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SCOURING APPARATUS

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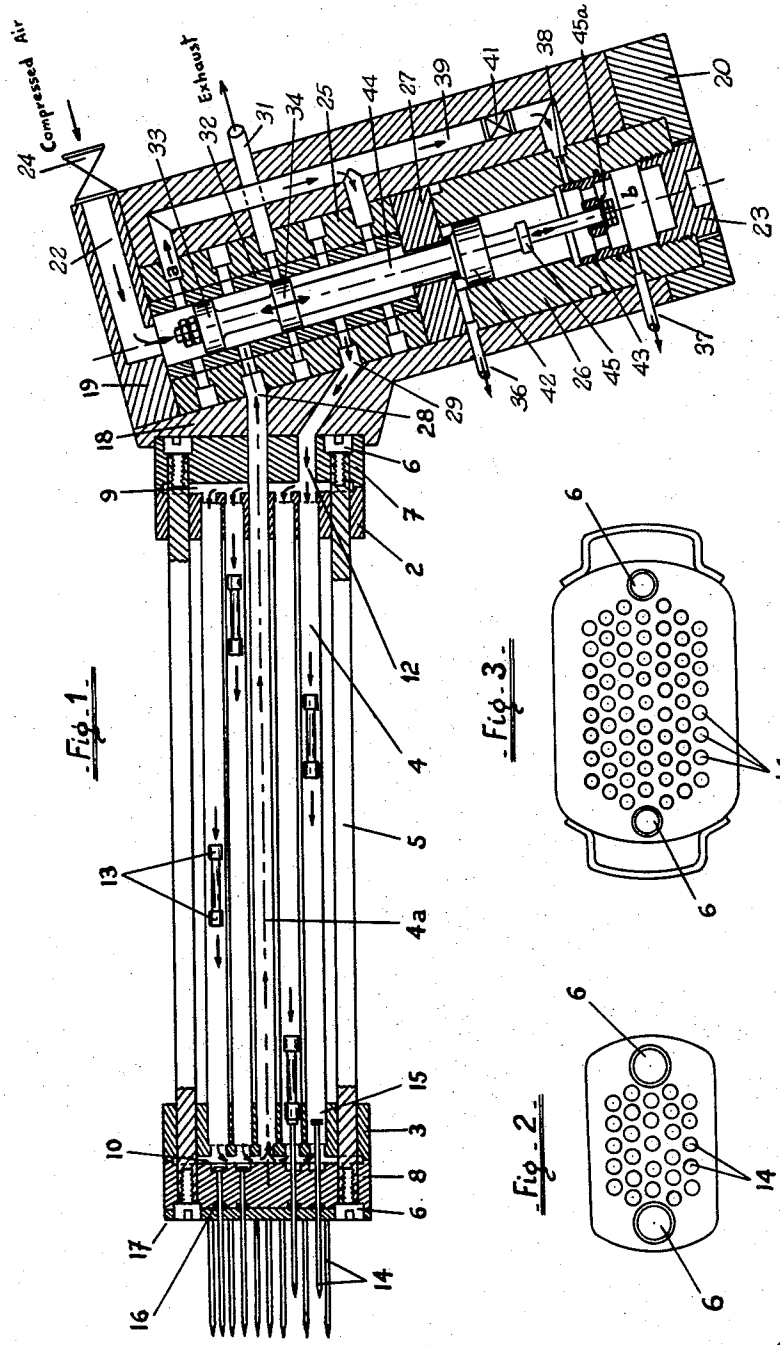


Fig. 1.

Fig. 3.

Fig. 2.

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SCOURING APPARATUS

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When it is desired to scour, remove dust, and clean any article and, more particularly, metal articles, the general procedure consists in a chemical treatment, a sand-blasting, a projection of shot, a brushing or a mechanical treatment with a pneumatic tool.

The chemical methods are not always suitable, since the product used does not attack certain layers of the material to be removed.

As to the sand-blasting, it shows a serious drawback arising through the necessity of resorting to fine broken sandy particles, associated with a very high cost price.

Shot projection is more interesting in many cases, but should be performed inside a closed chamber, since the recovery of the shot forming the missiles is essential for ensuring rentability of the method.

The scouring through brushing is scarcely satisfactory since numerous materials are highly shock-sensitive without being sensitive to a sufficient extent, if at all, to the friction exerted by metal brushes.

Pneumatic scouring tools exist, it is true, but they are generally designed only for well-defined applications such as stone roughening. By reason, furthermore, of the particular shape given to bush-hammers, said tools do not allow scouring surfaces having a comparatively intricate shape, such as convex surfaces, concave surfaces, corners, rivet peripheries or the like.

Certain pneumatic implements exist incorporating a tool constituted by a plurality of needles, which allows them to reach the different parts of intricate surfaces; it is however impossible for them to hit always with the desired energy, since all the needles are controlled by a single hammer; consequently, according to the outline of the surface to be scoured, only a number of needles operate at a time.

In order to cut out such a drawback, my invention has for its object a scouring apparatus of this last-mentioned type, i.e. of the needle type, wherein each needle is provided with a head and extends inside a tube inside which a movable hammer is slidingly carried, the different tubes being interconnected at each end with a transverse channel, said channels being alternatingly connected with a supply of compressed air and with the atmosphere, whereby said movable hammers are shifted alternatingly in the direction of the needles, so as to hit them on their heads and in the opposite direction, away from said needles.

It is readily apparent that each needle may recede within the body of the apparatus independently of any other needle, whereby the projecting sections of the surface to be scoured urge one or more needles into the body of the apparatus and are therefore subjected to an impact of the corresponding movable hammer which is less energetic than in the case of the depressed section of said surface.

Said scouring apparatus is fed with compressed air through the agency of a distributor which allows modifying the speed of distribution under an upwardly directed pressure of compressed air and without any braking of the admission of said compressed air, so as to adjust the impact power. As a matter of fact, it is possible to obtain a weak impact through the needles when the rhythm of distribution is high and, on the contrary, a powerful impact, when said rhythm is slow; it is even possible, when said rhythm is high enough, and is larger than that corresponding to any possible shifting of the

hammers or the like hitting members, to cut out operation, since the compressed air is then admitted at a high speed of alternation and in an almost continuous manner into both ends of the tubes in which the movable hammers slide and, consequently, remain in a balanced position inside said tube. This adjustment of the power of impact may, as mentioned, be executed independently of the adjustment of the pressure of the compressed air and of the cross-section and length of the tubes in which the hitting members or hammers are slidingly carried.

My invention will be readily understood upon reading of the following description, reference being made to the accompanying diagrammatic drawings illustrating by way of example and by no means in a limiting sense a preferred embodiment of my improved apparatus. In said drawings:

FIG. 1 is a vertical section of the complete portable apparatus including the actual scouring means and the distributor feeding them with compressed air and rigidly attached thereto.

FIGS. 2 and 3 are end views of said apparatus and of a similar apparatus provided with handles to allow its suspension to a belt respectively.

Turning to FIG. 1, the actual scouring means constituted by the parallel scouring tubes **4** are held between two terminal plates **2** and **3** provided with openings fitted over the corresponding ends of the scouring tubes **4**. Inside each of said tubes is slidingly carried a freely moving hammer **13**, the operation of which will be described hereinafter. The two terminal plates are held in position by means of two further tubes **5** extending throughout said terminal plates, so as to be secured in the latter by the screws **6** screwed into the tapped ends of said tubes **5** and the heads of which engage recesses formed in the outer surfaces of corresponding covers **7** and **8** secured by the tubes **5** on the outside of the cooperating terminal plates **2** and **3**. The cover **7** is rigid with the body **18** of the distributor described hereinafter. The outer surfaces of the terminal plates are recessed so as form chambers respectively at **9** and **10**. Said chambers, closed by the corresponding covers **7** and **8**, communicate with the ends of the different tubes **4** which open through slightly restricted outer sections of the openings in the terminal plates, said restricted outer sections forming inner flanges against which the tube ends abut. A further tube **4***a* is arranged in the same manner as the tubes **4**, but its end passing through an opening in the terminal plate **2** nearest the distributor does not terminate just ahead of a restricted opening in said plate, as described for the tubes **4**, but it extends beyond said opening and through the chamber **9** and also through the cover **7**, so as to be connected with the distributor channel **28**, as described hereinafter.

On the other hand, the chamber **9** between the terminal plate **2** and the cover **7** nearest the distributor communicates with another channel **29** in the latter, through a channel **12** formed in said cover **7**; it is thus obvious that an air circuit is formed between the ports **28** and **29** of the distributor, through the pipe **4***a*, the chamber **10** farther from the distributor, the scouring pipes **4**, the chamber **9** and the channel **12**. Therefore, if a stream of compressed air is fed into said circuit alternatingly in both directions, the movable piston-shaped hammers **13** will move reciprocatingly inside the scouring tubes, after the manner of pistons in cylinders.

The actual scouring members are constituted by needles **14** slidably carried in perforations formed coaxially with the tubes **4** in the cover **8** further from the distributor and projecting outside the latter, while their heads are adapted to freely enter the ends of the tubes **4** registering with the perforations carrying the needles, so as to move between a position engaging the corresponding tube and

a position for which the heads of the needles engage corresponding recesses formed at the ends of the perforations in the surface of the cover **8** facing the terminal plate **3**. Fluidtightness is ensured by annular washers **16** surrounding the needles at the point at which they pass out of the cover **8**, said washers being held in position by an outer plate **17** secured to the cover **8** by any suitable means such as gluing or securing by the screws **6**, for instance.

The rectilinear reciprocation of the hammers **13** under the action of compressed air flowing alternatingly in opposite directions produces, at regular intervals, shocks on the heads **15** of the needles **14**, so that the latter enter, independently of each other and of the sliding hammers, different positions defined by impact of the needle tips against the surface to be scoured.

As to the distributor, it includes a body **18** provided with covers **19** and **20**. The cover **19** is bored at **22** for the admission of compressed air under control of the cock **24**, while the cover **20** is provided with a plug **23** closing the central bore in the distributor body at one end thereof, said central bore slidingly carrying a piston system, as will be disclosed hereinafter.

Inside the bore in the body **18** are positioned two superposed sleeves, respectively **25** and **26**, separated by a transverse annular partition **27**.

The upper sleeve **25** carries two radial channels **28** and **29** which are connected respectively with the port **12** in the upper cover **7** of the scouring apparatus and with the upper end of the central tube **4***a* in the latter. The sleeve **25** carries furthermore at mid-height between said channels **28** and **29** a further radial channel **31** opening into the atmosphere.

The three channels **28**, **29** and **31** open inside perforations provided in a further sleeve **32** fitted inside the sleeve **25** and forming a cylinder for two rigidly interconnected pistons **33** and **34**.

Two further channels **36** and **37** extend through the lower sleeve **26** and open both into the atmosphere, while a perforation **38** extending through the sleeve **26** communicates with a channel **39** formed inside the body **18** of the distributor. This channel **39** opens in its turn respectively through ports *a* and *a'* inside the upper and lower ends of the upper sleeve system **25—32**. A cock **41** controls said channel **39**.

The lower sleeve **26** serves as a cylinder for a piston **42** and a cylindrical slide valve **43** slidably carried by the piston rod.

The three pistons **33**, **34** and **42** are rigid with a common central rod **44**, while the piston **42** has a diameter larger than that of the pistons **33** and **34**, since the bore in the sleeve **26** in which it slides is broader than the bore in the inner upper sleeve **32**. The slide valve **43** engages slidingly the lower end of the axial piston **44**, which is provided with a boss **45** at a distance above said slide valve **43**.

The distributor being assumed to occupy the position illustrated in FIG. 1, the opening of the cock **24** produces an admission of compressed air through the channel **22** into the upper section of the inner sleeve **32** and through the port *a* into the channel **39** in the distributor body and thence through the port *a'* into the section of the inner sleeve **32** located underneath the piston **34**. The lower surface of said piston **34** carried by a wider portion of the piston rod having, as clearly illustrated, a cross-sectional area which is smaller than that of the upper surface of the piston **33**, the piston rod **44** is constrained to sink inside the distributor body under the action of the thrust exerted by the compressed air on said piston **33**. If the cock **41** is open, this does not allow the passage of air beyond it, since the valve **43** is closed, while the chamber *b* is open to the atmosphere at **37**, which allows thus downward movement of the slide valve including the pistons **33**, **34** and **42** with the auxiliary slide valve **43**. Simultaneously, the compressed air admitted by the channel **39** into the lower section of the inner sleeve **32** passes through the channel **29** into the auxiliary channel or tube **12** of the scouring apparatus and thence into the upper chamber **9**, so as to produce an outward movement of the sliding hammers **13**.

There arises a moment during this downward movement of the rod **44** for which the piston **33** reaches a level underneath the channel **28**, while the piston **34** reaches a level underneath the level of the channel **29**. The compressed air fed into the distributor is admitted now into the channel **28** and thence into the lower chamber **10** of the scouring apparatus. The sliding hammers **13** assume consequently a sudden downwardly directed movement which produces for each hammer an impact on the head **15** on the corresponding needle **14**.

The downward movement of the novable system inside the distributor continues inside the body **18** and the boss **45** on the rod **44** carries along with it the slide valve **43**, so that the compressed air entering through the channel **39** enters then the lower sleeve **26**. The area of the lower surface of the piston **42** being larger than the area of the upper surface of the piston **33**, the movable system including the rod **44** and the pistons **42**, **34** and **33** is constrained to move upwardly. At the beginning of this upward movement, the compressed air continues being admitted into the scouring apparatus through the pipe **28** and the lower or outer chamber **10**. However, during the second stage of said upward movement, the distribution of the compressed air is performed through the pipe **29**, the tube **12** and the upper or inner chamber **9**. Finally, the distributor returns into the position illustrated in FIG. 1.

Obviously, when the admission of compressed air is performed through the pipe **28**, the pipe **29** is open to the atmosphere through the pipe **31** and reversely, so that the sliding hammers **13** may freely move in the direction towards which the compressed air urges them.

It is apparent that the hitting rhythm of the hammers **13** acting on the needles **14** does not depend on the pressure of the compressed air, but on the throughput of compressed air inside the channel **39** on the downstream side of the cock **41**. It is consequently sufficient to operate said cock when it is desired to modify the energy of impact, said energy being all the larger when the rhythm of operation of the distributor is slower. It is, in fact, apparent that the section of the distributor above the line CC serves for the actual distribution and the pistons **33** and **34** therein are subjected permanently, during operation, to a thrust exerted by the compressed air, both over the piston **33** and under the piston **34**, so that the movable piston system **42—34—33** is always urged downwardly by reason of the predominant action of the piston **33**. On the other hand, the section of the distributor underneath the line CC, which includes the slide valve **43** cooperating with the ports **37** and **38**, the large-surfaced piston **42** and its rod carrying the stops **45** and **45***a* inside the chamber *b* serves solely for urging upwardly the above-mentioned movable system against the normal thrust exerted on it, as just mentioned. This arrangement allows adjusting the rhythm of operation. As a matter of fact, the movable piston system is urged downwardly at a speed defined by the exhaust out of the chamber *b* at *d*. To adjust the rising speed of the movable piston system, the cock **41** is adjusted so as to allow the passage through the latter of a variable amount of air, which thus takes more or less time for filling the chamber *b* and acting then subsequently, so as to raise the piston **42** before it is exhausted through **37** into the atmosphere at *d*.

Thus, the downward movement of the movable system is operated substantially at constant speed, as adjusted by the exhaust once and for all. In contradistinction, the cock **41** allows adjusting the upward speed, so that it is possible to initiate the distribution of the air at higher speed in one direction; for instance, the hammers **13** may be subjected to a speedy action when subjected to com-

pressed air through their inner ends, while their return is obtained at a slower rate. These conditions may be readily interchanged by modifying the connections between the opening **12** and the central tube **4***a*, on the one hand, and the distributor channels **28** and **29**, on the other hand.

Obviously, my invention is not limited to the sole embodiment of this scouring apparatus which has been disclosed hereinabove by way of example and it covers in contradistinction all the modifications thereof falling within the scope of the accompanying claims, whatever may be the actual design of the distributor which may, in fact, be secured to the body of the apparatus or be independent thereof and, in particular, the apparatus may be designed for a position other than vertical.

What I claim is:

1. A pneumatic scouring apparatus comprising a plurality of parallel tubes of equal length, scouring needles including each a head and a shank sliding through the ends of said tubes facing the location of the surface to be scoured, hammers slidingly and fluidtightly carried inside said tubes and adapted to engage each the head of the needle in the same tube, terminal plates in which the first-mentioned ends of the tubes and the opposite ends are fitted respectively, said terminal plates being provided each with a chamber interconnecting the ends of the tubes fitted in said plate and the terminal plate associated with the first-mentioned tube ends being provided with perforations opening into the corresponding chamber and through which the scouring needles pass fluidtightly out of the latter, stops preventing the needles from dropping out of the ends of the tubes in which they slide, a distributor of compressed air adapted to feed compressed air alternatingly into each of the chambers and the ends of the tubes opening into the latter to urge the hammers into reciprocation inside the tubes, and means for exhausting the compressed air out of the other chamber and the ends of the tubes opening into the latter.

2. A pneumatic scouring apparatus, comprising a plurality of equal parallel tubes, needles including each a head and a shank sliding through the outer ends of said tubes facing the location of the surface to be scoured, a hammer slidingly and fluidtightly carried inside each tube and adapted to engage the head of the needle in said tube to produce an impact thereon, two terminal plates each provided with a chamber and in which the ends of the tubes facing corresponding directions are fitted respectively to open into the chamber in the plate, the outer surface of the terminal plate carrying the first-mentioned outer needle-engaged tube ends being provided with perforations for the fluidtight passage of the needles towards the surface to be scoured, abutments cooperating with last-mentioned terminal plate facing the location of the surface to be scoured and adapted to limit the outward movements of the needles, an auxiliary tube parallel with the first-mentioned tubes opening into the chamber in one terminal plate and extending through the terminal plate at the other end, a further auxiliary tube opening into the chamber in the last-mentioned terminal plate to form a distributing circuit connecting the auxiliary tubes through the two chambers and the parallel tubes, a distributor adapted to feed compressed air into one of the auxiliary tubes alternatingly and connecting the other auxiliary tube with the atmosphere.

3. A pneumatic scouring apparatus, comprising a plurality of equal parallel tubes, needles including each a head and a shank sliding through the outer ends of said tubes facing the location of the surface to be scoured, hammers slidingly and fluidtightly carried inside each tube and adapted to engage the heads of the needles to produce an impact thereon, two terminal plates in which the ends of the tubes facing opposite directions are fitted respectively, said two terminal plates being each provided with a chamber interconnecting the ends of the tubes fitted in said plate, the plate in which the first-mentioned needle-engaged tube ends are fitted being provided with perforations for the fluidtight passage of the needles towards the surface to be scoured, an auxiliary tube parallel with the first-mentioned tubes opening into the chamber in one terminal plate and extending through the other terminal plate, a further auxiliary tube opening into the chamber in last-mentioned other terminal plate to form distributing circuit sections connecting each auxiliary tube through the chamber into which it opens with the corresponding ends of the parallel tubes, a distributor including a supply of compressed air, a slide valve cylinder provided at spaced points of its length with a first, second, third and fourth port connected respectively with said supply, with one of the auxiliary tubes, with the atmosphere and with the other auxiliary tube, a by-pass opening into the cylinder at two points located respectively between the first and the second port and beyond the fourth port, a slide valve fluidtightly carried inside said cylinder and including a rod, a terminal piston rigid with said rod and shiftable across the first opening point of the by-pass and the first port, and a medial piston rigid with the rod and adapted to be shifted across the second and the third port, said slide valve being urged away from the first port by the compressed air flowing into the cylinder through said first port to thereby enter first a first position uncovering the first opening point of the by-pass to connect the supply through said by-pass with the fourth port and simultaneously connecting the second and third port with each other and then a second position providing connection between the first and second ports and simultaneously between the third and fourth ports, a differential piston carried by the end of the slide valve beyond the medial piston, means connecting the by-pass with the outer, larger side of said differential piston whereby the compressed air passing through last-mentioned means and acting on the differential piston urges the slide valve from its second into its first position, and a valve closing last-mentioned means and opened by the slide valve at the end of its travel from its first towards its second position.

4. A pneumatic scouring apparatus, comprising a plurality of equal parallel tubes, means including each a head and a shank sliding through the outer ends of said tubes facing the location of the surface to be scoured, hammers slidingly and fluidtightly carried inside each tube and adapted to engage the heads of the needles to produce an impact thereon, two terminal plates in which the ends of the tubes facing opposite directions are fitted respectively, said two terminal plates being each provided with a chamber interconnecting the ends of the tubes fitted in said plate, the plate in which the first-mentioned needle-engaged tube ends are fitted being provided with perforations for the fluidtight passage of the needles towards the surface to be scoured, an auxiliary tube parallel with the first-mentioned tubes opening into the chamber in one terminal plate and extending through the other terminal plate, a further auxiliary tube opening into the chamber in last-mentioned other terminal plate to form distributing circuit sections connecting each auxiliary tube through the chamber into which it opens with the corresponding ends of the parallel tubes, a distributor including a supply of compressed air, a slide valve cylinder provided at spaced points of its length with a first, second, third and fourth port connected respectively with said supply, with one of the auxiliary tubes, with the atmosphere and with the other auxiliary tube, a by-pass opening into the cylinder at two points located respectively between the first and the second port and beyond the fourth port, a slide valve fluidtightly carried inside said cylinder and including a rod, a terminal piston rigid with said rod and shiftable across the first opening point of the by-pass and the first port, and a medial piston rigid with the rod and adapted to be shifted across the second and the third port, said slide valve being urged away from the first port by the compressed air flowing into the

cylinder through said first port to thereby enter first a first position uncovering the first opening point of the by-pass to connect the supply through said by-pass with the fourth port and simultaneously connecting the second and third portion with each other and then a second position providing connection between the first and second ports and simultaneously between the third and air passing through said last-mentioned means acts on the further differential piston and urges back the slide valve into its first position, means for adjustably throttling the passage of compressed air through last-mentioned means, and a

valve closing last-mentioned means and opened by the slide valve at the end of its travel towards its second position.

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