Nov. 22, 1949 R. L. LUCE 2,489,097

METHOD FOR PROJECTING STREAMS

Filed Jan. 30, 1947

Fig. 1

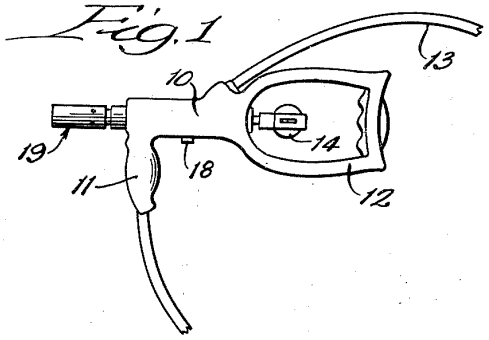


Fig. 2

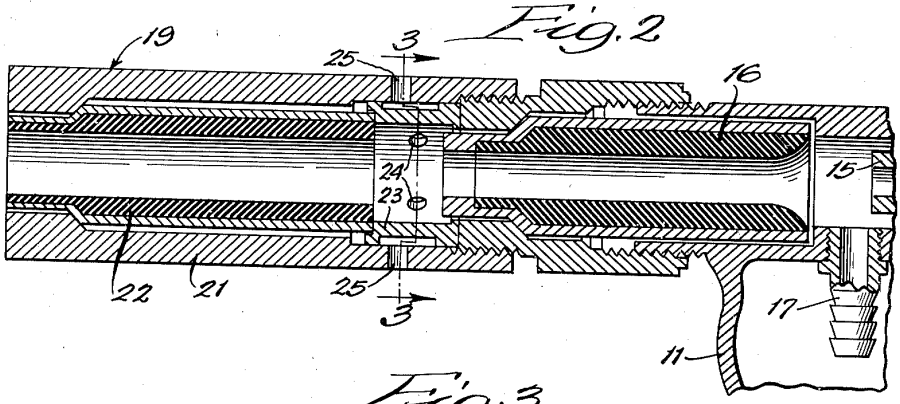
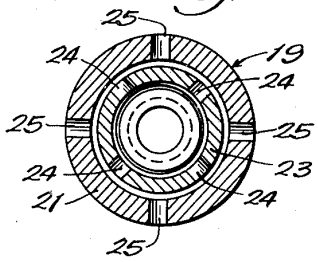


Fig. 3



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2,489,097

METHOD FOR PROJECTING STREAMS

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3 Claims. (Cl. 51—282)

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This invention relates to method for projecting liquid streams and more particularly to the projection of liquid, which may or may not contain abrasive material in suspension, in the form of an unbroken high velocity jet.

In many operations, as in liquid sandblasting, hydraulic mining, and the like, it is desirable to project streams of liquid through substantial distances without having the jets break-up into droplets or spray. With a plain nozzle, it has been found that the liquid jet tends to break-up or fuzz into a series of disconnected droplets or into a relatively fine spray within a short distance of the nozzle. A broken jet of this type is far less effective in liquid blasting or other hydraulic cutting operations than an unbroken stream.

It is one of the objects of the present invention to provide a method of projecting liquid streams in which air is added to the stream to be entrained thereby shortly before the final discharge of the stream.

Another object is to provide a method of projecting liquid streams in which the stream is passed through an auxiliary nozzle prior to its final discharge and has air added thereto immediately prior to its entrance into the auxiliary nozzle.

Still another object is to provide a method of projecting abrasive material with liquid in which abrasive material is first added to the liquid and air is subsequently entrained by the liquid prior to its discharge.

The above and other objects and advantages of the invention will be more readily apparent from the following description when read in connection with the accompanying drawing, in which—

Figure 1 is a partial side elevation of a liquid sandblasting apparatus for carrying out the method of the invention;

Figure 2 is an enlarged partial section of the discharge end of the apparatus, and

Figure 3 is a transverse section on the line 3—3 of Fig. 2.

Fig. 1 illustrates a liquid sandblast gun of the type more particularly described and claimed in the patent to Tirrell No. 2,200,587. As shown, the apparatus comprises a liquid blast gun formed by an elongated housing or casing 10 having a hand grip 11 at its forward end and an arm rest 12 at its rearward end. Liquid such as water under high pressure is supplied to the gun through a hose 13 and flow of liquid may be controlled by a valve having a handle 14. When the valve is open, liquid will flow at high velocity through the

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gun and through one or more internal nozzles carried by the housing 10. As seen in Fig. 2, two such nozzles are employed, one of which, indicated at 15, discharges a high velocity jet of water through a relatively enlarged space into the second nozzle 16 which is aligned with and of slightly larger diameter than the nozzle 15. Abrasive material may be added to the liquid jet between the two nozzles through a supply connection 17 which may be connected to a source of abrasive such as a flowable mixture of sand and water, as described more fully in the Tirrell patent. Passage of the water jet through the space between the nozzles will create a vacuum to draw the abrasive material into the jet to mix therewith. If desired, air may be added to the liquid stream prior to entrainment of the abrasive material through a valve nipple 18, as described in the Tirrell patent. It will be understood that any other desired type of liquid discharge apparatus such, for example, as that particularly described and claimed in the patent to Smith No. 2,040,715 could be employed equally well according to the invention and that addition of the abrasive material to the liquid stream could be omitted if desired.

According to the present invention, I have found that the stream or jet of liquid either with or without abrasive material suspended therein which is discharged by the nozzle 16 tends to break-up within a relatively short distance of the nozzle so that it cannot be used effectively for cleaning or cutting purposes except at relatively short ranges. According to the present invention, this breaking up of the stream or jet is minimized and delayed by the addition of air to the jet shortly before its final discharge. I have found that the addition of air at this point is highly effective even though air has previously been added to the jet through the valved nipple 18, as described in the Tirrell patent.

As shown, an auxiliary nozzle indicated generally at 19 is attached to the discharge end of the nozzle 16 in alignment therewith and provides for the addition of air to the stream or jet between the two nozzles. As best seen in Fig. 2, the nozzle 19 is formed by an outer sleeve 21 which may be threaded onto the end of the nozzle structure 16 and which carries an internal nozzle 22. The nozzle 22 is aligned with the nozzle 16 and has a slightly larger bore than the nozzle 16 to receive the jet of liquid therefrom. A spacer ring 23 is mounted between the ends of the nozzles 22 and 16 to hold them properly spaced apart and is of larger diameter than the bores in the

nozzles. To provide for the addition of air to the stream, the ring **23** is formed with a series of air inlet openings **24** and is under-cut on its exterior surface to provide an annular space communicating with atmosphere through openings **25** in the sleeve **21**. With this construction, the nozzle **22**, which may be subjected to a certain amount of wear, may easily be removed and replaced as required.

In operation, as the liquid jet passes from the nozzle **16** through the sleeve **23** into the nozzle **22**, it will create a partial vacuum in the sleeve **23** to draw air in through the openings **24** and **25**. This air will be entrained by the liquid jet and will be mixed therewith in the travel of the jet through the nozzle **22** so that the stream as finally discharged comprises a mixture of liquid and air with the possible addition of abrasive material. While the exact reasons are not entirely clear, it has been found by actual experiment that this stream will stay together in the form of an unbroken jet and will not fuzz or produce spray for a much longer distance then jet produced without employing the present invention. The effects are equally noticeable even though air has previously been added to the liquid through the valved nipple **18** so that an effective jet can be thrown for a much longer distance with the present invention than with ones of the type shown in the Smith and Tirrell patents or with a plain liquid nozzle.

It has further been found that the addition of an excessive quantity of air between the nozzles **16** and **22** will cause the stream to break-up into a spray very rapidly. This action occurs, for example, when air is supplied through the openings **24** under a super atmospheric pressure. Experiments have indicated that supply of the air under atmospheric pressure in substantially unrestricted quantities produces optimum results. The size and number of the air inlet openings **24** and **25** may be controlled by design to insure the introduction of the proper quantity of air into the liquid stream. It is also important that the nozzle **22** be slightly larger than the nozzle **16** to accommodate the increased volume due to the addition of air, but that it be not too large or air will tend to flow into the nozzle counter

to the liquid stream to assist in satisfying the partial vacuum produced in the sleeve **23**. The nozzle **24** should, therefore, be of a size such that it will maintain the jet confined without tending to compress it.

While one apparatus to carry out the method of the invention has been illustrated and described, it will be understood that this is not intended as a definition of the scope of the invention, reference being had for this purpose to the appended claims.

What is claimed is:

1. The method of projecting abrasive material with liquid which comprises projecting the liquid in a flowing stream, adding abrasive to the stream to mix therewith, thereafter adding air to the stream at its periphery, and maintaining the stream and added air confined for a limited distance after the addition of air to the stream.

2. The method of projecting abrasive material with liquid which comprises projecting the liquid in a flowing stream, adding abrasive to the stream to mix therewith, projecting the stream through an enlarged space containing air at substantially atmospheric pressure so that the stream will entrain air from the space, and confining the stream and entrained air for a limited distance posterior to said space.

3. The method of projecting liquid in a substantially unbroken jet which comprises projecting the liquid in a high velocity jet, adding air to the periphery of the jet adjacent to its point of projection, and maintaining the jet and added air confined for a limited distance after the addition of air to the jet.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
821,415	Hess	May 22, 1906
2,040,715	Smith	May 12, 1936
2,200,587	Tirrell	May 14, 1940
2,230,690	Lanza	Feb. 4, 1941