Feb. 23, 1954 J. R. McGRATH 2,669,809

SAND BLASTING APPARATUS AND METHOD

Filed April 18, 1951

2 Sheets-Sheet 1

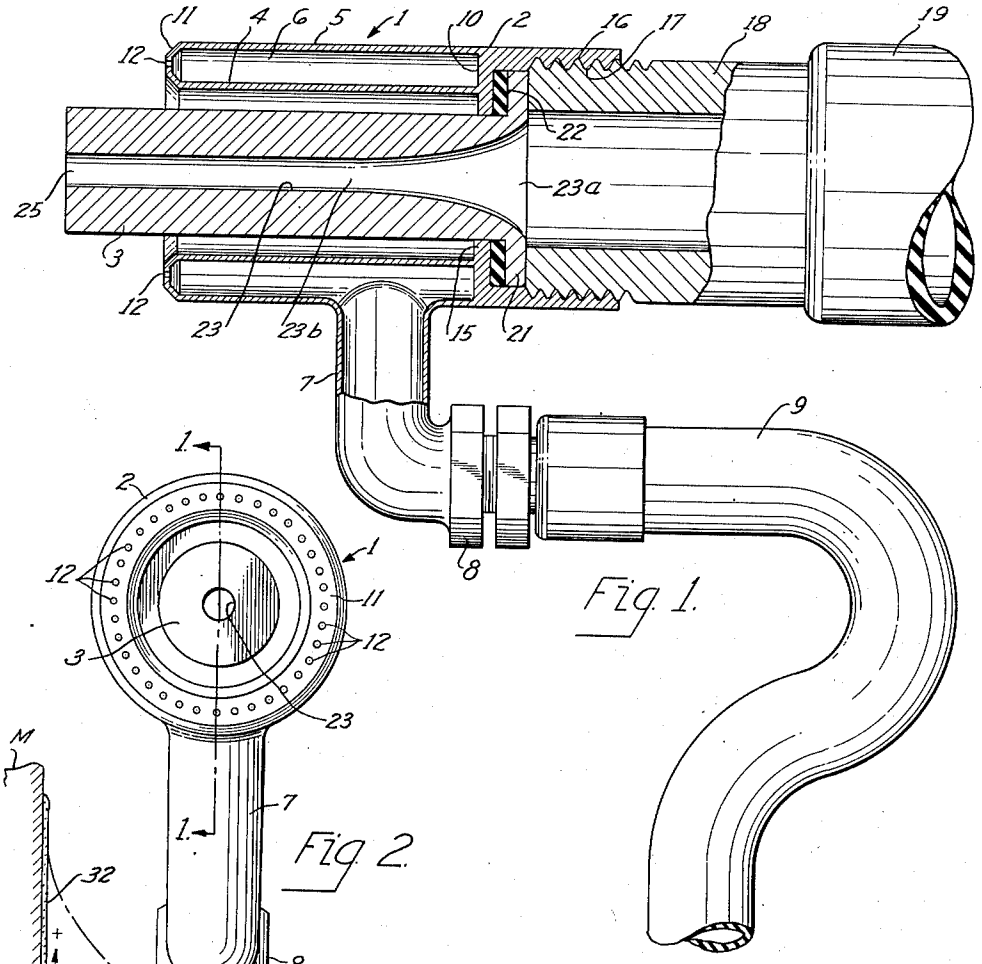

Fig. 1.

Fig. 2.

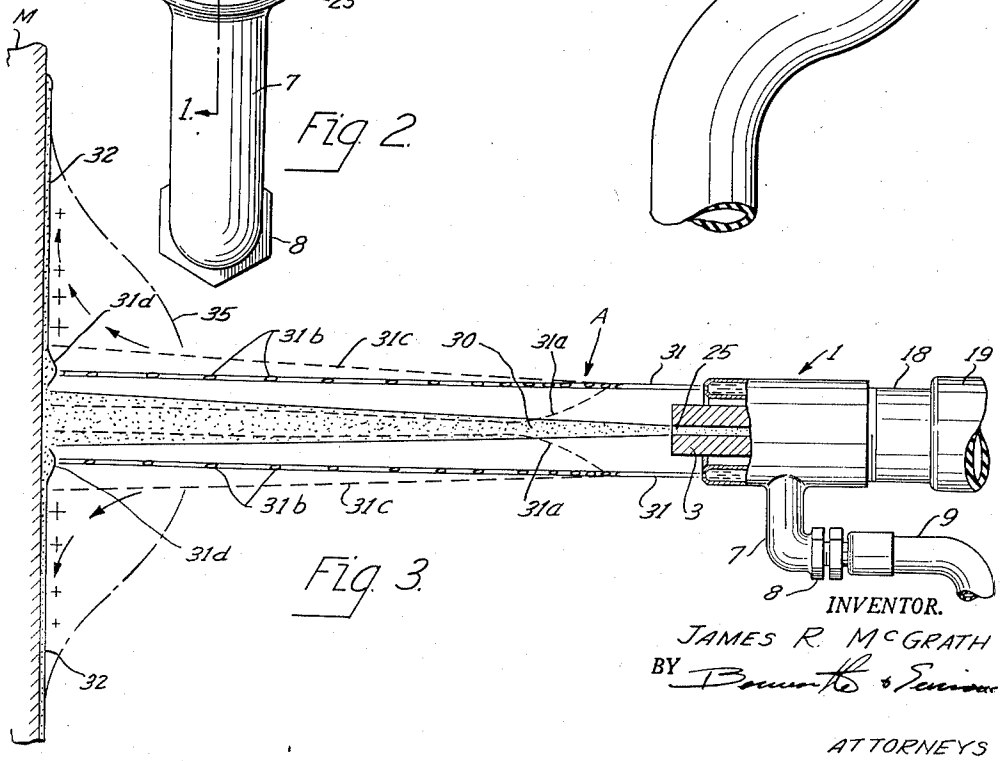

Fig. 3.

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SAND BLASTING APPARATUS AND METHOD

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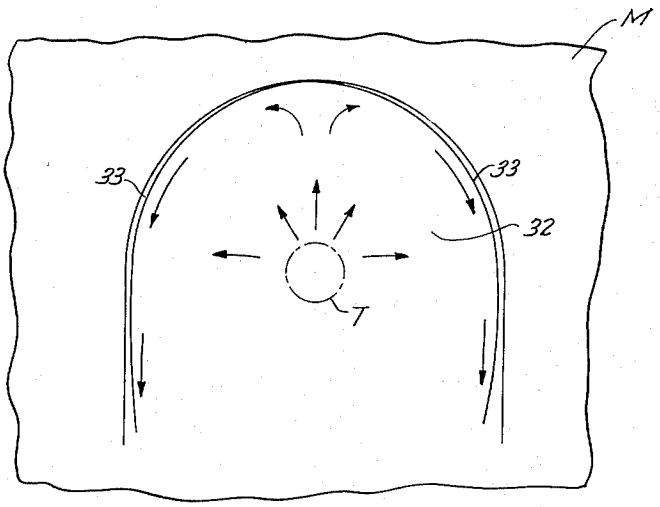

Fig. 4

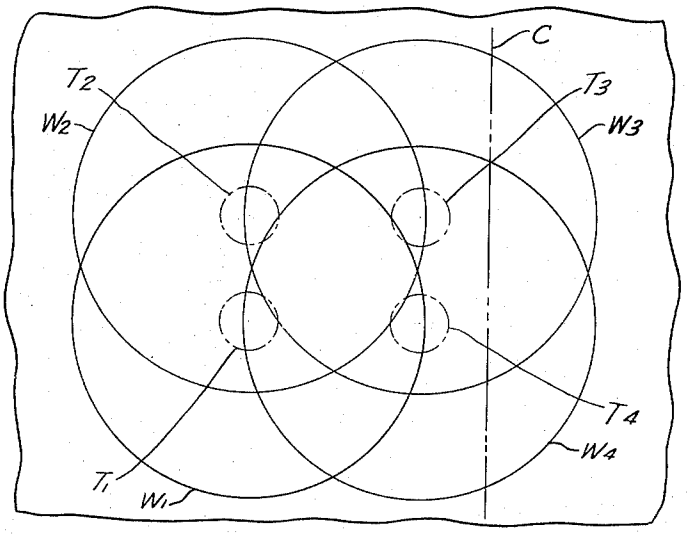

Fig. 5.

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SAND BLASTING APPARATUS AND METHOD

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Application April 18, 1951, Serial No. 221,603

9 Claims. (Cl. 51—11)

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This invention relates to cleaning surfaces and in particular to improved apparatus and method of sand blast cleaning of masonry surfaces and the like.

My invention is concerned with the use of a sand blast in conjunction with water in such a manner as to remove grime and dirt from the masonry surfaces quickly and effectively, without damage to the building surface or injury to the operator from the dust normally generated during sand blasting operations. I achieve these desirable results generally by shooting sand in a dry state from the blast gun while subjecting the building surface immediately adjacent the area of impact of sand therewith to a continuous flood of water so as to completely saturate the "skin" or outer layer of the masonry. By so saturating the building surface, I tend to prevent the formation of dust and/or effectively allay dust at the impact area of the sand, facilitate the removal of dirt by filling the pores of the masonry with water and maintaining the various areas of the surface in this condition until substantially the instant that the sand is blasted against them, and maintain a condition whereby the building surface is at all times plainly visible to the operator even at the core of the sand stream. Among the objects of my invention is to provide a method for cleaning buildings efficiently, safely and with great facility. Another object is to provide a method of sand blast cleaning masonry and the like in which the area being cleaned directly in the path of the blast is plainly visible to the operator who is thereby enabled to clean more effectively, in less time and with less danger to injury to the building surface through excessive abrading thereof.

Another object of my invention is to provide a method of sand blast cleaning of buildings and the like wherein the dust normally generated during the cleaning operation is completely eliminated without impairing the overall efficiency of the cleaning operation. A more specific object of my invention is to saturate the surface and subsurface of a building to be cleaned and to maintain it in a saturated condition until the instant it is abraded by the high velocity sand particles so as to facilitate and hasten the removal of dirt, grime and other foreign matter from the building surface.

Another object of my invention is to provide a method of cleaning a building with a sand blast wherein the surface being cleaned immediately adjacent the sand impact area is saturated without reducing the cutting action of the blast, that is without substantially impairing the velocity of the sand particles directed against sand surface. Another object of my invention is to provide a method of cleaning masonry and the like by sand blasting wherein the dust normally generated during such operations is not only allayed but is prevented from forming in the first instance.

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Another object of my invention is to provide a simple, inexpensive and yet durable sand blast gun by means of which the several objects set forth above may be accomplished. While the description will largely precede in reference to the cleaning of masonry surfaces, it will illustrate the utility of my invention for the cleaning of other surfaces.

These and other objects of my invention will become apparent from the following description of a preferred form and practice thereof, reference being had to the accompanying drawings in which Figure 1 is a vertical section of the blast gun taken on the line 1—1 of Figure 2; Figure 2 is an end view of the blast gun; Figure 3 is a partially schematic representation showing the characteristics of the sand blast and water streams as they are projected from the blast gun against the surface being cleaned; Figure 4 is a diagrammatic view of the surface being cleansed showing the flow characteristics of the sheet of water which surrounds the sand impact area; and Figure 5 is a diagram representing the successive positions of the impact area of the constantly moving sand blast stream over the surface being cleaned.

Before discussing the details and precepts of my invention, it will be helpful to an understanding of the principle involved to explain the technique of operators in the sand blast cleaning of masonry in buildings and like structures. The blast, that is, the high velocity stream of air and sand, is caused to move continually over the surface being cleaned to effect uniform abrading or wearing off of the dirt to be removed and preferably a minimum of top layer of the surface to be cleaned. The rate of movement of the core of the blast relative to the surface is determined by such factors as the kind of masonry being cleaned and the physical characteristics of the sand or other abrasive medium used, but in any event the movement should be continuous throughout the cleaning operation to prevent uneven wearing of the surface and to preserve the appearance and beauty of the structure.

According to the preferred practice of my invention, the surface area which is about to be subjected to sand blasting is first and/or preliminarily wetted and soaked with water. I prefer to fill the pores of the material and saturate the "skin" or top surface of same to a depth up to about ⅛" to ¼" with water before applying the sand blast. After this preliminary wetting, a sand blast consisting of sand or similar abrasive material carried at high velocity in a stream of air is directed against the pre-wet surface and is moved constantly thereover in the manner de-

scribed above to wear off dirt engrained in the material. At the same time, a plurality of streams of water arranged concentrically of and flowing substantially parallel to the sand blast are directed toward and against the surface being cleaned at points substantially on the periphery of the target area, that is, the area of the surface against which substantially all of the sand strikes and within which the abrasive cleaning takes place. Most of this water reaches the masonry surface in a solid state where it is redirected in the form of a thin sheet of water which lays flat against the surface and surrounds the target area and which flows rapidly radially outwardly from the target area. The effect of this radial flow of water from the target area is to bring the masonry surface up to saturation so that the sand stream being moved continually over the surface will always be directed against a part of the surface which the instant before was saturated with water. I have found that by maintaining the surface in such a saturated condition, the dust normally formed by the impact of the high velocity abrasive particles against the surface is either not generated or is effectively allayed. Also, the removal of dirt, grime and the like from the surface is greatly facilitated by what I believe to be the action of this flood of water in filling the pores of the masonry and thereby reducing or substantially eliminating the tendency of surface to absorb or "suck in" the dirt and foreign matter which has been loosened by the sand blast and is suspended in water on the surface.

My improved method of cleaning buildings is carried out preferably by means of the sand blast gun generally indicated at 1 in Figures 1 and 2. This gun consists essentially of an outer shell member or casing 2 preferably made of a non-corrosive material such as brass in which a nozzle 3 is adapted to be removably and concentrically mounted. The front part of the casing is a double wall construction consisting of radially spaced walls 4 and 5 which define between them an annular chamber 6. An elbow 7 communicating with the chamber 6 is adapted to be connected through a coupling 8 to a water hose 9 through which water under pressure flows from a suitable source to the chamber 6. The rear end 10 of chamber 6 is closed while the wall 11 at the opposite or front end is drilled or otherwise formed with a plurality of longitudinally extending holes 12 arranged in a circle and through which the water admitted to chamber 6 under pressure will shoot forwardly in as many narrow solid streams. The holes 12 are drilled with their axes parallel to the longitudinal axis of the casing 2 so that their axes will also be parallel to the axis of the bore or passage in nozzle 3 in order to insure that the water streams as they flow forwardly will be substantially equally spaced from and parallel to the core of the sand blast issuing from the nozzle 3. City water at a pressure of about 40 pounds per square inch is satisfactory for use with the gun 1. For such conditions, I have found that about 36 equally spaced water holes drilled on about a 1½ inch diameter circle in the end wall of the casing with a No. 58 drill (0.042" diameter) will give satisfactory results and will furnish a sufficient quantity of water to the surface about to be cleaned to completely flood and saturate same according to the precepts of my invention.

The casing 2 is formed with an inwardly extending annular flange 15 located at the rear

end of water chamber 6 which acts as an abutment or shoulder against which the nozzle 3 is seated when the nozzle is assembled with the casing. The rear part 16 of the casing 2 is a cylindrical, single walled extension that is open and threaded internally as indicated at 17 to receive the threaded end of a tubular adapter element 18 to which a flexible air-sand hose 19 is adapted to be connected for delivering sand and high pressure air to the nozzle 3. The hose 19 is connected at the other end to a source of high pressure air and sand, not shown and thus sand delivered to the sand nozzle 3 for ejection therefrom at a high velocity.

The sand nozzle 3 is a thick walled hollow tubular member having an annular flange 21 located at the rear end of the nozzle, that is, the end through which the air-sand stream enters the nozzle. Flange 21 is adapted to overlie the inner flange 15 on the casing 2 when the nozzle is inserted therein to locate the longitudinal as well as the coaxial position of the nozzle in the casing 2. When the nozzle is initially assembled with the casing, it is inserted longitudinally through the rear end 16; thereafter, adapter 18 is screwed into the casing so as to press and seat nozzle flange 21 tightly and firmly against flange 15. A resilient washer 22 may be interposed between flanges 21 and 15 to make the joint air tight.

The opening or central longitudinal bore 23 through the nozzle 3 is formed so that the cross-sectional area thereof gradually decreases or tapers from the entrance end 23*a* of the nozzle toward the throat 23*b* thereof as shown so as to impart a high velocity to the high pressure air passing therethrough in a manner well known by those skilled in the art of fluid nozzles. Thus, the individual particles of sand entrained in and carried along by the air stream will likewise be greatly accelerated so that they attain a high velocity upon passing through the nozzle, the velocity being in the order of 150 feet per second. Since the sand particles passing through the nozzle at such high velocities tend to rapidly wear down the nozzle and enlarge the opening therein, the nozzle 3 is made of a very hard wear-resistant material. When the throat 23*b* in the nozzle becomes enlarged through such abrasion to an extent that the velocity of the air-sand stream is reduced to a point where the blast no longer effectively and efficiently cleans the masonry, a new nozzle is substituted by disengaging the adapter 18 from the rear part 16 of the blast gun casing, removing the worn out nozzle and inserting a new one.

The nozzle 3 is sufficiently long to permit the accelerated stream of air and entrained sand particles to flow evenly and non-turbulently from the mouth 25 of the nozzle. The nozzle projects beyond the front wall 11 of the casing 2 as shown and also is radially spaced from the water holes 12. The purpose of this spacing between the nozzle opening and the water holes is to reduce the tendency of the high velocity blast issuing from the nozzle to immediately pull or draw the water into it as the water leaves the gun. Although according to my invention, a portion of the water or water vapor of the water stream may be drawn into the air-sand stream before the latter reaches the surface being cleaned, I prefer to maintain a suitable well defined radial spacing between the water streams and the blast at the mouth or exit end of the gun so that relatively little water will be atomized by the blast and a

substantial portion, preferably the greater portion, of the water will reach the surface being cleaned in the solid or non-atomized state. By way of example, I have found that an initial radial spacing of about ¾ of an inch between the water streams and the core of the blast with the mouth of the sand nozzle projecting about 1¾ inches in front of the water holes in the gun gives satisfactory results.

In Figure 3 I have shown the gun and a schematic representation of the air-sand stream or blast and the water streams between the blast gun and the surface being cleaned. The air-sand stream **30** diverges slightly as it approaches the target while portions of the surrounding water streams **31** are generally drawn into and atomized by the high velocity blast. This partial atomization of the water streams appears to begin at about 1½ to 2 inches in front of the nozzle mouth as indicated at point A in Figure 3. The broken lines *31a* represent the portion of the water streams that are separated from the main body of the stream **31** and are pulled and/or induced by gravity to fall inwardly into the air-sand stream **30**. At this point, the water and air-sand streams are prevaded by a somewhat transparent mist although solid water *31b* is plainly visible beyond the point A toward the target. A certain portion of the water streams takes a divergent course as indicated by the broken lines *31c*. As a result of partial atomization of the surrounding water streams **31**, finely divided water particles are carried by the air-sand stream to the target. The solid constituents *31b* of water that persist in solid water streams hit the surface adjacent the target, that is, at substantially the periphery or outer regions of the target area, and are redirected to flow away from the target in a sheet or layer **32** which flows rapidly radially outwardly from the sand impact area or target. I have observed this sheet to appear to be about ⅛ to ¼ inch in depth and to spread outwardly from the target area a minimum distance of about 1½ feet. There is substantially no rebound of the water particles, all of it being caused to flow into the sheet **32** and to move over and parallel to the surface of the building, soaking the surface adjacent the target. This is shown in Figure 4, the direction of the flow of water in the sheet **32** being indicated by the arrows. The portions of the water sheet directly above the sand impact or target area T flow in an arc under the influence of gravity and finally gather into a perceptible bead of water **33** at the outer edge of the sheet **32**.

According to my method, the surface of the building not only at the target area T but also immediately adjacent the target area is subjected to a continual flooding of water from the streams **31** which saturate the top layer or "skin" of the masonry M as indicated in Figure 3 by the heavy shading at **34**. This saturation process is accelerated by reason of the high pressure area of air, indicated by the broken line **35**, which forms around the target area when the air in the blast builds up and accumulates. It is my belief that this high pressure area or head of rapidly moving air exerts a pressure against the water sheet **32** in a direction normal to the surface thereby forcing water into the pores of the building surface and aiding the saturation thereof. This pressure will be greatest near the core of the sand stream and will diminish proportionately at greater radial distances therefrom, this being indicated by the size and position of

the plus signs in Figure 3. The rush of air in the blast as it curves from a direction of flow normal to the surface to one radially outwardly and parallel to the surface induces the water to flow radially outwardly and at the same time presses the resultant sheet flat against the building surface as shown in Figures 3 and 4. Thus, at all times the portions of the surface immediately adjacent the continually moving target area, that is, those parts of the surface which in the next instant will be subjected to the abrasive action and impact of high velocity sand particles are always saturated with water. The air blast cannot dry these portions of the surface because the sheet of water is interposed between the spreading air blast and the building surface. Also, the partial atomization of the solid streams of water results in some water being carried by the air-sand stream to the surface within the target area so that even at the core of the blast some moisture is supplied to the masonry surface to tend to preserve the saturated condition of the masonry against the drying effects of the moving air in the sand blast.

The partial atomization of the water streams **31** while resulting a misty appearance of the air-sand stream does not interfere with the visibility of the target. The light mist is actually transparent and is confined within the air-sand stream. The line of demarkation between the dirty and clean portions of the building surface can be easily seen at all times by the operator during the blasting operation. Thus by my method of sand blasting I provide for a complete flooding of the portions of the masonry surface at and adjacent to the target area without impairing the visibility of the target area to any appreciable extent.

The saturation of the building surface the instant before the same is struck by the sand particles appears to be largely responsible for the elimination of and/or the allaying of dust normally created at the point of impact. By saturating the top layer or "skin" of the material being cleaned, the tendency for harmful dust to be formed during the breaking off of the small surface pieces by the impact thereagainst of high velocity sand particles is at least greatly reduced. The water in the masonry itself thus tends to prevent dust from forming at the target area. The dust that tends to form from the breakup of the abrasive material itself upon impact and/or which results from the finely divided dust-like particles of abrasive material carried from the source of supply to the gun or are created in the hose or in the gun are also effectively allayed and prevented from filling the atmosphere in and around the working area by the practice of my invention. Based on observation I believe that this result is brought about by means of the flood of solid parts as well as the atomized parts of the streams **31** at and adjacent to the target area; that is, as the dust is carried to and/or bounds backward from the masonry surface, it becomes entrained in the rush of various sized water particles directed toward the surface as well as in the accumulation or "head" *31d* of water which builds up and surrounds the target area. I also believe that the entrainment of this dust in the water at and around the target area is further aided by the flow of air in the high pressure area **35** which induces this dust to fly into and become entrained in the water sheet **32** and be carried away from the target area. I have noted from observation of sand blasting

operations wherein my invention is practiced that water sheet 32 has a distinctly brownish color which I attribute to the sand and dust as well as the dirt and grime being carried away from the target area and that no dust of any visible amount appeared in or about the target area. The only particles that rebounded from the surface being cleaned were heavy solid grit-like pieces which were heard to strike against the operator's shield. These particles were too large and heavy to be breathed by the operator and did not impair visibility of the target area.

The continnous saturation of the building surface according to my method of sand blasting also contributes to quicker, easier and generally more efficient removal of dirt and grime from the surface. Masonry surfaces and particularly those of limestone and sandstone are quite porous and thus have a great affinity for water. Based on observation I believe that when water is introduced into the pores of such masonry surfaces, it is at once drawn rapidly inwardly by the force of capillary attraction. Whenever the surface is wetted to any degree less than a complete filling of these pores, I have found that this condition exists, that is, there is a tendency for the material to absorb or draw in the water which lays on the top of the surface. When the sand blast is directed against the surface and the dirt and grime thereon is loosened, this characteristic of the semi-wet surfaces appears and becomes manifest by what I have observed to be the tendency of the material to draw the dirt inwardly which makes the cleaning job more tedious and time consuming and results in a poor quality of cleaning. I avoid these effects by the practice of my method because, I believe, the surface immediately adjacent the target area is so saturated with water that the material has little or no affinity for or tendency to draw in more water and loosened grime or other foreign matter. To insure that this surface will be in such a saturated condition when the abrasive particles in the blast strike same and begin to loosen the dirt, I cause a flood of water to be directed at all time against the portion of the surface that are immediately adjacent the target area so that the continually moving sand blast will work on a portion of the surface which the instant before was completely saturated. When the blast dislodges dirt, there is no place for this dirt to go except to follow the flow of water in sheet 32 in which it has become entrained and to be carried away from the target area. Thus, by saturating the surface being cleaned especially the moment before it is blasted by the sand particles not only is the generation of harmful dust at the surface prevented but also a quicker, more thorough and generally better cleaning job is realized.

The water streams 31 are arranged so as to be entirely independent of and spaced from the air-sand stream at the nozzle. The air-sand stream is therefore dry as it passes through the nozzle and as such is capable of being accelerated to a high velocity which in turn enhances the abrading action of the sand particles on the surface about to be cleaned. The partial atomization of these streams does not seem to impair this cutting action of the sand. The atomized parts of the water do strike the surface being cleaned within the target area and, I believe, tends to keep this part of the surface saturated and aids in the allaying of dust.

As mentioned above, the sand blast stream should be moved constantly over the masonry surface to preserve the building surface against uneven wearing. I have shown in Figure 5 four positions of the target area T, that is, the core of the sand blast, which positions represent a sequence of movements of the blast over the masonry surface, as for example, from the position of T_1 in a clockwise direction to the position T_4. Also, there is represented schematically the corresponding areas covered by the sheet 32 of water which is represented by the concentric circles W_1 through W_4. While the core of the sand blast is moved from T_1 to T_2, as may occur during the cleaning operation, the sand particles will at all times strike against portions of the surface which the instant before were covered and saturated by the water sheet 32. This is indicated in Figure 5 by the showing that the area T_2 lies well within the area of W_1. As the sand blast is moved to the position of T_3 to the right of T_2, the same condition of saturation of the target area will exist. T_3 is shown as lying partially within the circle W_2 although it will be understood that as the sand blast is moved from T_2 to T_3 the water sheet will likewise move to the right and flood and saturate the surface by the time the sand blast reaches T_3. In like manner, the area T_4 is shown as having been flooded by the wash of water sheet W_3 corresponding to the previous position T_3 of the sand blast against the masonry surface. The gross result is that the masonry surface surrounding the continually moving target area is constantly being saturated by the sheet of water 32, which condition facilitates the cleaning of the surface and effectively allays dust formed during the sand blast operation.

Through the practice of my invention the cleaning of irregular and/or ornamental parts of buildings and the corners thereof as well as the flat continuous surfaces is greatly facilitated. In the case of irregular surfaces, the flood of water from streams 31 will tend to conform generally to the contour of the masonry surface by reason of the high pressure area of air around the target area and will be thereby urged to soak into the sub-surface of the material regardless of the irregular contours of same to saturate it prior to the impact therewith by the high velocity abrasive particles. Referring again to Figure 5, I have represented by a broken line C the corner of a building being cleaned. From the foregoing description, it will be apparent that the portions of the surface adjacent the corner C will be fully soaked by the water sheet 32 as the sand blast is moved up to the corner edge and the cleaning of these parts of a building will be complete.

While I have illustrated and described a preferred embodiment and manner of practicing my invention, modifications and changes will occur to those skilled in the art without substantially departing from the substance thereof or precepts of this specification and therefore I do not care to be limited in the scope of my patent to the form herein specifically illustrated and described nor in any manner not required by the state of the prior art.

I claim:

1. A method of sand blast cleaning comprising projecting a stream of sand at high velocity from a blasting gun toward the surface being cleaned, simultaneously directing a plurality of individual streams of water substantially parallel to said sand stream toward said surface so as to surround the sand stream in spaced relation there-

to adjacent the gun, causing said water streams to strike said surface immediately adjacent the point of impact of said sand stream therewith and to be thereafter redirected to flow radially outwardly from said impact area to saturate the area of said surface surrounding and immediately adjacent said impact area.

2. A method of cleaning masonry and the like consisting of the steps of projecting a stream of finely divided abrasive particles at high velocity from a gun against the surface being cleaned, simultaneously directing water from said gun in a direction substantially parallel to the sand stream, said water being radially spaced from said sand stream at the gun, and causing a substantial portion of said water to hit said surface at points at least as close to the area of impact of said sand stream thereagainst as said spacing between the water and the sand stream at the gun.

3. A method of sand cleaning masonry and like surfaces consisting of the steps of projecting a stream of sand at high velocity from a gun toward the surface being cleaned, simultaneously directing a plurality of streams of water from said gun toward said surface, said streams of water being concentric with and spaced from and flowing substantially parallel to said sand stream at least at the mouth of the gun and ultimately striking said surface at points approximately as close to said sand stream as the spacing between the water and the sand stream at the gun and thereafter causing said water to flow radially outwardly from the sand impact area in contact with said surface to wet portions of said surface completely surrounding the sand impact area.

4. A method of sand blasting masonry and the like consisting of the steps of pre-wetting a portion of the surface to be cleaned, directing a stream of sand at high velocity toward said pre-wet portion of said surface, simultaneously directing a plurality of streams of water from said gun toward said surface in a direction substantially parallel to the sand stream, said water streams being spaced from said sand stream at least at the mouth of the gun and ultimately striking said surface at points approximately as close to said sand stream as the spacing between the water streams and the sand stream at the gun, causing said water after striking said surface to be redirected to flow radially outwardly from the point of impact and to saturate the surface over which it flows, and continually moving the sand and water streams transversely of said surface.

5. A method of cleaning a masonry surface by sand blasting consisting of the steps of pre-wetting a portion of the surface to be cleaned, directing a continuous blast of abrasive particles from a gun at high velocity generally toward said pre-wet surface and continuously moving said gun so as to move the core of said blast continually over the surface being cleaned, simultaneously directing a plurality of streams of water from said gun initially concentrically of and spaced from and substantially parallel to the core of the blast and in a direction toward said pre-wet surface, said water streams ultimately striking portions of said surface proximate to and completely surrounding the area of impact of the abrasive particles, and thereafter causing said water streams to be converted into a thin sheet of water on said surface and flowing rapidly radially outwardly from said area of impact so as to constantly and thoroughly soak the portions of said surface against which the abrasive particles will next be directed.

6. The method according to claim 4 which includes the step of causing at least a portion of said water to strike the surface within said area of impact.

7. A method of sand blast cleaning comprising projecting a stream of sand at high velocity from a blasting gun toward the surface being cleaned, simultaneously directing a plurality of individual streams of water substantially nondivergently toward said surface and surrounding the sand stream in spaced relation thereto substantially throughout the length of the sand stream, causing said water streams to strike said surface immediately adjacent the point of impact of said sand stream therewith and to be thereafter redirected to flow radially outwardly from said impact area to saturate the area of said surface surrounding and immediately adjacent said impact area.

8. A method of sand blasting cleaning comprising projecting a stream of sand at high velocity from a blasting gun toward the surface being cleaned, simultaneously directing a plurality of streams of water toward said surface and surrounding the sand stream in spaced relation thereto, causing said water streams to strike said surface immediately adjacent the point of impact of said sand stream therewith and to be thereafter redirected to flow radially outwardly from said impact area to saturate the area of said surface surrounding and immediately adjacent said impact area.

9. A sand blast gun for use in cleaning surfaces comprising a hollow cylindrical casing, one portion of said casing having radially spaced walls defining an annular chamber, means for supplying water under pressure to said chamber, the end of said one portion of said casing having about 36 openings, each approximately 0.042" in diameter and communicating with said chamber, said openings being substantially equally spaced from each other and formed on a circle having a diameter of about 1½" and concentrically of the longitudinal axis of the casing, the axes of said openings being substantially parallel to the axis of the casing, a nozzle removably mounted within said casing and extending beyond said one end of said casing and having a longitudinal bore therethrough, the axis of said bore coinciding with the longitudinal axis of said casing, and means connected to another portion of said casing for supplying sand and air under pressure to said nozzle, the sand being projected at high velocity from said nozzle in radially spaced relation to the water issuing from said openings in the casing.

JAMES RICHARD McGRATH.

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