Oct. 16, 1945. W. H. SWENARTON 2,387,193

METHOD OF AND APPARATUS FOR SAND BLASTING OF SHIPS' HULLS

Filed July 3, 1944

Fig. 1.

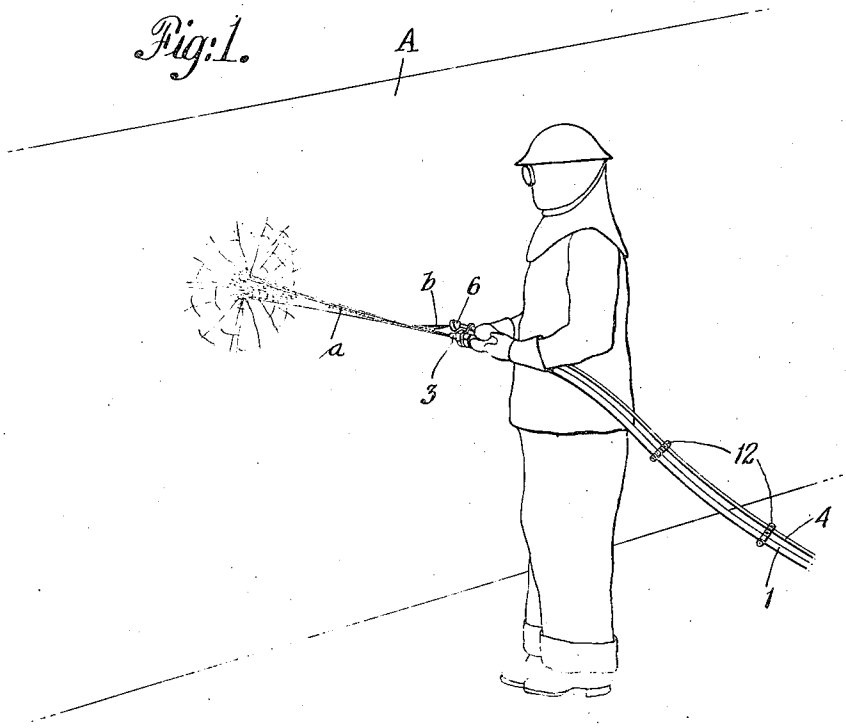


Fig. 2.

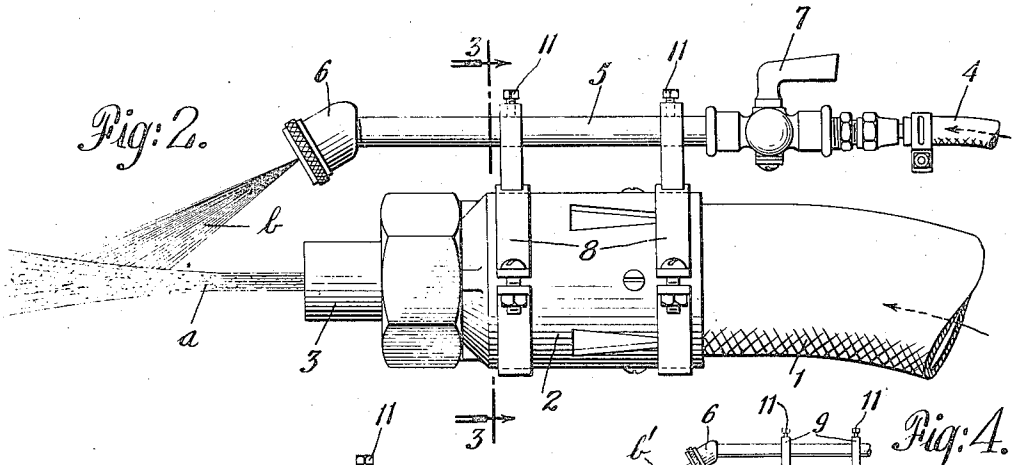


Fig. 3.

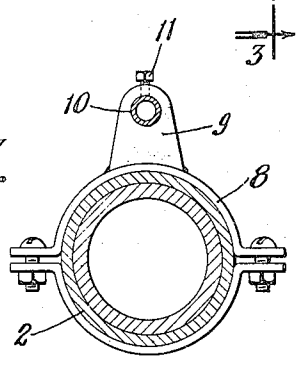
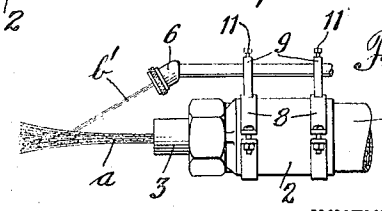


Fig. 4.



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METHOD OF AND APPARATUS FOR SANDBLASTING OF SHIPS' HULLS

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11 Claims. (Cl. 51—282)

This invention relates to the sand-blasting of ferrous metal plates and other ferrous metal shapes and more particularly to the sand-blasting of the component metal strakes of ships' hulls in order to effectively and expeditiously remove paint, rust-scale, barnacles or the like therefrom and has for its principal objects the provision of an efficient and economical method, which is non-hazardous to the operatives, for accomplishing these objects without objectionable corrosion of the blasted surface resulting from such operation. Other objects of the invention are hereinafter set forth.

Heretofore, as I am well aware, it has been proposed, in order if possible to eliminate or at least to minimize the hazard of silicosis, now generally recognized as an insidious occupational disease, (see the article on occupational diseases in the February 1935 issue of the Mechanical Engineering Magazine) to employ wet sand-blasting methods for the scaling and cleaning of metal, stone, concrete and brick surfaces. The wet blasting methods included the employment of relatively large quantities of steam or water introduced into the sand stream either before or after its emergence from the nozzle of the sand-blast hose. Such methods, when employed for the blasting of non-metallic surfaces, such as stone, concrete or brick for example, have met with quite general acceptance but when it has been attempted to utilize the same for blasting of steel or other corrodible ferrous metal surfaces, owing to the large volumes of steam or water employed, have resulted in not only promoting the rapid corrosion of the virgin or bare metal surfaces exposed by the sand blasting operation but also in the accumulation of large quantities of sand particles as a coating thereon whose complete removal, which was essential before the metal surface could be painted, could only be accomplished either laborious brushing operations or else by means of high pressure air or water jets. Such water jets promoted further corrosion besides rendering sedimentary sand which accumulated on the drydock in which the vessel was docked extremely sloppy and, in freezing weather, objectionably slippery. This, as a consequence, tended to defeat the main objects of the blasting operation, especially on ships, namely the expeditious and unobjectionable production of perfectly smooth virgin metal surfaces ideally adapted for the reception of glossy, even coats of paint and which painted surfaces in the case of ships' hulls, because of their remarkable smoothness, not only facilitate the maneuverability of the vessel but also serve to substantially increase the speed thereof besides being unusually resistant to barnacle growth because of the difficulty presented by virtue of their smoothness to any barnacles seeking to attach themselves thereto.

Among the aforesaid processes which have been proposed for the sand-blasting of metal plates and shapes are what may be appropriately termed hydraulic blast and vapor blast methods, the former employing a high pressure stream of water containing a relatively large percentage of sand in suspension, such stream of water flowing at the rate of about 30 gallons per minute, and the latter employing a high pressure air current admixed with a small volume of sand in which method from 15 to 60 gallons per hour of water is introduced into the mixed stream of sand and air prior to its emergence from the nozzle of the blast hose. Such processes, while serving to effectively lay the fine sand particles so as to render the same virtually harmless, have required excessive quantities of sand to accomplish the removal of the accumulations on the surface to be blasted and have been invariably accompanied by the aforesaid excessive corrosion of the virgin metal surfaces initially produced by the blasting operation. In an attempt to minimize such corrosion, it has been the practice to incorporate with the aqueous spray a corrosion-inhibiting agent, such for example as a dilute aqueous solution of sodium or potassium bichromate and trisodium phosphate and then to subsequently wash down the treated surface with water to remove such alkaline inhibitors. In addition to the foregoing disadvantages possessed by prior wet blasting methods, there is the additional disadvantage of freezing weather resulting in the freezing up of the mixture in the blast hose comprising sand and water in the case of the hydraulic blasting method or of sand, air and water in the case of the vapor blast method to say nothing of the annoyance encountered, in the case of the latter method, of clogging of the blast hose when the operative inadvertently allows the water to continue to be discharged into the blast hose after the flow of sand and air from the blasting machine has been momentarily cut off either by accident or design.

My investigations have led to the discovery that the aforesaid drawbacks encountered in prior wet sand-blasting methods which often rendered the same unsatisfactory for the effective removal of paint, scale, barnacles etc., from the metal surfaces of ships' hulls, can be substan-

tially entirely eliminated and as a result such metal surfaces can be rapidly and economically cleaned by a wet sand-blasting operation without endangering the health of the operatives and with the production, even in freezing weather, of a virgin metal surface that under normal fair weather conditions will resist corrosive action of the elements for a matter not of hours but of days, thus affording ample time for the application of a protective paint coating thereto. The invention is more fully set forth in the following description and drawing forming a part thereof in which latter

Figure 1 is a perspective view of an operative employing one form of my improved method of sand blasting for the removal of paint, rust scale and barnacles from the ship's hull;

Figure 2 is an enlarged detail fragmentary elevation of one form of nozzle element of the blasting equipment showing the manner in which a discrete aqueous spray composed of relatively large drops or particles is projected into the mixed sand and air stream;

Figure 3 is a vertical section, taken on the line 3—3 of Figure 2; and

Figure 4 is a fragmentary elevation similar to Figure 2 but on a reduced scale of a modification wherein a solid aqueous spray jet instead of a spray containing discrete aqueous drops or particles, whether relatively large or in the form of a fine mist, as hereinafter described, is employed.

Referring to the drawing and the construction shown therein, the reference numeral 1 designates the main sand-blast hose of a standard sand-blasting machine (not shown), 2 the nozzle holder which is rigidly fastened on the end of such hose and 3 the blast nozzle that is removably mounted on said holder. An auxiliary, relatively small hose 4 serves to supply aqueous liquid to a nipple 5 which has a spray nozzle 6 mounted on its outer end and preferably has a regulating cock 7 interposed between its other end and the hose 4. So-called pipe hangers 8 are securely clamped or if desired brazed to the nozzle holder 2, said hangers having vertical alined stanchions or lugs 9, provided with registering apertures 10, through which said nipple projects, and also having set screws 11 which serve to firmly anchor such nipple in the stanchions.

The reference numeral *a* designates the mixed blast of air, under high pressure, and sand delivered by the nozzle 3 and the numerals *b* and *b'* designate the aqueous discrete spray and the solid aqueous jet spray delivered by the spray nozzles in the two modifications of the invention illustrated in Figures 2 and 4, respectively.

In carrying out the method of wet sand-blasting of the steel strakes of the hulls of ships in accordance with the invention, a high pressure blast of mixed air and sand, as delivered into the blast hose from the mixing chamber of a typical sand blasting machine of well known construction, is discharged from the nozzle 3 while the same is directed at and held in proximity to the objective metal surface and simultaneously with the projection of the blast against such surface an aqueous spray, such as fresh water under pressure or a dilute solution of a rust inhibitor, either with or without an amount of ethyl or methyl alcohol sufficient to prevent freezing of the spray, is discharged from the spray nozzle 6 into the blast issuing from the nozzle 3 at a short distance beyond and above the latter. The amount of aqueous liquid so discharged from the nozzle 6 is extremely small when the spray is composed of relatively large drops or is in the form of a solid jet, desirably not more than two gallons per hour and insufficient to produce ripplets of water flowing over the resultant virgin metal surface such as would cause excessive corrosion thereof as well as cause the adherence of a layer of large sand particles thereon due to the surface tension of the water flowing over such surface, as coarse sand particles can only be expeditiously removed by washing down the surface with objectionable acceleration of the corrosion of such surface. Preferably in my method, when a solid jet is employed or the discrete spray contains relatively large drops of water, as distinguished from a fine mist, the amount of water so discharged is between about one and three gallons per hour, for example one and one-half gallons per hour is sufficient to dampen the surface but momentarily and to yield a substantially dry surface substantially uncorroded and free from a layer of coarse sand particles adhering thereto, almost immediately after the blast has passed from the area of the surface blasted to an adjacent area. In practice, a dry blast of clean sharp sand and air, issuing from a relatively small nozzle aperture, say from ⅛" to ⅜" diameter at a pressure of about 70 to 90 lbs. or more per square inch, will develop sufficient heat of friction, upon impact with the objective steel or iron surface, to produce a multitude of clearly visible sparks and such heat of friction, plus the extremely large expansive tendency of the highly compressed air, will co-operate to rapidly evaporate the water in the spray or jet, such as aforesaid, if the same is projected into such blast shortly after its issuance from the blast nozzle while at the same time such small amount of water so sprayed into the blast suffices to effectively lay the fine floating sand particles and render the same harmless to blasters operating the blast nozzles or to painters, welders and others at work on the same vessel in the vicinity of the blasters. Moreover, due to the substantial absence of a layer or layers of coarse sand particles adhering to metal surfaces blasted in accordance with my invention, it is wholly unnecessary to resort to the present practice employed in other so-called wet blasting methods of washing down such surfaces with plain water or with a solution of a rust inhibitor, in an effort to remove the sand and to minimize corrosion. Furthermore if the discrete aqueous spray is in the form of a fine mist and of wide angularity, for example as a conical spray having a spread of from about 45° to 90°, even larger amounts of water, say from 5 to 18 gallons per hour, can be discharged without causing the objectionable accumulation of layers of relatively large quantities of coarse sand particles that are of a size of 30 mesh or larger on the blasted surface, due to the fact that the extremely fine particles of water in such misty spray are too small to wet down such coarse sand particles sufficiently to produce a surface tension which will cause such particles to adhere to such blasted surface.

The blasted virgin metal surfaces obtained when performing my improved wet-blasting method, are not only essentially free from objectionable corrosion but will remain so, under fair weather conditions, not merely a few hours but for a matter of a day or more and as a consequence such blasted surfaces can be painted, if desired, the day following the completion of the blasting thereof and the resultant paint coat will not only be firmly bonded to the underlying

metal surface but, in the case of ships' hulls, the painted surface owing to its remarkable smoothness will improve materially the speed and maneuverability of the vessel besides materially inhibiting barnacle growth thereon.

Another distinct advantage of my improved method is that it lends itself to the employment of so-called rust inhibitors if, as is the present practice in the blasting of ships, the after-treatment of steel blasted surface of vessels with such inhibitors is required. While ordinarily such after-treatment, even with the most efficient rust inhibitors known, stimulates corrosion when sufficient water is present to cause ripplets of aqueous liquid containing such inhibitors to flow over the treated surface, yet nevertheless in my improved method wherein the objective steel surface is merely rendered visibly damp, the surface drys so rapidly, as above explained, particularly if the spray also contains a substantial percentage, say 20% or more, of alcohol, that little if any after-corrosion will result from the application of the rust inhibitor.

Among such rust inhibitors which may be so employed in my improved method are aqueous solutions containing small percentages, say one to two per cent by weight, of phosphoric acid, or ethyl, methyl and butyl non-ester compounds of phosphoric acid, or again an amino alcohol known as triethanolamine, the latter being especially desirable because of its being non-acid in character and non-corrosive to metal containers, such as small steel tanks of say 10 to 50 gallons capacity, which may be conveniently employed for supplying the various spray nozzles, when associated with a battery of blast nozzles, with the aqueous solution containing the selected rust inhibitor.

Spray nozzles adopted to deliver either a conical or a flat fan-like discrete spray, when water in the above prescribed amounts under a pressure of say 40 to 80 pounds per square inch, is delivered thereto, have been found to be especially desirable for the purpose of laying the fine floating sand particles originally present in the sand delivered to the blast nozzle or which result from the disintegration of the coarse sand particles, say those of about 30 mesh or coarser, upon impact with the objective blasted surface. When blasting ships' hulls, the principal portion of the fine, floating siliceous particles so laid by the aqueous spray projected into the blast are blown off the objective hull surface and rapidly subside to the ground while but a very small portion thereof temporarily settle upon the blasted surface in the form of a fine powder which, when the surface drys completely, either fall off or can be readily removed by blowing off the same with an air blast or by a light brushing operation with ordinary brooms.

When the amount of water projected into the blast is say five gallons or less, the quantity of alcohol or rust inhibitor required for the purposes herein specified is so small that the cost thereof is almost negligible where ships' hulls are being blasted, whereas in the aforesaid methods such as the hydro-blast and vapor-blast wherein either 30 gallons per minute or 15 to 30 gallons per hour of water is employed, the amount of alcohol required to prevent the freezing of the water in the blast hose in freezing weather is so excessive as to be almost prohibitive in cost where ships' hulls are being blasted.

The pressure of the air in the blast delivered by the blasting machine should be desirably in excess of 60 pounds per square inch and preferably such that when sand of say 20 to 30 mesh or even coarser is employed and the water spray is momentarily shut off, numerous sparks will be observed upon impact of such sand particles with the exposed virgin metal surface produced by the blast.

When a solid jet type of spray, such as aforesaid, is projected into the blast at the rate of say three gallons per hour or less and at a distance of from six to twenty-four inches beyond the nozzle 3, the same will be virtually exploded by the air in the blast into a fog or mist containing discrete, i. e. separate, aqueous particles, virtually as minute as if a discrete mist-like spray had been projected into the blast.

The method of wet sand-blasting embodying my invention while especially desirable for scaling the steel hulls of ships is also applicable to other ferrous metal surfaces as cast iron, malleable iron and the like which in their virgin uncoated state are corrodible on exposure to water and to the atmosphere.

The applicant specifically disclaims from the scope of the appended claims any method of sand blasting wherein the sand stream is moistened or otherwise admixed with aqueous liquid or an aqueous fluid as steam prior to its issuance from the blast nozzle.

Various modifications of the hereindescribed invention may be made without departing from the spirit of the invention as embraced within the scope of the appended claims.

Having thus described my invention, what I claim is:

1. The method of removing coatings from metal surfaces by sand-blasting, which comprises projecting a high pressure blast of air and sand through a blast nozzle and directing it against the objective metal surface while causing a very fine mist-like spray of aqueous liquid under pressure and flowing at a rate in excess of four gallons per hour but insufficient to create ripplets flowing over such surface to intersect such blast beyond said nozzle and prior to its impact with such surface.

2. The method of sand-blasting ferrous metal surfaces to remove coatings therefrom, which comprises projecting a high pressure blast of air and sand through a blast nozzle and directing it against the objective metal surface, while causing a small amount of an aqueous liquid under pressure and flowing at a rate between about one and four gallons per hour but insufficient to create ripplets flowing over such surface, to intersect such blast beyond said nozzle and prior to its impact with such surface.

3. The method of sand-blasting ferrous metal surfaces to remove coatings therefrom, which comprises projecting a high pressure blast of air and sand through a blast nozzle and directing it against the objective metal surface while causing a small amount of an aqueous liquid under pressure, flowing at a rate between about one and five gallons per hour, to intersect such blast beyond said nozzle and prior to its impact with such surface, the amount of such liquid being only sufficient to dampen such surface without producing ripplets of liquid running thereover such as to cause the accumulation on such surface of objectionable quantities of coarse sand particles.

4. The method of sand-blasting ferrous metal surfaces to remove coatings therefrom, which comprises projecting a high pressure blast of air

and sand through a blast nozzle and directing it against the objective metal surface while causing a small stream of aqueous liquid under pressure and flowing at a rate between about one and three gallons per hour but insufficient to create ripplets flowing over such surface to intersect such blast after it leaves said nozzle and prior to its impact with such surface.

5. The method of sand-blasting ferrous metal surfaces to remove coatings therefrom, which comprises projecting a high pressure blast of air and sand through a blast nozzle and directing it against the objective metal surface while causing a small stream of aqueous liquid under pressure, and flowing at a rate of the order of about one and one-half gallons per hour but insufficient to create ripplets flowing over such surface, to intersect such blast after it leaves said nozzle and prior to its impact with such surface.

6. The method of wet sand-blasting coated ferrous metal surfaces, to produce a virgin metal surface thereon, at temperatures below the freezing point of water, which comprises projecting a high pressure blast of air, containing coarse sand in suspension therein, through a blast nozzle and directing it against the objective ferrous metal surface while causing a small stream of aqueous liquid under pressure and flowing at a rate between about one and five gallons per hour and containing sufficient alcohol to prevent the freezing of the liquid at the prevailing low temperature to intersect such blast after it leaves said nozzle and prior to its impact with such surface.

7. The method of wet sand-blasting coated ferrous metal surfaces, to produce a virgin metal surface thereon, at temperatures below the freezing point of water, which comprises projecting a high pressure blast of air, containing coarse sand in suspension therein, through a blast nozzle and directing it against the objective ferrous metal surface while causing a small stream of aqueous liquid under pressure, and flowing at a rate between about one and five gallons per hour and containing sufficient alcohol to prevent the freezing of the liquid at the prevailing low temperature and a small percentage of a rust inhibitor, to intersect such blast after it leaves said nozzle and prior to its impact with such surface.

8. The method of sand-blasting ferrous metal surfaces to remove coatings therefrom, which comprises projecting a high pressure blast of air and sand through a blast nozzle and directing it against the objective metal surface while causing a small stream of aqueous liquid under pressure, containing a small percentage of triethanolamine and flowing at a rate between about one and five gallons per hour but insufficient to create ripplets flowing over such surface, to intersect such blast after it leaves said nozzle and prior to its impact with such surface.

9. The method of sand-blasting ferrous metal surfaces to remove coatings therefrom, which comprises projecting a high pressure blast of air and sand through a blast nozzle and directing it against the objective metal surface while causing a small stream of aqueous liquid under pressure, containing a small percentage, but not exceeding two per cent, of a rust inhibitor comprising essentially triethanolamine and flowing at a rate between about one and five gallons per hour, but insufficient to create ripplets flowing over such surface, to intersect such blast after it leaves said nozzle and prior to its impact with such surface.

10. The method of sand-blasting ships' hulls, to produce a virgin metal surface thereon, which comprises projecting a high pressure blast of air and sand through a blast nozzle and directing it against the hull to be blasted while causing a very fine mist-like spray of an aqueous liquid flowing at a rate of several gallons per hour and containing a small percentage of a rust inhibitor to intersect such blast after it leaves said nozzle and prior to its impact with such surface, said spray being of such a degree of fineness and being delivered in such volume as to be insufficient to cause the accumulation of a layer of coarse sand particles exceeding about 40 mesh in size on the blasted surface.

11. The method of sand blasting, which comprises projecting a high pressure blast of air and sand against an objective metal surface while simultaneously causing a very fine mist-like spray of an aqueous liquid to intersect such blast in mid air prior to its impact with such surface, such spray flowing at a rate in excess of four gallons per minute but insufficient to cause the accumulation of a layer of coarse grained sand particles exceeding about 40 mesh in size on the blasted surface.

WAITSTILL H. SWENARTON.