O. M. FOSTER.

PROCESS FOR CLEANING SURFACES.

APPLICATION FILED MAR. 6, 1915.

1,141,243.

Patented June 1, 1915.

2 SHEETS—SHEET 1.

Fig. 1.

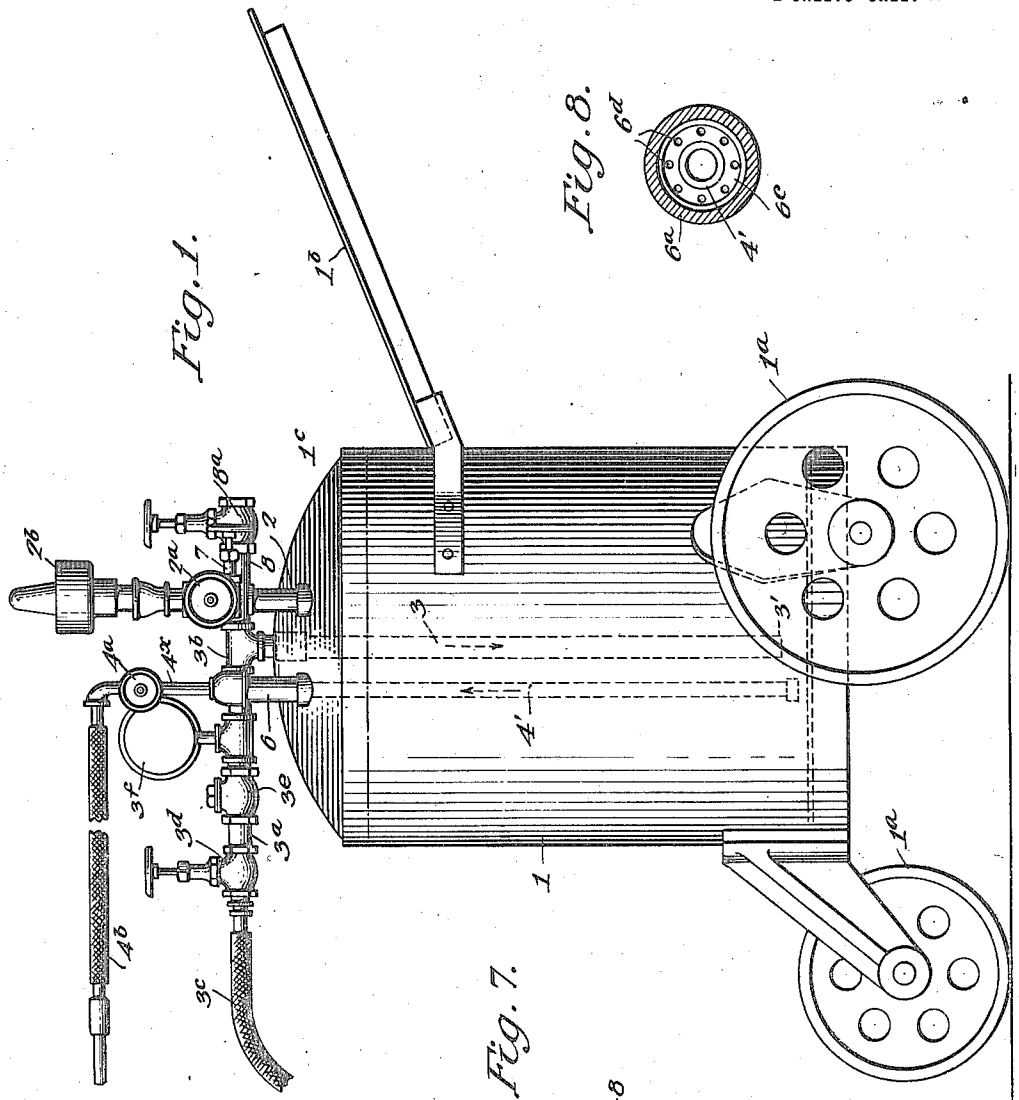
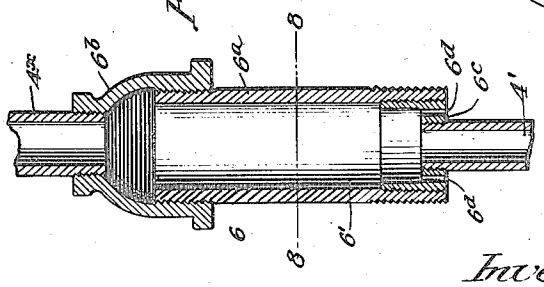


Fig. 8.

Fig. 7.



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2 SHEETS—SHEET 2.

Fig. 2.

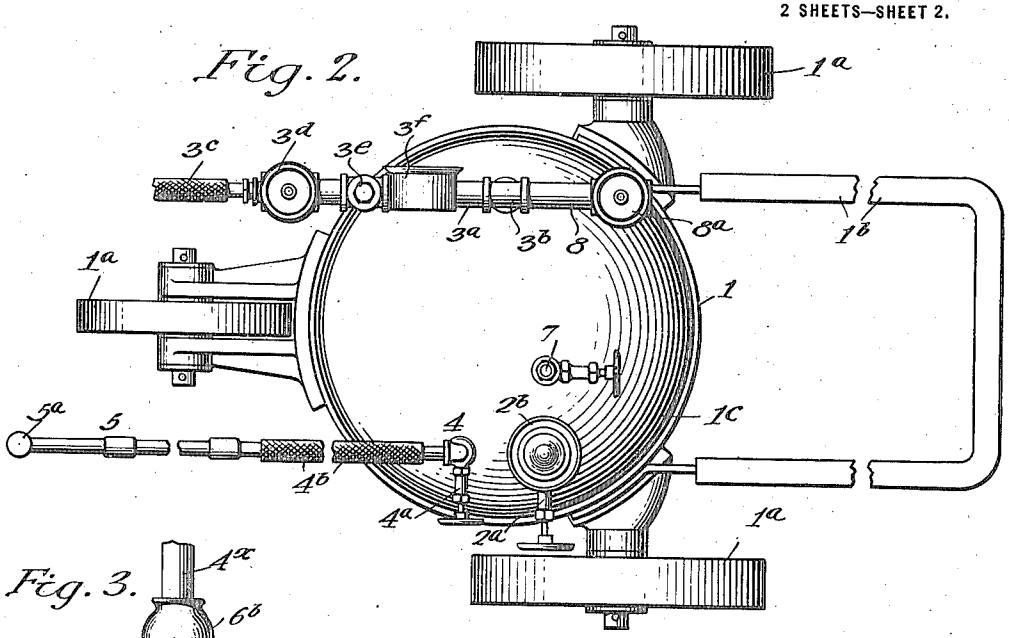


Fig. 3.

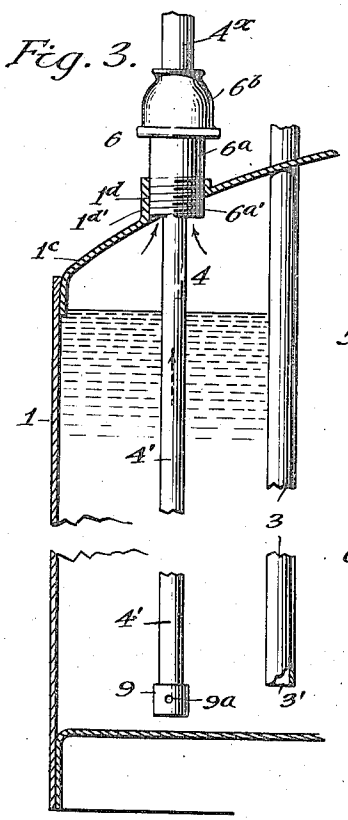


Fig. 4.

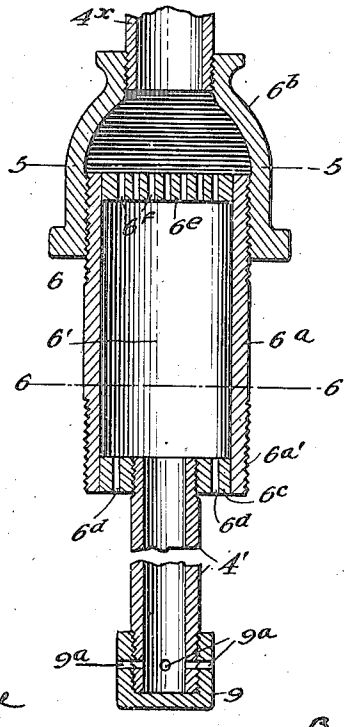


Fig. 5.

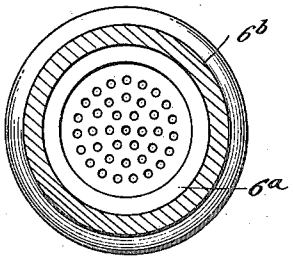
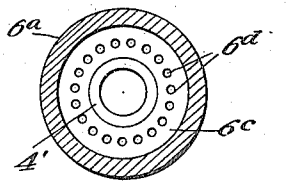


Fig. 6.



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UNITED STATES PATENT OFFICE.

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PROCESS FOR CLEANING SURFACES.

1,141,243. Specification of Letters Patent. Patented June 1, 1915.

Original application filed October 14, 1914, Serial No. 866,575. Divided and this application filed March 6, 1915. Serial No. 12,708.

To all whom it may concern:

Be it known that I, OLIVER M. FOSTER, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in and Relating to Processes for Cleaning Surfaces, of which the following is a specification.

This invention relates to a process for cleaning surfaces and objects.

More particularly it has to do with a process of treating and using soap or soap-like materials, air and water so as to bring about a substantially complete mixture or lather of the cleaning agents, then applying such mixture or lather to the surface to be cleaned under pressure so as to cause it to penetrate, lubricate and loosen up, and to combine or unite with or emulsify the foreign substances on the surface to be cleaned and separate or tend to separate them from such surface, and finally washing such surface clean by the application of water or like agent.

One of the objects of my invention has been so to prepare a soap or soap-like detergent material as to effect a substantially homogeneous mixture or tenacious lather in the form of suds, foam, lather or bubbles and to direct such mixture against the surface to be cleaned under the requisite pressure to effect a combining, mixing or emulsifying of the cleaning materials or agents with the dirt, grease, oils and foreign substances on the surface to be cleaned, so that by the further application of a final cleaning fluid, such as water, a substantially cleaned surface will result. For example, my new process is peculiarly applicable for the cleaning of the exterior surfaces of railway rolling stock, such as locomotives, tenders and cars. It is a well known fact that the exterior surfaces of such rolling stock in ordinary usage accumulate various sorts of dust, dirt, oil and grease, among other foreign substances, and that they in a relatively short time require cleaning both for the purpose of sightliness and preservation of their exteriors. Cleaning by hand such apparatus and machinery involves practically a prohibitive cost, being neither economical nor efficient. Various methods for cleaning such surfaces, using different detergent materials, as cleaning agents, heretofore have been devised, none of which have been entirely satisfactory in efficiency, economy and results, such as operating conditions demand. Accordingly, I have had in mind to invent a process using comparatively cheap soap or soap-like substances, and then effecting a comparatively cheap and thorough mixture thereof with water and air, and a comparatively cheap application of it to the surface to be cleaned, and as a final step in the process simply washing such surface clean with water or similar agent.

For the purpose of disclosing my new process, I will now undertake to set forth a series of steps embodying it.

First, I form a solution of soap and water. This may be done in any suitable manner. I prefer to do it in a liquid and air tight tank capable of readily withstanding any internal pressure to which it may be subjected in the various steps of operation to be hereinafter described. The proportions of soap and water may be varied to meet the various conditions to be dealt with. Assuming such a tank to hold twenty-six gallons, I introduce for example twenty-three to twenty-four gallons of water and from one-half to two gallons of soap, preferably a soft or liquid soap, such as a soap made with potash as a base, so called because it does not harden into cakes, but remains semi-fluid or ropy. Care should be taken not to fill the tank so full but that a substantial air space remains between the top of the tank and the top of its soap and water contents. I have found it advantageous to employ heat to facilitate the formation of the soap solution. This also may be done in any suitable manner. The water may be hot when it is introduced into the tank, but I prefer to inject live steam into the tank, preferably near the bottom thereof, after the soap and water have been introduced, as above stated. As the steam condenses there will be a heat transfer as well as a certain amount of agitation of the soap and water within the tank and a soap solution will be readily and

quickly formed under these conditions, and soap suds or foam will collect on top of the solution in the tank. Next, I apply pressure to the solution in the tank so that the solution may be delivered under pressure from the tank through a suitable opening provided for this purpose. I prefer to apply this pressure by means of compressed air, introduced into the solution in the tank in any suitable manner, usually near the bottom of the tank. When the air enters the solution, it will cause agitation thereof within the tank and the air bubbles will rise through the solution and assist in the forming of suds or froth at the top of the solution and the space within the tank above the solution therein will be occupied by air under pressure, that is compressed air. Next, I effect a thorough mixture of the contents of the tank, namely, air, water and soap, so as to form a substantially homogeneous mixture or lather substantialy devoid of free, unconfined liquid or water, or in other words a tenacious lather. An efficient way of doing this is to have an outlet or delivery duct extending through the solution in the tank almost to the bottom thereof and provided at its lower end with a port or ports, which will permit the solution to rise in the duct. At a point beneath the top of the tank and within it, this outlet duct communicates with a mixer or homogenizer in which complete combining or mixing of the cleaning agents takes place. The delivery duct has a discharge port inside the mixer through which the soap solution in the duct, under the pressure of the air within the tank, is delivered. Adjacent this discharge port are preferably a plurality of ducts of relatively small cross-sectional area, each communicating at one end with the interior of the tank in the space occupied by the compressed air and suds or froth, and at its other end terminating in a port opening within the mixing or homogenizing chamber adjacent to the outlet port of the discharge duct for the soap solution. The air under pressure in the top of the tank discharges through these ducts, probably carrying with it soap suds or froth from the top of the tank and as it enters the mixing chamber meets the stream of soap solution being discharged thereinto through the discharge port and unites with the solution to form soap bubbles or very tenacious lather. I prefer to effect even a more complete mixing or homogenizing of the cleaning agents than ordinarily results from the treatment just described, and my preferred way of doing so is to force the mixture or lather from the mixing or homogenizing chamber under the pressure of the air through a plurality of discharge orifices, each relatively small in cross-sectional area, thereby effecting a most thorough uniting of the air with the ingredients of the cleaning solution, resulting in the formation of an intimate, homogeneous mixture of relatively small bubbles constituting a very tenacious lather. Next, I direct under pressure the homogeneous mixture or lather against the surface to be cleaned. Preferably this is done by spraying it thereon under pressure, the pressure being regulated or varied in accordance with the conditions presented. An air pressure of from seventy to ninety pounds, for example, I have found to give excellent results for locomotive and tender cleaning. It may be increased or decreased as conditions will be found to warrant. The pressure should be sufficient to drive or force the apparently dry lather against the surface to be cleaned, so as to cause the necessary penetration to insure the freeing or loosening of foreign substances, that they may mix with, unite or emulsify with the cleaning agents and be removed therewith. This step may be accomplished by directing the lather in the condition it leaves the homogenizer or mixer through a tube or hose to a suitable spraying jet or nozzle by means of which it may be directed under the pressure of the air acting upon it against the exterior surface to be cleaned. Compressed air of requisite pressure is usually to be found in round houses for use for different purposes. The pressure with which the lather or homogenized mixture hits or engages the surface is sufficient to cause its contents to unite or emulsify with, loosen up or work their way under the dirt, oils, grease and foreign materials to be removed in the cleaning process. After application the lather may be allowed to remain on the surface to be cleaned for any desired period of time. I have found it preferable, for example, to permit it to stay on the surface of locomotives and tenders for several minutes. The next and final step in the process is to wash off the surface against which the cleaning agents have been directed, so as to remove any of the cleaning material and loose particles of dirt and foreign substances which have remained thereon. For this purpose I prefer to use water and have found it is advisable to have the water warmed, and direct it against the surface under pressure, say ordinary water pressure from the water mains. A hose connection with a source of supply will suffice.

The homogenizing or even mixing of which I speak will be found to be very efficacious when the nature of the resulting lather is such that it has, when first applied or sprayed under pressure upon the surface to be cleaned, a comparatively dry appearance. In this condition it may be considered to consist of an infinte number of relatively small bubbles. This dry appearance shortly will be noticed to give place to a moist or watery appearance, and the cleaning agents

will finally run down the vertical sides of the object which is being cleaned, whereas when first applied they struck thereto in an apparently dry condition. This change from a comparatively dry appearance to a wet appearance I believe is due to breaking down of the soap films and the accumulation of moisture thus liberated. It is conceivable that the apparently dry bubbles of lather in the condition in which they strike the surface to be cleaned, break and that particles of moisture thus liberated accumulate until the mass of liquid thus formed is sufficient to run down the surface. As a matter of fact, the instant this perfect and tenacious lather hits the surface to be cleaned, it immediately penetrates, lubricates, loosens and emulsifies, penetrates practically all dirt, grime and the like, lubricates part of it, loosens part of it mechanically and part by lubrication, and emulsifies with oils and greases, and finally substantially emulsifies or mixes with all the foreign substances, whereby the resulting mixture on the surface to be cleaned is readily washed off with water.

My process will be found applicable to and efficient and economical in the cleaning of various objects and surfaces, including railway rolling stock, motor vehicles, exteriors and interiors of buildings, etc.

The velocity with which the lather impinges against the surface to be cleaned will be dependent upon the pressure directing the lather from the spraying nozzle. While this pressure may be applied in any suitable manner, I prefer to use compressed air for the purpose and I have found it simplest to have an excess of compressed air passing through the mixer or homogenizer over and above that necessary merely to form the lather and to rely upon the pressure of this excess of compressed air to force the lather under pressure against the surface to be cleaned. It will be understood that the velocity with which the lather hits such surface will depend upon the pressure with which it is directed toward the surface and of course the distance at which the spraying nozzle is held from the surface, all of which factors may be regulated so as to obtain the required velocity of impact necessary to effect the cleaning of the surface.

Having heretofore described one way of carrying out my new process, I will now describe ways and means for carrying out its various steps.

Figure 1 is a side elevation of an apparatus suitable for use in connection with the carrying out of my improved process. Fig. 2 is a top plan view of the apparatus. Fig. 3 is a fragmentary sectional view through the casing or tank and showing the mixer or homogenizer device in elevation. Fig. 4 is a longitudinal section through the mixer. Figs. 5 and 6 are sections on the lines 5—5 and 6—6, respectively, of Fig. 4. Fig. 7 is a longitudinal section of a slightly modified form of the invention. Fig. 8 is a section on the line 8—8 of Fig. 7.

In the drawings, 1 indicates a casing or tank for containing the mixture of water and material which is to be transformed into lather, suds or froth and applied to the surfaces to be coated or cleaned. The tank 1 is preferably mounted on wheels 1^a and provided with a handle 1^b in order that it may be easily moved from place to place. The tank 1 is made air and liquid tight so that air or fluid under pressure and the cleaning solution may be introduced in and directed through it. The tank 1 is preferably provided with a dome shaped top 1^c to provide maximum air collecting space above the level of the cleaning solution in it.

2 indicates a pipe which extends through the top 1^c of the tank 1. The pipe 2 serves as an inlet, whereby the tank can be filled with water and other materials which are to be used.

2^a indicates a valve for closing the pipe 2 after the tank has been filled. At its upper or free end, the pipe 2 may be provided with a strainer 2^b to keep foreign matter out of the tank 1.

The tank 1 may be provided with gage devices, such as gage cocks (not shown), to indicate the height of the solution contained therein.

3 indicates a pipe for supplying steam or compressed air to the tank 1. The pipe 3 preferably extends through the top 1^c, it being connected to and supported by the top in a well known manner. The pipe 3 may extend downwardly to a point near the bottom of the tank 1 so that the steam or compressed air will be released at a point near the bottom of the tank 1, as shown at 3′. The purpose of this construction is to cause steam to condense near the bottom of the tank and the air to rise through substantially the entire body of the liquid to effect and maintain a thorough mixture of the water and material.

3^a indicates a pipe section connected at one end by means of a coupling 3^b to the upper end of the air or steam pipe 3. 3^c indicates a pipe, preferably of a flexible character, which is connected to the other end of the section 3^a and leads to the source of compressed air or fluid pressure supply, (not shown).

3^d indicates a valve for cutting off the air supply when desired.

3^e indicates a check valve interposed in the pipe section 3^a, and 3^f indicates a pressure gage connected to the pipe section 3^a, both of these appliances being preferably provided for well known purposes.

4 indicates a delivery pipe. This pipe

preferably comprises a section 4′ arranged vertically within the tank and serves as a conduit for the cleaning solution, and a section 4^x which is arranged outside the tank and serves as a conduit for the cleaning mixture in its homogenized condition. The lower end of the pipe 4′ leads downwardly to a point near the bottom of the tank 1 so that its inlet end will always be below the top of the solution in the tank in the normal operation of the apparatus. The pipe 4 passes through the top 1^c by which it may be supported in the manner to be hereinafter described.

4^a indicates a valve in the pipe section 4^x for controlling the flow of material therethrough.

4^b indicates a hose which is connected at one end to the upper end of the delivery pipe 4^x.

5 indicates a tool connected, preferably in a detachable manner, to the outer end of the hose 4^b. The tool 5 is provided with a spraying nozzle 5^a at its free end. The nozzle 5^a preferably comprises a section of pipe, closed at its opposite ends by screw threaded caps and formed with one or more longitudinal lines of perforations or openings 5^b through which the aerated mixture is forced. The hose 4^b is of sufficient length to permit the tool 5 to be operated conveniently withing reasonable distance from the tank 1.

6 indicates a device interposed in the delivery pipe 4 for transforming the mixture of water and material into a homogeneous lather or thick froth, or in other words effecting a combination of the cleaning agents, ready to be sprayed by the tool 5 on the surface to be cleaned. The opposite ends of the device 6 are preferably connected to the adjacent ends of the pipe sections 4′, 4^x, as shown in Figs. 4 and 7. The device 6 is preferably arranged so that its lower end is within the tank 1 and in communication therewith, as will be later described. This arrangement simplifies the construction in that no separate connection with the source of air or fluid under pressure supply is required.

Referring to the transforming or homogenizing device, 6^a indicates a hollow cylnder having upper and lower end walls 6^b, 6^c, respectively, to which the ends of the pipes 4′, 4^x, are connected, preferably by screw threads, in a well known manner. As will be seen from the drawings, the cylinder 6^a and its end walls 6^b, 6^c, coöperate to form a chamber 6′ somewhat larger in diameter than the diameter of the pipe sections 4′, 4^x, this being the preferred form of construction to effect a quick transformation or homogenizing of the liquid solution into a dense lather or homogenous mixture of aerated vesicles that is efficient for cleaning purposes The upper end wall 6^b preferably comprises a reducing coupling, screw threaded to the outer surface of the cylinder 6^a, so as to avoid so far as possible all obstructions to retard the flow of the lather or homogeneous mixture. The outer surface of the cylinder 6^a is provided with screw threads, near its lower end, as shown at $6^{a'}$, and this end fits into a screw threaded opening 1^d formed in the top 1^c of the tank 1, the wall of the top 1^c having a collar $1^{d'}$, around the opening 1^d to provide a relatively long engaging surface for the cylinder 6^a. This form of construction serves to rigidly support the transforming or mixing device 6 relative to the tank 1; furthermore, since the adjacent ends of the pipe sections 4′, 4^x, are rigidly connected to the opposite ends of the device 6, it also serves to rigidly support them in the position shown, and to permit their removal with the device 6 from the tank 1 as a unit.

6^d indicates a series of jet openings, formed in and extending through the lower end wall 6^c of the chamber 6′ to permit the compressed air in the tank 1 to flow therein-to. As the adjacent end of the pipe 4′ is connected to the end wall 6^c in line with the axis of the cylinder 6^a, the openings are arranged in a circle around the pipe 4′. This arrangement permits the compressed air to act simultaneously upon all sides of the stream of soap solution or cleaner discharged by the pipe section 4′ into the chamber 6′, as the air expands in and passes therethrough. The openings 6^d are relatively small in cross sectional area so as to provide a large number of relatively small air jets for contact with the solution.

6^e indicates a baffle plate or wall, having a plurality of perforations or jets 6^f. The plate 6^e extends transversely across the chamber 6′ intermediate its ends, but is preferably arranged at the upper end and within the side wall of the cylinder 6^a. The perforations or jet openings 6^f through the plate 6^e are also relatively small in cross sectional area being by preference substantially similar in size to the jets 6^d, and may be arranged in concentric circles and uniformly spaced relative to each other (see Fig. 5) so that the same volume of lather or homogeneous mixture may be formed and pass through all portions of the plates 6^e and be acted on thereby to the same extent.

The device 6 operates, as will be later described, to transform or combine the solution into a dense lather or frothy, comparatively homogeneous mass consisting of minute watery particles, globules or bubbles, and films connecting them together, substantially devoid of all liquid or drops of water capable of flowing, so that the lather or frothy mass sticks to and forms a heavy coat on the surface to be cleaned, capable, however, of returning to a liquid or semi-

liquid state as determined by the surrounding conditions after its application to such surface.

7 indicates a blow-off cock mounted in the top 1^c. This cock serves to permit the escape of the compressed air within the tank 1 when the spraying operation is finished.

The cleaning solution used, as previously stated is preferably a mixture of water and liquid soap. These materials may be mixed in any proportions desired, depending upon the amount and character of the foreign matter adhering to the surfaces and objects to be cleaned. I prefer to use hot water with the liquid soap. When hot water is not obtainable or it is desired to heat the solution already in the tank 1, I provide a steam pipe connection 8, the inner end of which is connected to the coupling 3^b. This connection is normally kept closed by a valve 8^a; but by closing the valve 3^d on the air pipe 3^a, connecting a steam supply pipe (not shown) to the outer end of the pipe 8 and opening the valve 8^a, live steam can be injected into the solution to heat it to the desired temperature.

The carrying out of my process in connection with the apparatus just described is as follows: The tank 1 is filled with water and soft soap in the desired proportions. Steam is introduced through the pipe 3 to heat the water and facilitate the formation of soap solution. Compressed air is then admitted to the tank through the pipe 3, which conducts the air to the bottom of the tank. From the open end 3′ of the pipe 3 the air rises to the top of the solution, thoroughly agitating and mixing the solution as it passes to the air space thereabove. The compressed air acts on the top surface of the solution and thus operates to force it to enter the lower open end of the pipe section 4′ and pass upwardly therethrough. As the solution flows out of the upper end of the pipe 4′ into the enlarged chamber 6′ it is subjected to a multiplicity of fine jets of compressed air issuing from the jets 6^d. The air from the jets 6^d acts on all sides of the stream simultaneously and expands slightly as it passes into the chamber 6′ and undoubtedly carries with it soap suds, froth or foam which has collected within the tank and upon top of the solution therein. This action of the compressed air upon the stream of solution operates mechanically to break up the solution and to intermingle the air and solution together, whereby there is formed a lather or dense frothy mass consisting of minute watery particles, globules or bubbles and films. This resulting lather or frothy mass is then forced violently against the wall 6^e and through the perforations or jets 6^f therein. This operation serves further to break up and subdivide the already formed watery particles and greatly increase the number of globules or bubbles, thus forming a dense, paste-like lather or substantially homogeneous, aerated lather. The lather or mixture thus formed is forced into the upper end of the transforming chamber 6′ from which it passes through the delivery pipe section 4^x and hose 4^b to the tool 5. The tool 5 then sprays the lather or mixture under pressure upon the surface or object to be cleaned, to which it adheres as a thick coat, first of apparently dry and then pasty material. As the lather or mixture leaves the spraying nozzle 5^a, the air is relieved of its compression, the effect of which is probably to cause the minute globules or bubbles to expand, thus increasing the mass of the lather.

I have found by actual demonstration that by producing and applying under pressure a lather or mixture of such thickness and density that it will not return to a liquid condition for an appreciable length of time, and devoid of bodies capable of flowing, the surface coated with the lather may be thoroughly cleaned, in other words, if the lather can be caused to engage the surface with sufficient pressure and prevented from quickly changing back to a liquid state, capable of flowing off of the surface or object by gravity, the action of the lather upon the surface or object will be exceedingly effective for cleaning purposes.

My apparatus lends itself admirably for this purpose for the reason that the transforming or homogenizing device 6 produces a lather substantially devoid of liquid bodies and of such density that when applied to the object to be cleaned, it forms a thick coat thereon and does not immediately change into a liquid state, thus giving the lather sufficient time to loosen up, mix, emulsify or unite with all foreign matters adhering to the object.

In Figs. 7 and 8, I have illustrated a slightly different form of transforming or homogenizing device 6. The device 6 illustrated in these figures, like that shown in Figs. 4, 5 and 6, consists of a cylinder 6^a, having end walls 6^b, 6^c, to form an enlarged chamber 6′. In this form of construction, however, I omit from the chamber 6′ the perforated wall 6^e. The device 6 of the form illustrated in Figs. 7 and 8 operates, as I have demonstrated in practice, to produce a lather of sufficient density and permanence to clean in an efficient manner surfaces which are not too thickly coated with foreign matter. Under most circumstances, however, the form of construction illustrated in Fig. 4 will be found to be the preferred one since the lather or mixture produced thereby has the quality of remaining in a substantially unchanged condition long enough to loosen up all of the foreign matter, particularly of the character noted on

the surface or object, irrespective of its thickness, as may exist under normal conditions.

As shown in Figs. 3 and 4, the lower end of the pipe section 4′ may be closed by a cap 9 and formed with a series of small openings 9ª—preferably four openings—through which the solution passes. This form of construction provides for the delivery of a relatively small quantity of solution through the pipe 4′ as compared with the quantity of air contacting with the solution as it enters the chamber 6′.

It will be noted that the device 6 operates to transform the solution into lather, the thickness and density of which may be regulated in part by the proportions of the materials used and in part by the action of compressed air jets upon the solution; furthermore, the action of the device 6 is such as to transform the entire body of the solution passing into the chamber 6′ into lather consisting of minute watery particles, bubbles and films, thereby producing what may be termed "dry" lather, capable of remaining substantially stationary upon the sprayed surface in an unchanged condition for an appreciable length of time, as contra-distinguished from suds consisting of froth and water or bodies of water capable of instantly flowing over the surface when applied thereto.

It will be understood that in the system just described there is a surplus of compressed air over and above that necessary merely to form the lather or homogeneous mixture and that the pressure of this air is utilized to force the lather through the spraying jets and against the surface to be cleaned so as to hit the latter with the requisite pressure.

To those skilled in the art many modifications of and widely differing embodiments and applications of my invention will suggest themselves, without departing from the spirit and scope thereof. My disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

This application is a division of my application Serial No. 866,575, filed October 14, 1914.

What I claim is:

1. The process of cleaning which consists in forming a solution of water and detergent material capable of being transformed into lather, transforming said solution under pressure into a homogeneous lather substantially devoid of free or unconfined liquid, applying said lather under pressure to the surface to be cleaned, and then washing off from said surface the cleaning agents and foreign substances.

2. The process of cleaning which consists in forming a solution of water and detergent material capable of being transformed into lather, subjecting such solution to the action of compressed air to form a homogeneous lather substantially devoid of free or unconfined liquid, applying said lather under pressure to the surface to be cleaned, and then washing off from said surface the cleaning agents and foreign substances.

3. The process of cleaning which consists in forming a solution of water and detergent material capable of being transformed into lather, subjecting such solution to the action of compressed air to form a homogeneous lather substantially devoid of free or unconfined liquid, applying said lather under air pressure to the surface to be cleaned, and then washing off from said surface the cleaning agents and foreign substances.

4. The process of cleaning which consists in forming a solution of water and detergent material capable of being transformed into lather, subjecting such solution to the action of compressed air to form a homogeneous lather substantially devoid of free or unconfined liquid, forcing said lather under the further action of such compressed air against the surface to be cleaned and finally washing off said surface with water.

5. The process of cleaning which consists in forming a solution of water and soap or soap-like material, subjecting such solution to the action of compressed air to form a substantially homogeneous lather, spraying said lather under pressure against the surface to be cleaned, and then washing off from said surface the cleaning agents and foreign substances.

6. The process of cleaning which consists in forming a solution of soap and water, forcing compressed air through said solution, discharging said solution in a stream and subjecting the solution as thus discharged to the further action of compressed air to form a homogeneous lather substantially dry in appearance to the eye, spraying such lather against the surface to be cleaned, and finally washing off the said surface with water.

7. The process of cleaning which consists in forming a solution of soap and water, forcing compressed air through said solution, discharging said solution in a stream and subjecting the solution as thus discharged to the action of compressed air to form a tenacious lather and under the further action of such compressed air forcing said lather against the surface to be cleaned, and finally washing off the said surface with water.

8. The process of cleaning which consists in mixing a cleaning material and water together into a solution, then agitating the solution by forcing air through it, then discharging the solution in a stream, then di-

recting a plurality of jets of air through the stream to transform it into lather, then spraying the lather on an object to be cleaned, and finally washing off the cleaning agents and foreign substances.

9. The process of cleaning which consists in causing to impinge at a high velocity against a surface to be cleaned a homogeneous lather of detergent material substantially devoid of free or unconfined liquid, and then washing off the surface with water.

10. The process of cleaning which consists in forming a tenacious lather of detergent material substantially devoid of free or unconfined liquid under the action of compressed air in excess of the amount necessary merely to form such lather, causing such lather under the action of such excess air to impinge against the surface to be cleaned, and then washing off the surface with water.

In testimony whereof I affix my signature in the presence of two witnesses.

OLIVER M. FOSTER.

Witnesses:

GEO. B. PITTS,

EDWARD R. ALEXANDER.