

Nov. 25, 1969

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3,480,201

PACKAGE SYSTEM FOR COMPRESSING GASES

Filed Dec. 29, 1967

3 Sheets-Sheet 1

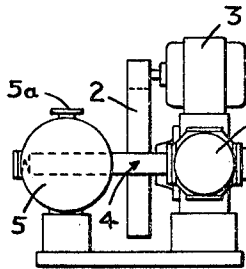


FIG. 1

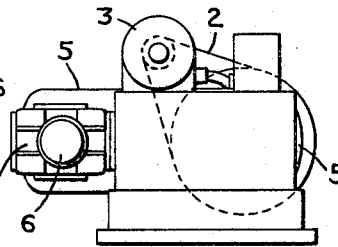


FIG. 2

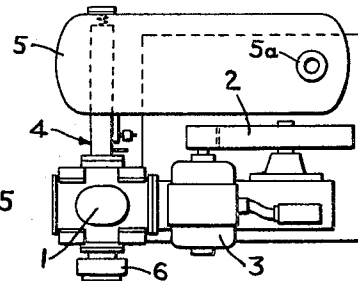


FIG. 3

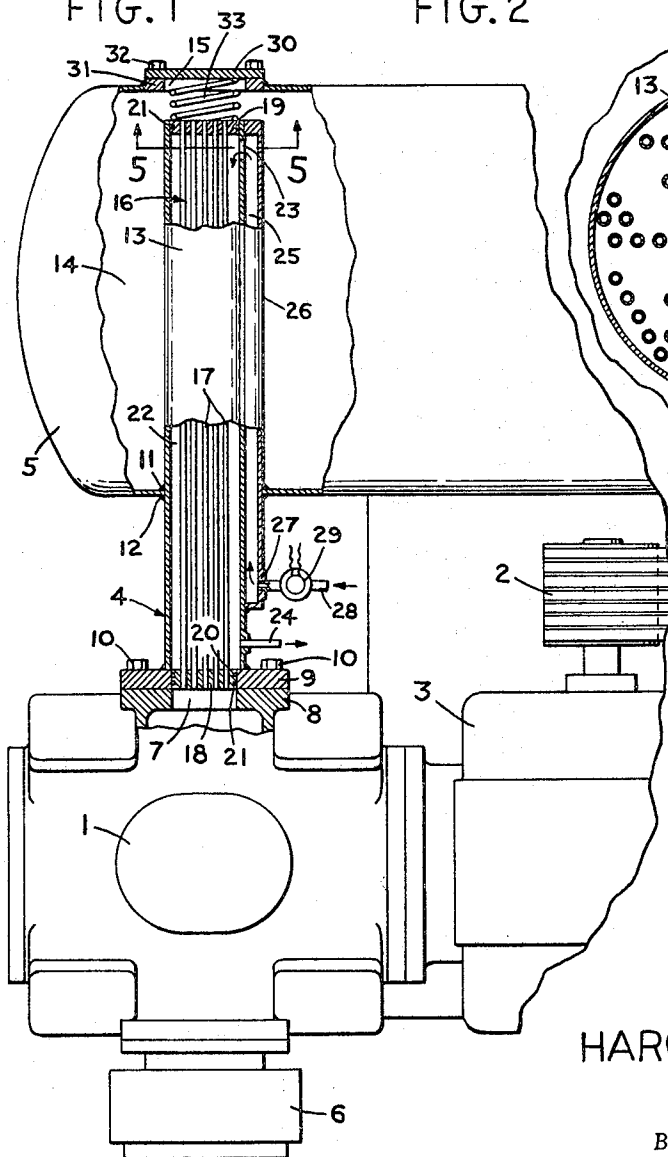


FIG. 4

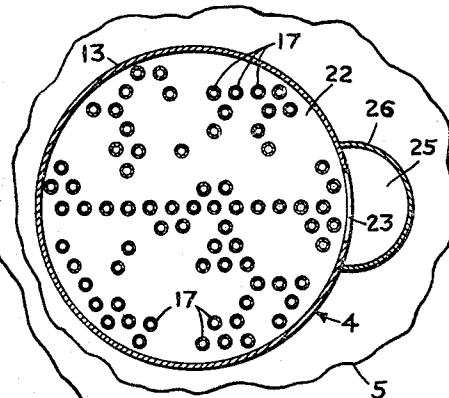


FIG. 5

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3 Sheets-Sheet 2

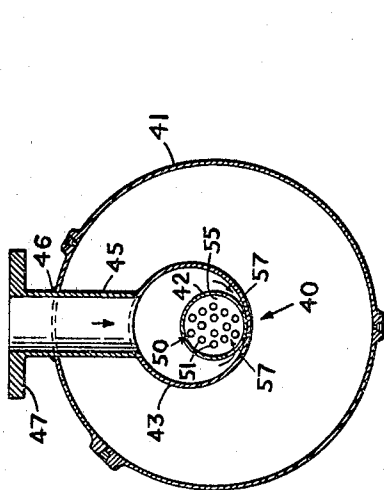


FIG. 9

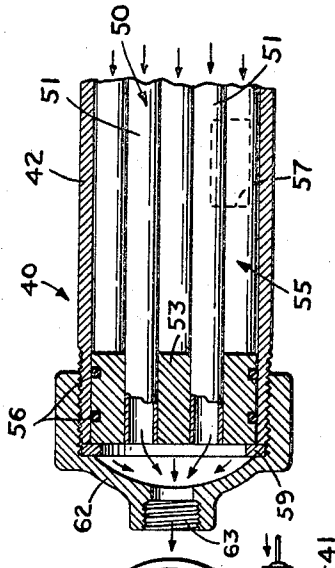


FIG. 10

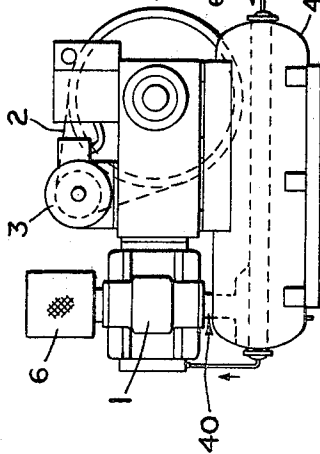
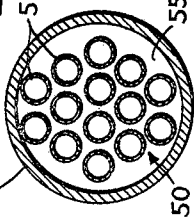


FIG. 6



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FIG. 8

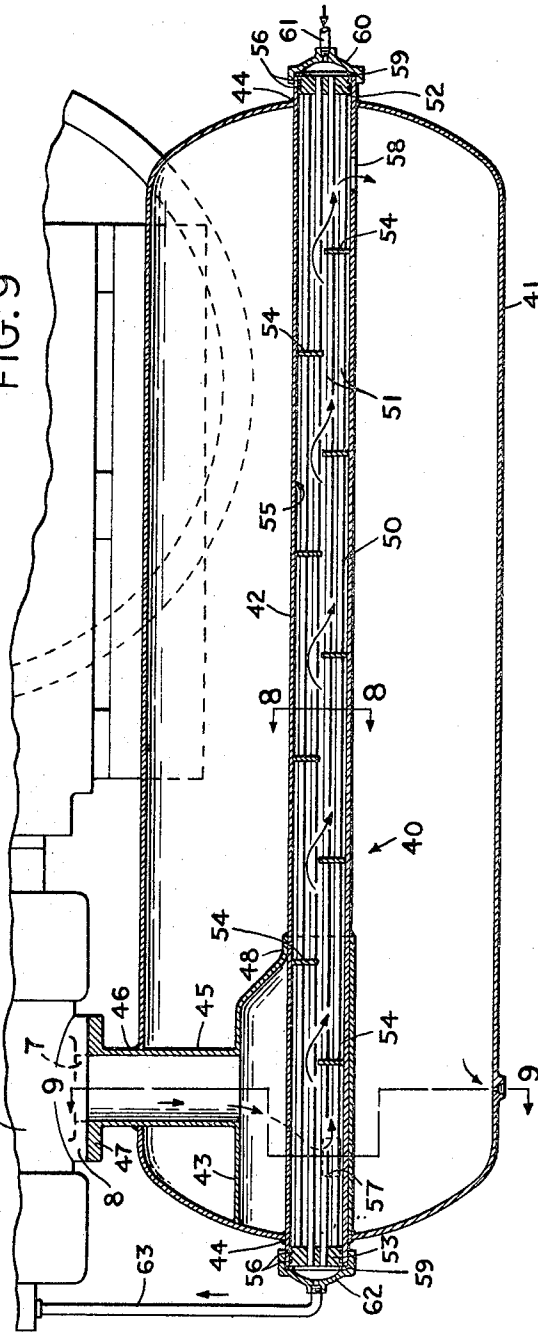


FIG. 7

Nov. 25, 1969

H. W. WHITING

3,480,201

PACKAGE SYSTEM FOR COMPRESSING GASES

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3 Sheets-Sheet 3

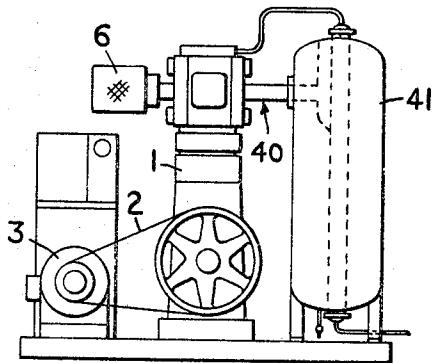


FIG. 11

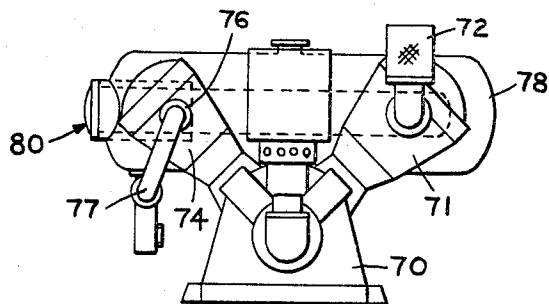


FIG. 12

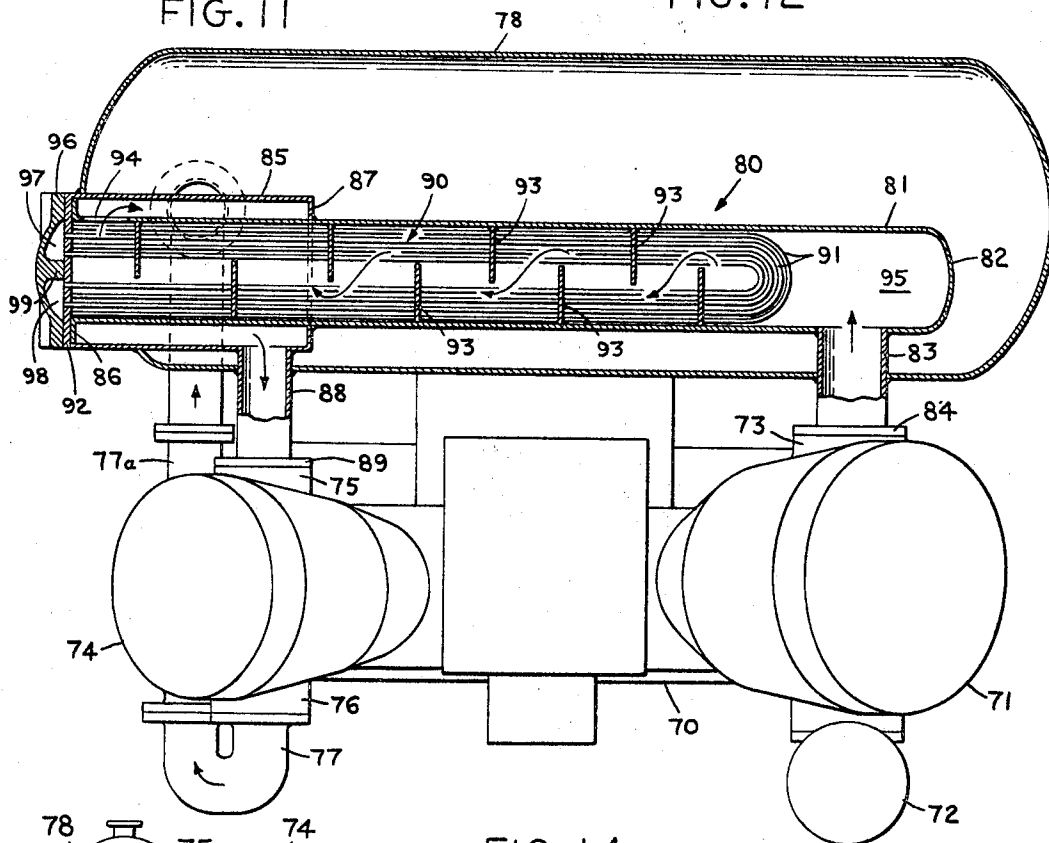


FIG. 14

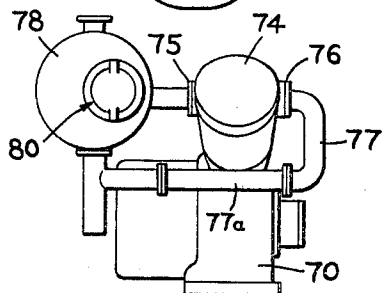


FIG. 13

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1

3,480,201

PACKAGE SYSTEM FOR COMPRESSING GASES
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Int. Cl. F04b 25/00, 39/06; F04c 29/04

U.S. Cl. 230—182

15 Claims

ABSTRACT OF THE DISCLOSURE

The invention relates to a package system for compressing gases wherein a compressing means, a heat exchanger, and a storage receiver for the compressed gases provide a compact assembly by having the heat exchanger connected at one end directly to the discharge outlet of the compressor and having the other end so connected to the receiver that the greater length of the heat exchanger is telescoped or extended into the receiver; the heat exchanger including, a plurality of conduits forming a tube nest therein, and a cooling means being disposed about the tube nest; and means being further provided operatively associated with the receiver to permit the tube nest to be removably held in the heat exchanger in its assembled position in the receiver.

PRIOR ART

Prior art references are U.S. Patents 2,772,828, 2,025,142 and 2,280,845.

It is known in the compressor art to utilize intercoolers and aftercooler heat exchange means for cooling the hot compressed gases being discharged from the compressor.

The broad combination of the compressor, a heat exchange means for hot compressed gases and a receiver is illustrated by U.S. Patent 2,772,828.

It is believed clear, that the said prior art uncovered does not show the interrelated construction of the compressor aftercooler heat exchanger means and receiver of the present invention to provide the desirable advantages hereinafter set for the more particularly for a package system for compressing gases.

The present invention eliminates lengthy pipe connections to conduct hot compressed gases from a compressor discharge outlet to a storage receiver inlet for a package compressor system and this is accomplished by telescoping and forcing the discharge pipe into a heat exchange means between the compressor discharge outlet and the receiver inlet and extending this heat exchange means into the receiver itself a predetermined distance to thereby reduce the spatial distance between the compressor and the storage receiver and simultaneously; providing support for the package system. Easy inspection and disassembly of the parts forming the heat exchange means for the hot compressed gases is also provided by this arrangement.

SUMMARY OF THE INVENTION

Thus, the present invention provides an improved package system for compressing gases including a receiver forming a storage chamber, a compressor having means for delivering compressed gases, and a heat exchange means connected to the compressor means for cooling the hot compressed gases discharged therefrom and for leading the same to the receiver, the heat exchanger being so constructed and arranged that it is positioned primarily within the receiver which encloses a substantial or appreciable portion of its length and is so disposed in the receiver that portions or parts of the heat exchanger can be easily disassembled for inspection after the heat ex-

2

changer is connected in assembled position to the storage receiver.

Accordingly, it is an object of the present invention to provide a simple, low cost, compact package system for compressing gases which eliminates the dangers of fire and explosion.

For a more complete understanding of this invention reference should be made to the following detailed description taken in connection with the accompanying drawings in which:

FIGURE 1 is an end view of a package system for compressing gases in accordance with the present invention.

FIGURE 2 is a side view of the invention shown in FIGURE 1.

FIGURE 3 is a top view of the invention shown in FIGURE 1.

FIGURE 4 is a top view of the heat exchanger and storage receiver means cut-away partly in horizontal section to show the interrelation between the heat exchanger, the discharge of the compressor and the storage receiver.

FIGURE 5 is a cross section taken on line 5—5 of FIGURE 4.

FIGURE 6 is a side view of an alternate arrangement of a package system for compressing gases embodying a modified form of the present invention.

FIGURE 7 is an enlarged vertical section through the heat exchanger and storage receiver of FIGURE 6.

FIGURE 8 is an enlarged cross section taken on line 8—8 of FIGURE 7.

FIGURE 9 is a cross section taken on line 9—9 of FIGURE 7.

FIGURE 10 is an enlarged vertical section through the coolant discharge end of the heat exchanger of FIGURE 7.

FIGURE 11 is a side view of another arrangement of the package system of FIGURE 6.

FIGURE 12 is a side view of a package system for compressing gases which embodies a Y type or two stage compressor and still another form of the present invention.

FIGURE 13 is an end view of the invention shown in FIGURE 12.

FIGURE 14 is an enlarged top view of the package system of FIGURE 12 with the heat exchanger and storage receiver in section.

Referring to the drawings FIGURES 1, 2 and 3 illustrate a package system for compressing gases including a compressor 1 connected by suitable belt driving means 2 to an electric motor 3 for driving the compressor, a heat exchange means generally designated 4 and a storage receiver 5.

The compressor illustrated is of the reciprocating type and includes a suction inlet at 6 and a discharge outlet at 7 shown in more detail in FIGURE 4 of the drawings.

In operation, the electric motor 3 will drive the compressor 1 through the belt means 2 and air or other gas will be drawn in through the suction inlet 6 compressed in the compressor 1 and discharged from the discharge outlet 7 to pass through the heat exchange means 4, as more fully described hereinafter.

The means for driving the compressor, and the operation of the compressor and the parts therefore are not more fully described because such compressors are old and well known in the art of compressing gases.

About the discharge outlet 7 of the compressor 1, a mounting flange 8 is provided to permit the flanged end 9 of the heat exchange means 4 to be connected to said mounting flange as by threaded members 10. The heat exchange member 4 is disposed to extend into the storage receiver 5 for compressed gases a substantial portion of its length through an opening 11 provided at a suitable

3

point on the storage receiver 5, and the heat exchanger 4 is connected to the receiver 5 by any suitable means to render the opening gas tight as by a weldment indicated at 12 or any other suitable means to accomplish this result. The receiver will have the usual outlet 5a for passing the compressed gases stored therein to use.

HEAT EXCHANGER OR AFTERCOOLER MEANS

The heat exchanger 4 acts as an aftercooler means for the hot compressed gases which are discharged through the outlet 7 of the compressor 1, and includes an outer casing or heat exchange housing 13 which has one end connected to the flange 9. The heat exchanger also is disposed in a horizontal plane as shown in the illustrated form of the invention in FIGURES 1 to 3 and extends through the opening 11 into the storage chamber 14 formed by the storage receiver 5 for a substantial portion of its length so that the end remote from the end connected to the mounting flange 9 lies relatively close to an access opening 15 formed in the wall of the storage receiver 5 for purposes which will appear clear hereinafter.

In order to convey hot compressed gases from the discharge outlet 7 of the compressor 1 to the storage chamber 14 of the receiver 5, a unitary cooling means such as a tube nest generally designated 16 which includes a plurality of conduits 17 connected at the ends thereof to tube headers 18 and 19, as provided. The header 18 is mounted in a bore 20 formed in the mounting flange 9, and header 19 is disposed to engage the inner wall of the casing or heat exchanger housing 13 adjacent the end thereof within the storage chamber 14.

Headers 18 and 19 are provided with O rings 21, as shown, to seal the ends of a fluid type cooling chamber 22 formed within the casing or heat exchanger housing 13 about the conduits 17 of the tube nest 16. Cooling chamber 22 has cooling fluid introduced therein through a port 23 in the casing or heat exchange housing 13 adjacent the end thereof remote from the end connected to the mounting flange 9. This received cooling fluid passes around the conduits 17 and will be discharged through a cooling fluid outlet 24 adjacent the end of the heat exchange housing or casing 13 connected to the mounting flange 9.

The port 23 provides communication between the fluid tight cooling chamber 22 and a chamber 25 formed in a pre-cooler means 26 disposed on the outer surface of the casing or heat exchange housing 13, which also functions as a conduit for the cooling fluid because of the telescoped position of the heat exchanger 4 in assembled position in the storage receiver 5.

The pre-cooler means 26 for the cooling fluid has a cooling fluid inlet 27 connected to an inlet supply line 28 which communicates with a suitable source of cooling fluid for the heat exchanger 4 all of which is clearly shown in FIGURES 4 and 5 of the drawings. FIGURE 5 further shows a solenoid operated valve 29 in the inlet line 28 to control the flow of cooling fluid to the heat exchanger means 4.

It is believed that those skilled in this art will understand that the solenoid operated valve 29 can be controlled automatically by any suitable, simple, electrical current carrying circuit to initiate the flow of cooling fluid either responsive to the starting of the electric motor 3 or to any number of variables such as the temperature of the hot compressed gases being discharged from the discharge outlet 7; or the temperature of the gases in the storage receiver 5. It should be further understood, that while a solenoid operated valve 29 is illustrated, that an air or hydraulically operated valve could also be used for this purpose without departing from the spirit of the present invention.

Further, however, while an automatic solenoid operated valve 29 is illustrated in the inlet line 28, a manually operated valve could be utilized in place thereof so

4

as to control the flow of fluid through the heat exchanger 4.

The access opening 15 will permit the tube nest 16 to be assembled into or removed from the heat exchanger 4 and is provided with an access cover means 30 which is connected to an access opening flange 31, disposed about the access opening 15, as by threaded members 32.

In order to hold the tube nest 16 in assembled position during operation, a spring member 33 is provided between the access cover member 30 and the outer end of the header 19 all which is shown in FIGURE 4 of the drawings. Any other suitable means for holding the tube nest in position can be utilized when the position of the tube nest 16 is altered, as for example in its use with a vertically disposed compressor and receiver arrangement as distinguishable from the horizontally disposed arrangement shown in FIGURES 1 to 3 illustrating the present invention.

OPERATION

After the package system for compressing gases is assembled in the manner above described, the electric motor 3 will be placed in operation to drive compressor 1 as was heretofore discussed.

If the solenoid operated valve 29 is responsive to the starting of the electric motor 3, the solenoid will move its valve to open position and cooling fluid will flow from the inlet line 28 to the cooling fluid water inlet 27, and through the pre-cooler chamber 25 and port 23 into the fluid tight cooling fluid chamber 22. Hot compressed gases passing from the discharge outlet 7 of the compressor 1 and through the conduits 17 of the tube nest 16 will be cooled by the cooling fluid, and the cooled gases will pass from the ends of the conduits 17 into the storage chamber 14 formed by the storage receiver 5 until such compressed gases are needed for use.

The heat exchanger 4 thus performs its function as an aftercooler and because of the compact construction only a limited length of the heat exchanger is exposed. This exposed limited length of heat exchanger 4 acts to substantially eliminate the dangers of fire and explosion inherent in the prior art systems which include hot discharge lines or elements between a compressor and a storage receiver.

The present compact construction also eliminates other piping problems, aids the appearance of the unit and reduces the space requirements thereof.

ALTERNATE PACKAGE SYSTEM ARRANGEMENTS

Referring now to FIGURE 6, the horizontally disposed compressor 1 with its belt driving means 2 and the electric motor 3 are positioned substantially as in FIGURES 1 to 3 except for the compressor head which is rotated 90° so the suction inlet is disposed at the top. The compressor 1 is positioned above a modified form of heat exchange means 40 and storage receiver 41 which also are horizontally disposed.

The package system of FIGURE 6 may be rearranged as is shown in FIGURE 11 wherein the modified heat exchanger means 40 and storage receiver 41 are positioned vertically and are laterally spaced from the electric motor 3. The compressor 1 is positioned vertically and between the electric motor 3 and the storage receiver 41. Therefore, the heat exchanger means 40 is connected to one side of the compressor 1 and the suction inlet 6 is disposed generally above the motor 3.

It should be understood that the compressor 1 with its belt driving means 2 and the electric motor 3 may be packages in any of the three arrangements shown in FIGURES 1, 6 and 11 with either the heat exchanger means 4 and the storage receiver 5 or the modified heat exchanger means 40 and storage receiver 41.

MODIFIED HEAT EXCHANGER MEANS

The modified heat exchanger means, as shown in FIGURES 7 and 9 may be considered to have a heat transfer

5

portion contained within a tubular casing 42, and an inlet manifold portion 43 to receive compressed gases to be cooled. The tubular casing 42 extends the full axial length of the storage receiver 41 and through openings in its ends. The ends of the receiver 41 and the adjacent portions of the tubular casing 42 are connected by any suitable means such as by weldments as indicated at 44 to render these connections gas tight.

The manifold 43 has a tubular inlet 45 which extends through the side of the receiver 41 at its end which is adjacent the head of the compressor 1. The inlet 45 also is suitably connected to the receiver 41 by any suitable means such as a weldment as indicated at 46 to render the resulting connection gas tight, and has an end flange 47, corresponding to the flange 9 of the heat exchange means 4, to be connected by any suitable means to the flange 8 at the compressor outlet or discharge 7.

The manifold 43 encircles the end of the tubular casing 42 within the storage receiver 41 and is transversely offset toward its inlet 45. One end of the manifold 43 is suitably connected to the end of the receiver 41 providing a gas tight juncture while the other end is necked down to provide a tight fitting sleeve portion 48 which is sealingly connected to the tubular casing 42.

Also referring to FIGURES 8 and 10, a tube nest 50 includes a plurality of conduits 51 connected at the ends thereof to a pair of axially spaced tube headers 52 and 53, as shown, which are positioned in opposite ends of the tubular casing 42 of the heat exchanger means 40. The tube nest 50 also preferably includes a plurality of baffles 54 which are fixedly connected at substantially equally spaced intervals between the headers 52 and 53 to a plurality of the conduits 51. The baffles 54 extend from one side of the casing 42 toward, but short of, the other side and are positioned to cause gas flow along the tube nest 50 to follow a tortuous path as will be further discussed.

The tubular casing 42 together with the headers 52 and 53 define an intercooling chamber 55. The headers 52 and 53 are provided with O rings the ends of the intercooling chamber 55. The tubular casing 42 has one or more openings or ports 57 within the manifold 43 forming the inlet for the chamber 55 while the outlet thereof is formed by one or more openings or ports 58 provided in the other end of the tubular casing.

An end cap or cover 60, connected to an inlet line 61 providing cooling fluid from a source (not shown), is connected to the exposed end of the tubular casing 42 which is remote from the manifold 43 and outwardly of the end of the receiver 41. A corresponding end cap 62, connected to a cooling fluid outlet line 63, is connected to the other exposed end of the tubular casing 42.

To prevent the tube nest 50 from moving axially in the tubular casing 42, annular spacers or spacer means 59 are provided in the end caps 60 and 62 and engage the headers 52 and 53, respectively.

In operation, cooling fluid from the inlet line 61 is provided to the end cap 60, flows through the conduits 51 of the tube nest 50 to the end cap 62, and exhausts from the heat exchanger means 40 through the outlet line 63. Simultaneously, hot compressed gases from the outlet 7 of the compressor 1 enter the manifold 43 through its tubular inlet 45.

The compressed gases in the manifold 43 pass through the inlet port or ports 57 to the intercooling chamber 55 and flow axially the full length thereof to the outlet port or ports 58 where the cooled compressed gases exhaust into the storage receiver 41 and are retained until required for use. The baffles 54 causes the flow in the intercooling chamber 55 to cause an undulating or swirling path from the chamber inlet 57 to the chamber outlet 58 and insures that the flowing gases will intimately contact the conduits 51 for maximum available cooling.

As was previously discussed, the conduits 51 are connected to the headers 52 and 53, and to the baffles 54 to form the tube nest 50 which is merely restrained from

6

movement within the tubular casing 42 by the spacer means 59 and the end caps 60 and 62. Therefore, it will be seen that the tube nest 50 can be axially removed from the casing 42 merely by removing the spacer means 59 and the end caps 60 and 62. This is accomplished without disturbing the cooling fluid connections, the intercooler inlet connection to the compressor and the assembly of the intercooler or heat exchanger means within the storage receiver.

While two forms of heat exchanger means made in accordance with the present invention have been described as being embodied in various package system arrangements and performing aftercooling functions, there is no intent to define the limits of the present invention thereby. As will now be described, a heat exchanger means made in accordance with the present invention can be embodied in a package system with a Y type or multi-stage compressor, and perform an interstage cooling function.

PACKAGE SYSTEM WITH MULTI-STAGE COMPRESSOR

Referring now to FIGURES 12 to 14 of the drawings, a Y type compressor 70 is provided with a first stage head 71 and a second stage head 72 each generally corresponding to the single head of the compressor 1. The first stage head 71 has a suction inlet 72 for receiving gases to be compressed and an outlet 73 for first stage compressed gases to be cooled. Similarly, the second stage head 74 has a suction inlet 75 to receive cooled first stage compressed gases and an outlet 76 which is connected to the storage receiver 78 by a suitable conduit indicated generally at 77 having a tubular type aftercooler 77a therein of conventional and well known design to recool these compressed gases.

A heat exchanger means 80, made in accordance with the present invention, is disposed in the storage receiver 78 and is suitably connected between the first and second compressor stages 71 and 74 to perform an interstage cooling function.

INTERSTAGE HEAT EXCHANGER MEANS

As is best shown in FIGURE 14 of the drawings, the heat exchanger means 80 has a tubular casing 81 which is closed at one end, which is adjacent the first stage compressor head 71, by a wall 82. The other end of the tubular casing 81 is open and extends through the end of the storage receiver 78 adjacent to the second stage compressor head 74.

The heat exchanger means 80 is provided with a tubular inlet 83 for hot first stage compressed gases which extends from the closed end of the tubular casing 81 through the side of the storage receiver 78 and is connected thereto by a weldment or any other suitable means which will provide a gas tight juncture, as heretofore discussed. The end of the tubular inlet 83 is provided with a flange 84 which is suitably connected to the first stage outlet 73 as has been previously discussed relative to the outlet connection of the compressor 1.

A manifold 85 for cooled compressed gases encircles the open end of the tubular casing 81 and is closed at its ends by an annular wall 86 disposed around the exposed edge of casing 81 and a similar annular wall 87 spaced axially therefrom. By means similar to those provided to connect manifold 43 in the heat exchange means 40 of FIGURE 7, the manifold 85 and its end walls 86 and 87 are sealingly connected to the receiver 78 and the tubular casing 81, respectively, by weldments or any other suitable means for providing gas tight joints.

The manifold 85 has a tubular outlet 88 for cooled compressed gases which extends through the side of the receiver 78 and is provided with an end flange 89. The tubular outlet 88 and its flange 89 are connected to the receiver 79 and the second stage compressor inlet 75, respectively, in a manner similar to the connection of the tubular inlet 83 and its flange 84.

A tube nest 90 includes a plurality of U shaped conduits 91 each being connected at its ends to diametrically

opposite sides of a header 92. The tube nest 90 also includes a plurality baffles 93 which are spaced axially from the header 92. The baffles 93, like baffles 54, are connected to a plurality of the conduits 91 and do not fully extend from one side of the tubular casing 81 to its other side. Therefore, as in the heat exchanger means 40, gas flow across the tube nest 90 is caused to course a tortuous path.

As shown, the baffles 93 may be connected to and extend across opposite legs of the U shaped conduits alternately to insure intimate contact by the flowing gases along the full lengths of the conduits 91 for maximum cooling.

The tubular casing 81 is provided with one or more ports or openings 94 disposed between the end walls 86 and 87 of the manifold 85 forming the outlet of an intercooling chamber 95 defined by the casing 81 between its end wall 82 and the header 92. The header 92 overlies the annular wall 86 of the manifold 85 and a suitable sealing means, such as a gasket, is provided therebetween.

A sealed cap or cover 96 is suitably connected to the open end of the heat exchanger means 80 and overlies the header 92. The cover 96 has a pair of recesses in its inner face which with the header 92 form a pair of chambers 97 and 98 which are isolated from each other by a diametrical wall 99. One of the chambers 97 and 98, which are in communication with opposite ends of the conduits 91, is connected to receive cooling fluid from an inlet line (not shown) while the other of the chambers is connected to discharge the cooling fluid to an outlet line (not shown).

In operation, cooling fluid which is provided to one of the chambers 97 or 98 flows through the conduits 91 to the other of the chambers 97 or 98 where the cooling fluid is exhausted.

Simultaneously, hot first stage compressed gases entering the tubular inlet 83, flow the length of the intercooling chamber 95 to the chamber outlet 94 and thereupon enter the manifold 85. The cooled first stage compressed gases in the manifold 85 are provided by the tubular outlet 88 to the second compressor stage 74 to be further compressed and delivered by the conduit means 77 to the storage receiver 78.

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. In a compact system for compressing gases and providing a source of such compressed gases to be used when required, a combination comprising:

a compressor means providing compressed gases;
a receiver forming a storage chamber for compressed gases prior to delivery thereof for use;
heat exchange means assembled with an appreciable portion of its length disposed within said receiver and connected thereto;

said heat exchanger means including an inlet connected to said compressor means for receiving compressed gases, an outlet for cooled compressed gases, a removable unitary means between said inlet and outlet for cooling compressed gases during flow thereof in said heat exchanger means, and said heat exchange means also including a tubular casing connected to said receiver, said tubular casing having at least one port therethrough forming said outlet of said heat exchanger means providing communication between said tubular casing and said receiver; and

means for removably retaining said unitary cooling means in said heat exchanger means so as to permit its insertion into and its removal from said heat exchanger means with the connections of said heat exchanger means to said compressor means and said receiver being undisturbed.

2. The compact system in accordance with claim 1, wherein:

a manifold to receive compressed gases to be cooled encircles a portion of the length of said tubular casing within said receiver at the inlet end of said heat exchanger means, said manifold communicating with said inlet and with said tubular casing, said tubular casing having at least one port therethrough within said manifold;

said unitary cooling means comprising a tube nest including header means and a plurality of conduits each connected at its ends to said header means;

said tubular casing and header means defining an intercooling chamber and said plurality of conduits being disposed in said intercooling chamber thereby providing said heat exchanger means with two flow paths each being independent of the other;

said inlet and outlet of said heat exchanger means being in communication with the opposite ends of one of said two flow paths; and

cooling fluid inlet and outlet means being connected to said heat exchanger means and being in communication with opposite ends of the other of said two flow paths.

3. The compact system in accordance with claim 2, wherein:

(a) said inlet and outlet of said heat exchanger means are in communication with opposite ends of said intercooling chamber;

(b) said tube nest further includes a plurality of baffles disposed in said intercooling chamber in an axially spaced series between said inlet and outlet; and

(c) each of said baffles being connected to a plurality of said conduits and extending across said intercooling chamber from one side thereof and spaced from the opposite side thereby causing flow of compressed gases to course a tortuous path between said inlet and outlet.

4. The compact system in accordance with claim 2, wherein:

(a) said tubular casing extends through opposite ends of said receiver;

(b) said header means comprises a pair of spaced headers each disposed in one end of said tubular casing opposite from the other;

(c) said means for removably retaining said unitary cooling means comprising a pair of caps each being removably connected to and closing a different end of said tubular casing; and

(d) said cooling fluid inlet and outlet means each being connected to a different one of said pair of caps.

5. The compact system in accordance with claim 2, wherein:

a pair of tubular means each connected at one end to said tubular casing provide said inlet and outlet of said heat exchanger means; and

said pair of tubular means extending through the side of said receiver each at an end thereof opposite from the other.

6. The compact system in accordance with claim 5, wherein:

(a) said compressor means has a first stage and a second stage each including a suction inlet and an outlet;

(b) said first stage suction inlet being adapted to receive gases to be compressed and said first stage outlet being connected to said tubular inlet means; and

(c) said second stage suction inlet being connected to said tubular outlet means and said second stage outlet being connected to said receiver.

7. The compact system in accordance with claim 5, wherein:

(a) at least one of said tubular means comprises a tubular portion encircling one end of said tubular casing and having a pair of annular end walls connected to said tubular casing to form a manifold;

(b) said manifold having a tubular member connected

at one end to said tubular portion and extending therefrom through the side of said receiver; and
(c) said tubular casing having a port therethrough and between said pair of annular end walls providing communication between said intercooling chamber and said manifold.

8. The compact system in accordance with claim 2, wherein:

- (a) said tubular casing extends into said receiver with one end being disposed in said receiver and the other end being exposed;
- (b) said end of said tubular casing disposed in said receiver being closed and defining one end of said intercooling chamber;
- (c) said header means comprising a single disposed across and an closing said exposed end of said tubular casing and defining the other end of said intercooling chamber;
- (d) said plurality of conduits each being of U shape with its ends connected to diametrically opposite sides of said header;
- (e) said means for removably retaining said unitary cooling means comprising a cover overlying said header and being removably connected to said exposed end of said tubular casing;
- (f) said cover having a pair of recesses therein which with said header form two chambers each isolated from the other and in communication with opposite ends of said conduits; and
- (g) said cooling fluid inlet and outlet means being connected to said cover and in communication with a different one of said pair of recesses.

9. The compact system in accordance with claim 8, wherein:

- (a) said tubular casing has at least one port there-through at its closed end forming said outlet of said heat exchanger means providing communication between said intercooling chamber and said receiver.

10. The compact system in accordance with claim 8, wherein:

- (a) a pair of tubular means each connected at one end to said tubular casing provide said inlet and outlet of said heat exchanger means; and
- (b) said pair of tubular means each extending from one end of said tubular casing opposite from the other and through the side of said receiver.

11. The compact system in accordance with claim 10, wherein:

- (a) said compressor means has a first stage and a second stage each including a suction inlet and an outlet;
- (b) said first stage suction inlet being adapted to receive gases to be compressed and said first stage outlet being connected to said tubular inlet means; and
- (c) said second stage suction inlet being connected to said tubular outlet means and said second stage outlet being connected to said receiver.

12. The compact system in accordance with claim 10, wherein:

- (a) at least one of said tubular means comprises a tubular portion encircling one end of said tubular casing and having a pair of annular end walls connected to said tubular casing to form a manifold;
- (b) said manifold having a tubular member connected at one end to said tubular portion and extending therefrom through the side of said receiver; and
- (c) said tubular casing having a port therethrough and between said pair of annular end walls providing communication between intercooling chamber and said manifold.

13. The compact system in accordance with claim 1, wherein:

- (a) said heat exchanger means further includes a tubular casing connected to said receiver;
- (b) said tubular casing having an exposed end and extending therefrom through the side of said receiver and terminating with its other enclosed end spaced from the opposite side of said receiver;
- (c) said exposed casing end providing said inlet and being connected to said compressor means, and said enclosed casing end providing said outlet;
- (d) said unitary cooling means comprising a tube nest including a pair of headers each disposed in a different end of said tubular casing, and a plurality of conduits each connected at its ends to said headers;
- (e) said tubular casing and headers defining an intercooling chamber for cooling fluid which is coextensive with said plurality of conduits through which compressed gases flow;
- (f) said cooling fluid inlet means being connected to said enclosed casing end in communication with the end of said chamber thereat; and
- (g) said cooling fluid outlet means being connected to said exposed casing end and in communication with the end of said chamber thereat.

14. The compact system in accordance with claim 13, wherein:

- (a) said cooling fluid inlet means includes a fluid conduit and a fluid inlet line;
- (b) said fluid conduit being disposed on the tubular casing with an exposed end outward of said receiver and its other end adjacent the enclosed tubular casing end and in communication with the end of the intercooling chamber thereat;
- (c) said fluid inlet line being connected to the exposed end of said fluid conduit; and
- (d) said cooling fluid outlet means including an outlet line connected to the exposed end of said tubular casing and in communication with the end of said intercooling chamber thereat.

15. The compact system in accordance with claim 13, wherein:

- (a) the side of the receiver spaced from the enclosed end of said tubular casing having an opening aligned with said casing; and
- (b) said means releasably retaining said unitary cooling means including a cover releasably connected to said receiver closing the opening aligned with said tubular casing, and a spring disposed in compression between said cover and said header disposed in the enclosed end of said tubular casing.

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230—208, 210