L. A. LAURSEN.

HYDRAULIC MOTOR.

APPLICATION FILED APR. 12, 1913.

1,116,083.

Patented Nov. 3, 1914.

2 SHEETS—SHEET 1.

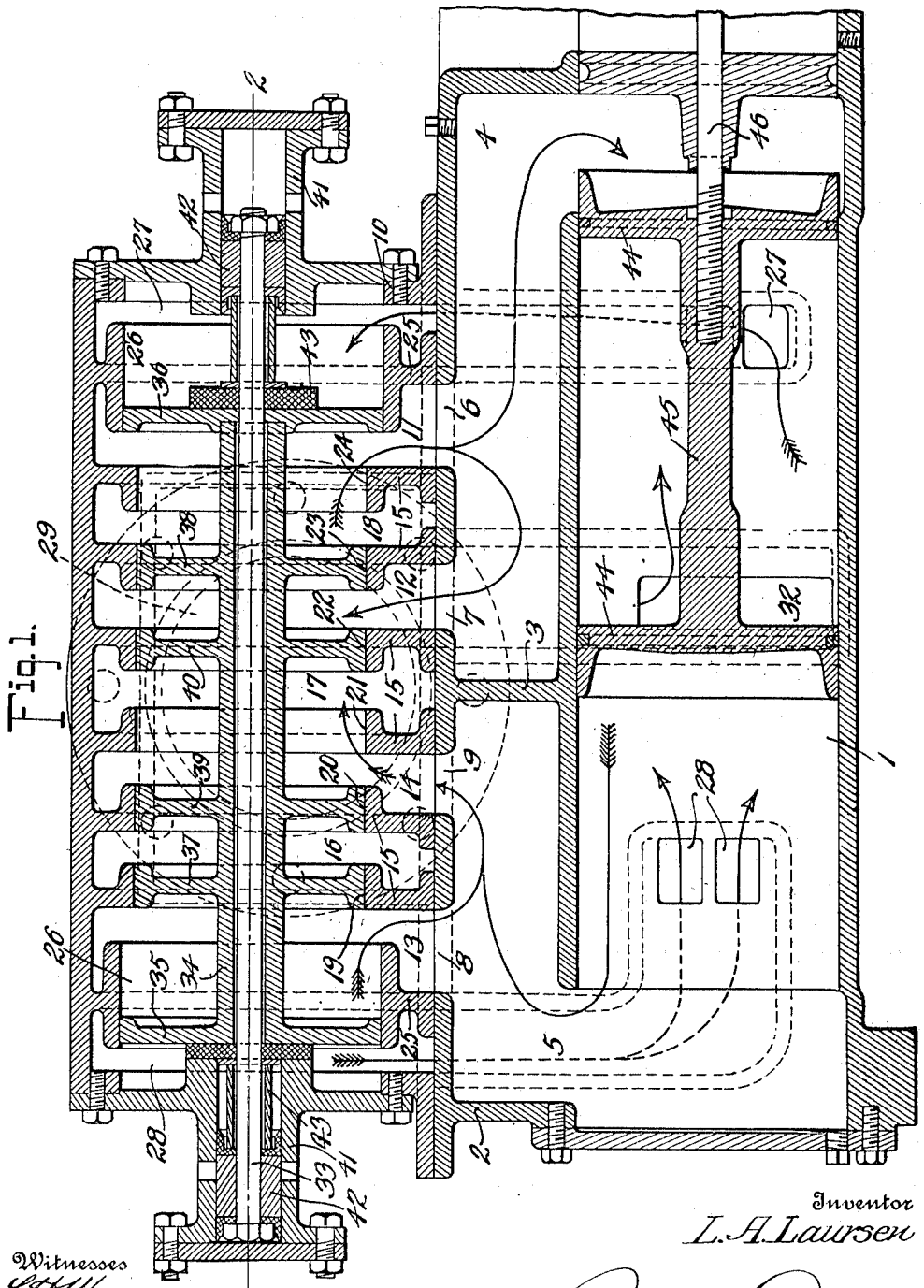

Fig. 1.

Witnesses

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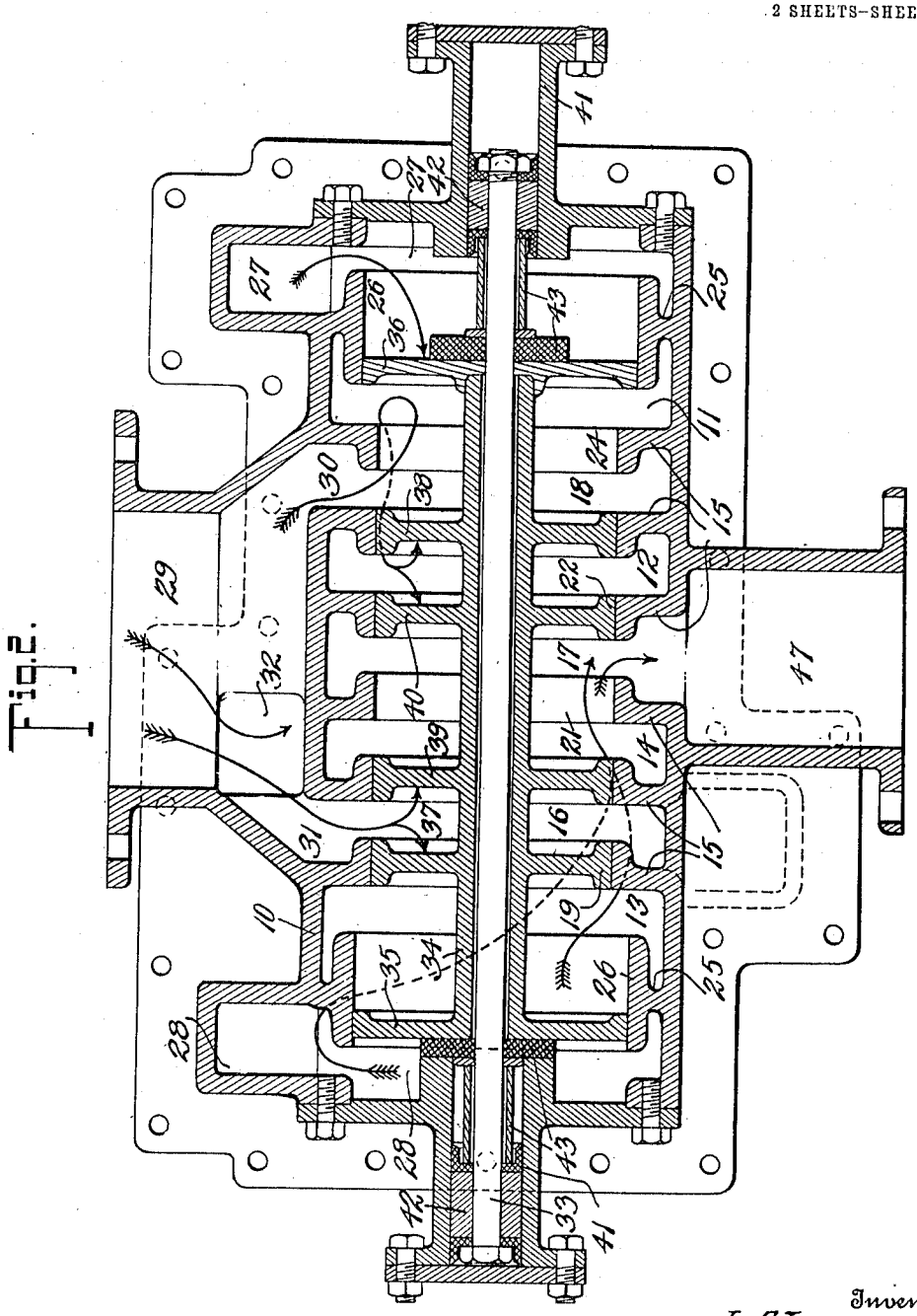
Fig. 2.



Witnesses

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UNITED STATES PATENT OFFICE.

LAURITS A. LAURSEN, OF EAU CLAIRE, WISCONSIN.

HYDRAULIC MOTOR.

1,116,083. Specification of Letters Patent. Patented Nov. 3, 1914.

Application filed April 12, 1913. Serial No. 760,769.

To all whom it may concern:

Be it known that I, LAURITS A. LAURSEN, a citizen of the United States, residing at Eau Claire, in the county of Eau Claire and State of Wisconsin, have invented certain new and useful Improvements in Hydraulic Motors, of which the following is a specification.

This invention relates to improvements in hydraulic motors, and the primary object in view is the simplification of the motor structure.

A further and more detail object in view is the effective control of direct pressure for actuating a reciprocating piston, the control being effected through the employment of a single valve structure.

With these and further objects in view, as will in part hereinafter become apparent and in part be stated, the invention comprises a cylinder, a piston reciprocally mounted therein, means for supplying water under pressure to said cylinder, and a single control valve disposed between the source of supply and the cylinder for automatically controlling the delivery of pressure alternately to opposite ends of the cylinder.

The invention comprises certain other novel constructions, combinations and arrangements of parts as will be hereinafter specified and claimed.

In the accompanying drawing:—Figure 1 is a longitudinal, vertical, central section through a hydraulic motor involving the features of the present invention. Fig. 2 is a longitudinal horizontal section taken on the plane indicated by line 2—2 of Fig. 1.

Referring to the drawing by numerals, 1 indicates a cylinder having open ends and inclosed by a housing 2. A partition 3 is arranged within the housing and outside of the cylinder so as to divide the space inclosed by the housing into intake and exhaust areas 4 and 5 each communicating with its respective open end of cylinder 1. The area 4 is formed with intake and exhaust apertures 6 and 7 and the area 5 is formed with similar apertures 8 and 9, the said apertures 6, 7, 8 and 9 being preferably formed in the uppermost portion of the wall of the housing 2, and surmounted on said wall is a valve housing or casing 10 which is formed with chambers 11, 12, 13 and 14 registering with the respective apertures 6, 7, 8 and 9. The casing 10 is formed with a series of partitions 15 forming the chambers 11, 12, 13 and 14, and also forming chambers 16, 17 and 18, each partition 15 being formed with a preferably annular valve seat indicated at 19, 20, 21, 22, 23 and 24. Adjacent each end of the casing 10 the casing is formed with a partition 25, each partition 25 being formed with an elongated, cylindrical valve seat 26, the valve seat 26 at the right hand end of the casing as seen in Fig. 1 opening into a port 27 and the corresponding valve seat, seen at the opposite end of the casing, opening into a port 28, the port 27 extending laterally outside of the casing 10 and housing 2 down to and communicating with the cylinder 1 at a point adjacent the right hand end of the cylinder. The port 28 is similarly arranged and similarly communicates with the cylinder 1 adjacent the left hand end thereof. As best seen in Fig. 2, an intake or supply pipe 29 communicates with the casing 10 through ports 30 and 31, the port 30 communicating with the chamber 18 and the port 31 communicating with the chamber 16. A port 32 also leads from the intake 29 downwardly outside of the casing 10 and housing 2 and communicates with the cylinder 1 substantially midway between the ends thereof.

Arranged within the casing 10 is a controlling piston valve which consists of a supporting rod or shaft 33 which sustains a sleeve 34 on which are mounted pistons 35, 36, 37, 38, 39, and 40, the several pistons 37, 38, 39 and 40 being of the same diameter and adapted to snugly fit in the several seats 24, 23, 19, 22, 20 and 21. The pistons 35 and 36 are slidingly mounted in the respective seats 26, each of the latter valves being of greater diameter than the pistons 37, 38, 39 and 40 but each being preferably of the same diameter as the other. As a means of preventing lateral play during reciprocal movement of the valve, outstanding cylinders 41 are preferably provided at the ends of the casing 10, and pistons 42 are slidingly arranged therein and are engaged by the respective ends of the shaft 33, suitable bushings 43 being arranged between the respective pistons 42 and adjacent piston 35 or 36.

It is to be observed that each of pistons 35, 36 is of less width at its periphery than the width of any one of the pistons 37, 38,

39 and 40 at its periphery, and each cylindrical valve seat 26 is of a length sufficient for permitting its respective piston to remain therein while the entire valve structure is reciprocating a distance sufficient for moving the several intermediate pistons from one seated position to the next seated position in the adjacent seats. It will also be observed that the width of each of the intermediate pistons 37, 38, 39 and 40 at its periphery is slightly greater than the width of any one of the chambers opening between the several intermediate valve seats 19, 20, 21, 22, 23 and 24.

Arranged within the cylinder 1 is a reciprocating piston which is of the double-headed type and formed with spaced heads 44, 44 connected by a piston shaft 45. A shaft 46 engages the piston within cylinder 1 and extends thence to any preferred type of pumping apparatus. The port 27 is spaced from port 32 a distance equal to the distance of the spacing from port 32 to port 28, and the inner faces of the pistons 44 are spaced apart a distance somewhat greater than the distance between the port 32 and either of the ports 27 or 28 so that at times port 32 communicates with port 27 through the cylinder 1 and between the pistons 44 while at other times the port 28 communicates with port 32 in the same manner.

In the operation of the structure described, assuming the parts to be in the position indicated in the drawing, the piston in the cylinder 1 having arrived at the extreme of its movement toward the right and the controlling valve having shifted to a position for effecting the return stroke of the piston, water under pressure is admitted through the supply 29, port 30, intermediate chamber 18, the area surrounded by valve seat 24, chamber 11, and apertures 6 to the area 4 and thence into contact with the right face of the piston head 44. At the same time the water is free to exhaust from the opposite end of cylinder 1 through aperture 9, chamber 14, the area surrounded by valve seat 21, chamber 17, to the exhaust pipe 47. It will be noted that the port 28 exhausts into cylinder 1 and that the cylinder 26 for piston 35 exhausts through chamber 13 and aperture 8 into the area 5. At the same time water is supplied under pressure through port 32 to the cylinder 1 between the piston heads and thence up through port 27 to the right hand end of the cylinder 26. There is, therefore, live pressure on both sides of the piston 36. There is also live pressure on both sides of piston 38, the pressure of the water admitted through chamber 18 acting on one side thereof and the pressure of the water admitted from the area 4 up through the aperture 7 and chamber 12 acting on the other side, the latter supply of water also acting on the right hand face of the piston 40. It is noted that the pressure is exhausted from the right hand face of piston 39 and that live pressure is admitted between the pistons 37 and 39 through port 31 and chamber 16. Thus the pressure on the left face of piston 37 is balanced by the pressure on the right face of piston 39, and the pressure on the adjacent faces of piston 38 balances while the pressure on both faces of piston 36 also balances. The pressure between pistons 38, 40, is balanced, and the pressures are otherwise balanced, except that between pistons 38, 36. The pressure upon opposite faces of piston 36 is the same, but there is an excess area upon the left as compared with the right hand face of piston 38, so that piston 36 would tend to move to the right, but this tendency is overcome by the greater area on the right hand side of the piston 36 as compared with this excess, so that the valve remains in the position shown. When piston 44 reaches the left hand limit of its stroke, so as to connect ports 32 and 28, live pressure is admitted upon the full area of the left hand face of piston 35, which of course overcomes the unbalanced pressure above noted, and the valve as a whole moves to the right and is held there, thus reversing the motor.

Under the live pressure acting on the piston in cylinder 1, the said piston will traverse the cylinder toward the left until the right piston head 44 passes the port 27, and then the live pressure enters the port 27 from the area 4 instead of from the port 32, but the effect upon the controlling valve will be the same and the valve will remain in its position as indicated in Fig. 1 as the piston in cylinder 1 continues its movement toward the left. This movement is continued until the piston arrives at the left hand end of the cylinder, in substantially the same relation thereto, with respect to the left hand end, as indicated with respect to the right hand end in the drawing. As the left piston head 44 passes the port 28 water under pressure will be admitted to the port 28 from within the cylinder 1, being supplied through port 32. As this water passes up the port 28 and begins to act upon the piston 35 the controlling valve will begin to move slowly toward the right because the surface of piston 35 which is exposed to the action of the water under pressure is slightly greater than the surface of piston 40 exposed to the active pressure of the water, this relatively slow movement of the valve toward the right continuing until the piston in cylinder 1 has arrived at the limit of its stroke toward the left, at which time the controlling valve will have moved to the right a distance sufficient for causing the

piston 38 to be partly seated in seat 24 while still remaining partly seated in seat 23, thus completely closing the chamber 18, and the valve 40 will be likewise disposed with respect to the port 12 so that the live pressure is cut off from the area 4 and there is therefore no pressure acting on the controlling valve toward the left but there is still live pressure being admitted through the port 32, the cylinder 1 and port 28 to the left side of the piston 35, which pressure then acts to quickly thrust the controlling valve to the extreme of its movement to the right. It is obvious, of course, that during this movement the water contained in the cylinder or cylindrical seat 26 of piston 36 will be exhausted down through the port 27 to the area 4 and out with the exhaust therefrom, the exhaust being open almost instantly after the cutting off of the pressure to the said area and the exhaust being effected through the apertures 7, chamber 12, the area surrounded by valve seat 22, chamber 17 and exhaust pipe 47. The parts are then exactly in the converse position to that of the starting point seen in the drawing and above described, and the unbalanced pressure on the piston 35 will retain the controlling valve in its position at the right of its casing until the piston in cylinder 1 has completed its stroke to the right, when the operation above set forth will be repeated.

Having thus described the invention, what is claimed as new is:—

1. In a hydraulic motor, the combination, with a cylinder and a piston reciprocally mounted therein, of a valve casing communicating with the ends of the cylinder, an intake pipe for the valve casing, an exhaust pipe for the valve casing, a port leading from the intake pipe to an intermediate point in the length of the cylinder, ports leading from terminal portions of the cylinder to terminal portions of the casing, a controlling valve reciprocally mounted in the casing and having a series of pistons thereon, the casing having intake and exhaust ports communicating with the intake and exhaust pipes, and the valve pistons being disposed to control the intake and exhaust relative to the location of the piston within the cylinder for effecting an unbalanced pressure on the valve at each stroke of the piston in an opposite direction to the direction of the travel of the piston for controlling the intake and exhaust of fluid under pressure to and from the cylinder.

2. In a hydraulic motor, the combination, with a cylinder and a piston reciprocally mounted therein, of a valve casing communicating with the ends of the cylinder, an intake pipe for the valve casing, an exhaust pipe for the valve casing, a port leading from the intake pipe to an intermediate point in the length of the cylinder, ports leading from terminal portions of the cylinder to terminal portions of the casing, a controlling valve reciprocally mounted in the casing and having a series of pistons thereon, the casing having intake and exhaust ports communicating with the intake and exhaust pipes, and the valve pistons being disposed to control the intake and exhaust relative to the location of the piston within the cylinder for effecting an unbalanced pressure on the valve at each stroke of the piston in a direction for causing the controlling valve to shift for reversing the admission and exhaust of fluid to and from the cylinder at each terminus of the stroke of the piston.

3. In a hydraulic motor, the combination of a cylinder 1, a housing 2 inclosing the cylinder, a double headed piston 45 reciprocally mounted in the cylinder 1, the heads of the piston being spaced apart, a valve casing 10 communicating with the housing, the housing being formed with a partition 3 dividing the communication of the casing relative to the ends of the cylinder 1, a port 32 extending from an intermediate point of the cylinder 1 to an intermediate point of the valve casing 10, terminal ports 27, 28 leading from end portions of the cylinder 1 to end portions of the casing 10, a supply pipe 29 communicating with the casing 10 and having direct communication with the intermediate port 32, an exhaust pipe 47 communicating with the casing 10, the casing 10 having a plurality of ports 6, 7, 8 and 9 spaced apart and communicating with the housing 2 at opposite sides of the partition 3, and a valve 33 arranged within the casing 10, the said casing having pairs of valve seats 19, 20 and 23, 24 adjacent to the respective ports 6, 8 communicating with each end portion of the housing 2, the casing 10 being formed with a pair of intermediate valve seats 21, 22 and being formed with chambers 11, 12, 13, 14, 16, 17 and 18 between said valve seats, and the valve 33 being formed with pistons 37, 39 and 38, 40 adapted to occupy some of said valve seats and control communication between the intake 29 and said chambers 11, 12, 13, 14, 16 17 and 18, and between the exhaust 47 and said chambers past said valve seats, the casing 10 being formed with an elongated valve seat 26 adjacent each of its ends and the valve 33 being formed with pistons 35, 36 for each of said elongated valve seats 26, each of said elongated valve seats 26 being disposed for having the area surrounded thereby communicate at one end with the respective terminal port 27, 28 and at the other end with a chamber 11, 13 communicating with the housing 2 at the respective side of the partition 3, each valve piston 35, 36 within the respective elongated

valve seat 26 being of greater diameter than the diameter of the valve pistons 37, 38, 39 and 40, the ports 6, 7, 8, 9, chambers 11, 12, 13, 14, 16, 17, 18, and ports 27 and 28 of the valve casing 10 being arranged for delivering an overbalancing pressure to the controlling valve 33 in one or the other direction of reciprocation thereof according to the location of the piston 45.

4. In a motor, the combination with a cylinder 1 and a piston 45 therein, of a fluid pressure actuated valve 33 for controlling intake and exhaust to and from the cylinder, a casing 10 for the valve having a substantially central, longitudinal valve-space accommodating said controlling valve 33, an intake 29 at one side of the valve-space and an exhaust 47 at the opposite side thereof, the intake and exhaust being substantially alined transversely of the valve-space, the intake having lateral ports 30, 31 communicating with the valve-space and the exhaust having a substantially direct chamber 17 communicating with the valve-space, the valve casing 10 having a plurality of partitions 15 forming a series of chambers 11, 12, 13, 14, 16, 17 and 18 communicating with the valve-space, and said partitions 15 being formed with valve seats 19, 20, 21, 22, 23 and 24 respectively, alined with and surrounding portions of said valve-space, the controlling valve 33 being formed with pistons 37, 38, 39, 40 for the valve seats, each adapted when on a seat to interrupt communication between the chambers at the opposite sides of the particular partition, there being ports 27, 28 respectively communicating between the respective ends of the cylinder and the valve-space and the port 32 communicating with the intake 29, the piston 45 being constructed to alternately afford communication between the ports 27, 28 and port 32, and means controlled by pressure supplied through the intermediate cylinder port 32 for shifting the controlling valve in timed relation to the movements of the piston.

5. In a motor, the combination, with a cylinder 1 and a double-headed piston 45 arranged therein, the heads being spaced apart a distance equaling approximately the length of the stroke of the piston, the cylinder having its ends open, a housing 2 inclosing the cylinder, a valve casing 10 connected with the housing 2 and communicating therewith, and a controlling valve 33 arranged in the casing 10, the valve casing 10 being formed with a valve-space for accommodating the controlling valve 33, a terminal port 27 being arranged to communicate between one end of the valve-space and an end portion of the cylinder 1, a second terminal port 28 communicating between the opposite end of the valve-space and the opposite end portion of the cylinder 1, the valve casing 10 being formed with an intake 29 and an exhaust 47, an intermediate port 32 communicating between the intake 29 and an intermediate portion of the cylinder 1, the point of communication of the intermediate port with the cylinder 1 being such with respect to the points of communication with the respective terminal ports 27, 28 with the cylinder 1 as to enable communication between the former and one of the latter when the piston 45 is at the respective extreme of its possible movement, the valve casing 10 being formed with a series of spaced partitions 15 and 25 forming chambers 11, 12, 13, 14, 16, 17 and 18 between said partitions, and the housing 2 being formed with a partition 3 dividing the area within the housing communicating with one end of the cylinder 1 from the area within the housing communicating with the other end of the cylinder 1, the partitions 15 and 25 being formed with valve seats 19, 20, 21, 22, 23, 24 and 26 surrounding their respective portions of the valve space, the valve seats 26 being elongated and having their respective spaces communicating with the respective terminal ports 27, 28, the controlling valve 33 being formed with a piston 35, 36 seated in the respective valve seat 26, the chamber 11, 13 between the respective valve seat 26 and the next inner adjacent partition 15 communicating directly with the respective area of the housing 2, there being six valve casing partitions 15 arranged in the space between the valve seats 26 and divided into an intermediate pair and a lateral pair at each side of the intermediate pair, the chamber 17 between the partitions of the intermediate pair communicating with the exhaust and the chambers 12 and 14 between the intermediate pair and the respective lateral pairs of partitions communicating through ports 7 and 9 respectively with the respective opposite areas of the housing 2 at opposite sides of the partition 3, the chambers 16, 18 between the partitions 15 of each lateral pair communicating with the intake 29, the controlling valve 33 being formed with pistons 37 and 39, 40 and 38 arranged in pairs, the pistons of each pair being spaced apart a distance equal to the distance of the spacing between any two valve seats 19, 20, 21, 22, 23, 24, and the adjacent pistons 39, 40 of the respective pairs being spaced a distance equal to twice the distance between two valve seats, the pistons 35 and 36 being of a different diameter from that of the other pistons.

6. In a motor, the combination, with a cylinder 1 and a double-headed piston 45 arranged therein, the heads being spaced apart a distance equaling approximately the length of the stroke of the piston 45, the cylinder having its ends open, a housing

2 inclosing the cylinder, a valve casing 10 connected with the housing and communicating therewith, and a controlling valve 33 arranged in the casing, the valve for accommodating the controlling valve 33, a terminal port 27 being arranged to communicate between one end of the valve-space and an end portion of the cylinder, a second terminal port 28 communicating between the opposite end of the valve-space and the opposite end portion of the cylinder, the valve casing 10 being formed with an intake 29 and an exhaust 47, an intermediate port 32 communicating between the intake 29 and an intermediate portion of the cylinder, the point of communication of the intermediate port with the cylinder being such with respect to the points of communication with the respective terminal ports 27, 28 with the cylinder as to enable communication between the former and one of the latter when the piston 45 is at the respective extreme of its possible movement, the valve casing 10 being formed with a series of spaced partitions 15 and 25 forming chambers 11, 12, 13, 14, 16, 17 and 18 between said partitions, and the housing 2 being formed with a partition 3, the partitions 15 and 25 of the valve casing 10 being formed with valve seats 19, 20, 21, 22, 23, 24 and 26 surrounding their respective portions of the valve space, and the valve seats 26 being elongated and having their respective spaces communicating with the respective terminal ports 27, 28, the controlling valve 33 being formed with a piston 35, 36 seated in the respective valve seat 26, the chamber 11, 13 between the respective valve seat 26 and the next inner adjacent partition 15 communicating directly with the respective area of the housing 2, there being six valve casing partitions 15 between the valve seats 26 divided into an intermediate pair and two lateral pairs, the chamber 17 between the partitions of the intermediate pair communicating with the exhaust 47 and the chambers 12 and 14 between the intermediate pair and the respective lateral pairs of partitions communicating with the respective opposite areas of the housing at opposite sides of the partition 3, the chambers 16 and 18 between the partitions of each lateral pair communicating with the intake 29, the controlling valve 33 being formed with pistons 37, 39 and 40, 38 arranged in pairs, the pistons of each pair being spaced apart a distance equal to the distance of the spacing between any two valve seats 19, 20, 21, 22, 23, 24, and the adjacent pistons 39, 40 of the respective pairs being spaced a distance equal to twice the distance between two valve seats, the terminal pistons 35, 36 having their valve seat engaging portions of less width than the length of the respective engaged valve seat and being of a diameter different from that of the other pistons, while the intermediate pistons comprising the several pairs are each formed of a peripheral width equal substantially to the width of the intermediate valve seats, and each valve seat being of a width greater than the width of the several chambers between the partitions.

7. In a motor, the combination with a cylinder 1 and a double-headed piston 45 arranged therein, the heads being spaced apart a distance equaling approximately the length of the stroke of the piston 45, the cylinder having its ends open, a housing 2 inclosing the cylinder, a valve casing 10 connected with the housing and communicating therewith, and a controlling valve 33 arranged in the casing, the valve casing 10 being formed with a valve-space for accommodating the controlling valve 33, a terminal port 27 being arranged to communicate between one end of the valve-space and an end portion of the cylinder, a second terminal port 28 communicating between the opposite end of the valve-space and the opposite end portion of the cylinder, the valve casing 10 being formed with an intake 29 and an exhaust 47, an intermediate port 32 communicating between the intake 29 and an intermediate portion of the cylinder, the point of communication of the intermediate port with the cylinder being such with respect to the points of communication with the respective terminal ports 27, 28 with the cylinder as to enable communication between the former and one of the latter when the piston 45 is at the respective extreme of its possible movement, the valve casing 10 being formed with a series of spaced partitions 15 and 25 forming chambers 11, 12, 13, 14, 16, 17 and 18 between said partitions, and the housing 2 being formed with a partition 3, the partitions 15 and 25 of the valve casing 10 being formed with valve seats 19, 20, 21, 22, 23, 24 and 26 surrounding their respective portions of the valve space, and the valve seats 26 being elongated and having their respective spaces communicating with the respective terminal ports 27, 28, the controlling valve 33 being formed with a piston 35, 36 seated in the respective valve seat 26, the chamber 11, 13 between each valve seat 26 and the next inner adjacent partition communicating directly with the respective area of the housing, there being six valve casing partitions 15 between the valve seats 26 divided into an intermediate pair and two lateral pairs, the chamber 17 between the partitions of the intermediate pair communicating with the exhaust 47 and the chambers 12 and 14 between the intermediate pair and the respective lateral pairs of partitions communicating with the respective opposite areas of the housing at opposite sides of the partition 3, the cham-

bers 16 and 18 between the partitions of each lateral pair communicating with the intake 29, the controlling valve 33 being formed with pistons 37, 39 and 40, 38 arranged in pairs, the pistons of each pair being spaced apart a distance equal to the distance of the spacing between any two valve seats 19, 20, 21, 22, 23, 24, and the adjacent pistons 39, 40 of the respective pairs being spaced a distance equal to twice the distance between two valve seats, each of the terminal pistons being of a different diameter than the other pistons.

In testimony whereof I affix my signature in presence of two witnesses.

LAURITS A. LAURSEN.

Witnesses:
E. WILLETT,
L. GORT.