June 22, 1926. 1,589,888

C. W. LUMMIS

BLOWING APPARATUS

Original Filed May 1, 1922

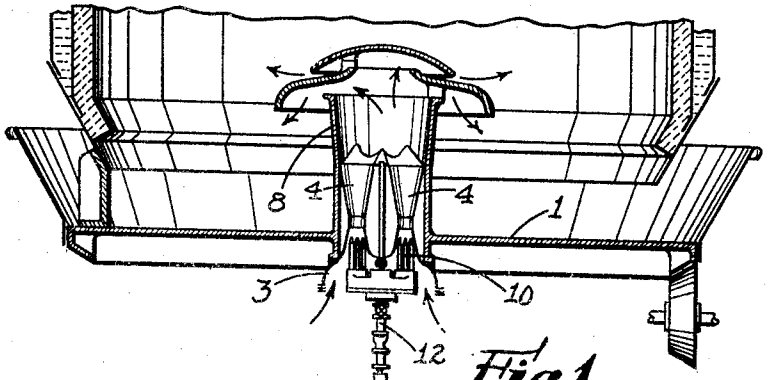


Fig. 1

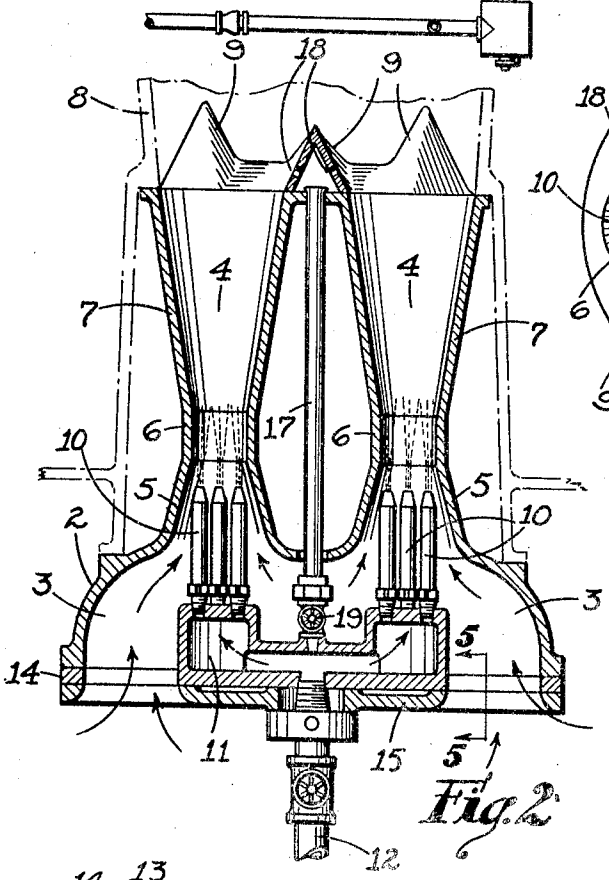


Fig. 2

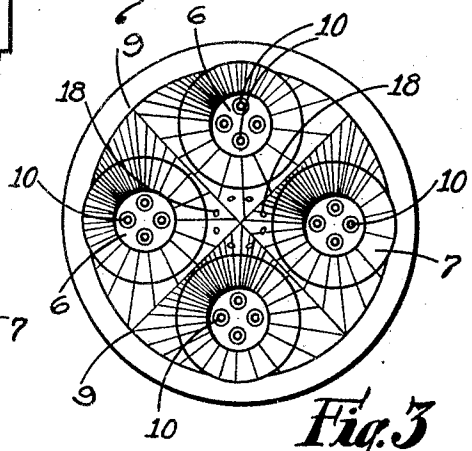


Fig. 3

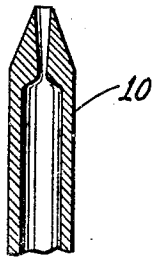


Fig. 4

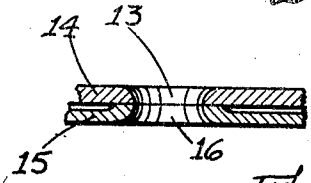


Fig. 5

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UNITED STATES PATENT OFFICE.

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BLOWING APPARATUS.

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The present invention relates to blowing or blast producing apparatus of the induction type, where a fluid under pressure, such as steam, is caused by its discharge, in jet form, to suck in and impart velocity and pressure to another fluid, such as air, and where gradual expansion of the resulting mixed current converts the velocity thereof into static pressure.

Blowing apparatus of this type, wherein two fluids, one the pumping fluid and the other the fluid pumped, are brought into admixture, has a variety of uses; for example, to supply the blast of air and steam which supports combustion in a gas producer. For purposes of illustration, the blowing apparatus of the present invention is shown in connection with a gas producer, and in the accompanying drawings,

Fig. 1 is a sectional view of a gas producer so equipped.

Figs. 2 and 3 are enlarged views, in longitudinal and transverse sections respectively, of the blowing apparatus proper.

Fig. 4 is a sectional view of one of the nozzles for the pumping fluid.

Fig. 5 is a sectional view on the line 5—5, Fig. 2.

Like reference characters refer to like parts in the different figures.

In previous adaptations in this type of blowing apparatus, whether of single or of multiple nozzle construction, the excessive length required for the gradual expansion that takes place has operated as a handicap; for example, in a gas producer blower as disclosed in the patent to Jefferies No. 1,170,070, dated February 1, 1916, the practice hitherto has required an extremely long connection from the blower nozzle or nozzles to the gas producer, in order to provide adequately and properly for the expansion phase of the characteristic Venturi action. This excessive length of expansion tube takes up a great amount of valuable space, and requires the blowing device itself to be located at a considerable distance from the gas producer or other piece of apparatus which is to be supplied with a current of mixed gaseous fluids under pressure; furthermore, in such a construction the losses from condensation of steam are very large, because of the great length of the expansion tube and the large area thereof which is exposed to the air.

The present invention contemplates a construction of blowing apparatus wherein the above difficulties and disadvantages are overcome. Instead of the usual single Venturi construction, with the large throat and long expansion tube heretofore used either with one or with a plurality of nozzles for the pumping fluid, the present invention employs a plurality of small and compactly arranged Venturi tubes, in each of which is handled and expanded, independently, a portion of the total quantity of blast to be produced.

As shown in Fig. 2, the apparatus of the present invention provides a suitable casing 2, inclosing an air chamber 3 in communication with a plurality of separate parallel Venturi tubes 4, 4, here shown as four in number, arranged in an annular series about the axis of casing 2. Each Venturi tube 4 has a gradually contracting approach portion 5, a throat portion 6, and an expansion portion 7.

In conjunction with each Venturi tube 4, the invention contemplates the use of a plurality of closely grouped steam nozzles 10, 10, all of the usual expanding type, as depicted in Fig. 4. The several groups or nozzles 10, 10 are supplied from a common steam box 11 carried by the casing 2, and connected by pipe 12 to a source of steam supply. The several nozzles 10, 10 of each group are arranged parallel to each other and to the axis of their associated small Venturi tube 4. The several small Venturi tubes 4, 4 discharge into a common blast tube 8, which is adapted to confine the one large current or stream that is formed by the confluence of the several independent small streams issuing from these small Venturi tubes 4, 4. With reference to the amount of air handled, the expansion portion 7 of each small Venturi tube 4, is of sufficient length to virtually complete the desired conversion of its stream's velocity into static pressure, for it is a characteristic of Venturi construction that the angle or taper by which the diameter of the expansion portion gradually increases is practically a constant, regardless of the throat diameter or size. For that reason, the present construction, wherein the total quantity of blast to be handled and expanded is apportioned between a plurality of small closely grouped Venturi tubes, permits of

the same degree of expansion being obtained in a much shorter distance than would be required in a single large Venturi tube having a throat area equal to the combined areas of the four small throats 6, 6. With no necessity therefore for an elongated expansion tube, the blowing apparatus, as shown in Fig. 1, can be constructed practically as a part of the gas producer or other mechanism to which it is applied,—and for the most part actually contained within the same. As shown in Fig. 1, the blower in its entirety is supported by and projects within the usual water seal pan 1 of the producer, here shown as of any conventional construction.

The small streams issuing at relatively low velocity, but with high static pressure from the individual Venturi tubes 4, 4 and into the common blast tube 8, are here shown as of circular form, but it is to be understood that the invention is not limited to this or any other form; whatever the form, it is clear that the merging of these small streams into a single large current would naturally create some tendency for eddy and cross currents to form, due to the voids and dead spaces left unfilled. To prevent any such action, the ends of the expansion portions 7, 7 of the small tubes may be flared to extend for varying distances into the blast tube 8, as shown in Figs. 2 and 3. In this way, practically the same rate of expansion for each individual small stream is maintained, even after it issues from its venturi 4, and until it merges with the adjoining streams. As shown in Figs. 2 and 3, the outwardly flaring tapered extensions 9, 9 so employed to guide and confine the individual small streams, as they pass into blast tube 8 after leaving their respective venturis 4, 4, entirely fill the voids of various sizes which would otherwise exist as the result of merging a number of small streams into a single large stream. The angle or taper of these extensions 9, 9 is in all cases the same, and as a consequence, their projection into the blast tube 8 is highly irregular, reaching its maximum distance for the large voids near the periphery of the casing and its minimum distance for the small voids between the individual streams, with a great variety of intermediate heights or distances, as shown. In connection with each small Venturi tube 4, the several parallel nozzles 10, 10 associated therewith are so closely compacted as to insure the issuance of all of the steam jets of said group within an area, not larger than that of throat portion 6. The maintenance of parallelism avoids interference between adjacent jets, and the restriction of each group of jets to the throat area avoids entirely the losses of energy incident to the impingement and deflection of the jets against the approach portion 5 of the venturi.

In addition to this, as shown in Fig. 2, the ends of all the nozzles 10 of each group are disposed in close proximity to the throat 6 of the venturi; this arrangement, by preventing any substantial breaking up of the jets in advance of the throat 6, leaves the way clear for the maximum inflow of air, at high velocity, through approach portion 5, and, in conjunction with the other specified features of the blower construction, operates as a contributing factor to increase the air handling capacity of the apparatus.

As shown in Figs. 2 and 5, the entrance of air to chamber 3 is by way of openings 13, 13 in a stationary bottom plate 14; cooperating therewith is a movable plate 15, having openings 16, 16 adapted to register with the openings 13, 13. Both sets of openings 13 and 16 have their edges rounded, as shown in Fig. 5, so that the approach and discharge for these air inlets is attended with a minimum of noise, when the plate 15 is in wide open position. In order to eliminate the necessity for throttling these air inlets (under which condition a certain amount of noise would inevitably be produced), the invention contemplates a construction which permits variation in the proportion of air and steam in the producer blast without disturbing the air inlet. This is accomplished by the use of a steam by-pass pipe 17 which leads from the box 11 to a plurality of discharge orifices 18 near the blower outlet. The by-pass 17 is equipped with a valve 19 for regulating the quantity of steam discharged through it, and by the adjustment of this valve may be determined the proportion of extra steam added to the blast under various conditions of operation. Although the resistance to the blast column, by this increase in its quantity, is made slightly greater, the effect is counteracted by the aspiration produced on said column, due to the velocity of the steam as it issues from the orifices 18.

The exceedingly compact arrangement of the apparatus makes it easy to adapt and apply it to a gas producer or other mechanism, with a total absence of expansion tubing exposed to the air.

I claim,

1. In blowing apparatus, the combination with a Venturi tube for propelling and propelled fluids, the inlet of said tube being in communication with an open chamber containing propelled fluid, of means for introducing the propelling fluid into the approach portion of said tube in a group of non-impinging jets, which jets issue entirely within the area of the Venturi throat after being confined through a major part of the length of the approach portion of the tube.

2. In blowing apparatus, the combination with a Venturi tube for propelling and propelled fluids, the inlet of said tube being in

communication with an open chamber containing propelled fluid, of a group of nozzles extending toward the throat of said tube for the major part of the length of the approach portion for introducing the propelling fluid in jets issuing unobstructedly entirely within the area of the throat of the tube.

3. In blowing apparatus, the combination with a Venturi tube providing a contracting approach portion in communication with a chamber open to the atmosphere and a throat portion, of a plurality of steam nozzles extending into said throat portion for the major part of its length, said nozzles being grouped to discharge jets entirely within the area of the said throat portion and without impingement on the walls of said approach portion.

4. A blower comprising a number of parallel closely grouped Venturi tubes, whose inlet and outlet ends terminate in common passages, with nozzles extending into the approach portion of each tube for a major part of the length of said portion, said nozzles being adapted to discharge a propelling medium entirely within the area of the throat portion of each tube and without impingement on the walls of the approach portion.

5. In blowing apparatus, a Venturi tube having its inlet in communication with an open air chamber, in combination with a plurality of steam nozzles, so grouped that the jets issuing therefrom are non-impinging, and unobstructed by the approach portion of said tube, said nozzles having their ends nearer to the throat portion of said tube, than to the inlet of said approach portion.

6. In the production of a blast column having low velocity and high static pressure, through the Venturi expansion of mixed propelling and propelled fluids, the improvement which consists in dividing the expansion of said fluids between a plurality of parallel closely grouped Venturi tubes, in each of which a portion of said fluids is brought independently to the approximate velocity and pressure conditions required for said blast column.

7. In the production of a blast column having low velocity and high static pressure, through the Venturi expansion of mixed propelling and propelled fluids, the improvement which consists in dividing the expansion of said fluids between a plurality of parallel closely grouped Venturi tubes, and combining the issuing columns at the exits of said tubes in a single column wherein the approximate velocity and pressure conditions reached in said individual tubes are substantially maintained.

8. In blowing apparatus, the combination with a plurality of steam jets for inducing the flow of air in admixture with the issuing steam, of a by-pass for increasing the proportion of steam in said mixture, without change in the quantity of air induced.

9. In blowing apparatus, a Venturi tube having its inlet in communication with an open air chamber, in combination with a group of non-impinging steam jets for the entrainment of air through said tube, said jets issuing nearer to the throat portion of said tube than to the inlet of the approach portion, whereby said jets are maintained intact until they reach the throat portion.

10. In blowing apparatus of the class described, the combination with a plurality of expansion tubes for the production of separate columns of propelling and propelled fluids, whose velocity by expansion in said tubes is converted into static pressure, and a common blast tube for combining said columns after expansion into a single pressure stream, of means for discharging the propelling fluid into each tube in a group of non-impinging jets, said jets issuing in close proximity to and within the area of the throat of each tube.

11. In blowing apparatus of the class described, the combination with a plurality of Venturi tubes, each open to the atmosphere at its inlet end, and adapted for the production of separate columns of air and steam whose velocity is converted into static pressure by expansion in said tubes, and a common blast tube for combining said columns after expansion into a single pressure stream, of a group of steam nozzles having their ends in close proximity to the throat of each tube so that the jets issue therefrom wholly within the area of the throat and without impingement.

12. Blowing apparatus of the class described for the production of a blast column of mixed propelling and propelled fluids, having relatively high static pressure and low velocity, and comprising a plurality of parallel closely grouped Venturi tubes, nozzles for the discharge of propelling fluid into the approach portions of each of said tubes, thereby to entertain the propelled fluid therethrough, and a combining tube common to the delivery ends of all of said Venturi tubes, in which combining tube the pressure and velocity conditions produced in said Venturi tubes are substantially maintained.

13. Blowing apparatus of the class described for the production of a column of propelling and propelled fluids under relatively high static pressure but with low velocity, and comprising a blast tube for said column, and a plurality of parallel closely grouped Venturi tubes discharging directly into said blast tube, each of said Venturi tubes adapted to expand a portion of the mixture of propelling and propelled fluids to substantially the same conditions of pres-

sure and velocity as those which prevail in said blast tube.

14. In blowing apparatus of the class described, a plurality of steam nozzles and associated Venturi tubes, for the production of a plurality of separate columns of air and steam, whose velocity by expansion in said tubes is substantially converted into static pressure, and means for combining the individual columns issuing from said tubes into a single stream wherein velocity and pressure conditions prevailing at the exits of said tubes are substantially maintained.

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