l'élément de soupape (18).

7. Soupape de commande de déplacement selon l'une quelconque des revendications 1 à 6,
dans laquelle
le moyen de déplacement comprend un élément sensible à la pression (12) contenu dans le carter de soupape (11) de façon qu'on obtienne une déformation de celui-ci en réponse à la pression régnant dans l'une au moins de la chambre d'aspiration (51) et de la chambre de manivelle (43), de manière à pousser l'élément de soupape (18) dans une direction d'ouverture de la soupape, et un mécanisme de poussée extérieur (19, 20, 21) couplé au carter de soupape (11) pour générer une force de poussée en réponse à un signal extérieur, de manière à appliquer la force de poussée à l'élément de soupape (18) dans une direction de fermeture de la soupape, l'élément sensible à la pression (12) pouvant se déplacer dans la direction prédéterminée et la soupape de commande de déplacement (10) comprenant en outre un ressort (14) disposé entre l'élément sensible à la pression (12) et le carter de soupape (11), pour pousser cet élément sensible à la pression (12) dans la direction d'ouverture de la soupape.

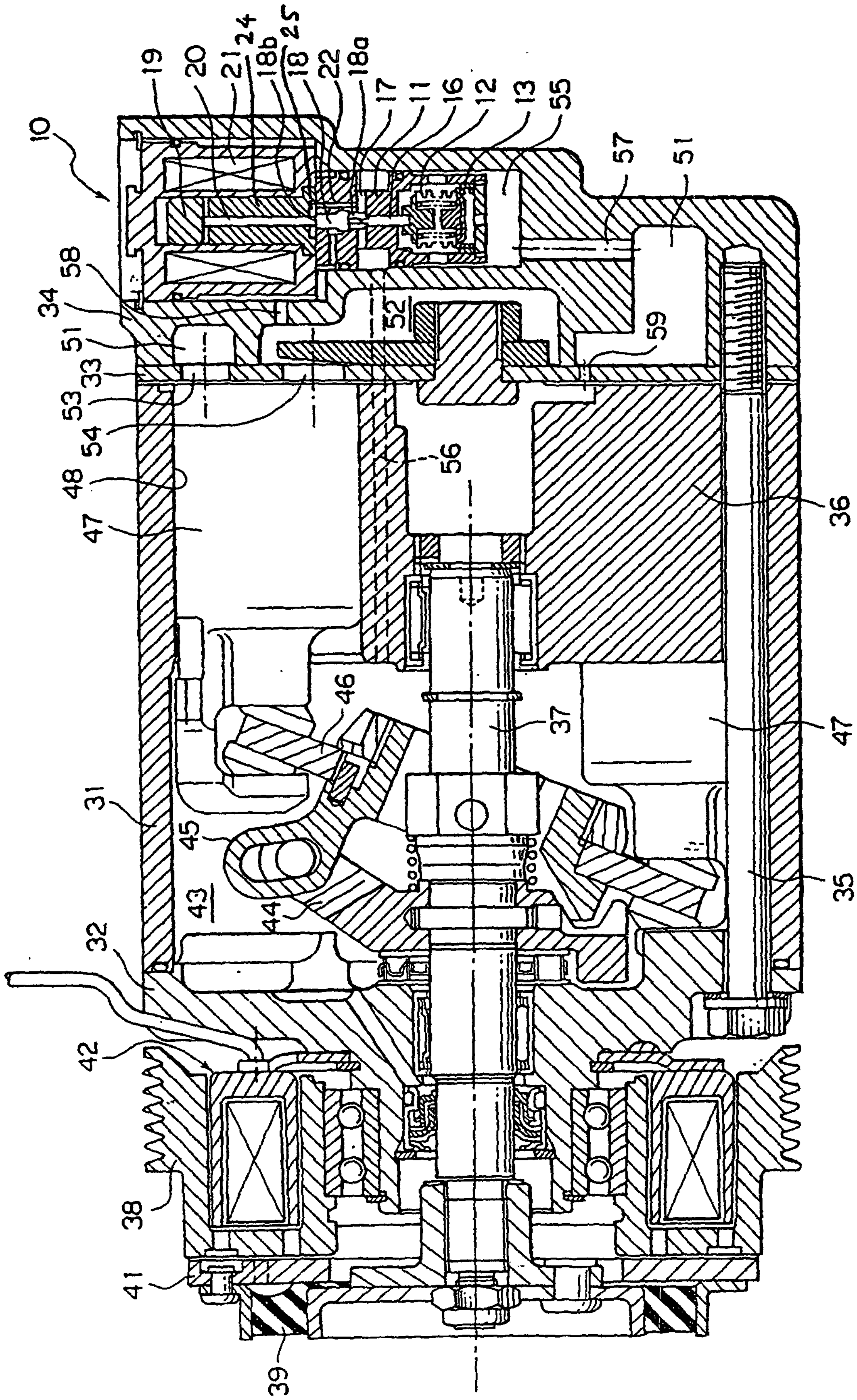

10
19
20
21
24
18b
25
18
22
18a
17
11
16
12
13
55
57
51
58
34
51
33
53
54
52
59
56
48
47
36
46
37
47
31
45
43
44
35
32
42
38
41
39

FIG. 1

FIG. 2A

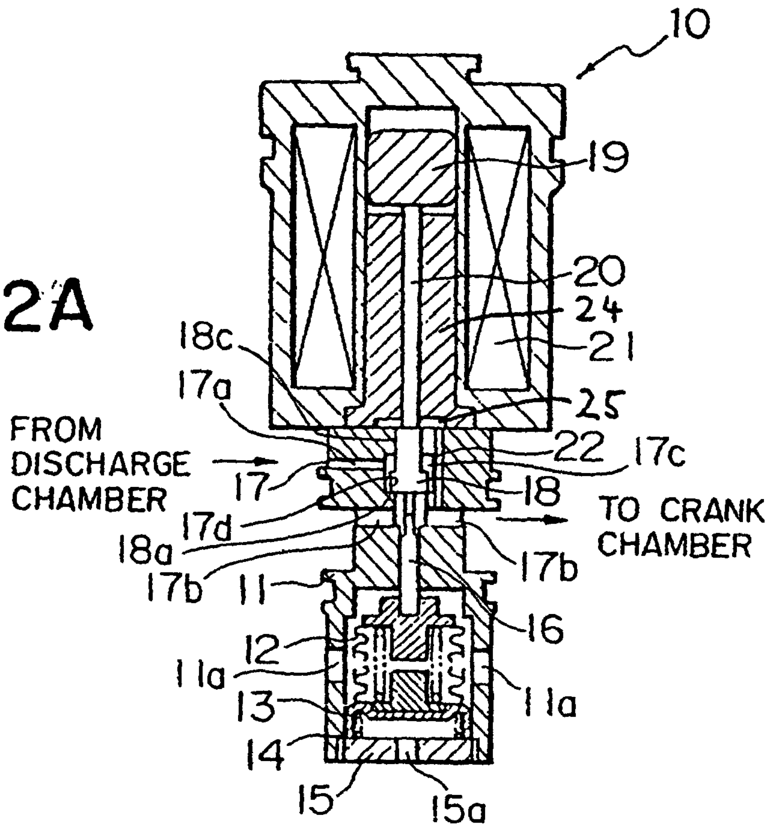
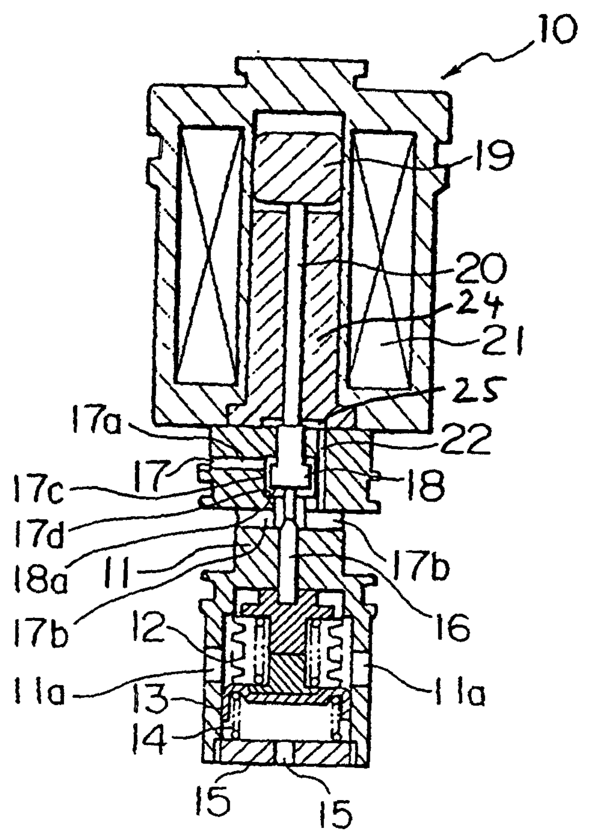

10
19
20
24
21
18c
25
17a
22
17c
FROM
DISCHARGE
CHAMBER
17
18
17d
TO CRANK
CHAMBER
18a
17b
17b
11
16
12
11a
11a
13
14
15
15a

FIG. 2B


10
19
20
24
21
25
17a
22
17
18
17c
17d
17b
18a
11
16
17b
12
11a
11a
13
14
15
15

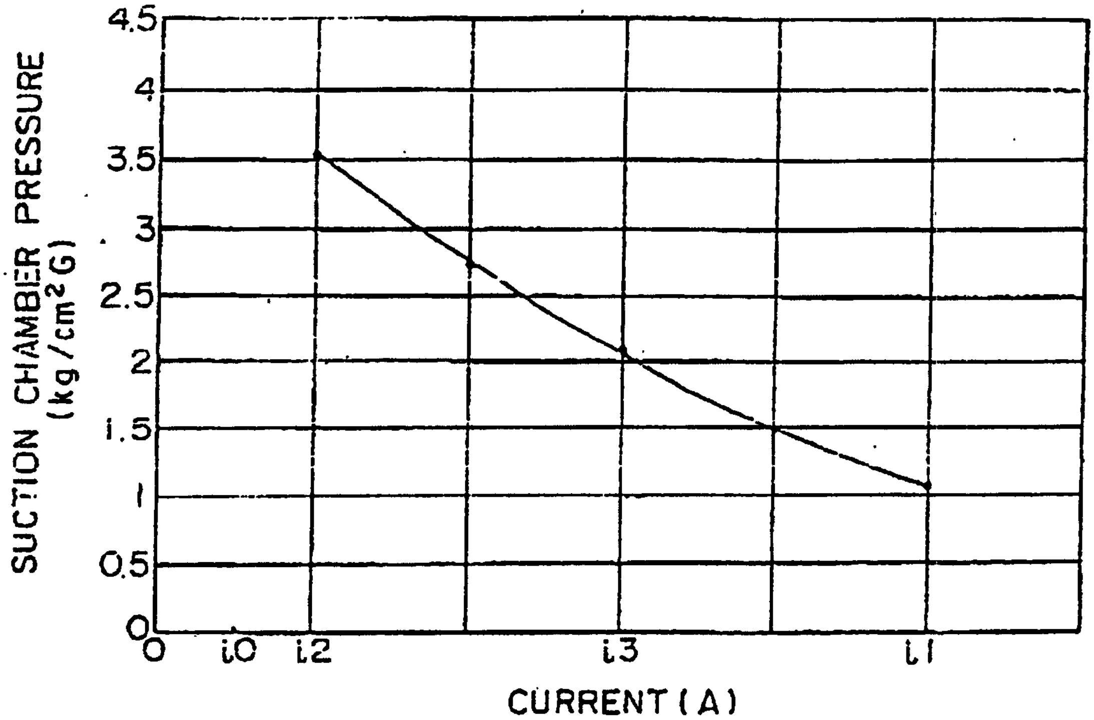

SUCTION CHAMBER PRESSURE (kg/cm²G)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
i0
i2
i3
i1
CURRENT (A)

FIG. 3

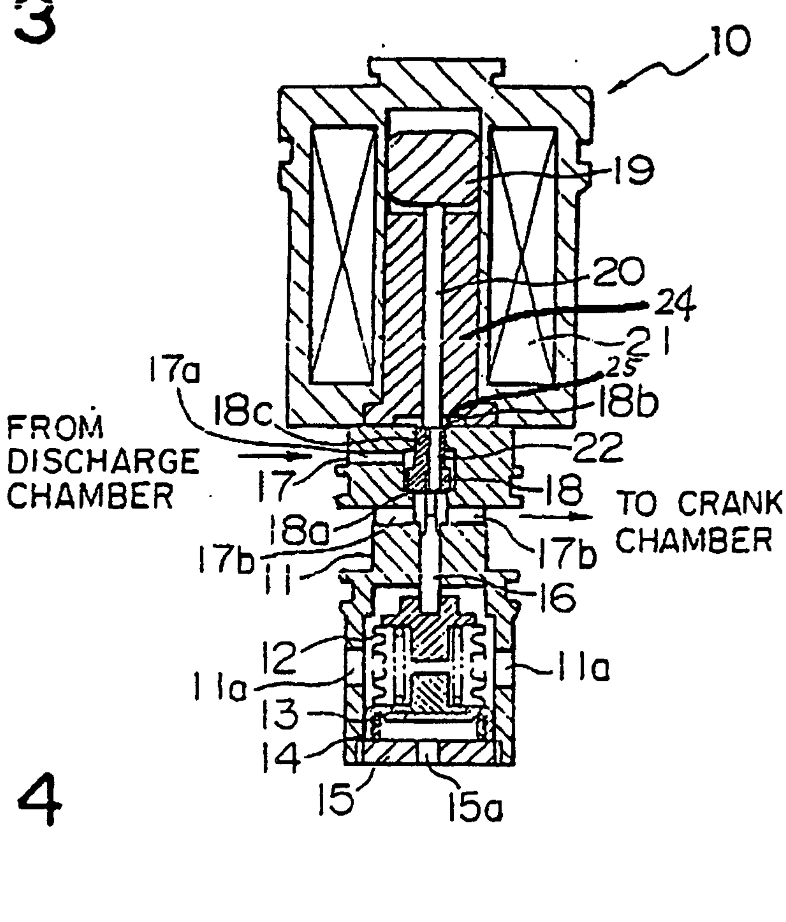

10
19
20
24
21
25
18b
17a
18c
FROM DISCHARGE CHAMBER
22
17
18
TO CRANK CHAMBER
18a
17b
11
17b
16
12
11a
11a
13
14
15
15a

FIG. 4

FIG. 5

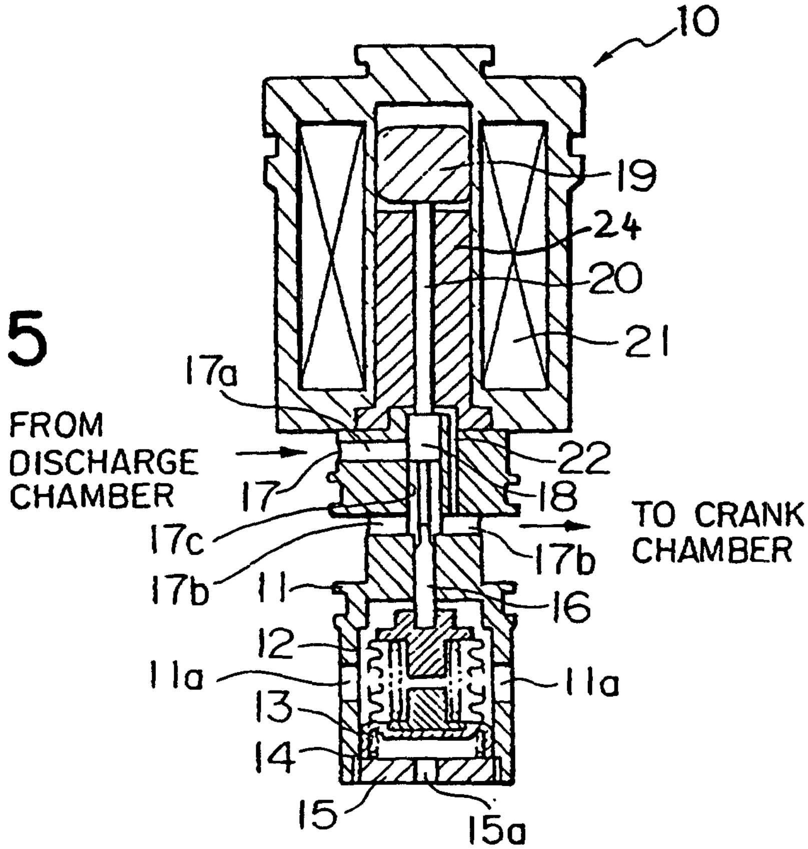
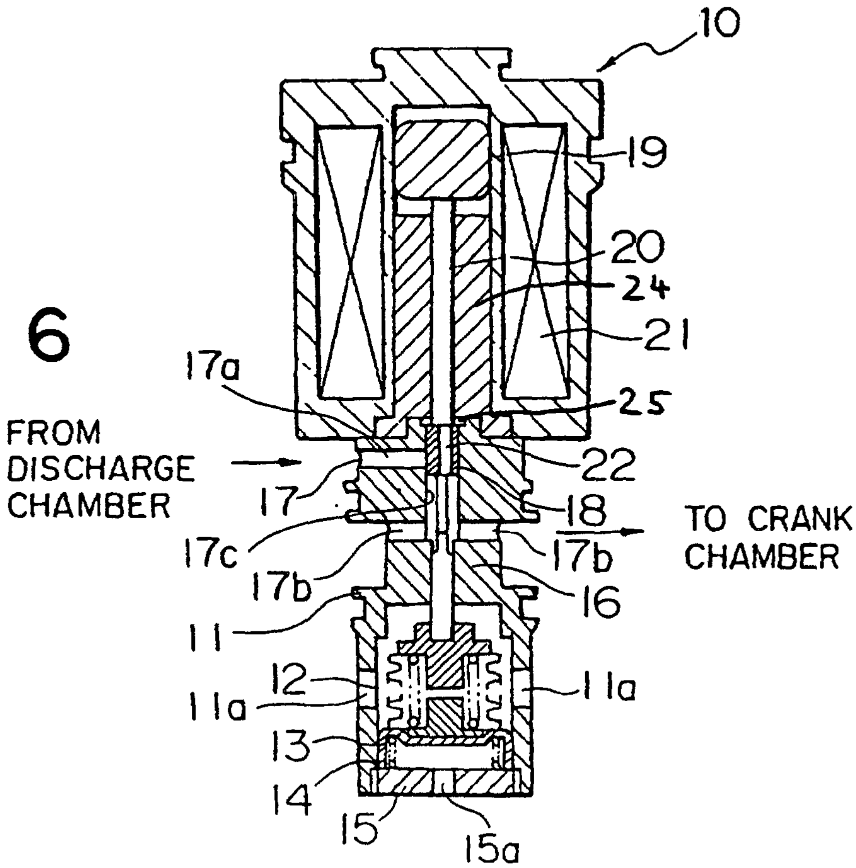

10
19
24
20
21
17a
FROM
DISCHARGE
CHAMBER
22
17
18
17c
TO CRANK
CHAMBER
17b
17b
11
16
12
11a
11a
13
14
15
15a

FIG. 6


10
19
20
24
21
17a
25
FROM
DISCHARGE
CHAMBER
22
17
18
TO CRANK
CHAMBER
17c
17b
17b
16
11
12
11a
11a
13
14
15
15a

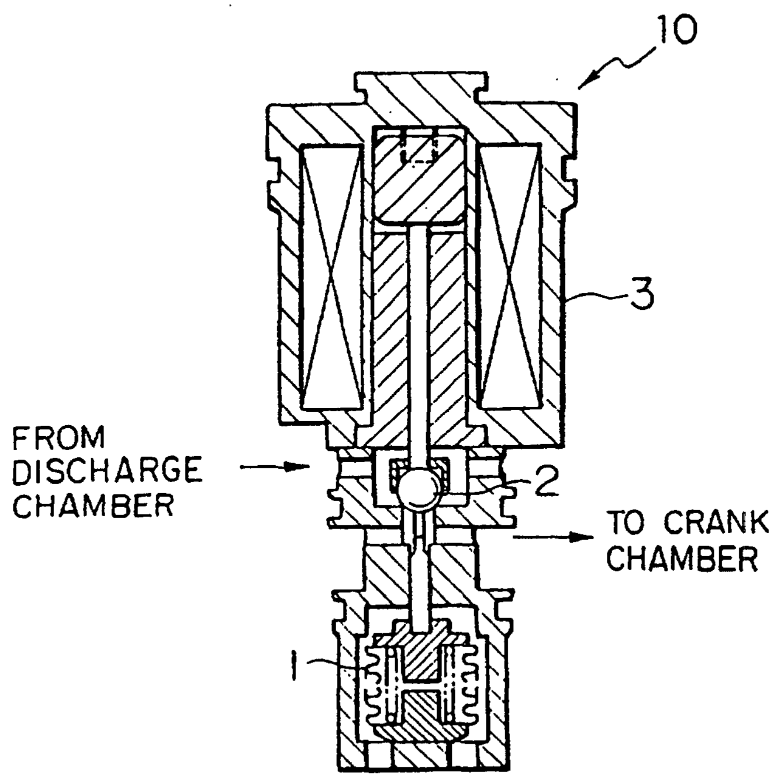


FIG. 7 PRIOR ART

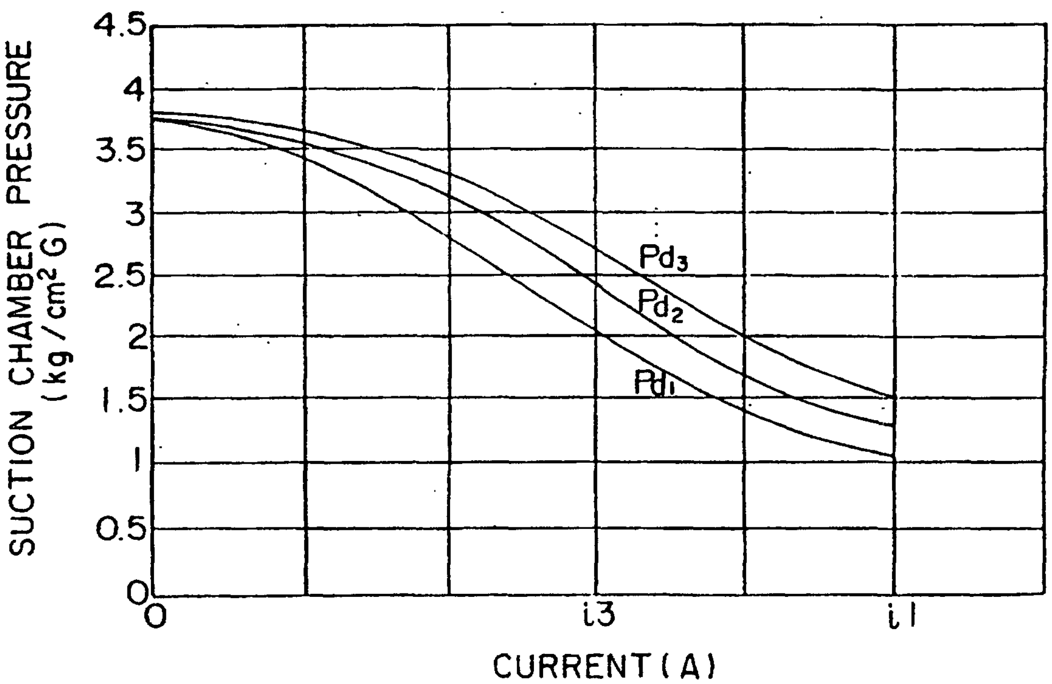


FIG. 8 PRIOR ART