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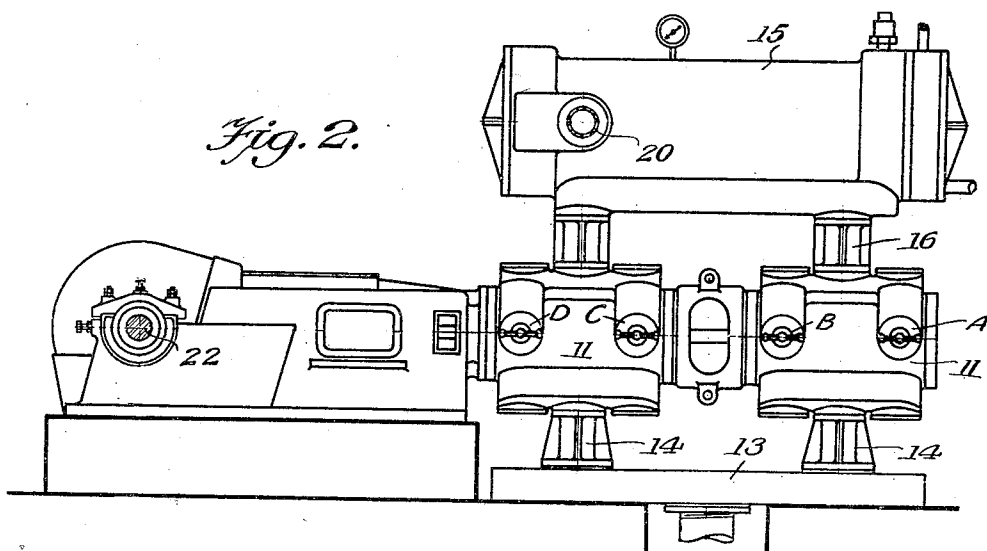
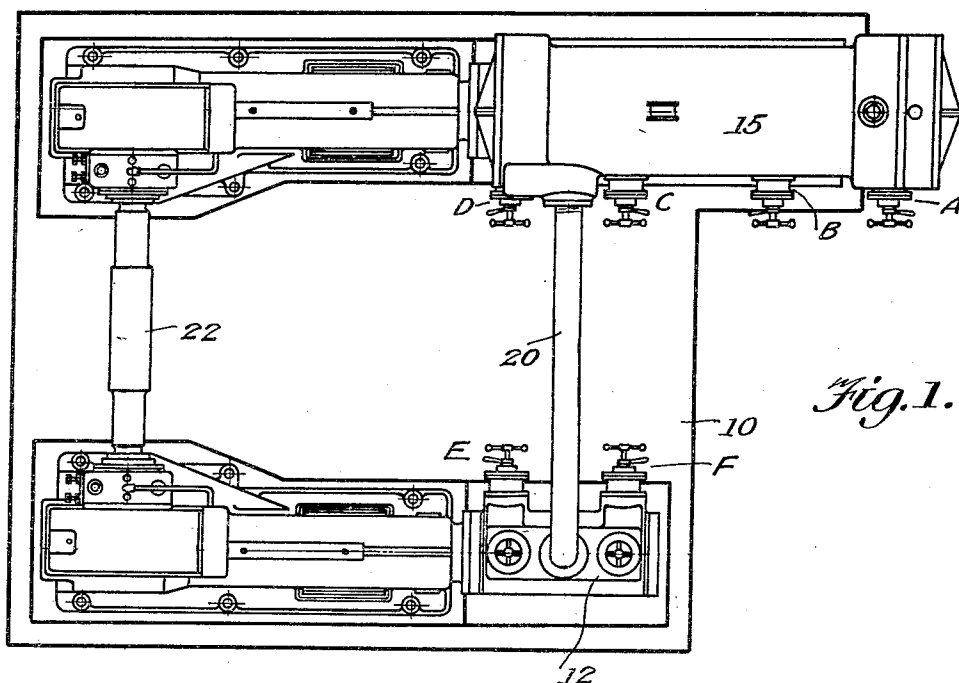
C. WAINWRIGHT

**1,817,862**

# UNLOADING SYSTEM FOR AIR AND GAS COMPRESSORS

Filed May 24, 1929

4 Sheets-Sheet 1



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**Aug. 4, 1931.**

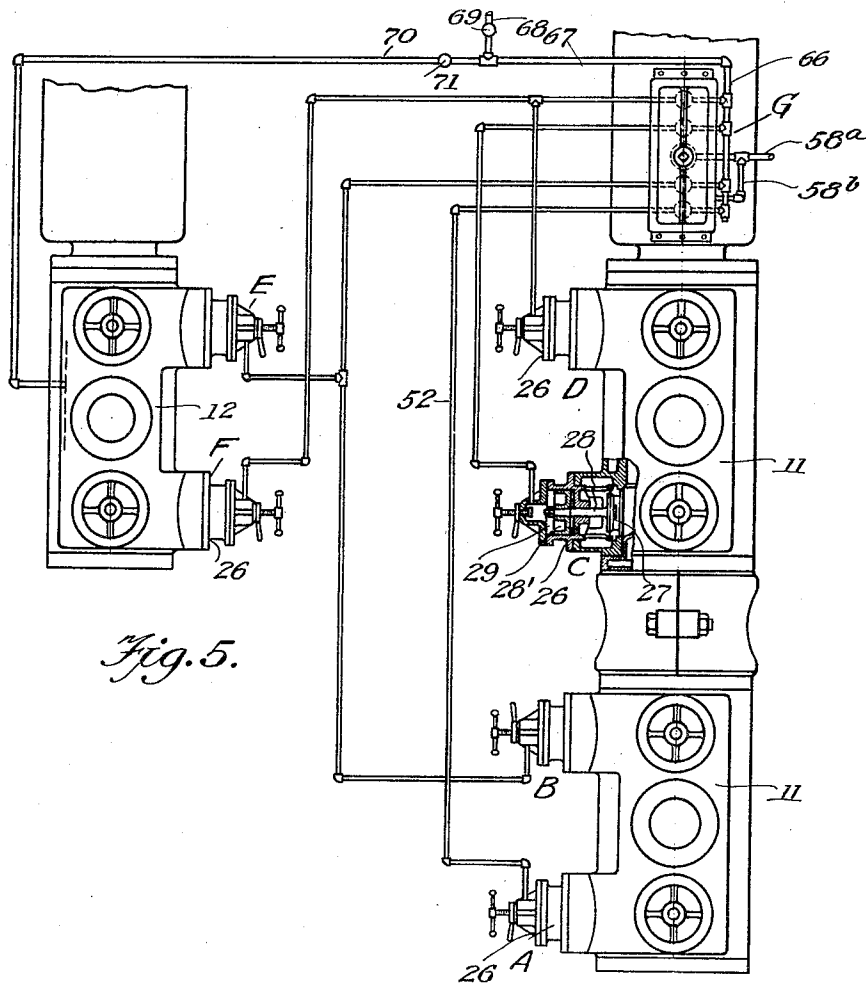
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## UNLOADING SYSTEM FOR AIR AND GAS COMPRESSORS

Filed May 24, 1929

4 Sheets-Sheet 2



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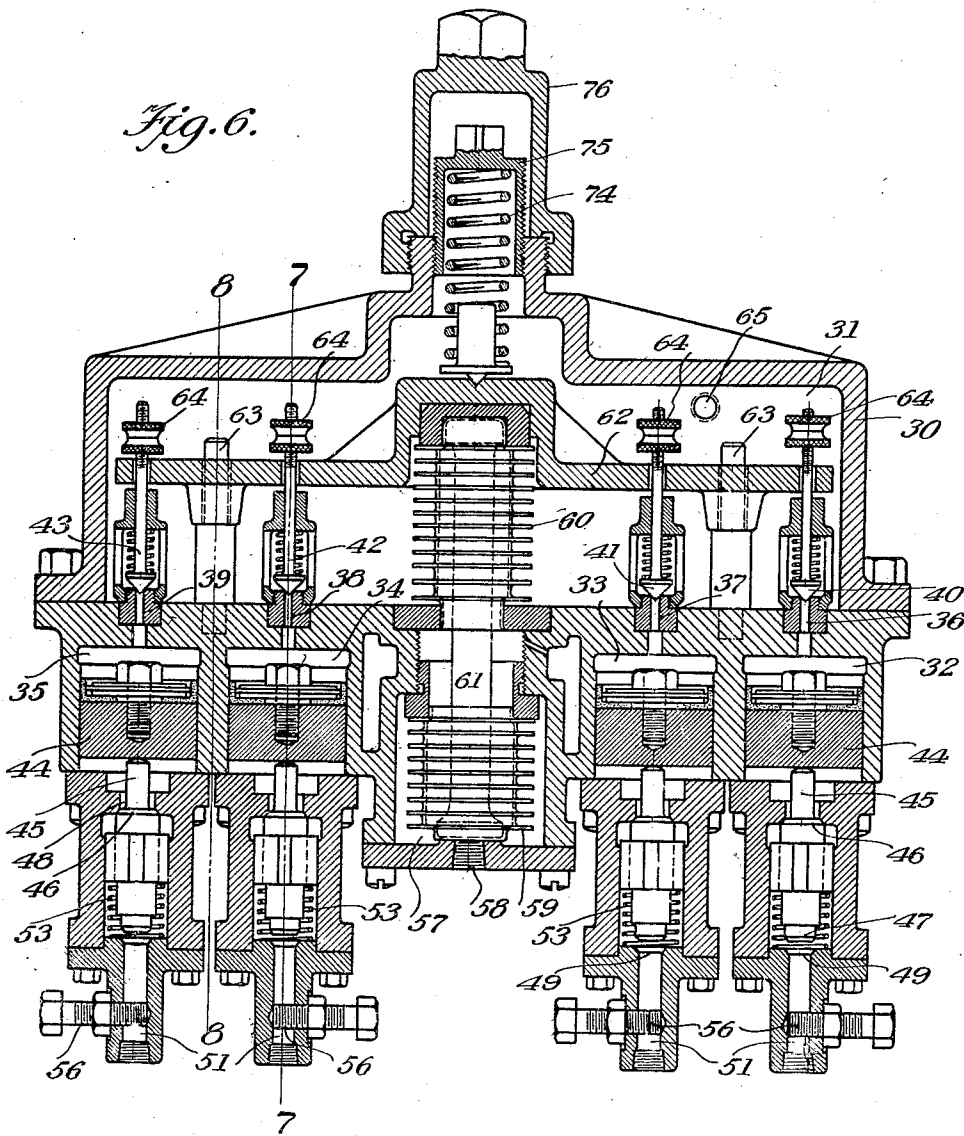
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UNLOADING SYSTEM FOR AIR AND GAS COMPRESSORS

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4 Sheets-Sheet 3



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UNLOADING SYSTEM FOR AIR AND GAS COMPRESSORS

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4 Sheets-Sheet 4

*Fig. 8.*

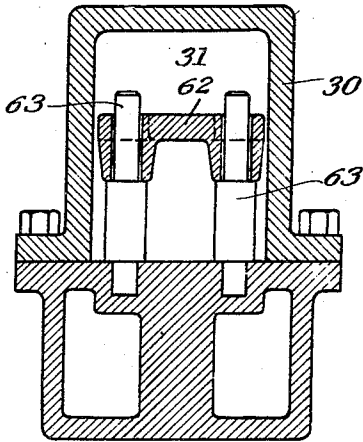


*Fig. 7.*

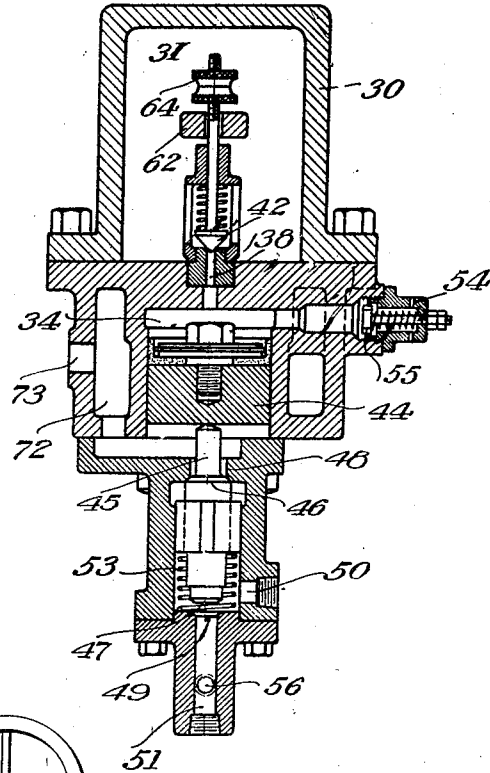


*Fig. 3.*

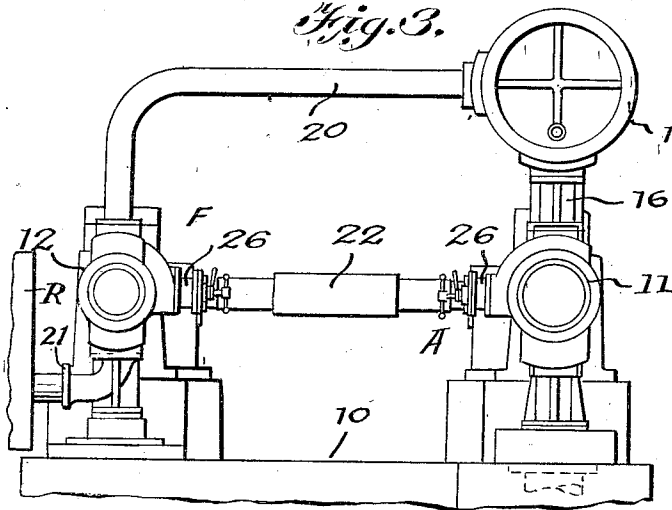
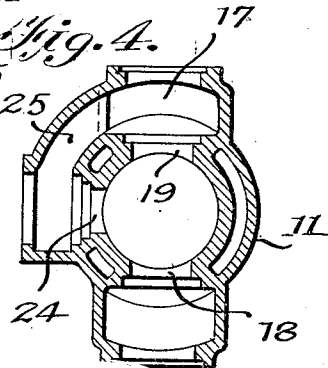


*Fig. 4.*



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## UNITED STATES PATENT OFFICE

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## UNLOADING SYSTEM FOR AIR AND GAS COMPRESSORS

Application filed May 24, 1929. Serial No. 365,751.

This invention relates to unloading systems for air and gas compressors and is an improvement upon the system set forth in Patent No. 1,180,213, granted to me April 18, 1916.

An object of the present invention is to provide means for unloading any one or more of the compressor cylinders by placing the interior of the cylinder or cylinders in communication with an intercooler upon a predetermined pressure within the compressor tank or receiver so that the compressor will operate in accordance with the required load and thus provide for an economy of operation.

Another object of the invention is the provision of means for regulating the degree of pressure at which the cylinder or cylinders will unload, as well as to selectively regulate their order of unloading.

Another object of the invention is the provision of a novel form of governor which is especially adapted for controlling the unloading operation of the cylinders.

With the above and other objects in view, the invention further includes the following novel features and details of construction, to be hereinafter more fully described, illustrated in the accompanying drawings and pointed out in the appended claims.

In the drawings:—

Figure 1 is a plan view of a multiple stage compressor arranged in accordance with the present invention.

Figure 2 is a side elevation of the subject matter of Figure 1.

Figure 3 is an end view.

Figure 4 is a skeleton transverse sectional view through one of the compressor cylinders, the valves and piston being removed.

Figure 5 is a diagram illustrating the manner of connecting the governor and compressor cylinders.

Figure 6 is an enlarged vertical sectional view taken longitudinally through the governor.

Figure 7 is a sectional view on the line 7—7 of Figure 6.

Figure 8 is a like view taken substantially on the line 8—8 of Figure 6.

Referring to the drawings in detail wherein like characters of reference denote corresponding parts, the reference character 10 indicates a base upon which are mounted low pressure cylinders 11 and a high pressure cylinder 12. The low pressure cylinders 11 are supported upon an intake chamber 13 through the medium of hollow supports 14, communication between the intake chamber 13 and the intake ports of the cylinders 11 through the hollow supports 14 being controlled by the usual intake valves (not shown). Mounted above the low pressure cylinders 11 is an intercooler 15. This intercooler is in communication with the exhaust ports of the cylinders 11 through hollow supports 16 and passages 17, communication being controlled by the usual exhaust valves (not shown).

In Figure 4 of the drawings, one of the intake ports is indicated at 18 and one of the exhaust ports at 19. The arrangement of ports just described applies to the low pressure cylinders, the intake and exhaust ports of the high pressure cylinder being reversed. A pipe 20 provides communication between the intercooler 15 and the inlet ports of the high pressure cylinder, while the exhaust ports of the high pressure cylinder discharge through an exhaust pipe 21 to an air tank or receiver R.

A shaft 22 which is common to both the low and high pressure cylinders for the purpose of operating their pistons, may be driven from any suitable source of power.

The foregoing is descriptive of a well known type of compressor, but it is to be understood that this type of compressor is illustrated and described for the purpose of explaining the invention and not to limit the invention to any particular form of compressor.

In addition to the intake and exhaust valves referred to, each compressor cylinder is provided adjacent its head with lateral ports 24. These ports are in communication with the passages 17 and consequently with the intercooler through passages 25 which are arranged circumferentially of the cylinders. The ports 24 are fitted with valve

cages 26 having seats to receive valves 27. The stems 28 of the valves 27 carry at their outer ends pistons 28' which operate in pressure chambers 29. As shown in Figure 5 of the drawings the valves for controlling these lateral passages are separately indicated at A, B, C, D, E, and F, the last two valves extending from the high pressure side of the compressor.

Broadly, it is the purpose of the invention to place the interior of the cylinders in communication with the intercooler of the compressor upon a predetermined pressure in the tank or receiver. To accomplish this, the valves A, B, C, etc., which are normally closed, are opened. The valves are held in closed position by pressure within the tank or receiver and the invention provides means for relieving pressure at one side of the valves so as to provide this communication. The opening of the valves is controlled by a governor which is indicated generally at G and which is in communication with the tank or receiver and with the chambers 29 of each of the valves.

The governor G as illustrated in Figure 6 of the drawings comprises a housing 30. This housing includes a chamber 31 from which extend cylinders 32, 33, 34 and 35. Ports 36, 37, 38 and 39 respectively provide communication between the chamber 31 and the cylinders 32, 33, etc. and these ports are controlled by valves 40, 41, 42 and 43.

The cylinders 32, 33, etc. have operating therein pistons 44 and these pistons engage the stems 45 of double acting valves 46 and 47 respectively. As shown in Figure 7 of the drawings, the valve 46 controls a port 48 while the valve 47 is adapted to be received upon a seat 49 arranged between ports 50 and 51.

The ports 50 just mentioned are in communication with the valve chambers 29 through pipes 52, while the ports 51 are in communication with the tank or receiver through pipes (not shown). Therefore, pressure upon the pistons 28' of the valves A, B, C, etc. is receiver pressure and these valves will be held closed until pressure within the receiver falls to a predetermined degree. The valves 47 are yieldingly held in open position and the valves 46 closed, through the medium of springs 53.

Each of the cylinders 32, 33, etc. is provided with auxiliary exhaust ports 54 which are normally held open by a spring influenced valve 55. Regulating elements 56 are adjustable to control the passage of fluid through the ports 51.

The housing 30 further includes a chamber 57 which is provided at one end with a port 58. This port is also connected to the air receiver through a pipe 58a. Arranged within the chamber 57 is a bellows 59 and this bellows is connected to a bellows 60

within the chamber 31 by means of a distance rod 61. Mounted upon the upper bellows 60 is a yoke 62 and this yoke is provided with openings for the reception of the stems of the valves 40, 41, etc. The yoke 62 is mounted for vertical movement upon guide pins 63 and threadedly mounted upon the stems of the valves 40, 41, etc. are nuts 64. A branch pipe 58b provides communication between the pipe 58a and the chamber 31 through a port 65, so that the chamber 31 is also in communication with the air receiver.

If desired, the ports 51 may communicate with a header 66 and this header may communicate with the air receiver by means of a pipe 67 and a pipe 68. This last mentioned pipe may be provided with a valve 69. A pipe 70 may extend from the pipe 67 to the discharge chamber of the high pressure cylinder of the compressor and this last mentioned pipe may be provided with a control valve 71. In this case, pipe 68 can be opened to atmosphere; then when starting compressor up against air receiver pressure, the valve 71 could be closed and the valve 69 opened. This scheme would provide a means of completely unloading compressor when starting compressor with compressed air in receiver. When compressor is up to speed the valve 69 is closed and valve 71 is opened, thus leaving compressor under control of governor.

When the compressor is working at full load, all of the valves A, B, C, etc. are closed.

Referring to Figure 6, when pressure from the air receiver is sufficient to operate the bellows 59 and 61 to raise the yoke 62, one or more of the valves 40, 41, etc. will be opened by being lifted from its seat. The sequence of operation of these valves is controlled through the medium of the screws 64, and as the screw of the valve 43 is adjusted closest to the yoke 62, this valve will be the first one to open. Conversely, the valve 40 will be the first valve to close upon reverse movement of the yoke. When the valve 43 is lifted from its seat, communication will be established through the port 39 to the cylinder 35, so that receiver pressure which is supplied to the chamber 31 through the port 65 will pass into the cylinder 35. This pressure will close the valve 55 and act upon the piston 44 within this cylinder. As the particular valve A, B, C, etc. which is controlled through the operation of the valve 43 is closed and held closed as long as communication is provided between the ports 50, 51, downward movement of the piston within the cylinder 35 will seat the valve 47 and cut off communication between the air receiver and said valves A, B, C, etc. As the valve 47 is seated, the valve 46 will be unseated, so that pressure may escape from the chamber 29 through the port 50, the port 48 and through

a passage 72 and a port 73 to the atmosphere. As pressure within the chamber 29 is relieved, the valve 27 will be opened so that pressure from the cylinder may pass through the port 24, the passage 25 and the passage 17 to the intercooler. The cylinder whose valve A, B or C is opened will thus be unloaded.

As previously stated, for full load all of the valves A, B, C, etc. are closed. For three-quarter load the valve A is opened; for one-half load the valves B and E are also opened; for one-quarter load the valve C is also opened; for no load the valves D and F are also opened, so that now the compressor cylinders are completely unloaded.

The foregoing is a description of a plural stage compressor comprising a trinity of compressor cylinders, in one of which the final stage of high compression takes place in two compression chambers, and in the others the initial stage of low compression takes place in four compression chambers and all of these compression chambers having communication with the intercooler. This communication is controlled by a valve which is automatically opened at predetermined pressures and determined sequences of operation through the medium of a governor.

In order to control the pressure to which the valves A, B, C, etc. will operate, the governor G is provided with a spring 74 which bears upon the yoke 62 and whose tension is adjustable by means of a threaded adjusting member 75. By adjusting the tension of this spring, more or less resistance may be offered to the operation of the yoke 62. A cap 76 covers the adjusting member 75.

The invention is susceptible of various changes in its form, proportions and minor details of construction and the right is herein reserved to make such changes as properly fall within the scope of the appended claims.

Having described the invention what is claimed is:—

1. In a plural stage compressor the combination of communicating high and low pressure cylinders, a receiver, an intercooler, and means operable upon a predetermined pressure within the receiver to provide continuous communication between the low pressure cylinders and intercooler.

2. In a plural stage compressor the combination of a receiver, an intercooler, and means operable upon a predetermined pressure within the receiver to provide continuous communication between the compressor cylinders and the intercooler.

3. In a plural stage compressor, the combination of a receiver, an intercooler, means operable upon a predetermined pressure within the receiver to provide continuous communication between the compressor cylinders and the intercooler, and means to regulate the degree of pressure at which communication will be provided.

ulate the degree of pressure at which communication will be provided.

4. In a plural stage compressor, the combination of compressor cylinders, an intercooler having communication with the cylinders, pressure operated means to control such communication, means to govern the pressure operated means and means to selectively control the order of operation of the cylinder and intercooler communication controlling means.

5. In a plural stage compressor, the combination of compressor cylinders, an intercooler, means providing communication between the cylinders and intercooler, means to control such communication, and means to selectively regulate the controlling means.

6. In a plural stage compressor, the combination of compressor cylinders, an intercooler, means providing communication between the cylinders and intercooler, a governor to control such communication, and means to set the governor to selectively control the order of communication between the cylinders and intercooler.

7. In a plural stage compressor, the combination of compressor cylinders, an intercooler, means providing communication between the cylinders and intercooler, a pressure controlled valve for each cylinder to control such communication, a pressure operated governor, and means to adjust the governor to regulate the amount of pressure required for the operation of the valves.

8. In a plural stage compressor, the combination of compressor cylinders, an intercooler, means providing communication between the cylinders and intercooler, a pressure controlled valve for each cylinder to control such communication, a pressure operated governor, and means to adjust the governor to control the sequence of operation of the valves.

In testimony whereof I affix my signature.  
CHARLES WAINWRIGHT.