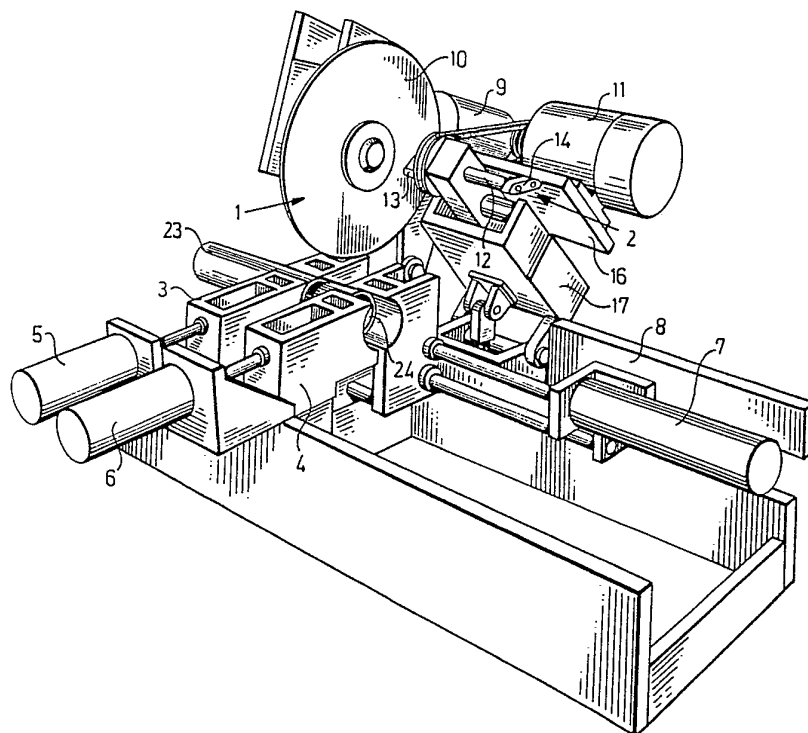




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(54) Title: METHOD AND APPARATUS FOR CUTTING AND DEBURRING TUBES



(57) Abstract

A method and an apparatus for cutting and deburring of tubes, whereby a base tube (23) is successively cut into several smaller tube pieces (24) and the cut edges thereof are deburred in a machine comprising a cutting means (1), a double acting deburring means (2) or a corresponding means and two carrier jaws (3, 4) at least one (4) of which is axially movable in relation to the other (3), whereby the base tube (23) is clamped by the jaws (3, 4) and is, in a non-rotating state, first cut into pieces, whereupon the cut edges are, still clamped by the jaws deburred in direct connection thereto.

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Method and apparatus for cutting and deburring tubes.

The present invention generally relates to a method and an apparatus for cutting and deburring tubes, and the invention is more particularly directed to such a method and such an apparatus in which a base tube is cut and deburred in a machine comprising two carrier jaws, a cutting means and a deburring means, whereby the cutting and the deburring of the base tube follow in a continuous operation, preferably without the need of removing the tube from the cutting and deburring machine during said workings.

In previously known apparatus the cutting of the tube and the deburring of the cut tube ends generally have been made in two separate operations and in two separate machines. This necessitates some work with transportation and eventually an intermediate storing of the tubes, and with mounting of the cut off tube parts in a deburring machine after the base tube has been cut into tube pieces. It may also involve some problems to maintain predetermined tolerances.

The object of the invention therefore is to solve the problem of suggesting a method and an apparatus for cutting and deburring tubes and cut off tube pieces respectively in a continuous operation in a machine comprising a cutting means and a deburring means and two carrier jaws, at least one of which is movable in relation to the other, and in which the cutting and deburring according to the invention is made with the tube, or the cut off tube piece resp., continuously clamped by the jaws.

In an embodiment of the invention the cutting and deburring is made according to the following cycle of operation:

- a base tube is fed from an input side of the machine through a first jaw and as far as to a stop means of a second jaw;
- the jaws are closed thereby clamp locking the tube;
- a cutting means is fold down against the tube and cuts same at a predetermined position in relation to the two jaws;
- the second jaw together with the cut off tube piece is displaced a predetermined distance axially apart from the first

jaw;

- the cutting means is withdrawn from the cutting position, and a double acting deburring means is moved into deburring position between the front end of the base tube and the rear end of the cut off tube piece;

- the deburring means is activated at the same time as the second jaw, by a predetermined biasing force, is moved into contact with the deburring means which is thereby, in turn, moved into contact with the front end of the base tube, and the two tube ends are deburred concurrently;

- the cut off and deburred tube piece is removed;

- the jaws are unclamped and a new cycle of operation including cutting and deburring is started.

Further characteristics of the invention and advantages thereof will be evident from the following detailed specification in which reference will be made to the accompanying drawings.

In the drawings figure 1 diagrammatically shows a machine for executing the method according to the invention. Figure 2 is a perspective view of practical embodiment of a machine according to the invention. Figures 3, 4 and 5 illustrate, fragmentary, perspective views of the machine of figure 2 at three different steps of the method according to the invention.

The machine diagrammatically shown in figure 1 generally comprises a cutting means 1, a deburring means 2 and two carrier jaws 3 and 4, at least one of which - in the illustrated case the right jaw 4 - is movable in relation to the left jaw 3 and coaxially therewith. The two jaws are operated by means of servo motors 5 and 6 (just intimated), preferably hydraulic pistons, and likewise the right jaw 4 is operated for its axial displacement to and from the fixed jaw 3 by means of a servo motor like an air piston 7. The entire apparatus is mounted on a support 8.

The cutting means 1 comprises a motor 9 which drives a cutting blade or saw blade 10, preferably over a gear drive (not shown). The cutting means is rotatably mounted on the support 8 so as to be rotatable from an inactive position aside of the jaws and an active

position in which the cutting blade is capable of cross cutting a tube which is held by the jaws. The cutting means is rotated by a motor actuated by a conventional actuation means.

The deburring means also includes a motor 11 which over a V-belt is connected to a deburring device having a rotatable shaft 12 and at each end thereof a deburring tool 13 and 14. Each deburring tool has a first cutting edge for external deburring and a second cutting edge for internal deburring of a tube end. The deburring means is mounted on an arm 15 belonging to a shelf 16 which is, in turn, reciprocatable on a fixed machine part 17 which is fixed mounted in relation to the support 8. Said fixed machine part 17 has a shaft 18 on which the shelf 16 with the motor 11 and the deburring means 12-16 are displaceably mounted, for instance over a ball bearing or a similar means. A spring 19 tends to move the shelf with the deburring means in direction away from the fixed left jaw 3, as shown in the drawing, and the shelf with deburring means is freely movable in the direction towards said fixed jaw against the action of the spring 19. An indexing means 20 is mounted on the rotatable shelf, which indexing means has a length that is adapted considering the distance between the deburring tools 13 and 14, and which is intended to foresee that the deburring tools act on its respective tube end to an exactly intended degree. The indexing means is mounted so that the right end thereof forms a stop 21 for the movable right jaw 4, whereas the left end thereof forms a stop 22 for the shelf against the fixed left jaw 3.

The jaws 3 and 4 are of known type and comprises a pair of cooperating jaw halves, viz. a non-movable jaw half 3a, 4a and a movable jaw half 3b, 4b (see figures 2-5), which are actuated by the hydraulic motors 5 and 6 resp.

Figures 2-5 show different details of the function of the apparatus, and figure 2 shows the apparatus in the initial position (starting position) in which a base tube 23 has been introduced through the fixed jaw 3 and as far as to a stop (not shown) of the movable right jaw 4. Said stop is adjustable so that a tube piece

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24 of exactly desired length can be cut off the base tube 23. When the base tube thereby comes into contact with the stop of the movable jaw 4 the two hydraulic cylinders 5 and 6 are operated thereby clamping the tube to the jaws.

5 In the next phase, which is illustrated in figure 3, the cutting means 1 is fold down so that the cutting blade or saw blade 10 comes into contact with the tube at the exactly intended place between the jaws 3 and 4, the motor 9 is started and the tube 23 is cut as indicated in the figure.

10 When the tube piece 24 has been cut off the base tube 23 the air cylinder 7 is actuated so that the movable jaw 4, together with the tube piece 24, which is still clamped by said jaw 4, is moved such long distance to the right (figure 4) that the deburring means 2 may be introduced in the space between the ends of base tube 23 and the cut off tube piece 24 (figure 5).

15 The motor of the deburring means is actuated so that the deburring tools 13 and 14 start rotating, and the air cylinder 7 is actuated, whereby the movable right jaw 4 is moved into contact with the stop 21 of the indexing means 20. By the actuation of the jaw 4 on the stop 21 and also by the actuation of the tube piece 24 on the deburring tool 14 the shelf 16 of the deburring means together with the motor and the deburring tools is moved to the left, so that the opposite stop 22 of the indexing means comes into contact with the fixed jaw 3, and so that the second deburring tool 13 comes into contact with the end of the base tube 23. Thereby the 20 two ends of the base tube 23 and the cut off tube piece 24 facing each other are deburred concurrently. The extent and the depth of the deburring is defined by the indexing means and can be adjusted as desired. Different types of deburring or other treatment of the tube ends can, if desired, be made at the front and the rear ends 25 respectively of the tube parts.

30 After the above described cutting and the directly following deburring operation is completed the deburring means is fold back to its withdrawn position, the cut and deburred tube piece 24 is removed, the movable jaw 4 is returned to its initial position 35

shown in figure 2, and a new cutting and deburring cycle starts.

In order to have also the front end of a new base tube 23 deburred it is possible to deburr same by clean-cutting the end of the tube and subsequently deburring said end, without getting thereby an actual cut off tube piece, or the deburring of the first
5 cut off tube piece can be made as conventional. Any subsequently cut off tube pieces are deburred automatically both at the front end and at the rear end.

As known per se the entire apparatus including the cutting
10 means and the deburring means are connected to an automatically operating control means, from which indications and starting/stopping signals are obtained when the base tube 23 is introduced to a desired extent in the movable jaw 4, that is in relation to the fixed jaw 3; when the cutting is to be started;
15 when the cutting is ended and the cutting means is to be withdrawn; when the deburring is to be started; when the air cylinder for the movable jaw is to be actuated; when the deburring means is to be withdrawn; when the cut off tube piece is to be removed, etc., so that the machine operates automatically.

20 By means of the method and the apparatus it is possible to cut and deburr also very short tube pieces and materials which are difficult to deburr, like copper. By the invention it is also possible to produce tube pieces with great accuracy and having very small differences in manufacturing tolerances.

25 It should be observed that the deburring means can be substituted by any other means for working of the front end of the cut off tube piece 24, for instance grinding of a tapering input end or a similar shape, and that the invention is not restricted only to deburr working.

30 It is also obvious to the expert that the illustrated and described apparatus is only an exemplifying embodiment which does not restrict the invention, and that many different modifications and variations may be presented within the scope of the appended claims.

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C L A I M S

1. Method for cutting and deburring of tubes, whereby a base
5 tube (23) is successively cut into several smaller tube pieces (24)
and is deburred in direct connection thereto in a machine
comprising a cutting means (1), a deburring means (2) or a
corresponding means and two carrier jaws (3, 4), at least one (4)
of which is axially movable in relation to the other (3),
10 characterized by the following cycle of operation:
- a base tube (23) is from an input end of the machine
introduced through a first jaw (3) and as far as to a stop of a
second jaw(4);
 - the jaws (3, 4) are closed thereby clamping the tube (23);
 - 15 - the cutting means (1) is fold down to the tube (23)
intermediate the jaws (3, 4) and cuts the tube at a predetermined
position in relation to the two jaws;
 - the second jaw (4) together with the cut off tube piece (24)
still clamped therein is moved a predetermined distance axially
20 apart from the first jaw (3) with the base tube (23) and the cut
off tube piece (24) extending coaxially with each other;
 - the cutting means (1) is moved out of cutting position, and
a double acting deburring means (2) or a similar means is
introduced into deburring position between the front end of the
25 base tube (23) and the rear end of the cut off tube piece (24);
 - the deburring means (2) is actuated at the same time as the
second jaw (4) is moved into contact with the deburring means (2),
and whereby the deburring means, in turn, is moved into contact
with the front end of the base tube (23) and the two tube ends are
30 deburred concurrently;
 - the cut off and deburred tube piece (24) is removed;
 - the jaws (3, 4) are unclamped and are returned to their
initial positions adjacent each other and a new cycle of operation
is commenced.

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2. Method according to claim 1, **characterized** in that the movable jaw (4), during the deburring working, is moved into contact with a first fixed stop (21), and that the deburring means (2) via a second fixed stop (22) is moved into contact with the fixed jaw (3) so as to restrict the extent of the deburring working.

3. Method according to claim 1 or 2, **characterized** in that the deburring means (2) is, in its non-operative condition, kept biased (19) in a position separated from the base tube (23) which is clamped by the fixed jaw (3).

4. Method according to any of claims 1-3, **characterized** in that the cutting and the deburring working or similar working is made alternately under the actuation of motors for rotating and driving (9) the cutting means, rotating and driving (11) the deburring means, the actuation (5, 6) of the two carrier jaws (3, 4) and the displacement (7) of the movable carrier jaw (4).

5. Apparatus for executing the method according to any of the preceding claims and comprising a cutting means (1), a deburring means (2) or a similar means and two carrier jaws (3, 4), at least one (4) of which is axially movable in relation to the other (3), **characterized** in that the cutting means (1) and the deburring means (2) are rotatably mounted on a support (8) so that they can alternately be moved between a withdrawn position and a working position intermediate the two jaws (3, 4) for alternatively providing a cutting and a deburring or a similar working of a cut off tube piece (24).

6. Apparatus according to claim 5, **characterized** in that the deburring means (2) is double acting and is formed with two opposite deburring tools (13, 14) mounted on an axially movable shelf (16) and adapted, in their non-operative condition, to resiliently be kept in a position spaced from one (3) of the jaws.

7. Apparatus according to claim 6, **characterized** in that carrier (15) for the deburring tools (13, 14) has an indexing means (20) providing a first stop (21) for the movement of the movable jaw (4) towards the deburring means (2), and a second stop (2) for

the movement of deburring means (2) towards the other jaw (3).

5 8. Apparatus according to any of claims 5-7, characterized in that the first carrier jaw (3) is fixed in the axial direction, and that the second jaw (4) is axially movable, thereby actuated by an air cylinder (7).

10 9. Apparatus according to any of claims 5-8, characterized in that the second carrier jaw (4), as seen in the direction of introducing the base tube (23) in the apparatus, has a fixed initial position adjacent the first jaw (3) and is formed with a stop means for making it possible to introduce the base tube (23) an exactly predetermined distance in the two jaws (3, 4).

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Fig. 1

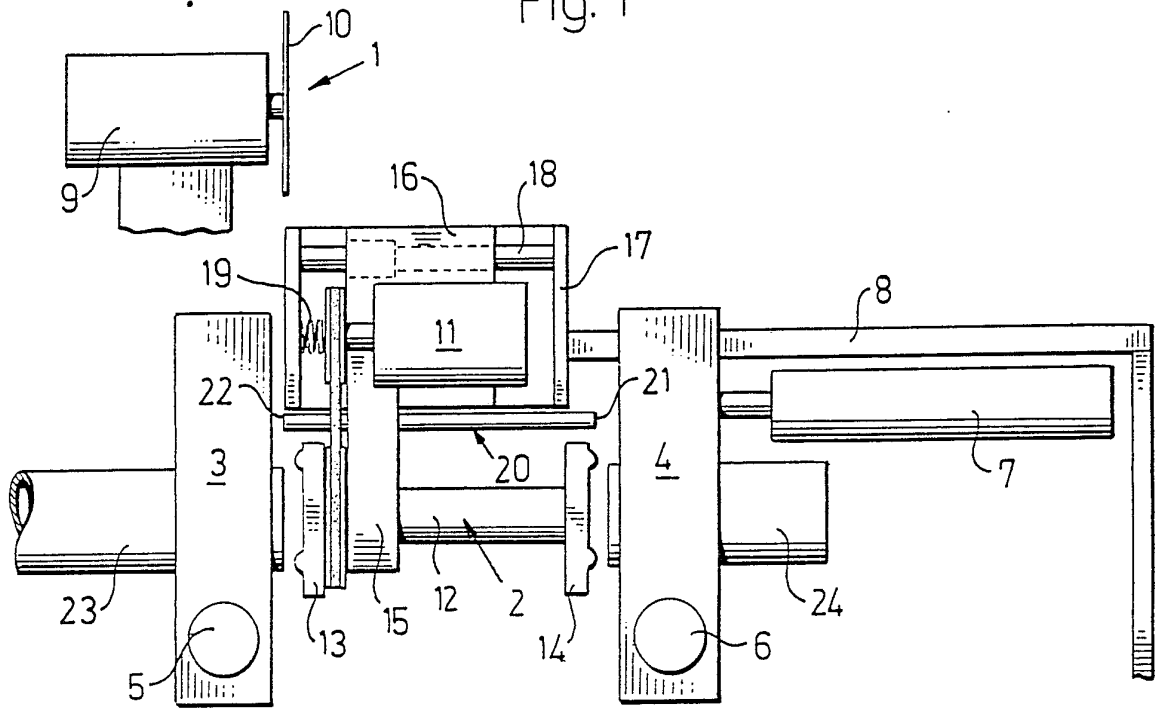
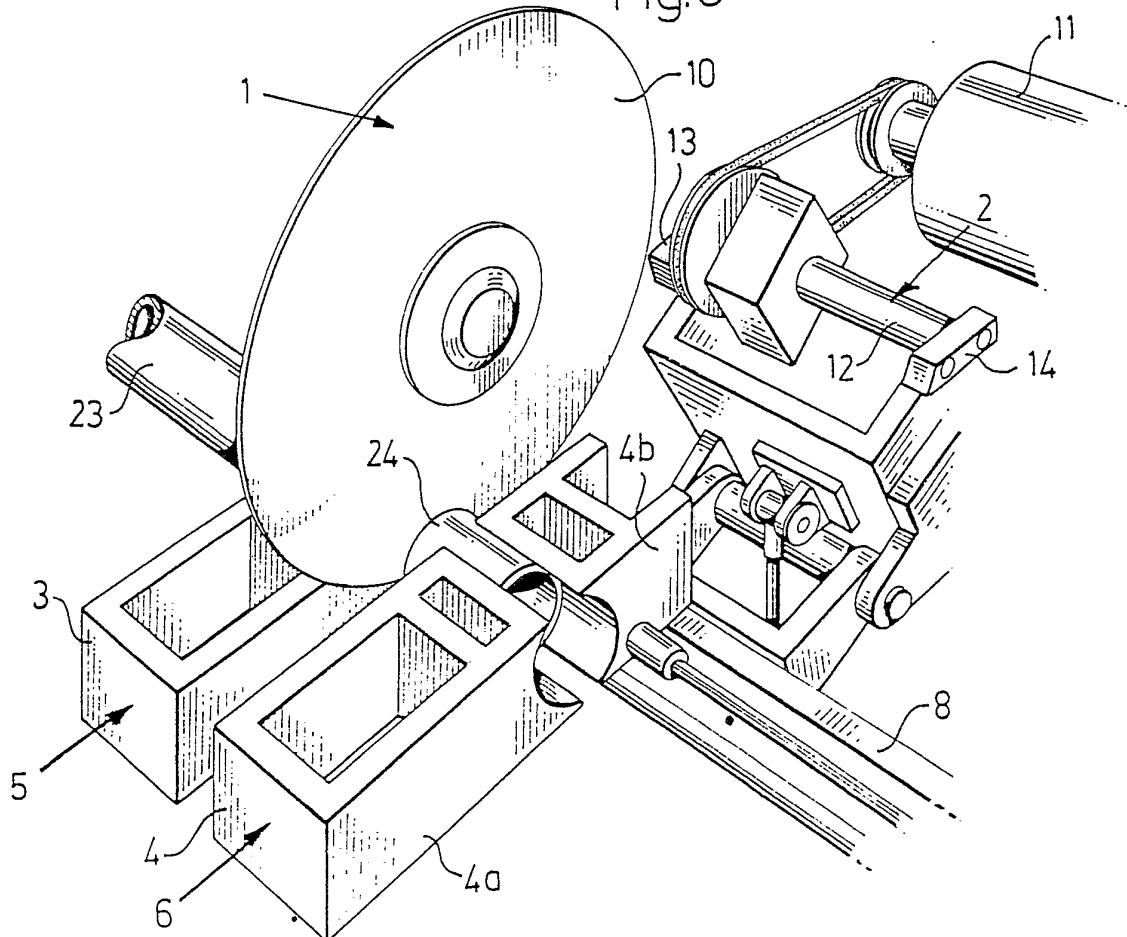


Fig. 3



SUBSTITUTE SHEET

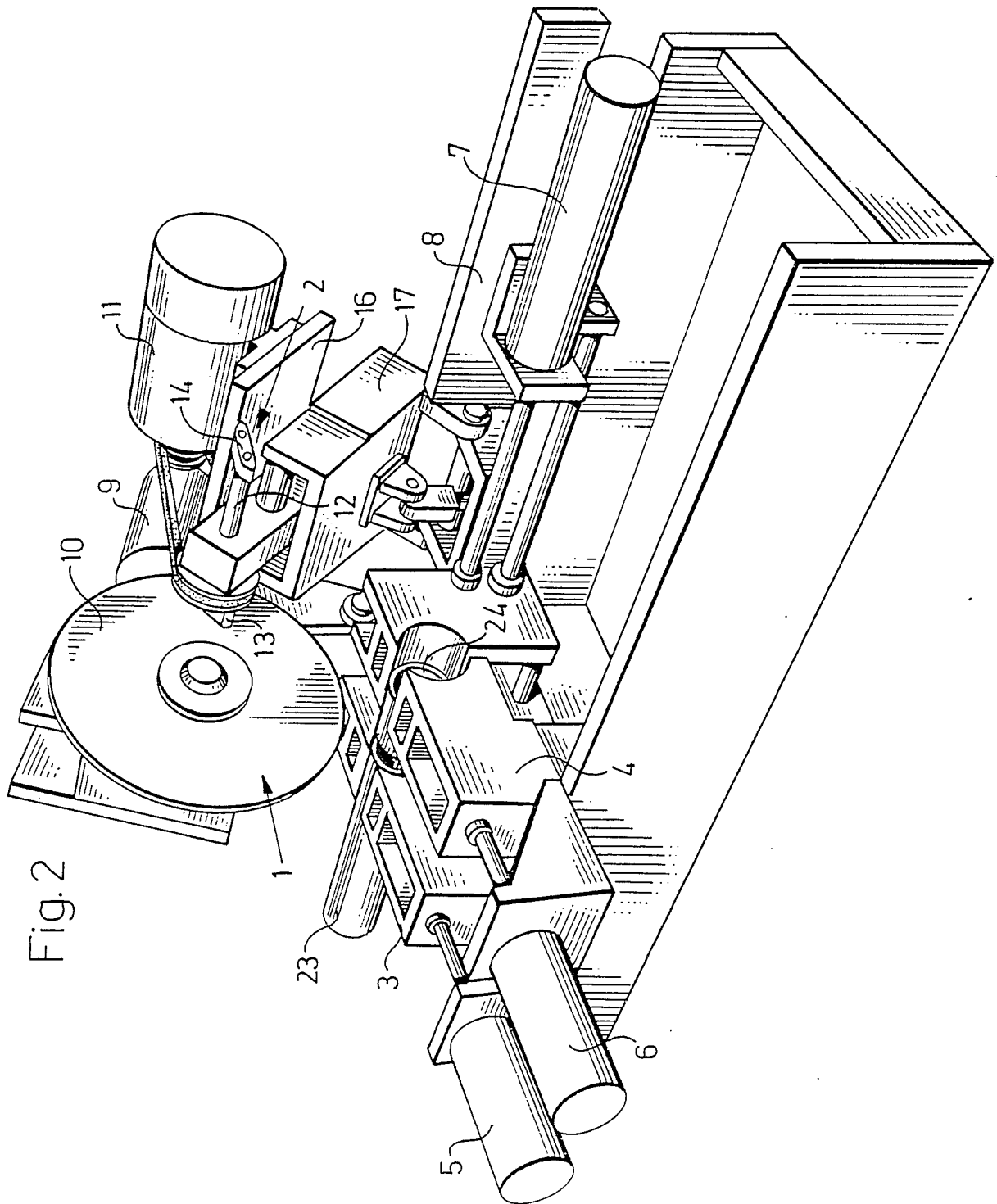


Fig. 2

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Fig. 4

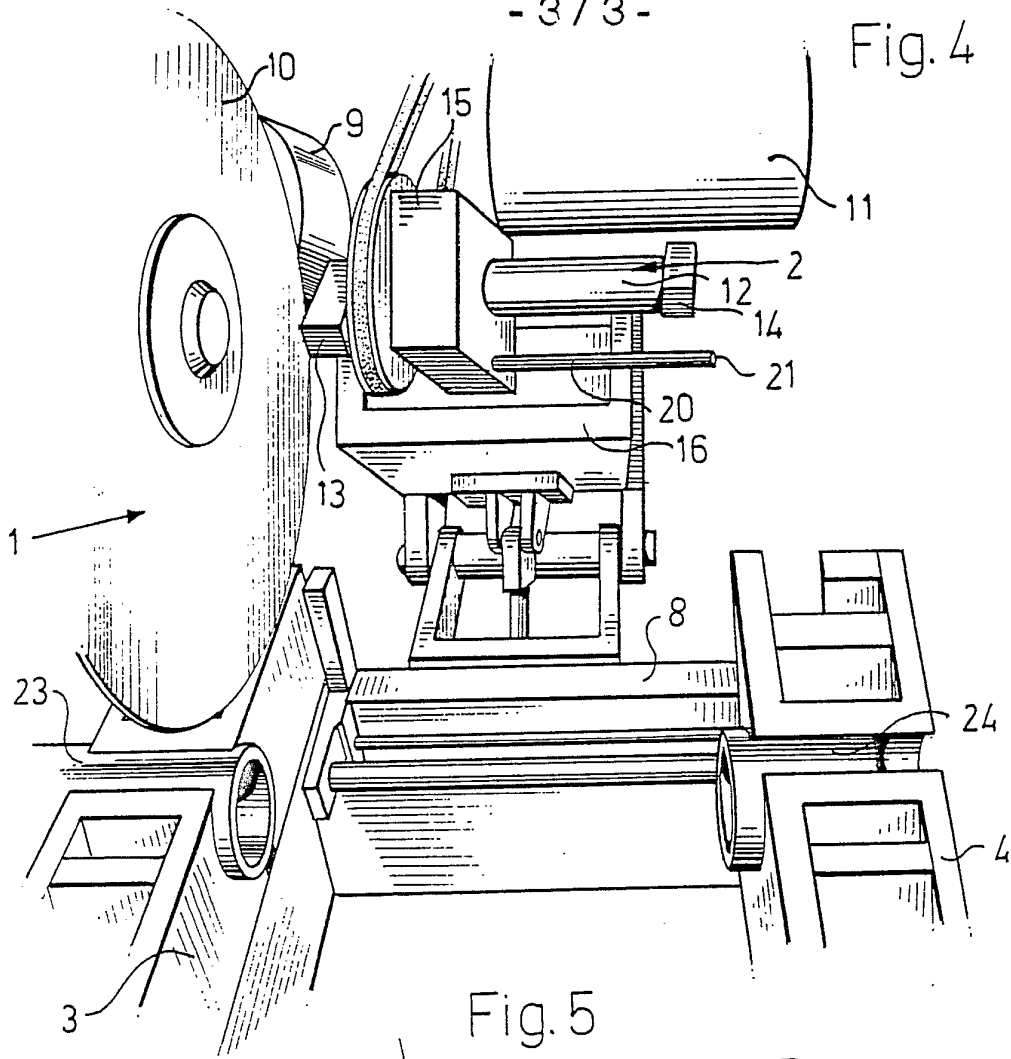
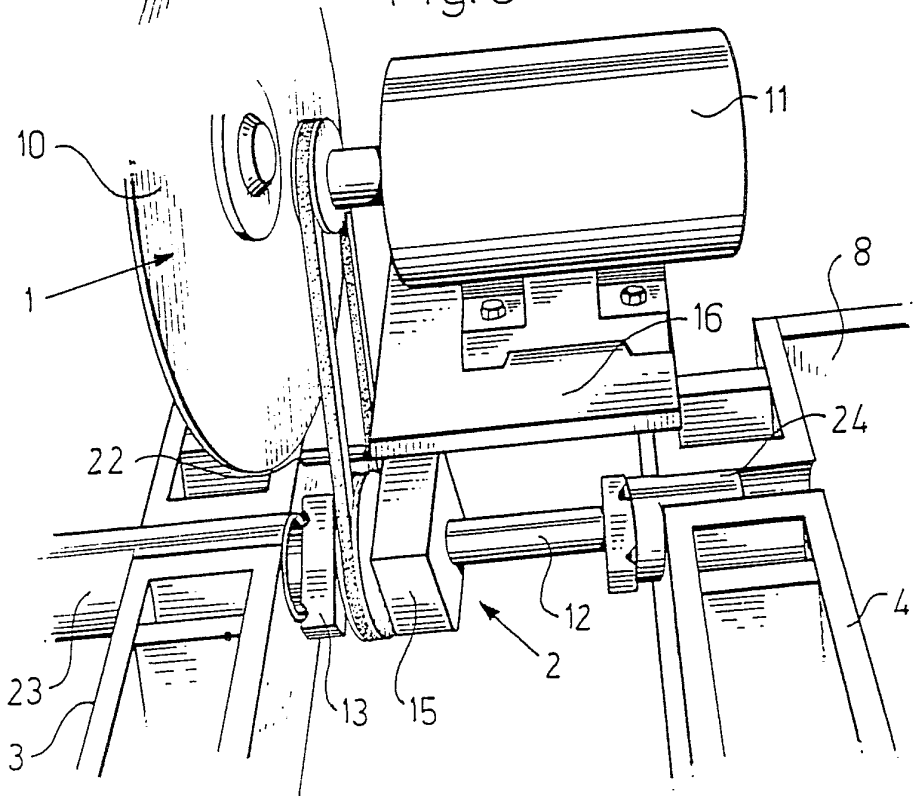
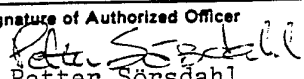


Fig. 5



INTERNATIONAL SEARCH REPORT

International Application No PCT/SE87/00616

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC ⁴		
B 23 D 21/04		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC 4 US C1	B 23 D 21/00-/04; B 23 B 5/16; B 23 P 23/00 29: 33; 30: 92-94, 102, 123	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
SE, NO, DK, FI classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category ⁹	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	DE, A, 2 015 795 (FAIRFIELD MACHINE COMPANY) 22 October 1970	
A	SE, B, 440 876 (BENGT GOTTFRID FJÄLLSTRÖM) 26 August 1985	
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IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
1988-03-14	1988 -03- 15	
International Searching Authority	Signature of Authorized Officer	
Swedish Patent Office	 Petter Sörsdahl	