Oct. 17, 1939. L. L. TIRRELL 2,176,577

SANDBLAST DEVICE

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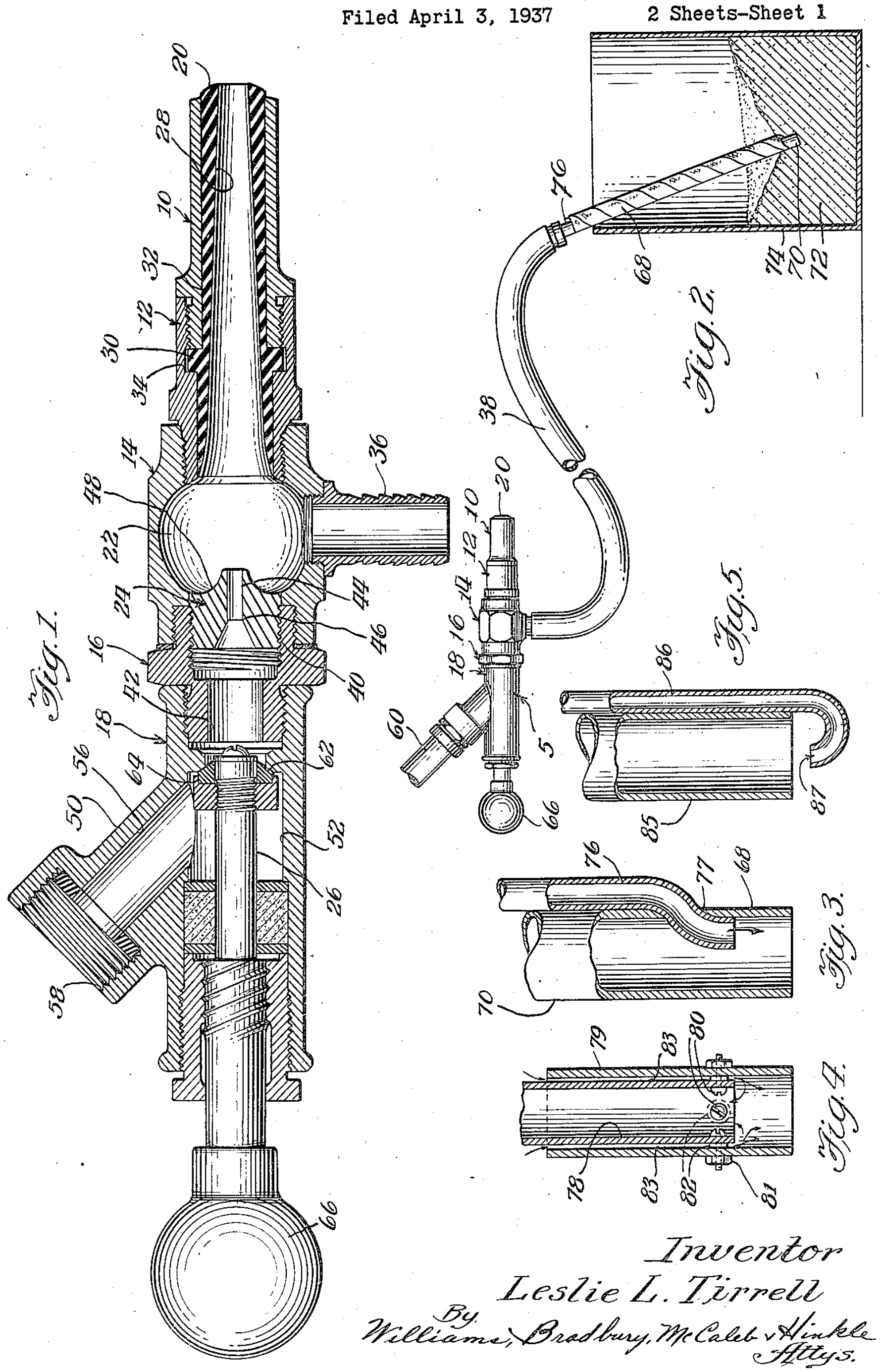

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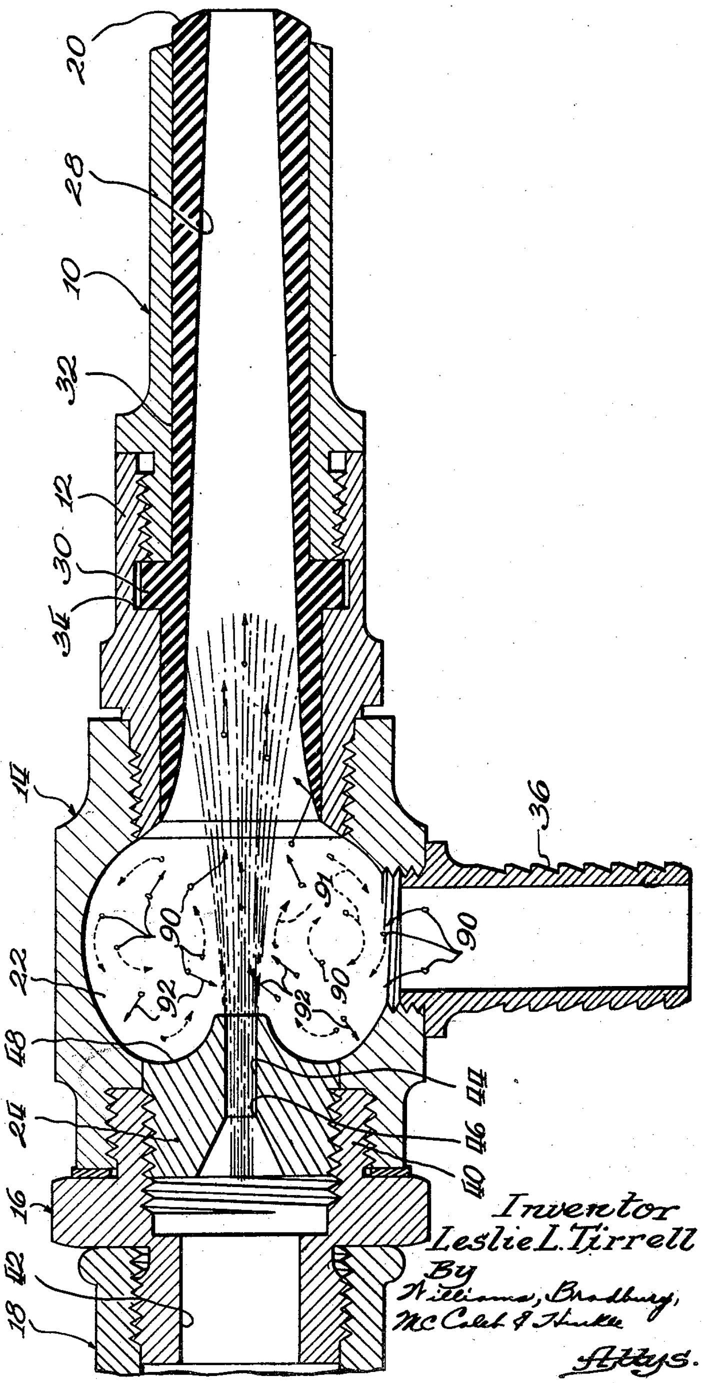
Fig. 6



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SANDBLAST DEVICE

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4 Claims. (Cl. 51—8)

This invention relates to improvements in sandblast guns and more particularly to a sandblast gun that is operated by hydraulic pressure.

In the art of cleaning and abrading, it has been customary to use steam or air as the motive power for projecting the abrasive from a sandblast gun. The use of water or other liquid, however, is more desirable than the use of steam or air since it costs less, prevents silicosis, effectively removes core sand from castings, washes back the used abrasive to a point where it can be collected and reemployed, avoids burning the surface being blasted, and provides better vision for the operator. Water or liquid, having higher surface tension and greater density than air or steam, also provides a more forceful and easily controlled stream. In the past, the use of water has generally been regarded as impractical, since a large amount of water has been required to project a relatively small amount of abrasive. This is because a stream of water projecting from one jet to another through a sand injection chamber in the gun is not easily penetrated by the abrasive particles. Consequently, only a small amount of abrasive is incorporated into the liquid stream.

The principal object of this invention is to provide a practical method for driving the abrasive particles into the liquid stream. A further object is to provide a method in which a small solid stream of water under high pressure can be employed to project a relatively large amount of abrasive. Other objects and advantages will appear hereafter in this specification.

I have found that a very small substantially solid stream of water or other liquid when employed under sufficiently high pressure, can be used to project a relatively large amount of abrasive, provided the abrasive can be driven into the stream. This I accomplish by so proportioning and shaping the mixing chamber that the abrasive particles mixed with air are rotated at high velocity and are thereby driven into the liquid stream by the resulting centrifugal force. The air in this mixture becomes incorporated with the water stream and aids the entry of the abrasive particles thereinto in a manner to be described.

For the purposes of illustration, I have shown one form of apparatus in which the method may be satisfactorily used. This apparatus is shown in the accompanying drawings, in which the various parts are always designated by the same numerals throughout the several views.

Fig. 1 is a longitudinal sectional view of a gun embodying this invention;

Fig. 2 is an elevation of the gun connected to a feeder in a sand bucket, the bucket being shown in section;

Fig. 3 is a partial sectional view of the sand feeder;

Fig. 4 is a partial sectional view of an alternative sand feeder; and

Fig. 5 is a partial sectional view of another alternative sand feeder.

Fig. 6 is a fragmentary sectional view of a portion of the gun shown in Fig. 1 and includes a representation of the liquid jet and abrasive particles.

In the drawings, the gun 5 consists of a tube made up of the axially aligned sections 10, 12, 14, 16 and 18. Within this tube are a nozzle 20, a chamber 22, a nozzle 24, and a water valve 26.

The nozzle 20 is of substantially cylindrical section with a tapered axial hole 28 extending therethrough. This hole 28 is smallest at the forward end and increases in size gradually as it extends rearwardly until it reaches a point near its rear end from where it flares outwardly to the periphery of the nozzle. This nozzle 20 has an external annular ridge 30 that is clamped between the sections 10 and 12 of the nozzle casing when they are screwed together.

The nozzle casing consists of the two sections 10 and 12 which when fitted together form a sleeve with an axial hole 32 to fit the nozzle 20 and an annular groove 34 to hold the ridge 30, so that the nozzle 20 will not be forced from the gun by the projected abrasive and water mixture.

Behind the nozzle 20 is the section 14 containing an annular recess 22 that is largest at a point near its center and is rounded inwardly toward both ends, so that it is of less diameter at its ends than in the center.

Into the lower side of this chamber 22 the abrasive is brought through the nipple 36, which is connected to the sand hose 38.

Fitted to the rearward side of the section 14 is the bushing 16 provided with an internal thread 40 into which is fitted the rear nozzle 24. Extending rearwardly through the bushing 16 is a water passage 42.

The rear nozzle 24 has a cylindrical opening 44 therethrough which cones outwardly and rearwardly from a point 46 near its center. The external forward face 48 of the nozzle 24 substantially continues the curve of the chamber 22, so that the inside surface of the chamber 22 plus the contiguous surface 48 of the nozzle 24 forms a modified toroidal surface.

The bushing 16 is joined at its rearward end to section 18 which contains a rearwardly extending recess 52 containing a valve 26 which is of well known construction; extending obliquely outwardly from the recess 52 is a water inlet passage 56 provided with a thread 58 at its outward end for attaching a water hose 60. Near the forward end of the section 18 is a valve seat 62 against which is forced a valve washer 64 when a knob 66 is turned to the right, thereby cutting off the flow of water through the gun.

The sand hose 38 is connected to a feeder 68 which consists of a sand pipe 70 joined to the hose and extending for an inch or two into some sand 72 in a barrel 74. Fastened to this pipe 70 is a tube 76 which is open to the air at the top and extends through an opening 77 in the sand pipe 70 at a point near its lower end. The lower end of the tube 76 is approximately one-half inch from the bottom of the pipe 70.

Since in operation the part of the tube 76 that is inside the pipe 70 is cut away in time by the abrasive particles, I prefer to join the two together by clamps or friction tape, so that the tube 76 can be easily removed from the pipe 70 and a new tube substituted.

In Figs. 4 and 5 are shown two alternate feeders that may be substituted for the above described feeder 68. Both of these alternate forms have a sand pipe connected to the hose 38 to supply sand thereto, and differ from the feeder 68 only in the manner in which air is mixed with the sand particles.

In Fig. 4 a sand pipe 78 is surrounded by a sleeve 79, the inside diameter of which is somewhat larger than the outside diameter of the pipe 78. The sleeve 79 projects about one-half inch below the end of the pipe 78 and is secured in spaced relation thereto by means of bolts 80, nuts 81 and spacing washers 82, thus providing an annular space 83 for the passage of air.

In Fig. 5 a sand pipe 85 is provided with a tube 86 open to the atmosphere at the top and which extends downwardly along the pipe 85 and at the end thereof is curved inwardly and upwardly so that the opening 87 of the tube faces upwardly and is about one-quarter inch below the surface of the pipe.

When it is desired to operate the apparatus, the gun is connected to a relatively high pressure water supply, in the nature of 700 pounds per square inch, and to the sand hose 38. The feeder 68 is thrust into the sand 72 about an inch or so.

When the valve 26 is opened by turning the knob 66, the water flows through the chamber 56, around the valve 26, and into the passage 42. As illustrated in Fig. 6, the water passes through the opening 44 in the nozzle 24 and comes out as a jet moving at great velocity. This jet of water passes through the abrasive injection chamber 22 and the front nozzle opening 28.

Since the nozzle opening 44 is cylindrical, the water passing therethrough will encounter considerably more friction along the surface than in the center. This friction causes the surface of the jet to be retarded with respect to the center, thereby causing the jet of water to expand as it passes through the chamber 22, and produce a depression therein and within the sand hose 38. Consequently air will flow downwardly through the tube 76 and into the sand pipe 70. This jet of air strikes the sand at the lower end of the pipe 70 and agitates it. The air then flows up inside of the pipe 70 to the gun, carrying the sand along in suspension. Because of the resistance offered to the flow of air by the tube 76 and by the weight of the sand particles in the pipe 70 and hose 38, the air enters the chamber 22 in a rarefied condition.

If the sand feeder shown in Fig. 4 is used, the operation is similar to that described above, excepting that here the air flows downwardly through the annular space 83 instead of through the tube 76.

When the construction shown in Fig. 5 is used, the open end of the pipe is forced into the sand bucket. Air under the influence of suction in the mixing chamber and sand pipe flows through the tube 86, passes from the opening 87 up through the sand into the pipe 85, thereby carrying the particles along in suspension.

Of the three sand feeders described, the one shown in Fig. 5 will deliver the largest amount of sand and is to be preferred if large quantities are desired, or if the sand must be lifted a great distance.

As illustrated in Fig. 6, when the sand and air strike the water stream in the gun, the particles such as 90 are driven forwardly, then outwardly, then rearwardly, and then inwardly, as indicated by dotted arrows 91. This is, the particles travel at a high speed which is dependent upon or proportional to the jet speed and in smoke-ring like manner. The centrifugal force produced by this movement of the particles is in substantially the direction illustrated by the arrows such as 92 and drives the sand particles into the liquid stream.

Since these abrasive particles are moving much more slowly than the water stream at the instant of impact, their inertia causes them to resist the accelerating force of the stream. Consequently, as each particle strikes the jet of water and is accelerated up to jet velocity, it causes a partial vacuum to be formed on the side of the particle toward the front of the gun. The many small vacuum spaces thus formed are in turn filled by the rarefied air which has been brought into the chamber 22 along with the sand. As the stream of water continues through the chamber 22 these pockets or bubbles of rarefied air provide an easily penetrable surface for additional sand particles, and likewise, sand drawn into the nozzle 20 along the surface of the jet easily finds its way into the central portion of the porous stream. Therefore, as the jet of water flows through the chamber 22, it will be seen that abrasive particles are incorporated therein both by the centrifugal force developed and also by the filling of the rarefied air bubbles with the abrasive particles.

From the chamber 22 the homogeneous mixture of water, sand, and rarefied air is projected from the nozzle 20 in the form of a jet which is highly effective in cleaning and abrading operations.

As far as my knowledge goes, past attempts to use water as a motive force in an abrading gun have resulted in the failure of the abrasive to penetrate to the center of the stream. This is because the stream of dense liquid having surface tension and under such high pressure presents a medium that is rather hard and that is not easily penetrated by the abrasive particles.

In accordance with my invention, and as illustrated in Fig. 6, a small stream under high pressure is provided, and the chamber 22 is so shaped that the abrasive particles carried in the rarefied air travel at high velocity in paths similar to those in which particles travel in a smoke-ring. The centrifugal force acting upon the sand particles by virtue of their movement throws them into the stream. The stream also becomes penetrable because of the rarefied air which is also taken in with the sand, as described above, to form a homogeneous mixture of sand, water, and rarefied air in which a small amount of water carries a suitably large quantity of abrasive. This mixture when projected is highly efficient in cleaning and abrading surfaces both because of its abrasive effect and because of the washing properties of the water.

While in the foregoing specification, I have given a preferred embodiment of my device and suggested certain pressures as desirable, it will be understood that the invention may be employed under various conditions with changes in pressures to accommodate the process to different classes of work. Also, it will be understood that the dimensions suggested are for the purpose of illustration only, and wide variations can be made therefore while utilizing the invention.

The foregoing detailed description has been given for the purpose of clearness of understanding only, and no unnecessary limitations should be understood therefrom.

Having described my invention, what I claim as new and useful and desire to protect by Letters Patent is:

1. A method for blast-treating a surface, comprising: passing a non-compressible liquid in a single confined stream and under a high pressure through a loading zone and thence to the surface to be blasted, supplying granular abrasive by suction to said zone, transferring said granular abrasive from said zone into an intimate mixture with said stream, the transference being accomplished by driving the granular abrasive into said stream by the centrifugal force developed by rapidly moving said granular abrasive in vortex rings within the loading zone by the force of said confined stream.

2. The method of admixing abrasive with a rapidly moving liquid stream comprising the steps of projecting the liquid stream, mixing abrasive particles with air, whirling the mixed abrasive particles and air in a space surrounding the projected stream to drive the abrasive particles and air into the liquid stream by centrifugal force to form a porous stream, and collecting more abrasive particles in the open spaces in the porous stream.

3. The method of projecting granular abrasive comprising the steps of mixing granular abrasive with air, projecting water as a high velocity jet, whirling the mixture of granular abrasive and air by the force of the jet in planes passing through the axis of the jet in a confined space surrounding said jet and at sufficient speed that the granular abrasive is thrown into the jet by centrifugal force, and reprojecting the water and entrained granular abrasive as a second high velocity jet.

4. The method of projecting granular abrasive comprising the steps of projecting a high velocity jet of fluid carrying medium through a confined space, introducing a mixture of granular abrasive and air into the said confined space, whirling the mixture of granular abrasive and air within the confined space by the force of the jet and at a speed dependent upon the speed of the jet, so that centrifugal force throws the granular abrasive into the jet, and reprojecting the fluid carrying medium and entrained granular abrasive as a second high velocity jet.

LESLIE L. TIRRELL.