N. H. HILLER.

CONDENSER.

APPLICATION FILED SEPT. 28, 1920.

1,385,827. Patented July 26, 1921.

Fig. 1.

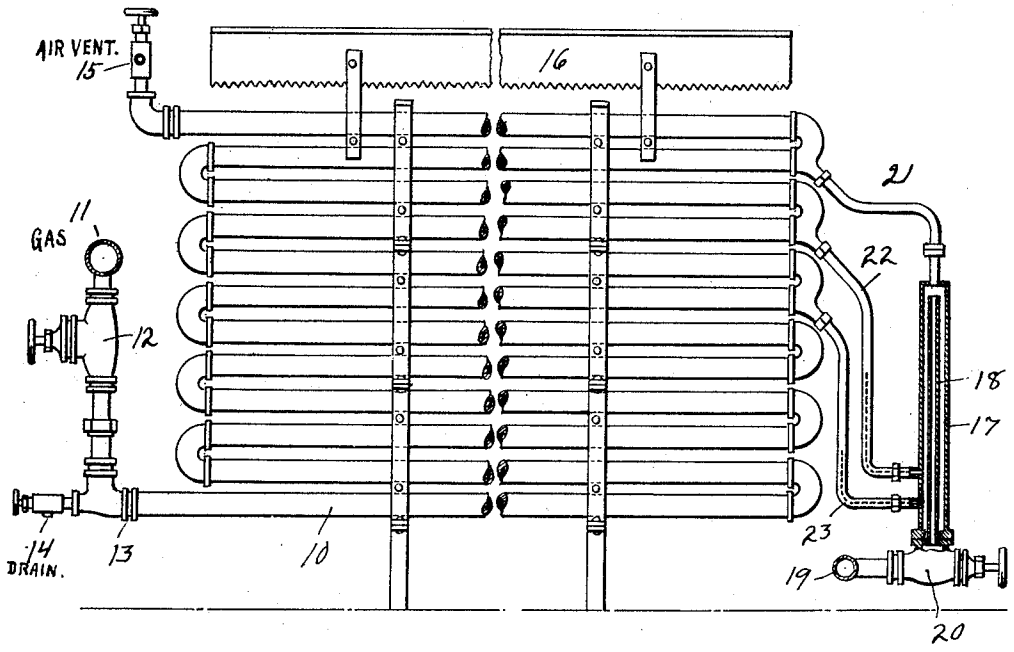
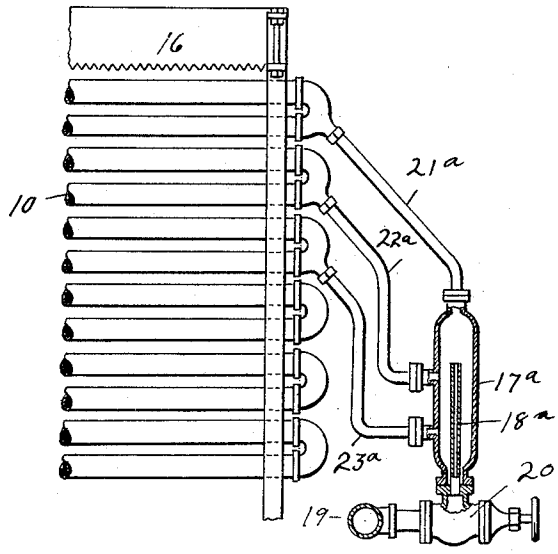


Fig. 2.



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CONDENSER.

1,385,827. Specification of Letters Patent. Patented July 26, 1921.

Application filed September 28, 1920. Serial No. 413,286.

To all whom it may concern:

Be it known that I, NICOLAI H. HILLER, a citizen of the United States, and a resident of Carbondale, in the county of Lackawanna and State of Pennsylvania, have invented certain new and useful Improvements in Condensers, of which the following is a specification.

This invention is an improvement in condensers particularly designed for use in refrigerating apparatus and for the cooling and liquefying of the refrigerating fluid, such for instance as ammonia; although I do not limit it to this particular use as it may be employed in any system where the condensed liquid or liquefied gas is to be drawn off at successive points along the cooled path of the gas. The subject matter of the present application is divided from that of my prior and copending application, Serial Number 38,851, filed July 9th, 1915, now Patent 1,360,748, issued November 30, 1920, and the present application is a continuation in part of the latter.

Although my invention is applicable to different types of condensers, it is particularly designed for use with a coil condenser of the upflow type, in which all of the liquefiable portion of the ammonia or other gas is condensed or liquefied by the time it reaches the upper and coldest part of the condenser. In this type it is desirable to permit the liquid to drain from the conduit at a plurality of points along the cooled path as successive portions of the gas are liquefied.

Difficulty has been experienced in collecting the liquefied gas from condensers of this type, due to the fact that the pressure in the condenser conduit is different at different liquid draw off points. Gas pressure is the highest at the lowest portion of the coil where the warm incoming gas is received from the compressor and the pressure is lowest at the upper portion of the condenser where the temperature is the lowest and substantially all of the gas has been liquefied and thus greatly reduced in volume.

The main object of my invention is to provide a simple, inexpensive and efficient liquid draw off and receiving means, permitting the liquid to draw off by gravity from a plurality of points along the cooled path, and at the same time preventing the short circuiting of the condenser by gas blowing from a higher pressure draw off through the liquid receiving means to a lower pressure draw off at a higher elevation in the condenser.

In the accompanying drawings:

Figure 1 is a side elevation of a condenser embodying my invention, certain of the parts being broken away and shown in section, and

Fig. 2 is a view similar to portions of Fig. 1, but showing a slightly different form, and corresponding in detail to the construction illustrated in my prior application above referred to.

I have illustrated my invention as applied to a coil condenser of the upflow type in which there are a plurality of substantially horizontal runs 10, connected in series to provide a back and forth upwardly progressing path for the gas to be liquefied. The gas is supplied from an inlet gas header 11, controlled by a suitable valve 12, and connected to the inlet 13 of the lowermost run of the condenser. Adjacent to this inlet 13 there may be a drain valve 14. This is not the main liquid draw off, but may be used at such times as the draining of the lower portion of the condenser is necessary or desirable. The upper end of the conduit is provided with a suitable air valve 15, whereby air or any other unliquefiable gas in the system may be purged. I do not wish to be limited to any particular method or apparatus for cooling the condenser coil, as various different means are commonly employed in this art and may be employed with the coil shown. Such means provide for the flowing of cooling water in heat interchanging relationship to the coil. A simple form of such means is illustrated as a water sprinkler trough which is supported by the upper portion of the gas conduit.

As an important feature of my invention I provide a liquid receiver 17, to which the liquefied gas is delivered from the condenser. This receiver has means for maintaining the liquid at a substantially constant level, such means being shown as an outlet tube 18, disposed within the receiver. This is shown as disposed substantially vertically with the open upper end, adjacent to the upper portion of the receiver 17, and with the lower end supported by and extending through the bottom of the receiver, to there connect with the main liquid header 19, the connection being controlled by a suitable valve 20. In case there are a series of

the condenser coils arranged in substantially parallel vertical planes, the gas inlet header 11 and the main liquid header 19 may be connected to each of the coils of the series in the same manner as it is shown connected to the coil of Fig. 1.

As an important feature of my invention this receiver 17 is connected to the condenser coil by a plurality of drip pipes here shown as three in number. The uppermost drip pipe 21 leads from the upper portion of the condenser and delivers to the receiver 17 at a point above the liquid level in the latter. Another pipe, 22, connects to the condenser coil at a point below the connection of the pipe 21, and leads into the receiver 17 at a point below the liquid level in the latter. A third pipe, 23, is shown as leading from a still lower point in the condenser and connected to a point in the receiver below the connection of the pipe 22. Thus the separate drip pipes connect to the condenser at different elevations, corresponding in order to those on the condenser conduit.

In operation, the gas entering from the gas header 11 passes upwardly through the condenser conduit and is cooled by the water flowing over the conduit. The coldest water is at the farthest end of the gas path. As the gas thus flows upwardly through the several runs of the coil it is continually condensed by the cooling action of the water and as successive portions of the gas condense in the different parts of the condenser the liquid condensate is drawn off through the drip connections to the receiver 17, and header 19. The pressure in the condensing coil is highest at the bottom and grows progressively lower toward the top, due to friction in the coil and decreasing hydrostatic head. In the drip connections the liquid will lie at different levels, dependent upon the relative pressures in the portions of the condenser to which these drip connections are connected; for example, the liquid will lie lower in the pipe 23 (the one having the lowest connection to the condenser) than it will in the pipe 22, which is connected to the condenser at a higher point where the pressure is lower. The condensed liquid in these drip pipes and in the receiver 17 serves to provide liquid seals for the various drip pipes, so that the latter constitute traps, prevent short circuiting of the gas from one pipe to another, and thus direct to the main outlet 18. The pressure in the uppermost portions of the condenser will be the same as that in the receiver 17, due to the fact that the pipe 21 is not sealed and enters above the liquid level.

In practice it has been found that these drip pipes very materially affect the performance of the condenser. In experiments the drip pipes have been closed off by valves provided in them, and it has been found that the head pressure of the condenser is materially higher than if these drip pipes were open. On the other hand there seems to be no occasion for the provision of drip pipes lower down in the condenser than shown, because when this was tried the pressure went up, possibly due to backing up of the liquid or the insufficient hydrostatic head to seal the drip pipes leading from the portion of the condenser conduit of higher pressure.

The trapped drip pipes greatly facilitate the drawing off of air and foul gas (gas which does not condense readily) from the condenser through the valve 15 or down through the receiver 17, valve 20 and header 19, and thence to the main anhydrous receiver. In certain old types of condensers attempts were made to draw off foul gas from the top of the condenser through the anhydrous receiver, and it was found that if this were attempted the gas to be condensed in runs other than the top run of the condenser would also be drawn off through the anhydrous receiver, but in my condenser since the drip pipes are trapped, gases can be drawn off from the top run without drawing off gas from the lower runs, except as that gas first passes up through the condenser into the top run.

I do not wish to be limited to the specific form, design or proportion as illustrated in Fig. 1, although from experience I have found that the form there shown operates very satisfactorily with an ammonia condenser or a refrigerating machine. The liquid level in the receiver and the corresponding height of the drip may vary with the pressure of the gas, and with the difference between the pressures at the inlet and upper portions of the system. In Fig. 2 I have shown a construction substantially identical with that shown in my prior application above referred to. Here the receiver 17^a is somewhat larger and shorter than that shown in Fig. 1, the liquid level in the receiver is lower and the traps formed by the pipes 22^a and 23^a are not as deep.

In my improved condenser the gas, as it rises, comes in contact with colder and colder water, the flow is counter current entirely, which means maximum water economy, low condensation pressure, large capacity for small surfaces and air purging at the outlet where all the noncondensible gases must collect. No ammonia need be wasted in purging, and as rapidly as the gas is liquefied is flows from the condenser, whereby all pipe service is used for condensing gas, and the short-circuiting of gases through the draw off is effectively prevented.

In designating the chamber or part 17 and 17^a as a receiver, I do not wish to imply that this is the main liquid receiver of the

condenser, as such main liquid receiver would be connected to the liquid header 19. The part 17 or 17ª merely acts as the main receiver for the particular condenser conduit to which it is connected, and only a comparatively small amount of liquid is maintained in said receiver 17, the excess constantly flowing through conduit 18 and the header 19 to the main receiver for the system.

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

1. An upflow condenser for readily liquefiable gases including a conduit having an inlet at the lower end and an air purge outlet at the upper end, means for flowing a cooling liquid in heat interchanging relationship to said conduit, a receiver for the liquefied gas, having a draw off from the upper portion thereof, and a plurality of liquid outlet connections along the path of the conduit to points at different elevations in said receiver, the liquid outlet nearest to the inlet of said conduit entering the receiver at the greatest depth below the liquid level in the latter.

2. An upflow condenser for readily liquefiable gases including a conduit having an inlet at the lower end, a liquid receiver, means for maintaining a predetermined liquid level in said receiver, an outlet connection from the upper portion of said conduit to the upper portion of said receiver above the liquid level in the latter, and an outlet connection from a point intermediate of the ends of said conduit to said liquid receiver below the liquid level in the latter.

3. An upflow condenser for readily liquefiable gases including a conduit having a gas inlet at the lower end, means for flowing cooling liquid downwardly over said conduit, a liquid receiver, a draw off from the upper portion of said receiver, and a plurality of liquid outlets from points at spaced elevations along said conduit to correspondingly spaced elevations in said receiver below the liquid level in the latter whereby traps are formed decreasing in depth from the one nearest the condenser inlet.

4. An upflow condenser for readily liquefiable gases including a conduit having an inlet at the lower end, a liquid outlet header, and a plurality of liquid draw off connections between said conduit and said header, said draw off connections including traps of different hydrostatic head, the trap of greatest head being in the connection to the conduit nearest the inlet of the latter.

5. An upflow condenser for readily liquefiable gases including a condenser coil, a series of drip pipes connecing with said coil at different heights, a receiver connected to said drip pipes in which the liquefied gas is collected, and means for holding a quantity of said liquefied gas in said drip pipes to seal the same and prevent bypassing of the gases, said means providing greater hydrostatic head in the drip pipe nearest to the condenser inlet than in the drip pipe nearer to the upper portion of the condenser.

Signed at Carbondale, in the county of Lackawanna and State of Pennsylvania this 23rd day of September, A. D. 1920.

NICOLAI H. HILLER