

Aug. 7, 1934.

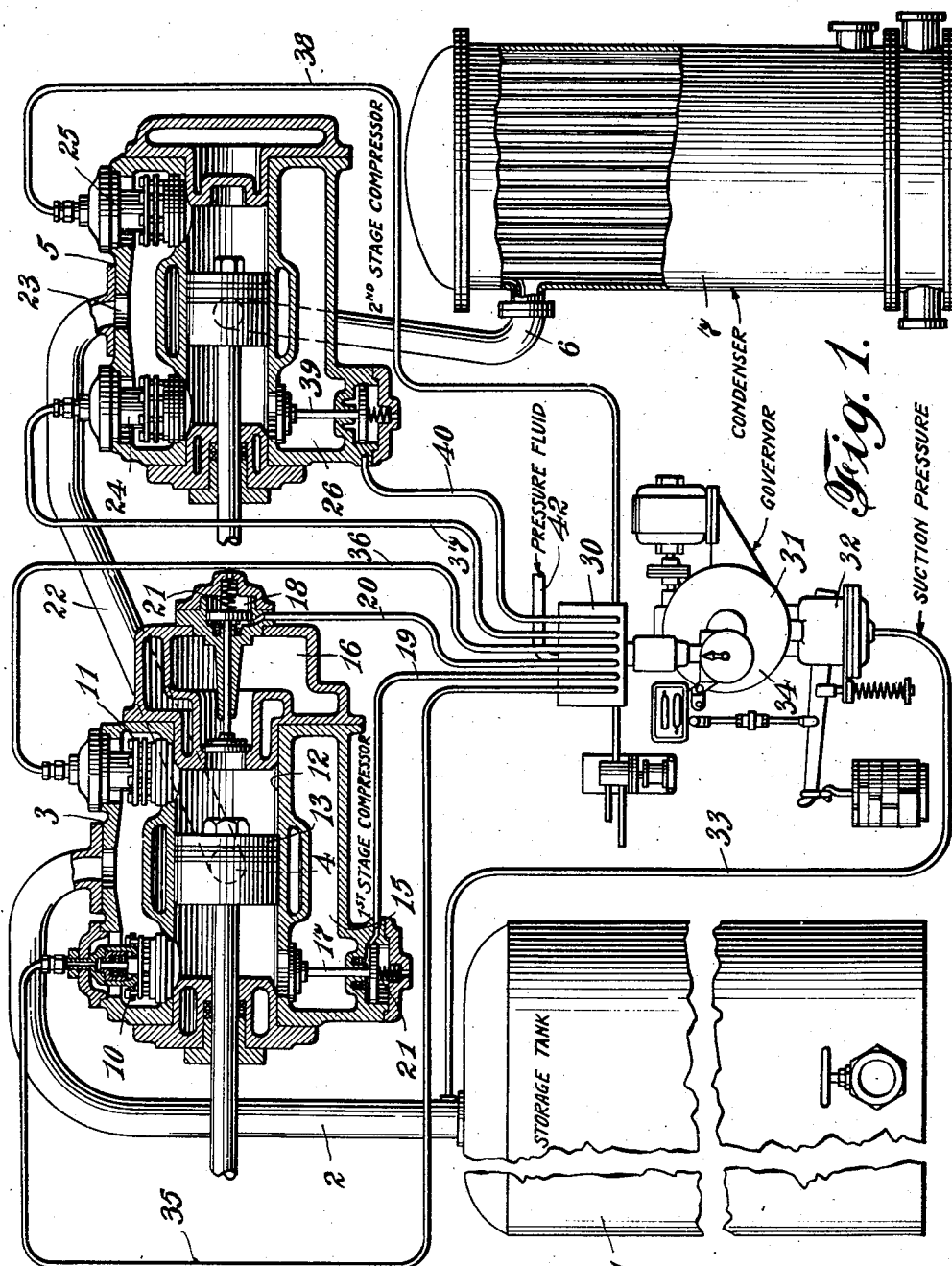
S. R. HIRSCH

1,969,076

COMPRESSOR

Filed March 22, 1934

3 Sheets-Sheet 1



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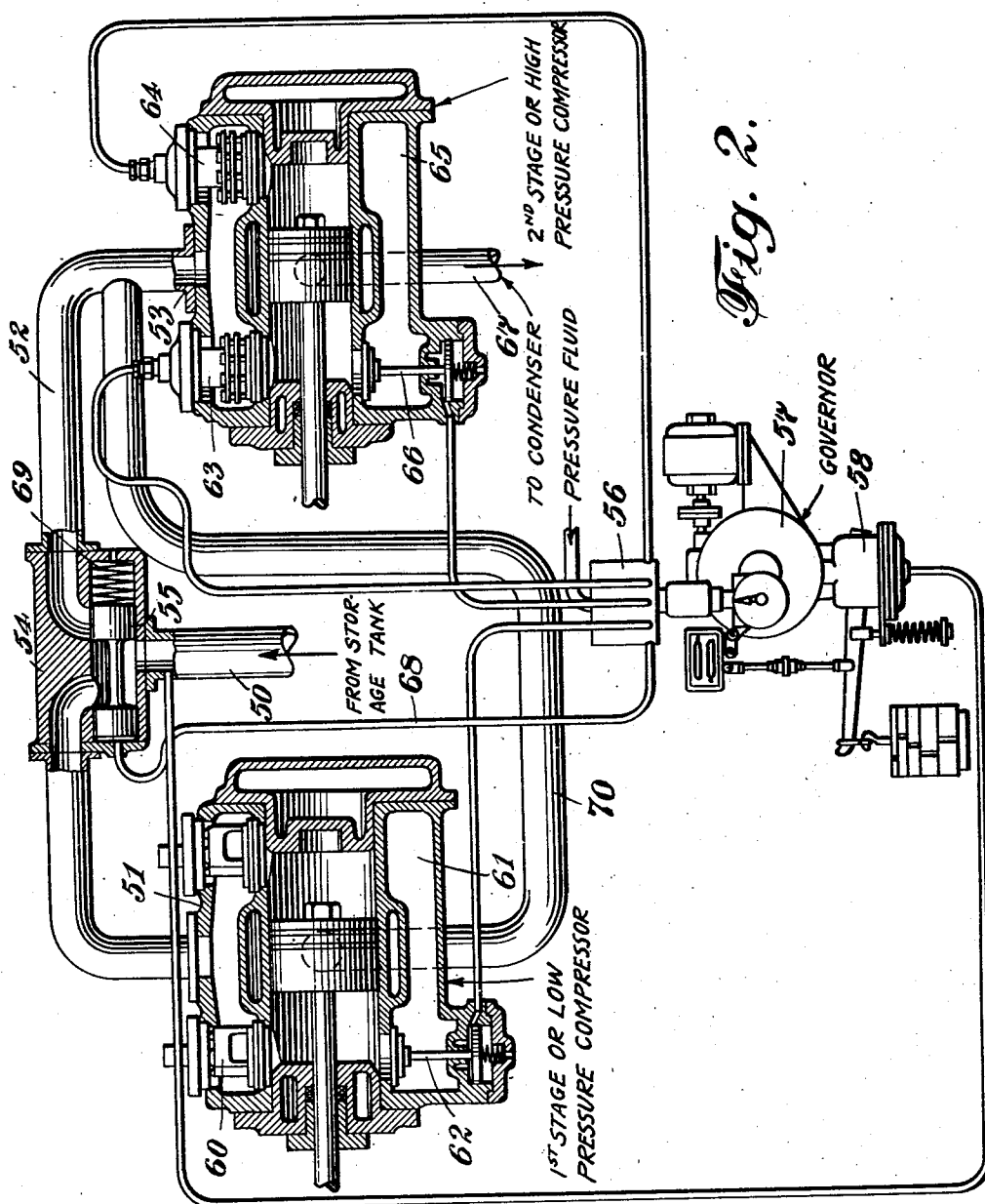
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COMPRESSOR

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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

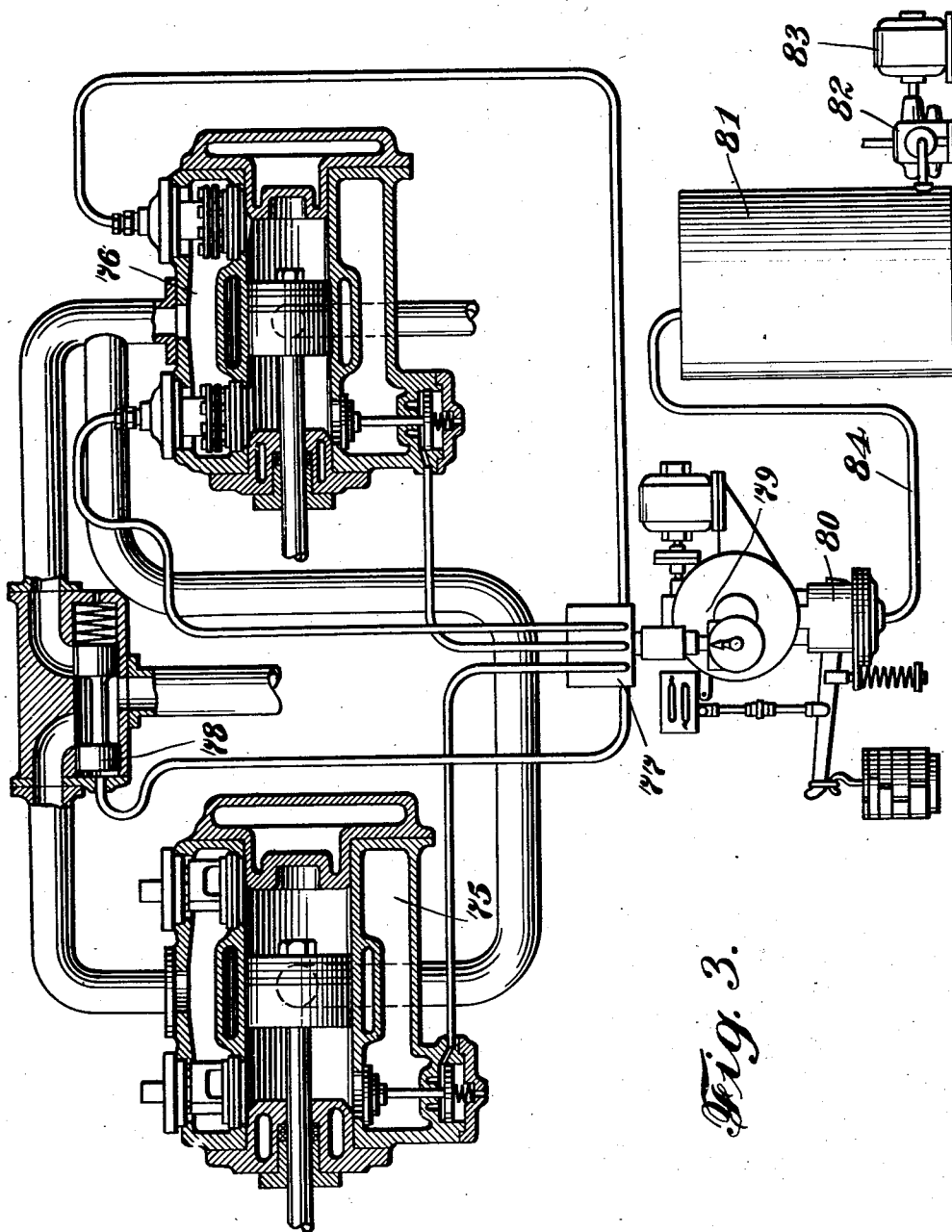


Fig. 3.

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1,969,076

COMPRESSOR

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Application March 22, 1924, Serial No. 716,743

19 Claims. (Cl. 230—21)

This invention relates to compressors for air or gas and an object of the invention is to provide a compressor unloading means and control therefor, whereby an approximate constant or predetermined weight of gas will be delivered at varying suction pressures and at a constant discharge pressure with a reciprocating compressor operating at constant speed.

More specifically the invention comprises a multi-stage compressor, and loading and unloading means therefor, which unloading means is controlled by pressure of gas entering the suction or inlet of the compressor whereby the capacity of the compressor stages is controlled in steps proportionate to the suction pressure, for maintaining approximately constant the weight and pressure of gas delivered by the compressor.

With these and other objects in view as may appear from the accompanying specification, the invention consists of various features of construction and combination of parts, which will be first described in connection with the accompanying drawings, showing a compressor of the preferred form, and the features forming the invention will be specifically pointed out in the claims.

In the drawings:

Fig. 1 is a diagrammatic view of a system view showing a multi-stage compressor and control mechanism therefor for carrying out the object of the present invention.

Fig. 2 is a diagrammatic view partly in section of a modified form of the compressor layout.

Fig. 3 is a diagrammatic view partly in section of a still further modified form of the invention.

Referring more particularly to the drawings, Fig. 1 shows one approved type of compressor layout and control whereby a multi-stage variable capacity compressor may be operated to deliver an approximate constant or predetermined weight of gas at various suction pressures and at a constant discharge pressure with a reciprocating compressor operating at a constant speed.

The layout shown in Fig. 1 is particularly adapted for treating crude petroleum oils and specifically for use in what is known as the propane pump-down dewaxing system. While the compressors and their control are shown as applied in Fig. 1, to a petroleum dewaxing system, it is to be understood that the invention is not to be limited to such systems but is applicable for use in any analogous system or in any sys-

tem where it is desired to carry out the broad specific idea of delivering a gas at a constant or predetermined weight and constant discharge pressure with varying intake pressure without varying the speed of operation of the compressor.

In the system shown in Fig. 1 of the drawings, the petroleum to be dewaxed is mixed with propane or the like and is placed in a storage tank 1 from which the gas is drawn off through the pipe 2 to the suction of the first stage or low pressure cylinder 3 of the multi-stage reciprocating compressor. The gases are discharged from the discharge, indicated at 4, of the first stage compressor 3 to the suction of the second stage or high pressure cylinder 5 of the compressor. From the high pressure cylinder 5 the compressed gases are discharge through a suitable conduit 6 to a condenser 7 where they are condensed and the propane separated or segregated from the other gases for future use in connection with other petroleum.

In the process for dewaxing lubricating stock, propane is blended with a definite amount of lubricating stock and held in a closed tank, the pressure of which is fixed by the temperature and vapor pressure of the volatile constituent, namely, propane. Separation is accomplished by progressively decreasing the pressure in the closed tank, under which condition the propane is evaporated and the amount of separation is proportional to the latent heat of the propane which is evaporated and removed. As the propane is removed, the pressure and consequently the temperature in the tank drops resulting in a congealing of the paraffin or wax base of the mixture, which congealing wax falls to the bottom of the tank and is segregated.

In order to control the rate of separation, it is necessary to control the rate at which the propane is evaporated and removed. During the initial stages of the process the pressure within the tank is relatively high, and therefore the volume of vapors to be removed to accomplish a given amount of separation is relatively small as compared with the volume which must be removed at the later stages of the process when the pressures are low and the specific volume of the gas removed is large.

At the beginning of the process the compressor is required to remove gas which is relatively dense, so that to remove a definite weight of gas the volume to be removed is small. As the pressure within the tank decreases the gas becomes less dense, and therefore the volume corresponding to a given weight of gas increases,

so that the compressor must work at an increasing volumetric capacity as the process progresses. It must be remembered that at the beginning of the process the ratio of compressions is small and from this point the ratio of compressions gradually increases until at the end of the process the ratio is relatively large.

It will be appreciated that the ratio of pumping of the gas from the storage tank must be definitely controlled so as to control the desired rate of temperature change in the tank and consequently the rate at which the wax is congealed. The gas removed from the tank must be discharged at a predetermined pressure maintained constant, into the condenser 7. To provide these results a novel system of loading and unloading the compressor cylinders is provided which is controlled by any approved type of compressor unloading governor which governor is in turn pressure operated and controlled by pressure of the gasses entering the suction of the first or low pressure stage of the compressor.

In the construction shown in Fig. 1 of the drawings, the first stage or low pressure cylinder of the compressor is of the approved type of double acting compressor and is provided with suction valves 10 and 11 which control the inlet of the gas into the opposite ends of the cylinder 12 and on opposite sides of the piston 13.

These suction valves 10 are of the unloading type such as disclosed in United States Patents Nos. 1,579,781 and 1,798,435 and their specific construction will not be described in detail in the present application. The suction valves are of the unloading type and are held open by pressure so that when the suction valve 10 is held open the crank end of the compressor cylinder 3 will operate without compressing, the gas merely passing in and out through the suction valve. When the suction valve 11 is held open the head end of the compressor cylinder will operate without compressing, and when both suction valves are held open the compressor cylinder 3 will operate at zero capacity.

Clearance pockets 15 and 16 are shown which are adapted to be connected to the ends of the cylinder through the medium of pressure operated unloading valve structures 17 and 18 for the purpose of fractionally unloading the ends of the compressor.

These pressure operated unloading valves 17 and 18 may be of any approved type such as those shown in Patent No. 1,764,646 wherein the valves are opened when the pressure in the operating pressure lines 19 and 20 reaches a predetermined degree necessary to overcome the tension of the springs 21. While in the drawings only two clearance pockets are shown it is to be understood that any number of clearance pockets may be provided for providing fractional unloading of the compressor cylinder in any percentage of its capacity.

The first stage or low pressure cylinder 3 of the multi-stage reciprocating compressor discharges through a suitable conduit 22 into the suction 23 of the second stage or high pressure cylinder 5 of the compressor.

The second stage or high pressure cylinder 5 of the compressor is also of the double acting type, and is provided with suction valves 24 and 25 of approved type such as the suction valves 10 and 11. The suction valves 24 and 25 are pressure operated unloading valves for

unloading the ends of the compressor independently or for completely unloading the compressor by having both of the suction valves held open. In the drawings only one clearance pocket, namely the clearance pocket 26, is shown associated with the high pressure cylinder 5 to provide fractional unloading thereof, but it is to be understood that any desired number of clearance pockets may be provided without departing from the spirit of the present invention.

The various unloading valves and unloading suction valves are operated by pressure fluid which is delivered thereto through the distributing valve structure 30 which forms a part of the governor mechanism 31.

The governor mechanism 31 is specifically illustrated and described in Patent No. 1,798,435. The distributing valve 30 is operated to control the distribution of pressure to the various valves for loading or unloading of the compressor cylinders by the governor mechanism 31 and the governor mechanism 31 is in turn controlled by the pressure operated mechanism 32 which forms a part of the governor 31. The pressure operated mechanism 32 is connected by means of the pipe 33 with the suction of the low pressure cylinder 3 of the compressor. In the drawings such connection is illustrated as being established through the pipes 33 and the delivery pipe 2 but the pipe 33 may be connected directly to the suction of the compressor cylinder if desired.

By connecting the pressure operated mechanism 32 with the suction of the low pressure compressor cylinder 3, the loading and unloading of the cylinders 3 and 5 will be controlled by the pressure of the gas entering the suction of the first stage or low pressure cylinder of the compressor mechanism.

Thus; when the pressure gas in the storage tank 1 and consequently at the suction of the low pressure cylinder 3 is high or at its greatest point the pressure operated mechanism 32 will operate the distributing valve 30 to deliver pressure fluid through the pipes or connections 35 and 36 to both of the suction valves 10 and 11 of the low pressure cylinder 3 for holding these valves open and permitting the gas from the tank 1 to pass through the low pressure stage of the compressor without being compressed. If the pressure of the gas is sufficiently high then the valve 30 will also at the same time deliver pressure fluid through the distributing valve 30 and pipes 37 and 38 to the suction valves 24 and 25 of the second stage or high pressure cylinder of the compressor and thus the gas will pass through both the compressor cylinders to the condenser without being compressed.

As the pressure falls in the storage tank and consequently as the pressure of the fluid at the suction of the low pressure cylinder falls the distributing valve 30 will be operated to close first the suction valve 25, second the suction valve 24 at which time the high pressure cylinder will be operated at full capacity. If the pressure of the suction gas is slightly in excess of the desired pressure, the unloading valve 39 which controls the clearance pocket 26 will be operated by pressure fluid from the distributing valve 30 through the pipe 40 so as to partly or fractionally reduce the compressing capacity of the high pressure cylinder. When the pres-

sure in the suction pipe 2 falls further, the unloading valve 39 will be closed and the suction valve 11 of the low pressure cylinder will be closed permitting the low pressure cylinder to operate at approximately fifty percent of capacity. If the pressure of the suction gas is such that it is desirable to operate the low pressure cylinder at fifty percent of capacity, the clearance chamber 16 may be brought into communication with the head end of the cylinder 3 by means of the unloading valve structure 13 which unloading valve structure will close when the suction pressure falls to a sufficient predetermined degree to warrant operation of the first stage cylinder at fifty percent of capacity.

Upon further drop in the pressure of the suction gas the suction valve 10 will be closed which will permit the low pressure cylinder to operate at one-hundred percent of its capacity. Should the suction pressure, however, be such that it is not desirable to operate the low pressure stage at one-hundred percent capacity, but only at seventy-five percent of capacity, the clearance pocket 15 will be brought into service by the opening of the unloading valve mechanism 17. The unloading valve 17 will close when the pressure of the gas at the suction of the low pressure cylinder falls to the predetermined degree necessary for full capacity operation of the low pressure stage.

The pressure fluid for operating the various suction valves 10, 11, 24 and 25 and the unloading valves 17, 18 and 39 may be obtained from any suitable source and it is delivered to the distributing valve 30 through suitable piping indicated at 42.

From the foregoing description taken in connection with Fig. 1 of the drawings, it will be apparent that with the layout of the compressor as shown and as above described the pressure of the suction gas at the inlet to the low pressure cylinder or first stage of the multi-stage compressor will control the operation of the compressor and by so doing it will be possible to provide a discharge of approximately a constant weight of gas at a constant pressure regardless of the suction pressure, into the condenser 7, with the compressor operating at a constant speed.

In Fig. 2 of the drawings a modified form of the compressor mechanism and control is illustrated. In this form the gas is delivered through the suction pipe 50 to the suction of the low pressure cylinder 51 and the pipe 50 has a branch 52 therein which passes to the suction of the second stage or high pressure cylinder 53 of the compressor structure. A valve chest 54 is interposed in the pipe 50 and a valve 55 is provided which controls the passage of the suction gas either through the suction pipe 50 to the inlet of the cylinder 51 or to the inlet of the high pressure cylinder 53.

The valve 55 is shown in the drawings as a pressure operated valve operated by pressure fluid distributed thereto through the distributor valve 56. The distributor valve is the same as the distributor valve 30 and the distributor valve 11 of Patent No. 1,798,435. The distributor valve 56 is operated by the governor mechanism 57 which is similar to the governor mechanism 31 which governor mechanism is in turn controlled by pressure of gas passing through the suction or intake pipe 50 through the medium of the pressure operated mechanism 58.

When the pressure of the gas or air passing through the intake pipe 50 is at a predetermined high degree the valve 55 will be operated to by-pass the suction fluid past the low pressure cylinder 51 directly to the high pressure cylinder 53 and when the pressure of the fluid in the pipe 50 falls to a predetermined degree the valve 55 will be operated to deliver the suction fluid to the suction of the low pressure cylinder 51.

With the valve 55 interposed in the suction line to the first stage or low pressure cylinder 51 it is unnecessary to provide unloading suction valves, and consequently any approved type of suction valve as indicated at 60 may be provided for the first stage or low pressure cylinder 51. Any number of clearance pockets such as the clearance pocket 61 may be provided for permitting fractional unloading of the low pressure cylinder. Only one of such clearance pockets is shown in Fig. 2 of the drawings but they are well known and various numbers and types of clearance pockets are shown in prior patents, as for instance in Patent No. 1,764,646. The clearance pockets may be opened to communication with the cylinder by any approved type of unloading valves such as that shown at 62, and which construction of pressure operated unloading valve is clearly shown and described in the last mentioned United States Patent.

The high pressure cylinder 53 is provided with unloading suction valves 63 and 64 and with a clearance pocket 65 to permit operation of the compressor at fractional percentages of its capacity. The clearance pocket 65 is opened to the cylinder or cut off therefrom by a pressure operated unloading valve 66 which is of the same construction as the unloading valve 62.

While the specific construction of pressure operated valve is shown at 55, it is to be understood that any approved type of either pressure operated or manually operated valve may be substituted for the construction shown without departing from the spirit of the invention. In the operation of the modified construction shown in Fig. 2, when the pressure of the suction fluid passing through the pipe 50 is at a predetermined high pressure, for instance at its highest pressure, the governor mechanism 57 will operate the distributing valve 56 to in turn operate the pressure valve 55 to by-pass the suction fluid past the low pressure cylinder to the suction of the high pressure cylinder 53 and at this time both the suction valves 63 and 64 will be held open permitting the gas to pass straight through the compressor and out the discharge pipe 67. As the pressure of the suction fluid drops the suction valves 64 and 63 will be successively closed through the operation of the governor mechanism 57 to load the high pressure cylinder. If an intermediate capacity of the high pressure cylinder is desired than the governor mechanism may be regulated to open the clearance pocket 65, or any other desired number of clearance pockets, to the cylinder for regulating the capacity of the cylinder in fractional percentages. When the pressure of the suction falls still further the pressure against the valve 55, which is delivered thereto through the pipe 68, will be relieved and the spring 69 will operate the valve to open the pipe 50 to the suction of low pressure cylinder 51 and at the same time cut off communication between the pipes 50 and 52. When the low pressure cylinder 51 is compressing, at which

time of course the suction fluid is delivered from the pipe 50 to the low pressure cylinder, the low pressure cylinder will discharge through the pipe 70 to the suction of the high pressure cylinder 53.

The low pressure cylinder 51 may have any desired number of clearance pockets connected thereto to permit fractional unloading of the low pressure cylinder if desired.

As will be seen from the foregoing taken in connection with Fig. 2 of the drawings, the layout shown in Fig. 2 will provide the same result as that obtained from the structure illustrated in Fig. 1, differing from Fig. 1 principally in that the gas to be compressed is by-passed around or past the low pressure cylinder of the compressor instead of being by-passed through the low pressure cylinder as is the case in the structure illustrated in Fig. 1.

In the layouts shown in Figs. 1 and 2 of the drawings, the loading and unloading of the compressor is controlled indirectly through suitable pressure operated means by the pressure of the gas entering the suction of the first stage of the compressor. However, it may at times be desirable to provide a construction in which a time factor will enter into the control of the loading and unloading of the compressor to permit such operation irrespective of the pressure of the suction of gas.

In Fig. 3 of the drawings such a layout is shown. In this modified form of layout, the compressor comprises the first or low stage compressor 75 and the second or high stage compressor 76, which are constructed in any approved manner but are illustrated as being constructed in the same manner as the first and second stage compressors shown in Fig. 2 of the drawings, their loading and unloading being controlled through the medium of the distributor valve 77 in the same manner in which the compressor stages shown in Fig. 2 are loaded and unloaded. This construction shown in Fig. 3 also shows a pressure operated valve 78 for controlling the delivery of the fluid to be compressed either to the first or second stage compressor, being operable to permit the cutting out of the first stage compressor to permit the gas to be by-passed directly to the second stage. However, it is to be understood that the time controlled element embodied in the governor mechanism and which forms the essence of the modification shown in Fig. 3, may be used in connection with compressors as shown in Fig. 1 of the drawings without departing from the spirit of the present invention.

The distributor valve 77 is operated by means of the governor mechanism 79, which is the same in all essentials as governor mechanisms 31 and 57, and is in turn operated by the pressure operated means 80 which likewise is similar to the structures 32 and 58. However, this modified construction shown in Fig. 3 differs from the structure shown in Figs. 1 and 2, in that the pressure fluid derived for operating the mechanism 80 is delivered thereto from a suitable reservoir 81 in which pressure of fluid is built up by means of a gear pump 82 or any other approved type of pump. The pump 82 is operated by a synchronous or constant speed motor 83.

In operation, of this modified form, when the compressor layout is started, the motor 83 will be started, and operating at a constant speed

of operation will operate the pump 82 for pumping any suitable fluid into the reservoir 81. The steady constant speed of operation of the pump 82 will provide constant and even raising of pressure in the reservoir 81, and this pressure fluid passing from the reservoir 81 through the pipe 84 to the pressure operated means 80 will operate the governor 79 which will in turn operate the distributing valve 77 and control the loading and unloading of the compressor. The time factor enters into the various stepped loading of the compressor, in that the pressure in the tank 81 is built up in a predetermined steady flow and by regulating the governor 79 for operation at definite pressures, the loading of the compressor will be controlled at definite time intervals predetermined upon the intervals between such definite pressures being provided in the reservoir 81.

It will be understood that the invention is not to be limited to the specific construction or arrangement of parts shown but that they may be widely modified within the invention defined by the claims.

What is claimed is:

1. The combination with a compressor of controlling means for loading and unloading the compressor in successive steps of predetermined percentages of cylinder capacity, pressure operated means for operating said controlling means, said pressure operated means connected to the compressor suction whereby the loading and unloading of the compressor will be controlled by pressure of inlet gas thereto.

2. The combination with a multi-stage compressor, of controlling means for loading and unloading the compressor in successive steps of predetermined percentages of cylinder capacity, pressure operated means for operating said controlling means, said pressure operated means connected to the suction of said compressor whereby the loading and unloading of the compressor will be varied in proportion to the variations in the pressure of inlet gas to the compressor.

3. The combination with a multi-stage compressor, of means for by-passing gas to be compressed past the low pressure stage of the compressor, pressure operated means controlling operation of said first named means, said pressure operated means connected to the suction of the compressor for operation by pressure of inlet gas to the compressor.

4. The combination with a multi-stage compressor, of means for by-passing gas to be compressed past the low pressure stage of the compressor, controlling means for loading and unloading the compressor in successive steps of predetermined percentages of cylinder capacity, pressure operated means for controlling operation of said first named means and said unloading controlling means, said pressure operated means connected to the suction of the compressor for operation by pressure of inlet gas to the compressor.

5. The combination with a multi-stage compressor, including a low pressure stage and a high pressure stage, of means for rendering the low pressure stage of the compressor non-compressing, unloading means for unloading the high pressure stage of the compressor in successive steps of predetermined percentages of cylinder capacity, pressure operated means controlling operation of said first named means and of said unloading means, said pressure operated

means connected to the suction of the compressor for operation by pressure of inlet gas to the compressor.

6. The combination with a compressor, of controlling means for loading and unloading the compressor in successive steps of predetermined percentages of cylinder capacity, said controlling means including means for holding open the suction valves of the compressor, pressure operated means for operating said unloading means, said pressure operated means connected to the compressor suction, whereby the loading and unloading of the compressor will be controlled by pressure of inlet gas thereto.

7. The combination with a multi-stage compressor, of controlling means for loading and unloading the compressor in successive steps of predetermined percentages of cylinder capacity, said controlling means including means for holding open the suction valves of the compressor, pressure operated means for operating said controlling means, said pressure operated means connected to the suction of said compressor whereby the loading and unloading of the compressor will be regulated in proportion to variations in the pressure of inlet gas to the compressor.

8. The combination with a multi-stage compressor including a high pressure stage and a low pressure stage, of controlling means for loading and unloading the compressor in successive steps of predetermined percentages of cylinder capacity, said controlling means including means for holding open the suction valves of the low pressure stage of the compressor whereby gas to be compressed will be by-passed through the low pressure stage of the compressor, pressure operated means for operating said controlling means, said pressure operated means connected to the suction of said compressor whereby the loading and unloading of the compressor will be regulated in proportion to variations in the pressure of inlet gas to the compressor.

9. In a compressor for delivering an approximate predetermined weight of gas at varying suction pressures and at a constant discharge pressure with a constant speed of operation of the compressor, in combination, with a multi-stage compressor including a low pressure cylinder and a high pressure cylinder, of controlling means for loading and unloading the compressor in successive steps of predetermined percentages of cylinder capacity, means for rendering the low pressure cylinder non-compressing, means for rendering the high pressure cylinder non-compressing, and selective means controlled by pressure of gas at the suction of the low pressure cylinder for operating said controlling means and for operating said means for rendering the cylinders non-compressing.

10. In a compressor for delivering an approximate constant weight of gas at varying suction pressures and at a constant discharge pressure with a constant speed of operation of the compressor, in combination, with a multi-stage compressor including a low pressure cylinder and a high pressure cylinder, of controlling means for loading and unloading the compressor in successive steps of predetermined percentages of cylinder capacity, means for rendering the low pressure cylinder non-compressing, means for rendering the high pressure cylinder non-compressing, means operated by pressure of gas at the suction of the low pressure cylinder

for operating said controlling means and for operating said means of rendering the cylinders non-compressing.

11. The combination with a compressor, of controlling means for loading and unloading the compressor in successive steps of predetermined percentages of cylinder capacity, and selective means controlled by pressure of gas at the suction of the low pressure cylinder for operating said controlling means.

12. The combination with a multi-stage compressor including a high pressure stage and a low pressure stage, of means for by-passing gas to be compressed past the low pressure stage of the compressor, and selective means controlled by pressure of gas at the suction of the low pressure stage for operating said first named means.

13. In a compressor for delivering an approximate constant weight of gas at varying suction pressures and at a constant discharge pressure with a constant speed of operation of the compressor, in combination, with a multi-stage compressor including a low pressure cylinder and a high pressure cylinder, an intake pipe connected to the suctions of said cylinders and a valve in said pipe for controlling the delivery to said cylinders of the fluid to be compressed.

14. In a compressor for delivering an approximate predetermined weight of gas at varying suction pressures and at a constant speed of operation of the compressor, in combination, with a multi-stage compressor including a low pressure cylinder and a high pressure cylinder, an intake pipe connection to the suction of said cylinders, a valve in said pipe for controlling the delivery to said cylinders of the fluid to be compressed, and means for operating said valve, said means connected to said intake pipe, whereby pressure of fluid flowing through the pipe will control operation of the valve.

15. In a compressor for delivering an approximate predetermined weight of gas at varying suction pressure, and at a constant discharge pressure with a constant speed of operation of the compressor, in combination, with a multi-stage compressor including a low pressure cylinder and a high pressure cylinder, an intake pipe connected to the suctions of said cylinders, a valve in said pipe for controlling the delivery to said cylinders of the fluid to be compressed controlling means for loading and unloading the compressor in successive steps of predetermined percentages of cylinder capacity, and means for operating said valve and said controlling means, said means connected to said pipe whereby pressure of fluid flowing through the pipe will control operation of said controlling means and said valve.

16. In a compressor for delivering an approximate predetermined weight of gas at varying suction pressures and at a constant discharge pressure with a constant speed of operation of the compressor, in combination, with a multi-stage compressor including a low pressure cylinder and a high pressure cylinder, an intake pipe connected to the suctions of said cylinders, a valve in said pipe for controlling the delivery to the cylinders of fluid to be compressed, controlling means associated with said high pressure cylinder for unloading and loading the high pressure cylinder in successive steps of predetermined percentages of cylinder capacity, means for automatically operating said valve and for

operating said controlling means, said means connected to said intake pipe whereby pressure of fluid flowing through the pipe will control operation of said controlling means.

- 5 17. In a compressor for delivering an approximate predetermined weight of gas at varying suction pressures and at a constant discharge pressure with a constant speed of operation of the compressor, in combination, with a multi-stage compressor including a low pressure cylinder and a high pressure cylinder, of means
10 for by-passing gas to be compressed past the low pressure stage of the compressor, and time controlled selective means for operating said first named means.

- 15 18. In a compressor for delivering an approximate predetermined weight of gas at varying suction pressures and at a constant discharge pressure with a constant speed of operation of the compressor, in combination, with a multi-stage compressor including a high pressure stage and a low pressure stage, of controlling means for loading and unloading said compressor in successive steps of predetermined percentages
20 of cylinder capacity, said controlling means in-

cluding means for holding open the suction valves of the low pressure stage of the compressor whereby gas to be compressed will be by-passed through the low pressure stage of the compressor, means for operating said controlling means, and time controlled selective means for operating said operating means.

19. In a compressor for delivering an approximate predetermined weight of gas at varying suction pressures and at a constant discharge pressure with a constant speed of operation of the compressor, in combination with a multi-stage compressor including a low pressure cylinder and a high pressure cylinder, of controlling means for loading and unloading the compressor in successive steps of predetermined percentages of cylinder capacity, means for rendering the low pressure cylinder non-compressing, means for rendering the high pressure cylinder non-compressing, and time controlled selective means for operating said controlling means and for operating said means for rendering the cylinders non-compressing.

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