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(71) Applicant: **TEKNOX S.r.l.**
40054 Prunaro Di Budrio BO (IT)

(72) Inventor: **Caroli, Aurelio**
40024 Castel S. Pietro (Bologna) (IT)

(74) Representative: **Dall'Olio, Giancarlo**
INVENTION S.R.L.
Via delle Armi, 1
40137 Bologna (IT)

(54) **Apparatus for removing scraps and lubricant residues remaining after working from mechanical parts**

(57) An apparatus for removing scraps and lubricant residues remaining after working from mechanical parts (1) includes a washing chamber (2), which has an aperture (3) and closing means (4), which close the chamber during the apparatus (100) operation.

Support means (10, 60) for the mechanical parts (1) are situated inside the washing chamber (2) and hold the mechanical parts (1) in working position during the removal of the scraps and residues.

Compressed air delivering means (20, 70) are situated inside the washing chamber (2) and are set in communication with a source of compressed air. The delivering means (20, 70) deliver compressed air to the mechanical parts (1), through a plurality of nozzles (25) directed toward the mechanical parts (1), in order to free the latter from scraps and lubricant residues.

Scraps collecting means (5) are situated in the lower part of the washing chamber (2) for collecting the scraps after their removal from the mechanical parts (1). A control unit (30) controls the operation of the apparatus (100) according to prefixed operation sequences.

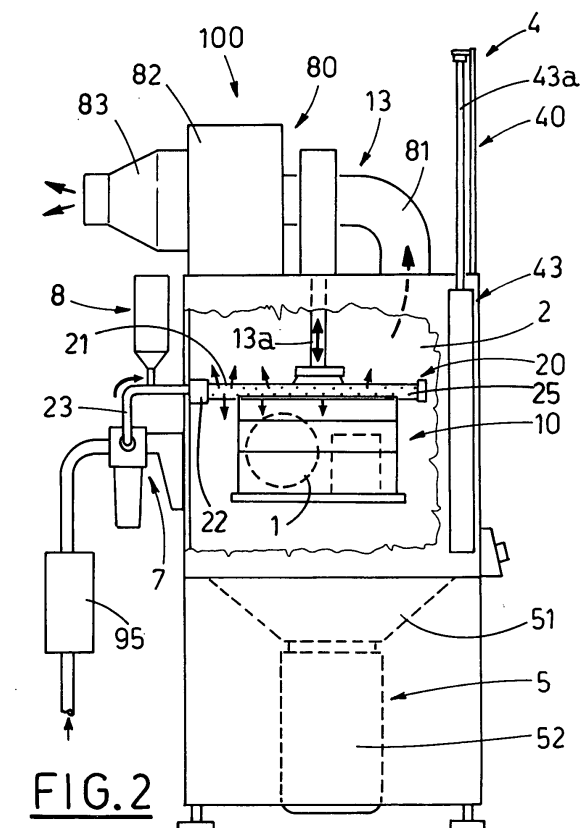


FIG. 2

Description

DESCRIPTION OF THE INVENTION

[0001] The present invention relates to the technical field concerning the machines for cleaning mechanical parts after the working operations.

[0002] In particular, the invention relates to an apparatus for removing scraps or lubricant residues remaining after working and adhering to the mechanical parts, which have just been subjected to lathe turning or other operations.

[0003] It is known that the production of different types of mechanical parts needs not only a first forming step by molding or other techniques, but also a further step of working with machine tools, such as lathes, grinders, drills and others, in order to obtain the finished part.

[0004] The above operations usually include the removal, from the part, of a certain quantity of material under the form of scraps and/or powder.

[0005] Moreover, during the working, the tool and the part are usually sprayed with a water and oil emulsion, to be cooled and lubricated.

[0006] Consequently, when the working is completed, the finished part is wet with the emulsion, as well as "dirty" with powder and scraps, which adhere to the part also due to the adhesive action of the emulsion.

[0007] In order to be used subsequently, either to be mounted in a device, of which it is an element, or only to be stored or packaged, the part must be perfectly clean, and thus free of scraps or metallic powder, as well as of the residue emulsion patina.

[0008] The above mentioned mechanical parts are cleaned by known washing machines, aimed at removing completely the scraps and lubricant residues remaining after working by means of jets of water under high pressure and/or at high temperature.

[0009] Such machines belong mainly to two different types.

[0010] In a first type of washing machine, the parts to be cleaned are introduced into a substantially sealed chamber, put on suitable supports.

[0011] A plurality of nozzles are also situated in the sealed chamber, connected to a source of liquid under pressure by suitable pipes and aimed at ejecting jets of the washing liquid toward the parts.

[0012] The chamber includes also a container for collecting the washing liquid and the scraps and lubricant residues.

[0013] The nozzles are arranged and oriented in the sealed chamber in such a way that the jets of liquid produced thereby reach the parts from every angle and in every point of their surface.

[0014] Moreover, the nozzles or the parts supports are movable, so that it is possible to change the incidence angle of the jets of washing liquid, according to prefixed programs.

[0015] Another type of washing machine includes a

tunnel, opened at its ends, through which the parts are gradually transported by suitable conveyors.

[0016] In this case, the nozzles for washing the parts are situated along the tunnel.

5 **[0017]** Therefore, the jets of washing liquid hit the parts during their passage through the nozzles action range.

[0018] In the most sophisticated tunnel washing machines, the nozzles are situated on robot controlled arms, whose movement can be programmed in relation to the shape and other characteristic features of each part to be washed, such as e.g. particularly arranged and oriented holes, or recesses, which are difficult to reach.

[0019] Systems including suitably arranged sensors detect the position and orientation of the arriving parts and allow the machine control unit to move the nozzles adequately, so that their jets reach every point of the parts, in which there can be some scrap or residue to remove.

[0020] The washing liquids used by the above mentioned machines are mixtures of water and chemical detergent substances of different type, whose composition is known to those skilled in the art and which will not be explained in detail, because it does not concern the present invention.

20 **[0021]** The above described washing machines usually allow to obtain excellent washing effects also in the most difficult cases.

[0022] However, they are rather complicated to construct, and consequently, they have proportionally high purchase cost, as well as the maintenance costs.

30 **[0023]** Moreover, in many cases, they can be complicated to adjust and to program.

[0024] Another disadvantage of all the above mentioned washing machines lies in the fact that the used washing liquids are toxic or anyway, highly polluting and, according to the regulations in force, they must be collected and disposed according to very precise and rather expensive procedures.

35 **[0025]** Likewise, the tightness of the sealed washing chambers must be kept in best condition, to avoid leakage of atomized liquid, which could pollute the surrounding environment and be inhaled by the operators present in the area.

[0026] Moreover, the energy consumption of the above mentioned machines is rather high, mainly because of the power required to heat and to compress the washing liquid up to the necessary high working pressures and temperatures.

40 **[0027]** A further disadvantage derives from the down times during activation of the known washing machines, due to the heating of the washing liquid as well as to the time necessary for the liquid periodic substitution.

[0028] On the other hand, a big percentage of the mechanical parts, which are subjected to the cleaning from residue by the above mentioned machines, have a rather simple shape, or they do not necessitate a particularly accurate cleaning level.

55 **[0029]** In these cases, the purchase, maintenance, as

well as use of the above mentioned machines, and therefore their operation costs, are too high with respect to the required results.

[0030] In these cases, the scraps and lubricant residues are often removed directly by the machine operators, by a jet of compressed air operated manually, when the part is removed from the machine tool.

[0031] These operations are rather dangerous for the personnel performing them, first of all because they are often performed without the protections required by the regulations.

[0032] First, there is a "direct" danger, resulting from the risks deriving from the high pressure blowing at the scraps, which can become real bullet and hit the operator's eyes or other exposed parts of the body.

[0033] There is also "indirect" danger, resulting from the long term risks of inhalation of the metallic powders and the oily emulsions atomized by the jet of compressed air into the surrounding environment, and from the exposure to the intense noise generated by the same jet, which can cause hearing problems.

[0034] The main object of the present invention is to propose an apparatus for removing scraps and lubricant residues remaining after working from mechanical parts, and in particular from mechanical parts, whose shape is not particularly complicated, or which do not require an especially high cleanness level.

[0035] The proposed apparatus does not generate toxic or polluting products, which should be subsequently disposed of or which could contaminate the surrounding environment in some way and create problems for the personnel.

[0036] Another object of the present invention is to propose an apparatus, which can assure a very good cleaning level for simple mechanical parts, and whose purchase, use and maintenance costs are reduced.

[0037] A further object of the present invention is to propose an apparatus, whose structure is simple and extremely reliable.

[0038] The above mentioned objects are obtained in accordance with the contents of the claims.

[0039] The characteristic features of the invention will be pointed out in the following detailed description, with reference to the enclosed figures, in which:

- Figure 1 is a schematic, front view of an apparatus for removing scraps and lubricant residues from mechanical parts, obtained according to a preferred embodiment of the present invention;
- Figure 2 is a lateral view of the apparatus of Figure 1;
- Figure 3 is a schematic view of a different embodiment of the parts holder and of the nozzles of the apparatus proposed by the invention;
- Figure 4 is a schematic view of an embodiment of the apparatus of Figures 1 and 2.

[0040] Figures 1 and 2 illustrate a first embodiment of an apparatus 100 for removing scraps and lubricant residues remaining after working from mechanical parts 1, obtained according to the present invention.

[0041] The apparatus 100 includes a substantially parallelepiped washing chamber 2, mounted on a support structure 2a resting on the ground.

[0042] The chamber 2 includes a fore aperture 3, which has closing means 4, aimed at closing the chamber during working on the apparatus 100.

[0043] In particular, the closing means 4 include a shutter 40, sliding vertically between lateral guides 41, 42, situated at the edges of the aperture 3.

[0044] The shutter 40 is operated by operating means 43, 44 and controlled by a suitable control unit 30, so as to perform raising and lowering movements.

[0045] In particular, the operating means 43, 44 include a pair of pneumatic cylinders, whose stems 43a, 44a have their ends fastened to the upper part of the shutter 40.

[0046] Means 10 for supporting mechanical parts 1 are situated inside the washing chamber 2, for carrying the above mentioned mechanical parts 1 in working position during the operations for removing the scraps and lubricant residues therefrom.

[0047] According to the described first embodiment, the support means 10 include a cage-like holder 11, which has a plurality of sections 12 for housing the mechanical parts 1, and means 13 for operating the holder 11 to move alternately in vertical direction inside the washing chamber 2.

[0048] The operating means 13 include a pneumatic cylinder, fastened externally to the upper part of the washing chamber 2 and having a stem 13a, which extends vertically inside the chamber 2 and whose free end is fastened to the above mentioned holder 11.

[0049] The apparatus 100 includes also means 20 for delivering pressurized air, situated inside the washing chamber 2 and set in communication with an external source of compressed air.

[0050] The delivering means 20 are aimed at delivering compressed air to the mechanical parts 1 housed in the holder 11, to remove the scraps and lubricant residues therefrom.

[0051] According to the described embodiment, the delivering means 20 include a plurality of delivering pipes 21, which extend horizontally, like a comb, from a linear connection element 22, situated inside the washing chamber 2 and introducing between the sections 12 of the holder 11, so as not to interfere with the alternate movement of the latter.

[0052] The delivering pipes 21 include a plurality of delivering nozzles 25, substantially distributed in a regular way on their whole surface.

[0053] According to an embodiment, shown schematically in Figure 4, the holder moves also horizontally, toward the washing chamber aperture 2.

[0054] For this purpose, the holder 11 is mounted glid-

ing on a horizontal slide 90, fastened to the free end of the stem 13a of the cylinder 13.

[0055] A second pneumatic cylinder 91, fastened to the rear end of the slide 90, has a stem 91a, to whose free end the holder 11 is fastened.

[0056] The second pneumatic cylinder 91 is operated, in prefixed ways and controlled by the control unit 30, to move the holder 11 alternately, its functional task will be explained later on.

[0057] According to a further embodiment of the invention, not shown for sake of simplicity, but deducible immediately, the delivering pipes 21 move alternately, while the holder 11 is mounted motionless in the washing chamber 2.

[0058] From a working point of view, there is no difference between the two embodiments.

[0059] The apparatus 100 includes also a pressure adjusting device 7, which is situated between the source of compressed air and the above described linear joint 22, and connected to the latter by a channel 23, aimed at defining the pressure of compressed air going out of the nozzles.

[0060] Means 5 for collecting the scraps, situated in the lower part of the washing chamber 2, receive the scraps after they have been removed from the mechanical parts 1, due to the action of the compressed air delivered by the delivering pipes 21.

[0061] The collecting means 5 include a hopper 51, whose inlet opening is situated on the bottom of the washing chamber 2, and a bin 52, removably fastened to the outlet opening of the hopper 51 and aimed at collecting the scraps.

[0062] The bin 52 can be advantageously removed, after having been filled with the scraps as mentioned above, in order to dispose the latter.

[0063] A deterging product dispenser 8 is situated between the pressure adjusting device 7 and the delivering pipes 21, for supplying an atomized stream of the deterging product together with the compressed air delivered by the delivering pipes 21, in order to facilitate the detachment of the scraps and the removal of possible residues of emulsion remaining on the parts 1.

[0064] The dispenser 8 includes a tank, which is connected to the above mentioned channel 23 and aimed at collecting the product to supply continuously small doses thereof, due to the suction action of the compressed air passing through the channel 23.

[0065] It is obvious that the conformation of the tank 8 shown in Figure 2 is not exhaustive and that bigger tanks can be situated on the ground or in another position inside the apparatus 100, but anyway connected to the compressed air supply by the delivering pipes 21.

[0066] According to a useful embodiment of the collecting means 5 conformation, a suitable container-filter 53 is introduced into the bin 52, in order to separate the solid scraps removed from the parts 1 from the liquid deterging product, deriving from the tank 8, although in small quantities, and from the oily residues removed from

the parts 1.

[0067] The apparatus 100 includes also filtering means 80, set in communication with the washing chamber 2 and aimed at withdrawing therefrom the excess of air, at filtering and expelling it outside.

[0068] The filtering means 80 include, arranged in a series with respect to the flow of air, a feeding channel 81, connected to the upper part of the washing chamber 2, a filtering cartridge 82 and a discharge channel 83, opening to the outside the apparatus.

[0069] A heater 95, situated upstream of the delivering pipes 21 and of the pressure adjusting device 7, along the compressed air supply path, is operated, controlled by the control unit 30, to heat the entering flow of air.

[0070] According to the above described first embodiment, with the shutter 40 in open position, the mechanical parts 1 to be cleaned are introduced into the washing chamber 2 and put into the holder 11, in the suitable sections 12.

[0071] Then, the shutter 40 is lowered, due to operation of the pneumatic cylinders 43, 44, by acting on suitable pushbuttons of the apparatus control unit 30.

[0072] At this point, the compressed air is introduced into the washing chamber 2, through the pressure adjusting device, the delivering pipes 21 and the relative nozzles 25.

[0073] At the same time, the pneumatic cylinder 13 operates the holder 11 to reciprocate vertically, at a suitable motion rate.

[0074] Thus, a plurality of jets of compressed air gradually act on the whole surface of the mechanical parts 1, removing the scraps and/or powder adhering thereto, due to the mechanical action.

[0075] The removed materials fall, due to the gravity, onto the bottom of the chamber 2, and consequently, to the hopper 51 and the bin 52.

[0076] The finest, and consequently the lightest particles of metallic powder are sent, together with the exceeding air present in the washing chamber 2, creating overpressure therein, to the feeding channel 81, and then to the filter 82.

[0077] The particles are held inside the filter, while the air is expelled outside through the discharge channel 83.

[0078] The suction effect of the compressed air generates also a flow of atomized deterging product, picked up by suction from the corresponding tank 8.

[0079] Also the deterging product acts on the mechanical parts 1 and facilitates the detachment therefrom of the scraps and oil emulsion residues, possibly present on their surface.

[0080] If the collecting means 5 include the above mentioned container-filter 53, a quite big part of the used deterging liquid and of the oily emulsion removed from the parts 1 is collected in the bin 2, while the solid parts, such as the scraps and the powder, are kept by the container-filter 53.

[0081] Nevertheless, the presence of this product, as well as of the corresponding dispenser is supplementary,

and therefore, they can be omitted without reducing considerably the removal operation results.

[0082] According to a functional embodiment of the invention, concerning the use of the deterging product, the scraps and residues removal operations are performed in two separate steps.

[0083] In the first step, the scraps and the metallic powder, together with the oil emulsion residues, are removed by the compressed air and atomized deterging product, while in the second blowing step only compressed air is used to dry the parts 1.

[0084] The heating of the compressed air by the heater 95, situated upstream of the delivering pipes 21, can be also added to the above described operations, in the drying step only, or in both.

[0085] This allows to accelerate the scraps and residues removal without causing significant increase of electrical energy consumption, because heating of the used air is definitely more economical than heating big quantities of water and deterging product, used in known washing machines.

[0086] According to the embodiment of the invention shown in Figure 4, the presence of the slide 90 and of the second pneumatic cylinder 91 allows to add two extra functions to the apparatus 100.

[0087] First, the second pneumatic cylinder 91 can be operated, during the working residue removal operations, to reciprocate the holder 11 within a limited range, so as to keep it within the dimensions of the washing chamber 2.

[0088] This, together with the reciprocatory vertical movement, imposed by the pneumatic cylinder 13, makes the parts 1 to be hit by the jets of compressed air in a more complete way, and at always variable angles.

[0089] Consequently, the removal of the scraps and lubricant residues is more efficient.

[0090] Second, the second pneumatic cylinder 91 can be operated, before and after the beginning of the removal operations, to remove at least partially the holder 11 from the washing chamber 2 and to reintroduce it therein, respectively for facilitating the arrangement of the parts 1 in the holder 11 and their removal when the operations are completed.

[0091] Moreover, the holder 11 can be mounted removably on the slide 90, using wholly known and not shown devices, so as to be substituted with another holder.

[0092] According to a second embodiment of the invention, shown in Figure 3, the support means 60 include a rotating holder 61.

[0093] The holder 61 is a substantially cylindrical, cage-like member and houses the mechanical parts 1 to be cleaned in its inside.

[0094] There are also operating means 63 for driving the rotating holder 61 into rotation, in order to bring the whole surface of the parts 1 to be gradually acted on by the compressed air delivered by the 70.

[0095] In particular, the operating means 63 include a

motor 64, situated outside the washing chamber 2 and coupled to a vertical shaft 65, which carries the rotating holder 61, fastened to its free end.

[0096] The delivering means 70 include a plurality of delivering pipes 71, which extend vertically from a ring-like connection element 72, situated in the lower part of the washing chamber 2.

[0097] The delivering pipes 71 are regularly spaced apart, externally and laterally with respect to the rotating holder 61.

[0098] The delivering pipes 71 include nozzles 25, distributed on the portion of the pipes surface, which is oriented toward the holder 61, so as to deliver compressed air in prefixed directions and hit the mechanical parts 1 housed in the holder 61.

[0099] Furthermore, the delivering means 70 include a plurality of additional delivering pipes 73, which extend horizontally from the free ends of the delivering pipes 71, in a substantially radial direction, toward the inside of the rotating holder 61.

[0100] Likewise, the additional delivering pipes 73 have nozzles 25, turned toward the holder 61, so as to act on the parts 1 situated therein.

[0101] The additional delivering pipes 73 are indicated with broken line in the above mentioned Figures, because their presence is not fundamental for the invention purposes, and therefore, they can be avoided in other possible embodiments of the invention.

[0102] The working of the apparatus 100 obtained according to the above described embodiment differs from the one described with relation to the first embodiment, basically because of the different movement of the holder 61, which in this case is rotating.

[0103] As for the rest, the description and the considerations made in relation to the first embodiment are equally valid.

[0104] One of the advantages of the above described apparatus 100 lies first of all in the fact that its use does not generate or spread toxic or polluting products.

[0105] Therefore, consequent complicated and expensive disposal operations are avoided, and the surrounding environment is not contaminated by the used products.

[0106] Another advantage of the invention derives from the fact that it assures a very good cleaning level for simple mechanical parts, while keeping purchase, use and maintenance costs reduced.

[0107] A further advantage of the present invention results from the fact that it proposes an apparatus, whose structure is simple and extremely reliable.

[0108] It is understood that the above description is a pure, not limiting example. Therefore, possible changes and variants of the invention remain within the protective scope of the present technical solution as described above and claimed below.

[0109] The changes and variants can include e.g. different or additional ways of the holder movement, technically within the knowledge of those skilled in the art,

such as high frequency vibration of the holder; the use of different types of known devices for delivering air and supply pressures, such as micro-nozzles at very high pressure; the use of devices for generating the so-called "air-blades", that is two-dimensional fronts of compressed air, instead of or in addition to the above described nozzles.

Claims

1. Apparatus for removing scraps and lubricant residues, remaining from working, from mechanical parts (1), **characterized in that** it includes: a washing chamber (2), having an aperture (3) and closing means (4), which close the chamber during said apparatus (100) operation; support means (10, 60) for said mechanical parts (1), situated inside said washing chamber (2) and keeping said mechanical parts (1) in working position during the scraps and lubricant residue removal; compressed air delivering means (20, 70), which are situated inside said washing chamber (2) and set in communication with a source of compressed air, and which deliver compressed air to said mechanical parts (1), through a plurality of nozzles (25), turned toward said mechanical parts (1), in order to free the latter from the scraps and lubricant residues; scrap collecting means (5), situated in the lower part of the washing chamber (2) for collecting the scraps after their removal from said mechanical parts (1); a control unit (30), which controls the operating of said apparatus (100) according to prefixed operation sequences.
2. Apparatus, as claimed in claim 1, **characterized in that** said closing means (4) include a shutter (40), which slides vertically between lateral guides (41, 42) situated at the edges of said aperture (3).
3. Apparatus, as claimed in claim 1 or 2, **characterized in that** said closing means (4) include also means (43, 44) for operating said shutter (40), which include a pair of pneumatic cylinders, whose stems (43a, 44a) have the respective ends fastened to the upper part of said shutter (40), with said stems (43a, 44a), controlled by the control unit (30) to raise and lower said shutter (40).
4. Apparatus, as claimed in claim 1, **characterized in that** said support means (10) include a holder (11), which has a plurality of sections (12), housing said mechanical parts (1), and reciprocating driving means (13), connected to said holder (11) and operating it to reciprocate in a vertical direction inside said washing chamber (2), to bring the whole surface of said mechanical parts (1) to be acted on by the compressed air delivered by said delivering means (20).
5. Apparatus, as claimed in claim 4, **characterized in that** said operating means (13) include a pneumatic cylinder, fastened externally to the upper part of said washing chamber (2) and having one stem (13a), which extends vertically inside the washing chamber (2) and whose free end is fastened to said holder (11).
6. Apparatus, as claimed in claim 1 and 4, **characterized in that** said delivering means (20) include a plurality of delivering pipes (21), which extend horizontally from a linear connection element (22) and which have nozzles (25), substantially regularly spaced apart on their whole surface.
7. Apparatus, as claimed in claim 1, **characterized in that** said support means (10) are situated motionless inside said washing chamber (2), and **in that** said delivering means (20) reciprocate, so that the compressed air acts on the entire surface of said mechanical parts (1).
8. Apparatus, as claimed in claim 1, **characterized in that** said operating means (60) include a substantially cylindrical rotating holder (61), which houses said mechanical parts (1), and operating means (63), which drive said rotating holder (61) into rotation, so as to bring the whole surface of said mechanical parts (1) to be progressively acted on by the compressed air delivered by said delivering means (70), said operating means (63) including a motor (64), situated outside said washing chamber (2) and coupled to a vertical shaft (65), whose free end carries said rotating holder (61).
9. Apparatus, as claimed in claim 8, **characterized in that** said delivering means (70) include a plurality of delivering pipes (71), which extend vertically from a ring-like connection element (72), which are regularly spaced apart externally and laterally with respect to said rotating holder (61), and which have nozzles (25), situated on a portion of their surface facing said rotating holder (61), and delivering compressed air in prefixed directions.
10. Apparatus, as claimed in claim 9, **characterized in that** it includes also a plurality of additional delivering pipes (73), which extend horizontally from the free ends of said delivering pipes (71) in a substantially radial direction toward the inside of said rotating holder (61), and which have nozzles (25) directed to said rotating holder (61).
11. Apparatus, as claimed in claim 1, **characterized in that** it includes also a pressure adjusting device (7), situated between said source of compressed air and said delivering means (20, 70) and defining the pressure of compressed air going out of the delivering

means.

12. Apparatus, as claimed in claim 1, **characterized in that** it includes also means (8) for delivering a deterging product, which include a tank of said product, connected to said delivering means (20, 70) to supply an atomized flow of deterging product together with the compressed air. 5
13. Apparatus, as claimed in claim 1, **characterized in that** said collecting means (5) include a hopper (51), situated in the lower part of said washing chamber (2), and a bin (52), fastened removably to the lower part of said hopper (51) to collect said scraps. 10
14. Apparatus, as claimed in claim 13, **characterized in that** said collecting means (5) include also a container-filter (53), situated between said hopper (51) and said bin (52), to separate the solid scraps residue from lubricant residues. 15 20
15. Apparatus, as claimed in claim 1, **characterized in that** it includes also filtering means (80), set in communication with said washing chamber (2), to take out therefrom exceeding air, to filter and expel outside the taken out air. 25
16. Apparatus, as claimed in claim 15, **characterized in that** said filtering means (80) include, arranged in a series with respect to the flow of air, a feeding channel (81), a filtering cartridge (82) and a discharge channel (83). 30
17. Apparatus, as claimed in claim 1 or 4, **characterized in that** said holder (11) is mounted sliding on a horizontal slide (90), operated by said reciprocating driving means (13), and that second reciprocating driving means (91) are fastened to said horizontal slide (90) inside said washing chamber (2) for reciprocating said holder (11) to and from said aperture (3). 35 40
18. Apparatus, as claimed in claim 17, **characterized in that** said second reciprocating driving means (91) include a second pneumatic cylinder, which has a stem (91a) with a free end fastened to said holder (11). 45
19. Apparatus, as claimed in claim 17 or 18, **characterized in that** said holder (11) is moved horizontally by said second reciprocating driving means (91), during the removal of the scraps and residues from said mechanical parts (1), within such a stroke, that said holder (11) remains inside the washing chamber (2). 50 55
20. Apparatus, as claimed in claim 17 or 18, **characterized in that** said holder (11) is moved horizontally by said second reciprocating driving means (91), be-

fore and/or after the removal of the scraps and residues from said mechanical parts (1), within such a stroke, that said holder (11) is taken out from said washing chamber (2) at least partially.

21. Apparatus, as claimed in claim 17 or 18, **characterized in that** said holder (11) is mounted removably on said slide (90).
22. Apparatus, as claimed in claim 1, **characterized in that** it includes also a heater (95), which is situated along the compressed air supply path, upstream of said delivering means (20, 70), and which heats the compressed air before its delivery.

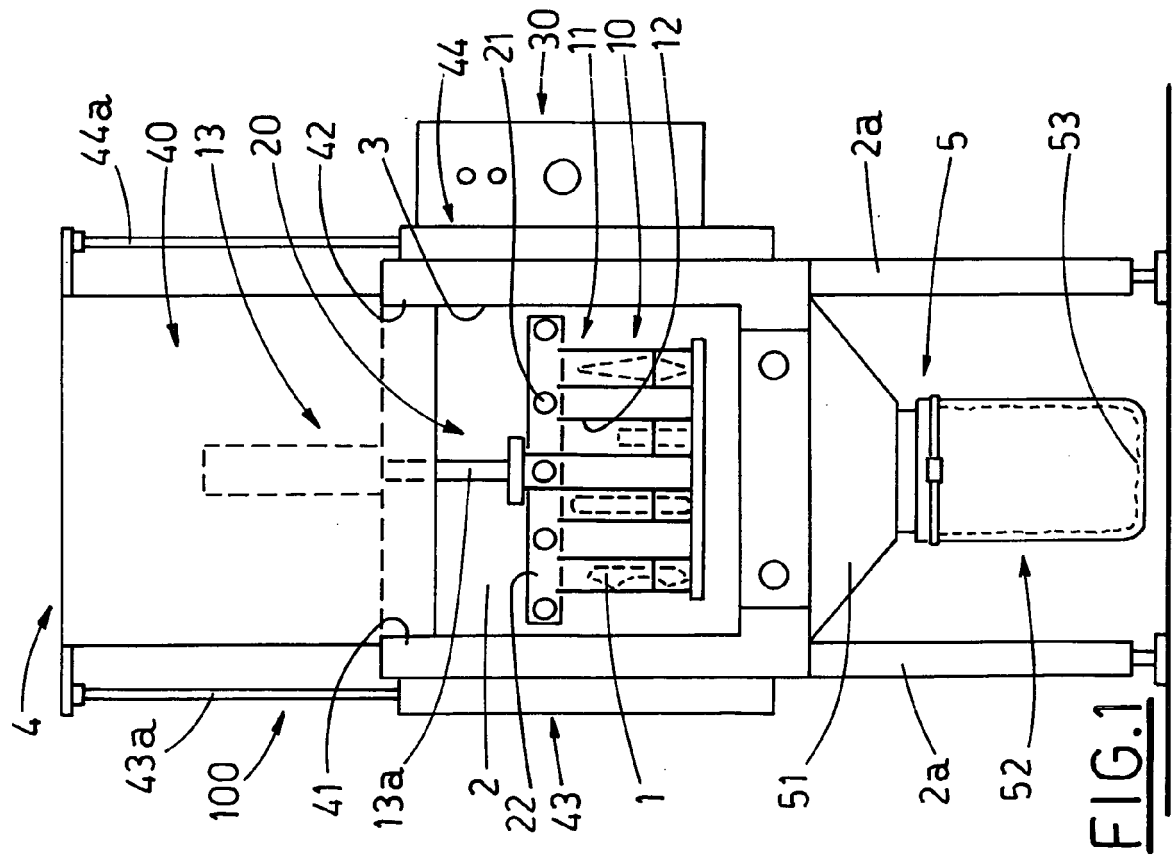
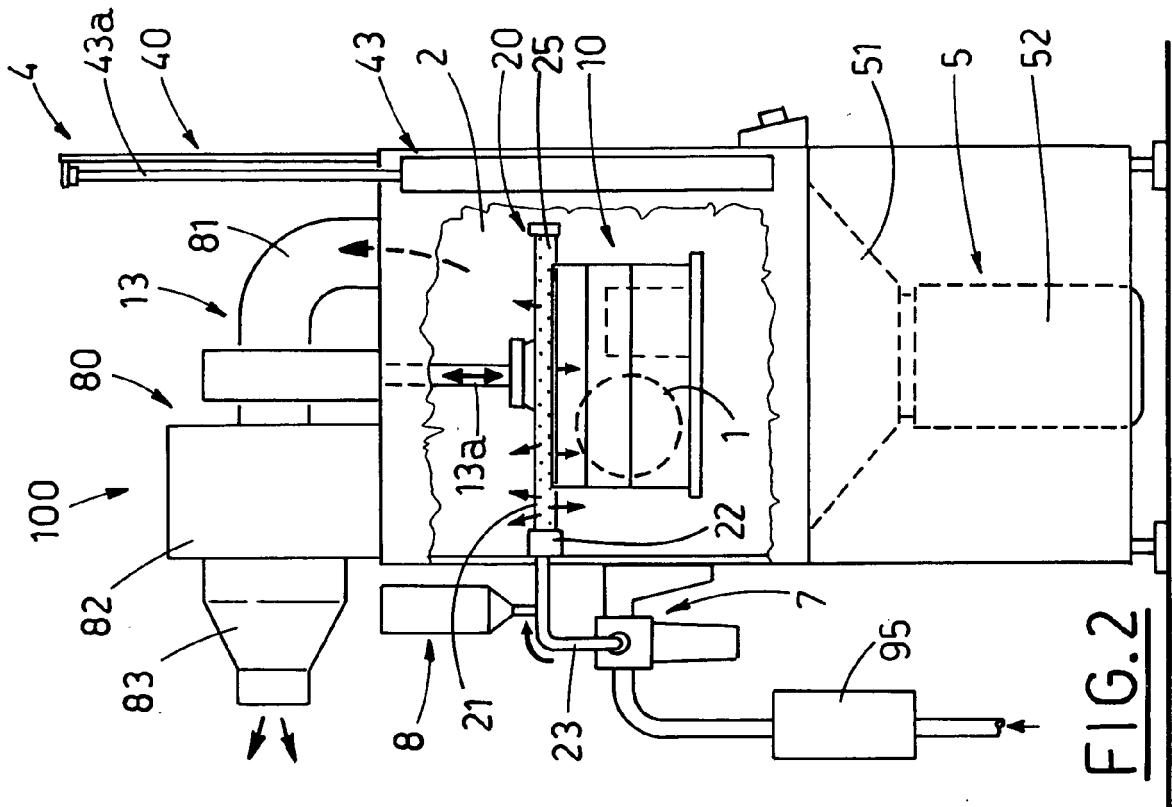


FIG. 3

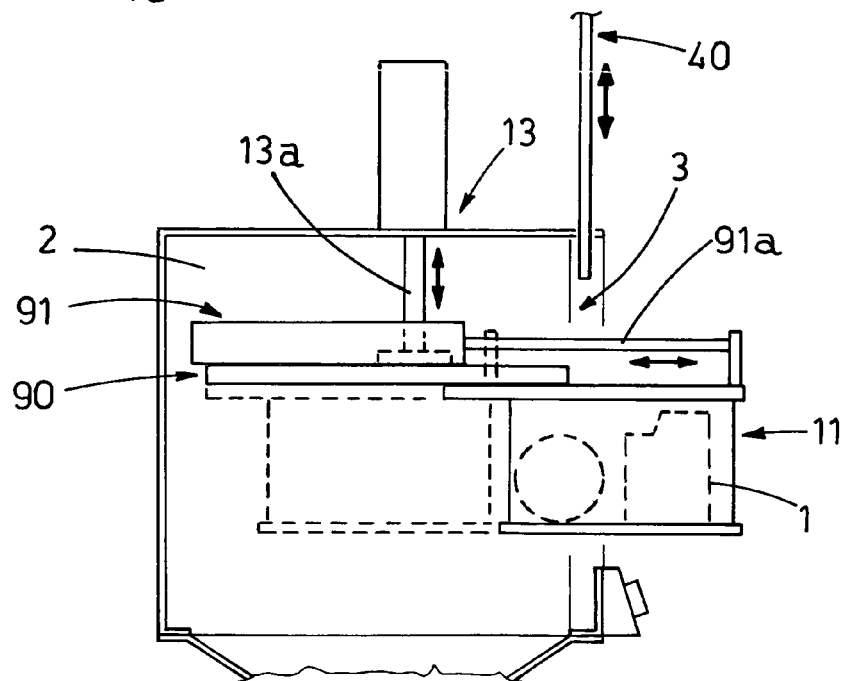
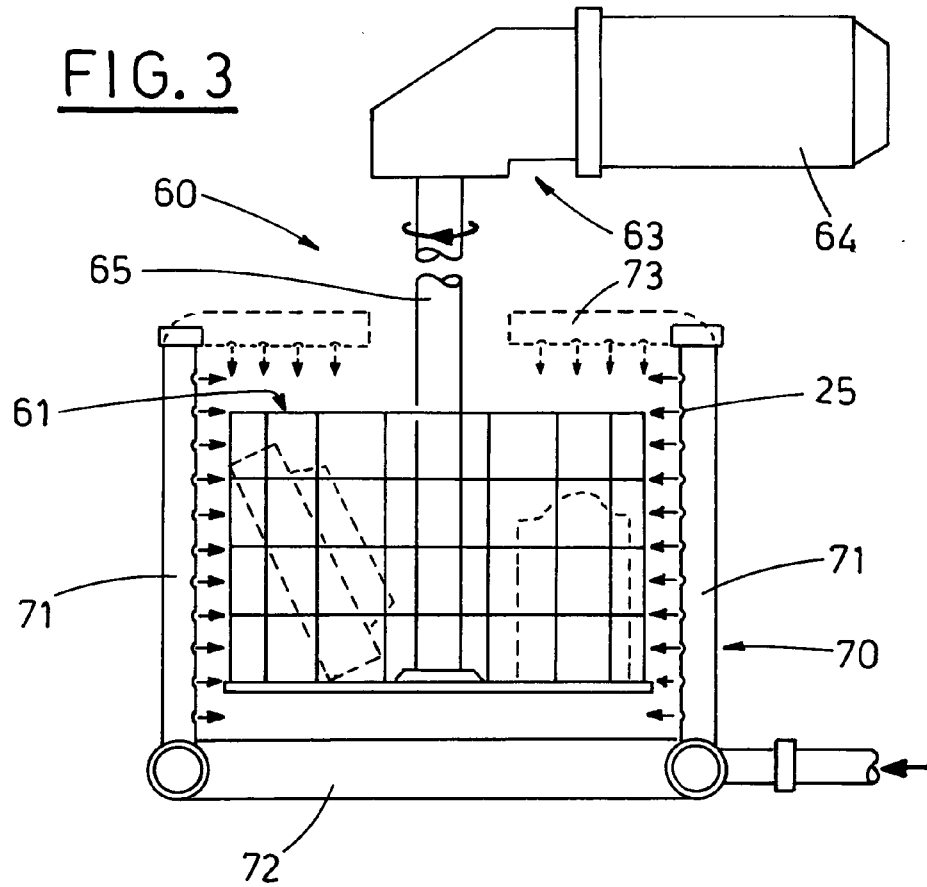


FIG. 4



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 196 29 436 A1 (GROSS, HANS HERMANN, DIPL.-ING., 50935 KOELN, DE) 29 January 1998 (1998-01-29) * column 4; claim 1; figure 1 *	1	INV. B08B5/02 B08B3/02 B08B13/00
Y	GB 2 337 325 A (* RICOH COMPANY, LTD) 17 November 1999 (1999-11-17) * claims 1,4,5 *	1	
A	* figure 3 *	2,3	
Y	DE 31 35 819 A1 (CHEMOTEC ENGINEERING GMBH) 17 March 1983 (1983-03-17) * claim 1; figure 1 *	1	
A	US 2004/010883 A1 (FURRER STEFAN ET AL) 22 January 2004 (2004-01-22) * abstract *	1	
A	DE 80 19 194 U1 (RINGLER, BERNHARD, 7076 WALDSTETTEN) 4 December 1980 (1980-12-04) * page 8 - page 9; figure 1 *	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC) B08B F26B
Place of search Munich		Date of completion of the search 3 May 2006	Examiner Devillers, E
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 05 02 8628

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