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ROTARY INJECTOR COMPRESSOR

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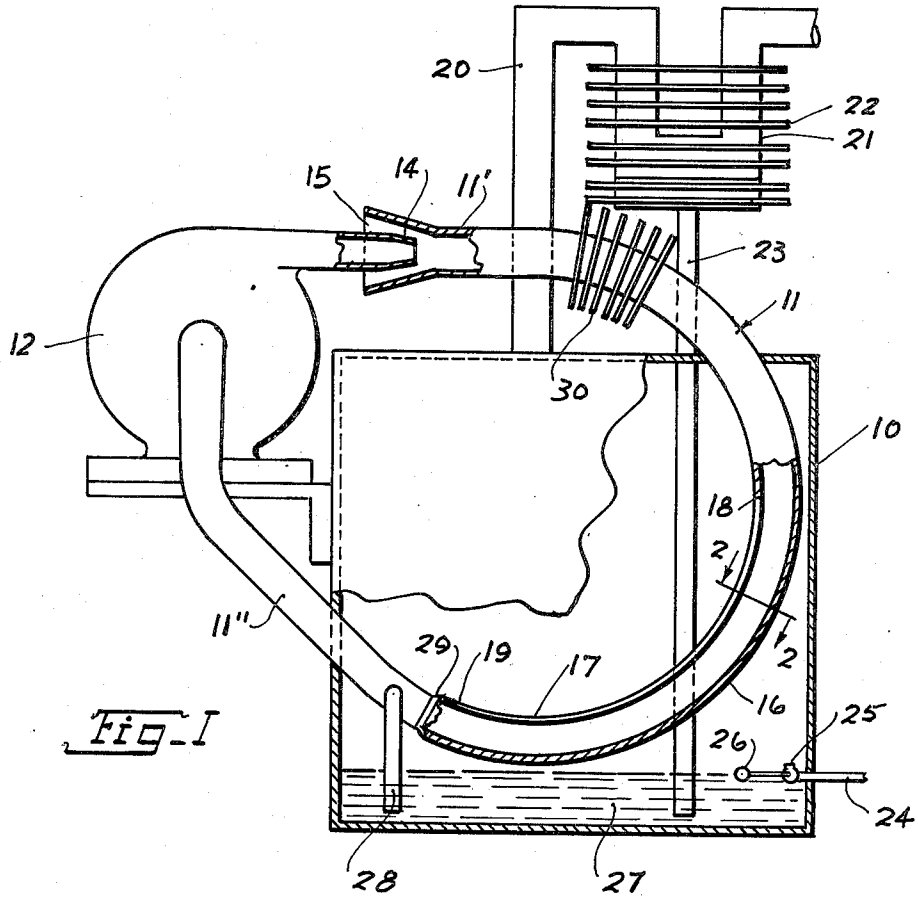


Fig. 1

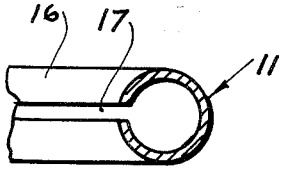


Fig. 2

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ROTARY INJECTOR COMPRESSOR

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4 Claims. (Cl. 230—108)

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This invention relates to new and useful improvements in rotary injector compressors.

More particularly, the invention relates to a gas (or vapor) compressor using the velocity of a liquid to carry the gas or vapor into a tank. An arrangement is proposed whereby the gas or vapor is compressed as it is forced into the tank by the kinetic energy of the liquid stream.

More specifically, the invention proposes a relatively short pipe system and a centrifugal pump for circulating a liquid at high velocity through the pipe system. It is an object of this invention to arrange the pipe system so as to extend from a front point exterior of a tank for collecting and storing the compressed gases through and out of said tank. It is proposed that the pipe system include a liquid nozzle and a gas intake nozzle located at said front point exterior of said tank and cooperative with each other for drawing in and compressing gases into said pipe system. It is an important object of this invention to provide the pipe system with a centrifuge within the tank and to the back of said front point for centrifugally separating and releasing into the tank said compressed gases from the liquid in said pipe system.

Another object of this invention is to arrange the pipe system in an endless fashion so that the same liquid may circulate around and around during the operation of the compressor. With this arrangement the power required for compressing gases is relatively small since the liquid is at all times circulating at a high speed and power is merely required to overcome frictional and other loses and for the work necessary in compressing the gases.

The invention also proposes simple means for replacing liquid which may be lost from the endless pipe system.

It is also proposed to provide means for cooling the compressed gases.

Another object of the invention is the construction of a device as described which is simple and durable and which may be manufactured and sold at a reasonable cost.

For further comprehension of the invention, and of the objects and advantages thereof, reference will be had to the following description and accompanying drawing, and to the appended claims in which the various novel features of the invention are more particularly set forth.

In the accompanying drawing forming a material part of this disclosure:

Fig. 1 is an elevational view of a rotary injector compressor constructed in accordance with this invention, certain parts being broken away to disclose interior parts.

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Fig. 2 is a fragmentary enlarged sectional view taken on the line 2—2 of Fig. 1.

The new rotary injector compressor, in accordance with this invention, includes a tank 10 for storing compressed gases and a pipe system 11 associated with the tank 10 in a certain way. Means is provided for circulating a liquid at high velocity through said pipe system 11. Preferably, this means comprises a driven centrifugal pump 12. The pipe system 11 extends from a front point 11' exterior of said tank 10 through and out of said tank to a back point 11''. The pipe system 11 includes a liquid nozzle 14 connected with the discharge of the centrifugal pump 12 and cooperative with a gas intake nozzle 15. These nozzles 14 and 15 are located at said front point 11' exterior of the tank 10. The nozzles 14 and 15 are cooperative with each other for drawing in and compressing gases into said pipe system 11.

The pipe system 11 also includes a centrifuge 16 within the tank 10 and to the back of said front point 11' for centrifugally separating and releasing into said tank 10 said compressed gases from the pipe system. This centrifuge 16 comprises merely an annular-like pipe portion having a slot 17 or other opening or openings extended along a portion of its inside diameter. The slot 17 extends from a point 18 in the vicinity of a horizontal plane through the center of curvature of the centrifuge 16 to a point 19 at the bottom of the centrifuge 16. The liquid passing through the centrifuge 16 will be thrown outwards by centrifugal force causing the air to separate. The air will escape out through the slot 17 and into the tank 10. The pipe system 11 is endless because the back point 11'' is connected with the intake of the pump 12, while the nozzle 14 is connected with the discharge of said pump.

The tank 10 is provided with a discharge pipe 20 for connection with a utilizer of the compressed gases. This discharge pipe 20 is provided with a trap 21 for condensing and collecting liquid which may be escaping through the discharge pipe 20. The trap 21 is provided with cooling means 22 for condensing the liquid vapors in the gases. A tube 23 extends from the trap 21 into the tank 10 for discharging the condensate back into the tank 10. The tank 10 is provided, near its bottom, with a liquid supply pipe 24 which is controlled by a valve 25 controlled by a float 26 so as to maintain liquid 27

in the bottom of the tank 10 at a level, as illustrated in the drawing. The condensate return pipe 23 extends into the liquid 27. A tube 28 connects with the pipe system 11 back of the point 19 and extends into the liquid 27 so that the pump 12 may draw needed liquid into the pipe system 11. Preferably, the pipe system 11 in back of the point 19, particularly, at the point 29, contracts slightly in diameter since past this point the pipe system contains only liquid and therefore it need not be so large in cross section as before the point 19 where it contains liquid and gases. Cooling means 30 is mounted upon the pipe system 11 for cooling the compressed gases.

A typical cycle of operation of the new rotary injector compressor may be understood from the following:

As illustrated in Fig. 1 the mixture of gases being compressed is atmospheric air and the liquid used in the system may be water. The centrifugal pump 12 rapidly circulates the water through the pipe system 11. The water emerging from the nozzle 14 at a high velocity draws in atmospheric air through the nozzle 15 and into the pipe system 11. The drawn in air is compressed and cooled as it passes the cooling means 30. The compressed air and water are separated by centrifugal force as they pass through the centrifuge 16. The water being heavier than the air is thrown to the outer circumference of the centrifuge 16 and the air is forced from the centrifuge through the slot 17 into the tank 10. The stream of water continues at a high velocity to the inlet of the centrifugal pump 12 because of its velocity and pressure energy. The velocity of the water is increased by the pump 12 and the cycle of operation repeats.

Any water escaping from the pipe system 11 with the compressed air through the discharge pipe 20 is condensed and discharged into the bottom of the tank 10 and re-enters the pipe system 11 through the small tube 28. Any water permanently lost from the circulating system is replenished by the float controlled valve 25 opening the water supply 24 for maintaining the level of the reserve water 27 in the tank 10. The kinetic energy of the water stream emerging from the pump 12 is approximately equal to the energy required to compress the air, plus the frictional losses in the pipe system 11 and pump 12, plus the kinetic energy and pressure energy of the water entering the pump 12.

The overall efficiency of the pump 12 is high because it does not have the divergent nozzles which are required to convert velocity energy into pressure energy in the ordinary centrifugal pump. The air is compressed approximately isothermally so that the heat of compression is relatively low. The pipe system 11 has a very smooth interior to minimize friction losses. Therefore the combined elements of this compressor make the compressor highly efficient and there are no reciprocating parts.

One use for this rotary injector compressor would be to supply air at constant pressure to a prime mover to operate on the Joule cycle for heat engines.

While I have illustrated and described the preferred embodiment of my invention, it is to be understood that I do not limit myself to the precise construction herein disclosed and the right is reserved to all changes and modifications coming within the scope of the invention as defined in the appended claims.

Having thus described my invention, what I claim as new and desire to secure by United States Letters Patent is:

1. In a rotary injector compressor, a closed tank for storing compressed gases, a pipe for a mixture of liquid and gases extending into and out of said tank and having a centrifuge portion for centrifugally separating and releasing into said tank said gases from said mixture of said liquid and gases, a gas intake nozzle on one end of said pipe, a nozzle for liquid discharging through said gas intake nozzle into said pipe, and a centrifugal pump having its intake connected with the end of said pipe which is remote from said gas intake nozzle and having its output connected with said nozzle for liquid in order that when said compressor operates said liquid will circulate at a high speed through said centrifuge portion of said pipe.

2. In a rotary injector compressor, a closed tank for storing compressed gases, a pipe for a mixture of liquid and gases extending into and out of said tank and having a centrifuge portion for centrifugally separating and releasing into said tank said gases from said mixture of said liquid and gases, a gas intake nozzle on one end of said pipe, a nozzle for liquid discharging through said gas intake nozzle into said pipe, and a centrifugal pump having its intake connected with the end of said pipe which is remote from said gas intake nozzle and having its output connected with said nozzle for liquid in order that when said compressor operates said liquid will circulate at a high speed through said centrifuge portion of said pipe, that portion of said pipe between said centrifuge and said pump being slightly smaller in diameter than that portion of said pipe between said gas intake nozzle and said centrifuge in order to streamline the flow of said liquid and conserve its kinetic energy.

3. In a rotary injector compressor, a closed tank for storing compressed gases, a pipe for a mixture of liquid and gases extending into and out of said tank and having a centrifuge portion for centrifugally separating and releasing into said tank said gases from said mixture of said liquid and gases, a gas intake nozzle on one end of said pipe, a nozzle for liquid discharging through said gas intake nozzle into said pipe, and a centrifugal pump having its intake connected with the end of said pipe which is remote from said gas intake nozzle and having its output connected with said nozzle for liquid in order that when said compressor operates said liquid will circulate at a high speed through said centrifuge portion of said pipe, that portion of said pipe between said centrifuge and said pump being slightly smaller in diameter than that portion of said pipe betwen said gas intake nozzle and said centrifuge in order to streamline the flow of said liquid and conserve its kinetic energy, means for maintaining a supply of water in the bottom portion of said tank at an elevation below said centrifuge portion, and a water supply tube connected with said smaller diameter portion of said pipe immediately adjacent said centrifuge and extending downwards into said supply of water in said tank in order to maintain the liquid supply in said pipe for maintaining its kinetic energy.

4. In a rotary injector compressor, a closed tank for storing compressed gases, a pipe for a mixture of liquid and gases extending into and out of said tank and having a centrifuge por-

tion for centrifugally separating and releasing into said tank said gases from said mixture of said liquid and gases, a gas intake nozzle on one end of said pipe, a nozzle for liquid discharging through said gas intake nozzle into said pipe, and a centrifugal pump having its intake connected with the end of said pipe which is remote from said gas intake nozzle and having its output connected with said nozzle for liquid in order that when said compressor operates said liquid will circulate at a high speed through said centrifuge portion of said pipe, means for maintaining a supply of water in the bottom portion of said tank at an elevation below said centrifuge portion, and a water supply tube connected with said pipe at a point between said centrifuge portion and the intake of said pump and extending

downwards into said supply of water in said tank in order to maintain the liquid supply in said pipe for maintaining its kinetic energy.

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