



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/IT93/00004 (22) International Filing Date: 22 January 1993 (22.01.93) (30) Priority data: MI92A000124 24 January 1992 (24.01.92) IT (71)(72) Applicant and Inventor: CATALFAMO, Giuseppe [IT/IT]; Via Sanvito Silvestro, 14, I-21100 Varese (IT). (74) Agent: DI GIOVANNI, Italo; Ufficio Brevetti Dott. Ing. Digiovanni Schmiedt, Via Aldrovandi, 7, I-20129 Milano (IT). (81) Designated States: AT, AU, BB, BG, BR, CA, CH, CZ, DE, DK, ES, FI, GB, HU, JP, KP, KR, LK, LU, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SK, UA, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, SN, TD, TG).</p>		<p><b>Published</b> <i>With international search report.</i></p>
<p>(54) Title: SMOOTHING MILL WITH SUCTION, BY DEPRESSION IN THREE STAGES, OF DUST SO GENERATED</p>		
<p>(57) Abstract</p> <p>Smoothing mill for compressed ejectors (3, 4) of several stages, incorporated, for suction of dust generated and for conveying it through a flexible tube (19) to a collecting area, use being made of the compressed air discharged from the motor (40) which sets the abrasive disk (9) in rotation.</p>		

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SMOOTHING MILL WITH SUCTION, BY DEPRESSION IN THREE STAGES,  
OF DUST SO GENERATED

The present invention concerns smoothing mills for finishing the surfaces of manufactured articles or for preparing  
5' such articles for subsequent treatment.

Smoothing mills, particularly the disk type, are well-known tools and by means of an abrasive body, especially a rotating disk, are used for treating the surface of structures such as the body of a car, a piece of wooden furniture, flooring or thresholds of stone or wood, to obtain a good finish  
10 or to prepare the surface for further treatment such as painting.

Special devices enable the dust, produced by the abrasive body on the surface to which said body is applied, to be  
15 sucked up and carried into chambers placed for the purpose, in order to keep the environment cleaner and healthier. Suction and damping down the dust produced by such work is an important aspect of the process.

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In one known model there is a fan fitted onto the motor shaft that rotates the plate-shaped part carrying the abrasive disk.

The fan sucks up air and dust through a set of holes in the plate and in the abrasive disk and conveys it into a tube. Suction produced by the fan, moved by the same rotating shaft as that moving the abrasive disk, is in no way sufficient for the purpose.

To overcome this insufficiency use is made of a separate self-propelled electric suction fan (of the bin-type vacuum cleaner) whose suction tube is connected to the smoothing mill.

A drawback to this system is the awkward presence of the electric cable feeding the fan as well as the high consumption of energy involved.

Other systems comprise a fixed suction system having one or more articulated arms carrying suction tubes connected to one or more smoothing mills by couplings at the ends of said arms.

These fixed installations require a considerable investment and maintenance costs are also high.

Further, coupling the smoothing mill to an articulated arm of the system limits movement, and consumption of energy is even higher than that for a mobile suction unit.

Purpose of the present invention is to provide a smoothing mill comprising built-in means of dust suction which are more powerful, more effective and more efficient.

A further purpose is to exploit the air discharged by the motor and the compressed air from the machine, which would otherwise be lost, and this saves a great deal of energy.

Subject of the invention is a smoothing mill comprising a

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suction duct for generated dust and a suction device made by fitting inside said suction duct one or more tubular ejectors each comprising an initial truncated-cone shaped chamber and a final cylindrical chamber.

5 Said ejectors are arranged coaxially in series, one partially inside another, with the truncated-cone shaped part preceding the cylindrical part, in the direction of suction. The compressed air enters the first of these ejectors through a coaxial nozzle.

10 Internal diameter of the cylindrical chambers is equal to the lesser diameter of the truncated-cone shaped chambers preceding them.

Internal diameters of the second ejector are greater than the corresponding ones of the first ejector while internal  
15 diameters of the third ejector are greater than the corresponding diameters of the second ejector, and so on.

In this way a smooth passage of air in the cavities among the ejectors arranged in series is assured.

The overall purpose is to obtain, for each ejector and by  
20 associated action of the truncated-cone and cylindrically shaped chambers, a high progressively multiplying capacity and suction power in the various stages of suction created by the ejectors arranged in series.

The first ejector lies practically inside the truncated-  
25 -cone shaped chamber of the second ejector which in turn lies practically inside the truncated-cone shaped chamber of the third ejector.

In a preferred execution the smoothing mill is of the disk type.

30 Said disk is mounted at the end of the shaft of a motor and comprises a suction chamber placed behind said disk

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and communicating with the working area through a specially made aperture in the disk.

The dust suction duct communicates with said suction chamber through apertures made in the top of said chamber.

5 The nozzle of the compressed air duct communicates with the first truncated cone-cylindrical ejector at a position practically on the front edge of said ejector.

In a preferred type of execution the smoothing mill is worked by a compressed air motor, the compressed air discharged by said motor being used to feed the nozzle associated to the truncated cone-cylindrical ejector.

10 A valve for regulating opening and closing of the passage for fluid is fitted on the duct bringing in compressed air. Said valve comprises a shutter whose position in relation to the valve can be continuously adjusted by a ring nut.

15 By moving the lever that works the valve and adjusting rotation of the ring nut, the quantity of compressed air can be regulated as required.

In another type of execution the smoothing mill is operated by an electric motor, the nozzle associated to the truncated cone-cylindrical ejector being connected to a generator of compressed air by a flexible tube.

The above-mentioned abrasive disk is supported by a plate, the surface that couples it to said disk being virtually annular and containing radial grooves which extend from a central lower zone to the outer circumference.

25 Said abrasive disk is held in place by a retaining part with radial arms that compress said abrasive disk and, bending it, force it inside said grooves.

30 The openings for dust suction through said plate and abrasive disk, and which are formed inside said lower central

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zone of said plate, through the radial grooves referred to above ensure suction paths for said ejectors which will not become blocked up during operation even when the abrasive disk is in contact with the work surface.

5 The invention clearly offers many advantages.

By the use of a compressed air motor, the flow of compressed air discharged by the motor forms the primary fluid that actuating the dust suction system thus ensuring a rational form of operation and and economy in consumption  
10 of energy by the machine.

Suction of dust by a number of ejectors, and therefore in several stages, gives rise to increased effects appreciably raising the power of suction, capacity and efficiency. The presence of radial grooves on the working surface of  
15 the abrasive disk improves suction of dust produced while the smoothing mill is in operation.

Said radial grooves collect within them a large proportion of the dust produced during rotation, interception and suction being more immediate. Under all conditions, there-  
20 fore, these radial grooves ensure suction of air from outside close to the external circumference of the rotating abrasive disk, preventing interruption in the suction flow during work.

Characteristics and purposes of the invention will be made  
25 still clearer by the following examples of its execution illustrated by diagrammatically drawn figures.

Fig. 1 The invented smoothing mill with compressed air  
motor and two-stage suction, longitudinal section.

Fig. 2 Plan view of the mill partially cut away.

30 Fig. 3 Detail of the two-stage suction device.

Fig. 4 Detail of the three-stage suction device.

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Fig. 5 Smoothing mill with electric motor, longitudinal section.

The smoothing mill comprises a body 1 of die-cast plastic material, provided with a handle 2.

5 A compressed air motor 40 is installed inside said body 1. On the end of the shaft 6 of said motor, a plate 7 has been mounted to which plate is fitted an abrasive disk 9, with a pad 8 of elastic material interposed between them.

In said pad 8 there is a central hole 10 and two or more 10 radial grooves 8s, angularly spaced one from another and extending from said central hole 10 to the outer edge of said abrasive disk 9.

The abrasive disk 9 is locked in place by a retaining part 11, this in turn being fixed to the end of the shaft 6 15 by a screw 12.

In the plate 7 there is an opening 7a whose position corresponds to that of the central hole 10 in the pad, and similarly there is a central hole 9a in the disk 9.

On the back of the plate 7 there is a suction chamber 13 20 with cylindrical walls 14 of a flexible material.

Said chamber 13 communicates through a hole 15 at its top with a longitudinal duct 16 made in the handle 2.

Inside said handle 2 are two more ducts, practically parallel to the first, respectively a duct 17 carrying compressed air and a duct 18 for discharging it. 25

Compressed air is received from a flexible tube 19.

On the compressed air entry duct 17, upstream of the motor 30, is mounted a control valve 20 that can be worked by the operator by an external lever 21 acting on a shutter 30 20 with a pin and return spring 23.

The end position of the shutter 22 when the valve 20 is

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is opened, obtained by moving the lever 21, can be adjusted by means of a knurled ring nut 24 supported by the lever 21, so that micrometric regulation of the rotating speed of the abrasive disk can easily be done by increasing or  
5 reducing the passage opening of the valve 20.

Having started up the motor 40, the compressed air returns through the duct 18 from where it flows into the nozzle 26 in line with a tubular ejector 3 which, in the direction of forward movement of the compressed air, comprises an  
10 initial truncated-cone shaped part 27 and a second cylindrical part 28 whose internal diameter is equal to the lesser diameter of the truncated cone.

The ejector 3 sucks up air and dust from the working area through the duct 16, the hole 15 in the chamber 13 on the  
15 plate 7, the holes 7a in said plate, those 9a in the abrasive disk 9, and hole 10 in the rubber pad 8.

The ejector 3 is surrounded by a second ejector 4 formed of a tubular body comprising an initial truncated-cone shaped part 29 and a second cylindrical part 30.  
20 The jet flowing from the first ejector 3 therefore penetrates into the second ejector 4 at the position of the second cylindrical part 30.

A further flow of air is created in the cavity between the first ejector 3 and the second ejector 4, making the flow  
25 passing from the first ejector more powerful.

A flexible discharge tube 31 connected to the end of the body of ejector 4, carries discharged compressed air from the motor, the dust produced by the process and outside  
30 air sucked in from the working area towards a collecting chamber.

In the figures the path followed by the compressed air is

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is indicated by arrows and continuous lines while those taken by the mixture received from the ejectors and carried to the collecting chamber are indicated by arrows and dotted lines.

5 The best suction is obtained when the end of the nozzle 26 is placed practically flush with the front edge of the first ejector 3.

Fig. 4 shows a variation.

The second ejector 4 is in turn lodged inside a tubular  
10 body constituting a third ejector 5 comprising an initial truncated-cone shaped part 41 and a second cylindrical part 42.

The end of said tubular body is connected to the discharge tube for dust, like the tube 30 in Fig. 1.

15 Fig. 5 illustrates a further version.

Rotation of the abrasive disk 9 is obtained by an electric motor 50 fed through an electric cable 52.

A flexible tube 53, for feeding in compressed air as the primary fluid for the dust suction system, is directly con-  
20 nected to the nozzle 26 coaxial with the first ejector 3.

In locking the abrasive disk 9 the retaining part 11 is aided by the radial arms which bend the abrasive sheet inside the radial grooves 8s in the rubber pad.

The coordinated openings in the disk 9, plate 7 and pad 8,  
25 corresponding to the central lower area of the working surface of the plate 7, keep said central lower area in communication with the outer air even when the abrasive disk is pressed against a flat surface. This makes suction of dust from the process more efficient still, as has been  
30 already explained.

Claims

1. Smoothing mill comprising a duct (16) for suction of the generated dust and a suction device characterized in that said suction device is obtained by inserting in the suction duct (16) one or more tubular ejectors (3,4,5) each comprising an initial truncated-cone shaped chamber (27, 29,41) and a final cylindrical chamber (28, 30, 32) arranged coaxially in series and inserted partially one inside another with the truncated-cone part preceding, with respect to the direction of suction, the cylindrical part, and in that compressed air is put into the first (3) of said ejectors (3,4,5) through a coaxial nozzle (26) , the internal diameter of the cylindrical chambers (28,30,42) being equal to the lesser diameter of the truncated-cone shaped chambers (27,29,41) that precede them, the internal diameters of the second ejector (4) being greater than the corresponding diameters of the first ejector (3), the internal diameters of the third ejector (5) being greater than the corresponding diameters of the second ejector (4) and so on, this in order to permit regular passage of air in the cavities between the various ejectors (3,4,5) arranged in series, the overall purpose being to obtain, by associated action in each ejector (3,4,5) of the truncated-cone shaped chambers (27, 29,41) and of the cylindrical chambers (28,30,42) a high progressively multiplying capacity and power of suction in accordance with the various stages of suction created by the ejectors (3,4,5) arranged in series.
2. Smoothing mill as in claim 1, characterized in that the first ejector (3) is practically inside the truncated-cone shaped chamber (29) of the second

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ejector (4), this latter in turn being practically inside the truncated-cone shaped chamber (41) of the third ejector (5).

3. Smoothing mill as in claim 1,  
5 characterized in that it is of the disk type, said disk (9) being mounted at the end of the shaft of a motor (40), (50), and comprises a suction chamber (13) placed behind said disk (9) and communicating with the working area through apertures (9a) made in the disk, (10) in the rubber pad and  
10 (7a) in the plate (7), the dust suction duct (16) being placed in communication with said suction chamber (13) by openings (15) at the top of said chamber.

4. Smoothing mill as in claim 1,  
15 characterized in that the nozzle (26) on the suction duct (16) is placed in communication with the first truncated-cone shaped cylindrical ejector (3) at a position practically flush with the front edge of said ejector (3).

5. Smoothing mill as in claim 1,  
20 characterized in that it is worked by a compressed air motor (40) compressed air discharged from said motor (40) being used to feed the nozzle (26) associated to the truncated-cone shaped cylindrical ejector (3).

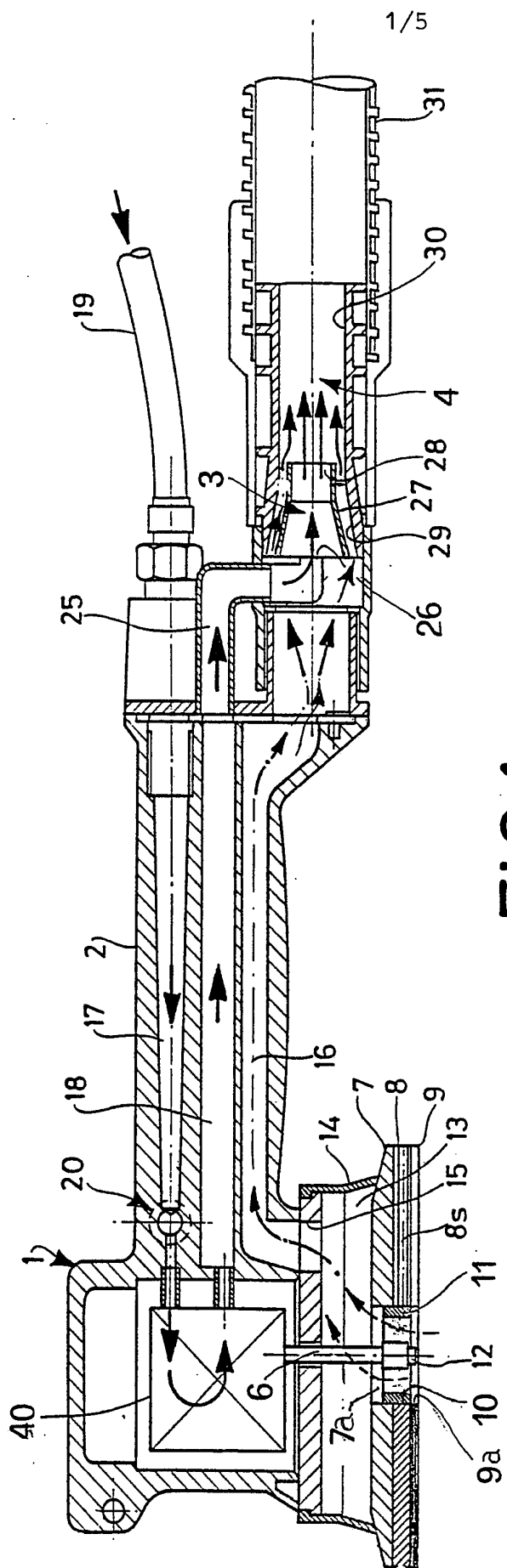
6. Smoothing mill as in claim 5,  
25 characterized in that on the compressed air duct (17) feeding the motor (40), a regulating valve (20) is mounted operated by a bar (21) to open and close the passage way for fluid, comprising a shutter (22) whose position in relation to the valve (20) is continuously adjustable by means of a ring nut (24) supported by said bar (21) it being thus possible,  
30 sible, by working the lever (21) that controls the valve (20)

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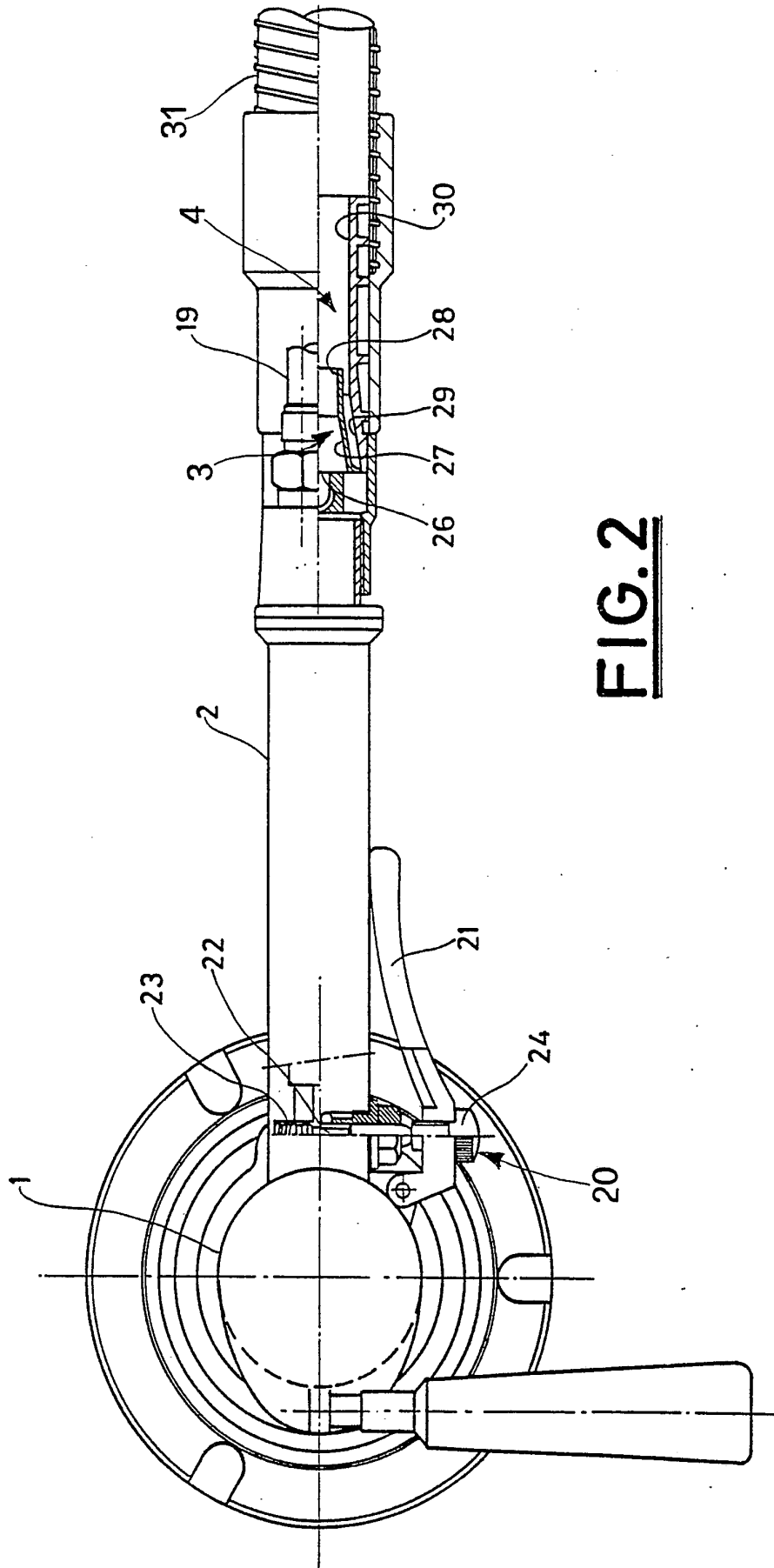
and rotating the ring nut (24) to obtain the quantity of compressed air needed for the work in hand.

7. Smoothing mill as in claim 1,  
characterized in that it is worked by an electric motor  
5 (50) the nozzle (26) associated to the truncated-cone  
shaped cylindrical ejector (3) being associated to a generator of compressed air by a flexible tube (53).

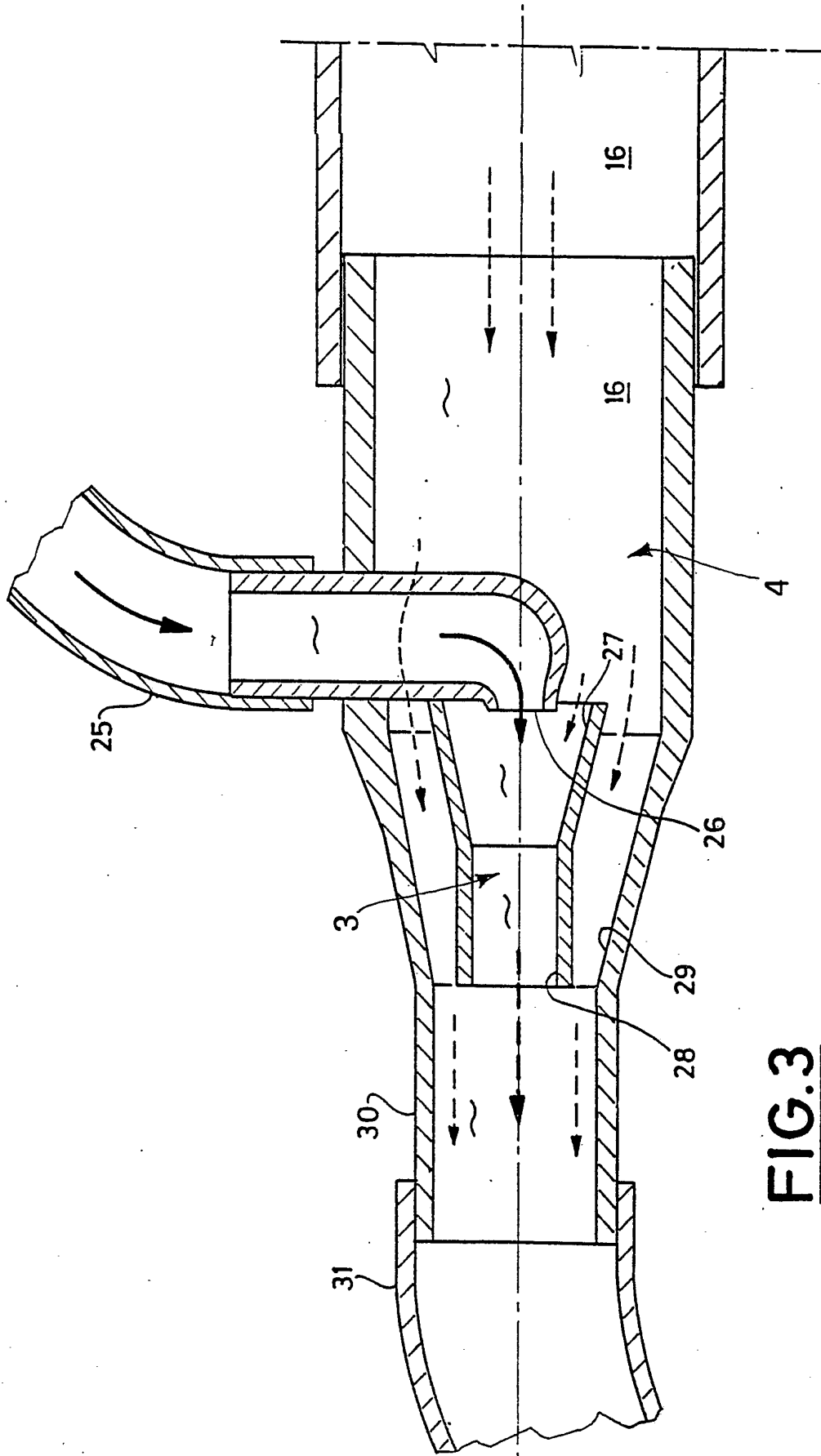
8. Smoothing mill as in claim 3,  
characterized in that the abrasive disk 9 is supported by  
10 a plate (7) whose surface coupling with said abrasive  
disk (9) is virtually annular and contains radial grooves  
(8s) which extend from a central lower zone to the outer  
circumference, said abrasive disk (9) being kept in position by a retaining part (11) having radial arms that by  
15 bending the abrasive disk (9) compress it into said radial  
grooves (8s) assuring for the dust suction openings in said  
plate (7) and in said abrasive disk (9), communicating with  
said lower central zone (10) in said plate, through said  
grooves, paths of suction for the dust generated that will  
20 not become blocked up during the work even when the abrasive  
disk is in contact with the working surface.



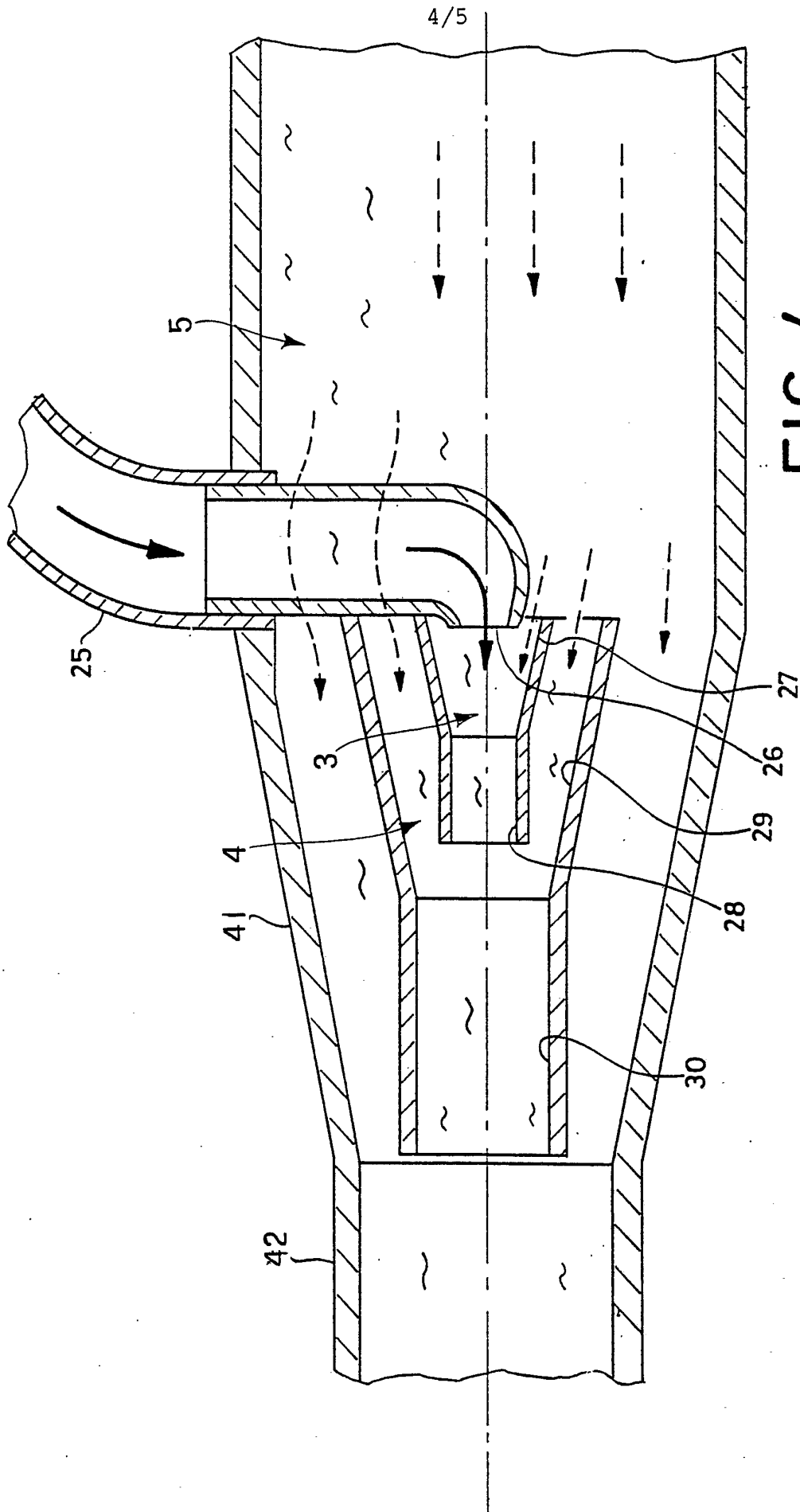
**FIG. 1**

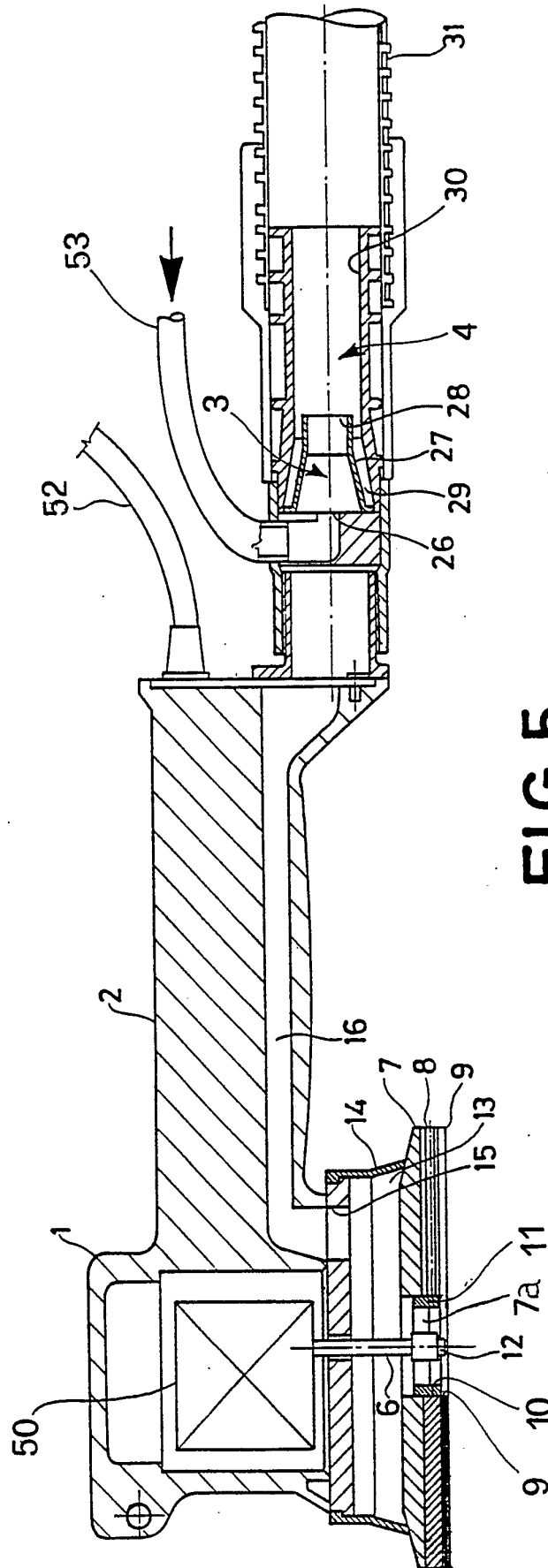


**FIG. 2**



**FIG. 3**





**FIG. 5**

## INTERNATIONAL SEARCH REPORT

PCT/IT 93/00004

International Application No

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>6</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC Int.Cl. 5 B24B55/10; B24B23/02		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
Int.Cl. 5	B24B	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b>		
Category <sup>o</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
X	CH,A,271 710 (SVIT) 1 February 1951	1,4
A	see the whole document	2
P,X	US,A,5 105 585 (HAMPL ET AL.) 21 April 1992 see column 3, line 45 - line 65; figures	1,3-5,8
X	US,A,3 824 745 (HUTCHINS) 23 July 1974 see column 3, line 10 - line 25; figure 1 see column 5, line 33 - line 41; figures 4,5	1,7
A	FR,A,1 301 137 (SPITZNAS GMBH) 2 July 1962 see abstract; figure	6
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<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
12 MAY 1993	19. 05.93	
International Searching Authority	Signature of Authorized Officer	
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**ANNEX TO THE INTERNATIONAL SEARCH REPORT  
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CH-A-271710		None	
US-A-5105585	21-04-92	AU-A- 1989892 WO-A- 9219421	21-12-92 12-11-92
US-A-3824745	23-07-74	None	
FR-A-1301137		None	

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