Jan. 23, 1923. 1,443,315

R. N. EHRHART.
EJECTOR.
ORIGINAL FILED MAY 19, 1920.

Fig. 1.

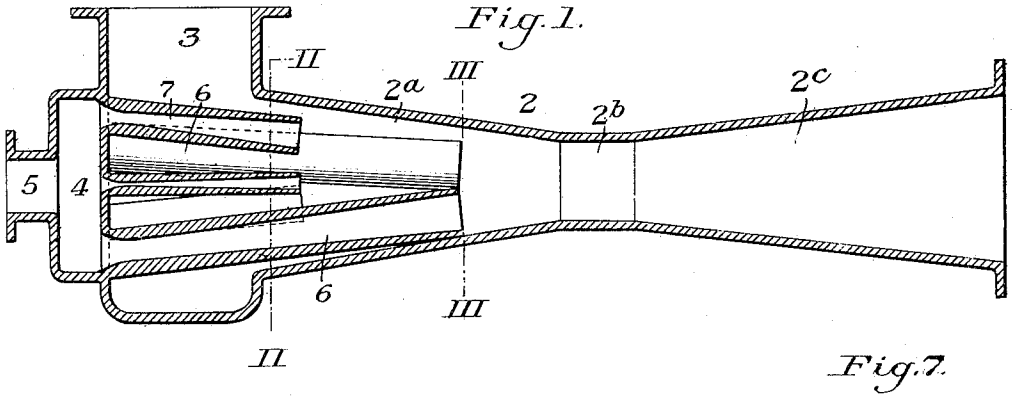


Fig. 2.

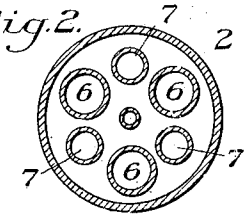


Fig. 3.

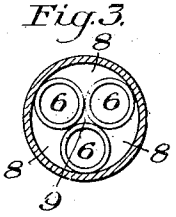


Fig. 7.

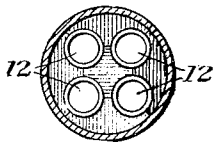


Fig. 8.

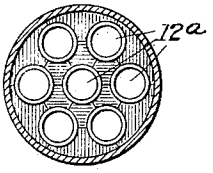


Fig. 4.

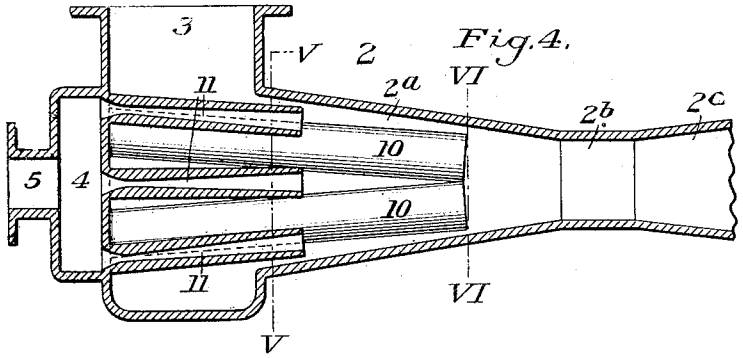


Fig. 9.

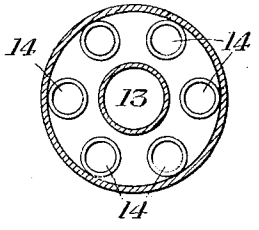


Fig. 5.

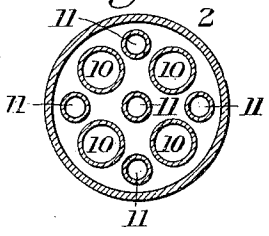
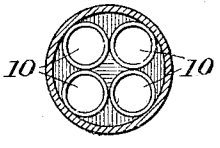


Fig. 6.



Inventor
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By Dabney, Byron & Carmichael
their Attorneys.

Patented Jan. 23, 1923. 1,443,315

UNITED STATES PATENT OFFICE.

RAYMOND N. EHRHART, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO ELLIOTT COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

EJECTOR.

Application filed May 19, 1920, Serial No. 382,654. Renewed June 28, 1922. Serial No. 571,478.

To all whom it may concern:

Be it known that I, RAYMOND N. EHRHART, a citizen of the United States, residing at Pittsburgh, Allegheny County, Pennsylvania, have invented a new and useful Improvement in Ejectors, of which the following is a full, clear, and exact description, reference being had to the accompanying drawing, forming part of this specification, in which

Figure 1 is a longitudinal sectional view showing a less efficient form of my invention, but illustrating the principle thereof.

Figures 2 and 3 are sections taken on the lines II—II and III—III of Figure 1, respectively.

Figure 4 is a view similar to Figure 1, but partly broken away, and illustrating a more efficient form of the invention.

Figures 5 and 6 are sections taken on the lines V—V and VI—VI, respectively, of Figure 4, and

Figures 7, 8 and 9 are diagrammatic cross-sections illustrating other embodiments of my invention.

All of the figures of the drawing are more or less conventional.

My invention has relation to improvement in ejectors, and more particularly to ejectors of the single-stage type, such as are described and claimed in my pending application, Serial No. 287,255, filed April 3, 1919.

As stated in said application, I have discovered that a single-stage ejector can be made which will operate to produce high ratios of compression, and which is eminently suited to the same service to which highly developed multistage ejectors are now applied. In my said application I have disclosed a certain construction, proportioning and arrangement, of a single-stage ejector comprising accelerating nozzles and compressing nozzles which has been found very efficient in service.

My present invention is designed to further increase the efficiency of ejectors of this type.

Referring first to Figures 1, 2 and 3 of the drawing, the numeral 2 designates the diffusion structure having the converging portion 2^a, the intermediate throat portion 2^b and the diverging portion 2^c. 3 designates the inlet which is connected to the condenser or other vessel to be exhausted, and 4 is the steam inlet chamber provided with the supply connection 5. 6 designates a series of compressing nozzles and 7 a series of shorter accelerating nozzles, all of these nozzles receiving their steam supply from the chamber 4. In the construction illustrated in these figures, there are three compressing nozzles and four accelerating nozzles.

By reference to Figure 3, it will be apparent that the areas for steam flow at the end portions of the compressing nozzles, and which I term the "interstice" areas, are non-uniform. That is to say, while the spaces 8 between the nozzles 6 and the inner wall of the diffusion structure are of substantially equal areas, the central space 9 between said nozzles is of very much less area. Therefore, while the spaces 8 provide for relatively free flow of the fluid discharged by the outer accelerating nozzles, there is relatively little space for the flow of the fluid discharged by the central accelerating nozzle. If the volume of fluid discharged by this central nozzle were the same as that discharged by the outer nozzles, the result would be inefficient operation. I have discovered, however, that I may, to a considerable extent, increase the efficiency even with this arrangement of the nozzles by very considerably reducing the cross-sectional area of the central accelerating nozzle so that such area will be reduced in proportion to the reduced cross-sectional area of the space 9.

A better arrangement, however, is that shown in Figures 4, 5 and 6 of the drawing. In these figures, it will be noted that the compressing nozzles 10 are so spaced as to give approximately an equal area for the discharge from each of the accelerating nozzles 11. In order to make this more apparent the interstice areas referred to are shaded in Figure 6.

Figure 7 shows still another arrangement of the compressor nozzles to give the same result. This arrangement differs from that shown in Figure 6, in that the compressing nozzles 12 are not tangent either to each other or to the inner wall of the diffusion structure.

Another form of my invention is shown in Figure 8, in which 12^a are the compressing nozzles. This arrangement, it will be noted, gives substantially equal interstice areas,

Another form of my invention is shown in Figure 9, in which there is a single central compressing nozzle 13 and a series of accelerating nozzles 14 arranged around this single compressing nozzle. This arrangement also gives the desired result in that each accelerating nozzle has the proper interstice area in which to discharge.

I have found that in order to get the most efficient operation, no interstice area should be less than fifty per cent (50%), nor more than one hundred and fifty (150%) per cent of the average interstice area where the accelerating nozzles each deliver the same amount of steam. Where the interstice area fed by a particular accelerating nozzle is small, as in the construction first described, a fair efficiency may be obtained by correspondingly proportioning the accelerating nozzle which feeds it so that the flow imposed upon this particular interstice area is relatively the same as that through the interstice areas which are fed by the larger accelerating nozzles. In other words, within certain limits, it should not be attempted to impose more than a certain rate of flow through any given interstice area.

In practice, the accelerating nozzles should deliver steam to the compressing nozzles at speeds in excess of 750 ft. per second and from this up to 2000 ft. per second.

In an ejector of this type, the accelerating nozzles deliver the impelling fluid at an accelerated velocity to the next group of nozzles instead of delivering it at low velocities with substantially all of its energy in the form of pressure. There is, however, some increase in pressure, the amount depending upon the arrangement and proportioning of the various parts.

The expressions "long" and "short," and similar expressions used throughout the specification and claims, are used as definitive broadly of nozzles and nozzle structures which, irrespective of their length, discharge respectively nearer or farther away from the throat of the diffuser structure.

It will be understood that the drawings herein are not intended to illustrate any particular exact form of nozzle or diffusion structure, but are conventional in these respects. It will also be understood that various groupings of the nozzles may be employed within the spirit and scope of my invention as defined in the appended claims.

I claim:

1. An ejector having a compressing nozzle and a plurality of shorter accelerating nozzles, each accelerating nozzle being proportioned, constructed and arranged to deliver an amount of steam which is proportional to the particular area into which it discharges, substantially as described.

2. An ejector having accelerating and compressing nozzles, in which the interstice areas between the compressing nozzles are respectively proportional to the volume of flow through the corresponding accelerating nozzles, substantially as described.

3. An ejector having accelerating and compressing nozzles, constructed and arranged whereby the interstice areas are proportioned each with respect to the volume of flow through the corresponding accelerating nozzle, substantially as described.

4. An ejector having accelerating and compressing nozzles, constructed and arranged whereby the interstice areas are proportioned each with respect to the volume of flow through the corresponding accelerating nozzle, said nozzles and interstice areas being proportioned to cause a steam flow through such areas of from 750 to 2000 feet per second, substantially as described.

5. An ejector having accelerating and compressing nozzles and interstice areas, said nozzles and areas being so arranged that no interstice area is less than one-half nor greater than one and one-half times the average interstice area, substantially as described.

6. A single-stage ejector having a converging-diverging-diffusion structure, a set of compressing nozzles, a set of accelerating nozzles, said accelerating nozzles projecting to a less extent into the converging portion of the diffuser structure than to the compressing nozzles, and said nozzles being so constructed and arranged that the interstice areas between are proportioned each relatively to the flow through the corresponding accelerating nozzle, substantially as described.

7. A single-stage ejector having a converging-diverging-diffusion structure, a set of compressing nozzles, a set of accelerating nozzles, said accelerating nozzles projecting to a less extent into the converging portion of the diffusion structure than to the compressing nozzles, and said nozzles being so constructed and arranged that the interstice areas between are proportioned each relatively to the flow through the corresponding accelerating nozzle, said accelerating nozzles being constructed to maintain a smaller volume of flow than that through the compressing nozzles, substantially as described.

8. A single stage ejector, comprising two sets only of nozzles, the nozzles of one set forming accelerating nozzles and being shorter than the nozzles of the other set, which are compressing nozzles, the interstitial spaces between the compressing nozzles and the accelerating nozzles being proportioned and arranged relatively to each other, whereby each such interstitial area is proportional to the volume of steam flow through the particular accelerating nozzle which discharges into that particular area, substantially as described.

9. A single stage ejector comprising a plurality of longer compressing nozzles and a plurality of shorter accelerating nozzles, the interstitial areas between the discharge end portions of the longer nozzles being each of an area which is definitely proportioned with respect to the volume of steam discharged by the corresponding shorter nozzle into that area, whereby the steam discharged by all the shorter nozzles reach the longer nozzles at substantially the same velocity, substantially as described.

10. In an ejector, a diffuser structure, a set of long divergent nozzles and a set of short divergent nozzles, said nozzles forming a plurality of passages converging toward the throat of the diffuser, each of said short nozzles discharging into one of said converging passages, substantially as described.

11. In an ejector, a diffuser structure, a set of long divergent nozzles and a set of short divergent nozzles, said long nozzles forming a plurality of adjoining converging passages between themselves and between themselves and the diffuser, and said short nozzles discharging into said passages, substantially as described.

12. In an ejector, a diffuser structure, a set of long divergent nozzles and a set of short divergent nozzles, the long nozzles forming a plurality of converging passages between themselves and between themselves and the diffuser, said short nozzles delivering fluid to the small ends of said passages at speeds within a range of 750 to 2000 feet per second, substantially as described.

13. In an ejector, a diffuser structure, a set of long divergent nozzles and a set of short divergent nozzles, the long nozzles forming converging passages between themselves and between themselves and the diffuser, said nozzles being so grouped that the stream of fluid delivered by the short nozzles substantially surrounds the fluid issuing from each long nozzle, substantially as described.

14. In an ejector, a diffuser structure, a set of long divergent nozzles and a set of short divergent nozzles, said nozzles having their axes inclined toward the axis of the diffuser whereby the axes of both the long and short nozzles lie substantially in the same imaginary cone, substantially as described.

15. In an ejector, a diffuser structure, long and short diverging nozzles, said long nozzles and diffuser structure forming converging passages having their small ends nearest the diffuser throat, the axes of said passages converging toward said diffuser throat, said short nozzle delivering streams of fluid into each of said passages so that the said streams should substantially surround the fluid issuing from each long nozzle, substantially as described.

16. In an ejector, a diffuser structure, a nozzle structure, a second nozzle structure, said first nozzle structure terminating nearer the throat of the diffuser than the second nozzle structure, and said second nozzle structure delivering fluid to the first nozzle structure at velocities ranging from 750 to 2000 feet per second, substantially as described.

17. In an ejector, a diffuser structure, a compressing nozzle structure, an accelerating nozzle structure, said accelerating nozzle structure discharging relatively farther from the throat of the diffuser than the compressing nozzle structure, the accelerating nozzle structure being proportioned, constructed and arranged to deliver an amount of steam which is proportional to the particular area into which it discharges, substantially as described.

18. In a single stage ejector, a diffuser structure, a set of compressing nozzles, a set of accelerating nozzles, said accelerating nozzles discharging relatively farther from the throat of the diffuser than the compressing nozzles, said compressing nozzles being so constructed and arranged that the interstice areas therebetween are proportional each relatively to the flow of the corresponding accelerating nozzle, said accelerating nozzles being constructed to maintain a smaller volume of flow than that through the compressing nozzles, substantially as described.

19. In an ejector, a diffuser structure, a set of divergent nozzles, a second set of divergent nozzles, said sets of nozzles discharging at relatively different distances from the throat of the diffuser, the nozzles discharging nearer the throat of the diffuser forming a plurality of passages converging toward said throat and into which the other nozzles discharge, substantially as described.

In testimony whereof, I have hereunto set my hand.

RAYMOND N. EHRHART.