

We, **BENDING TOOLING S.r.l.** of Via Orbassano, 17-19, Frazione Garino, I-10048 Vinovo, Italy state the following in connection with Australian Application No. 39511/93:

1. We are the nominated person.
2. The nominated person is the assignee of the actual inventor.
3. The nominated person is the applicant of the basic application listed in the declaration under Article 8 of the PCT.
4. The basic application is the application first made in a Convention country in respect of the invention.

Dated: 26 September 1994

By **PHILLIPS ORMONDE & FITZPATRICK**
Patent Attorneys for the Applicant
By:

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To: The Commissioner of Patents

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Our Ref: 384831

1925x



AU9339511

(12) PATENT ABRIDGMENT (11) Document No. AU-B-39511/93
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 666723

- (54) Title
A UNIVERSAL SUPPORT AND POSITIONING STRUCTURE FOR TOOLS USED BY AN ELONGATE ELEMENT BENDING MACHINE
- (51)⁵ International Patent Classification(s)
B21D 007/022
- (21) Application No. : **39511/93** (22) Application Date : **02.04.93**
- (87) PCT Publication Number : **WO93/19864**
- (30) Priority Data
- | | | |
|------------------|-----------------|-----------------|
| (31) Number | (32) Date | (33) Country |
| TO92A0313 | 06.04.92 | IT ITALY |
- (43) Publication Date : **08.11.93**
- (44) Publication Date of Accepted Application : **22.02.96**
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- (56) Prior Art Documents
US 4351178
FR 1378361
US 2884987
- (57) Claim

1. A universal support and positioning structure for tools ^{usable} ~~used~~ by a machine for clamping and bending elongate elements such as tubes or profiled sections, including at least one base body and a support platform for said tools movably mounted on the base body and provided with means for rotating the support platform circumferentially with respect to a pivot fixed to the base body and further including means for displacing the support platform radially with respect to the pivot contemporaneously to its rotation.

CORRECTED
VERSION *

PCT

WORK

under INID Number (54) "Title", replace the existing text by "A UNIVERSAL SUPPORT AND POSITIONING STRUCTURE FOR TOOLS USED BY AN ELONGATE ELEMENT BENDING MACHINE"



39511/93

INTERNATIONAL APPLICATION

ATION TREATY (PCT)

(51) International Patent Classification 5 :

B21D 7/022

A1

(11) International Publication Number:

WO 93/19864

(43) International Publication Date:

14 October 1993 (14.10.93)

(21) International Application Number: PCT/EP93/00813

(22) International Filing Date: 2 April 1993 (02.04.93)

(30) Priority data:
TO92A000313 6 April 1992 (06.04.92) IT

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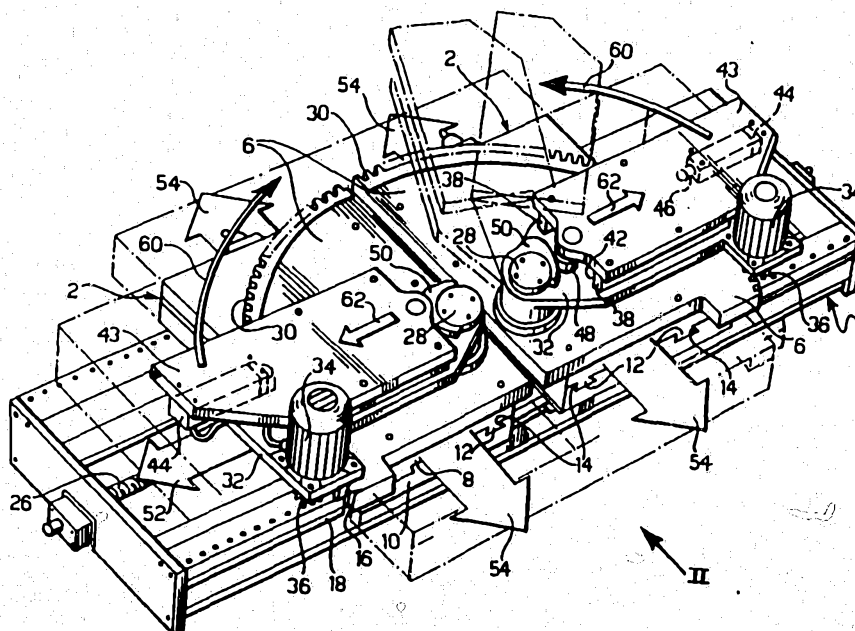
(74) Agents: GERBINO, Angelo et al.; Jacobacci-Casetta & Perani S.p.A., Via Alfieri, 17, I-10121 Torino (IT).

(81) Designated States: AU, BB, BG, BR, CA, CZ, FI, HU, JP, KP, KR, KZ, LK, MG, MN, MW, NO, NZ, PL, RO, RU, SD, SK, UA, US, VN, 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, NE, SN, TD, TG).

Published
With international search report.

666723

(54) Title: A UNIVERSAL SUPPORT AND POSITIONING STRUCTURE FOR TOOLS USED BY AN ELONGATE ELEMENT BENDING MACHINE



(57) Abstract

The universal positioning and support structure for tools (56) used by a machine for bending elongate elements (58) such as tubes or profiled sections, includes at least one base body (6) and a support platform (43) for said tools (56), movably mounted on the base body (6). The platform (43) is provided with means (30, 34, 36) for rotating it circumferentially and means (44-50) for contemporaneously displacing it radially with respect to a pivot (28) fixed to the base body (6).

**A UNIVERSAL SUPPORT AND POSITIONING STRUCTURE FOR TOOLS
USED BY AN ELONGATE ELEMENT BENDING MACHINE**

The present invention relates to a support and positioning structure for tools used by a machine for bending elongate elements such as tubes or profiled sections.

Known structures of the type indicated are designed for well defined applications and therefore have the disadvantage that they cannot be adapted for use in bending elements different from those originally intended.

~~The object of the present invention is that of providing a structure of the type indicated above which is adapted for use in positioning and supporting various tools used for bending elongate elements of widely varying forms, thereby obtaining apparatus which is not excessively complex and which operates simply and with wide versatility in use.~~

This object is achieved with a structure of the type indicated above, characterised by the fact that it ~~includes at least one base body and a support platform~~



type indicated above which is adapted for use in positioning and supporting various tools used for bending elongate elements of widely varying forms.

- Accordingly, the present invention provides a universal support and positioning structure for tools ~~used~~^{useable} by a machine for clamping and bending elongate elements such as tubes or profiled sections, including at least one base body and a support platform for said tools movably mounted on the base body and provided with means for rotating the support platform circumferentially with respect to a pivot fixed to the base body and further including means for
- 5 10 displacing the support platform radially with respect to the pivot contemporaneously to its rotation.



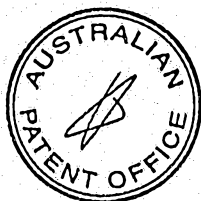
~~for said tools movably mounted on the base body and provided with means for rotating it circumferentially and for contemporaneously displacing it radially with respect to a pivot fixed to the base body.~~

Preferably, said base body and support platform form part of a slide movably mounted on a support frame, means being provided for moving the slide relative to this latter in at least one direction.

More preferably the structure according to the invention comprises two slides movably mounted on a single support frame and each comprising a respective base body and a respective support platform.

Before use of the machine for bending elongate elements into a desired configuration the slides are conveniently positioned with respect to the frame by their associated movement-drive means. Then the tools required by the type of bending which it is intended to effect are positioned on the support platforms of the slides. Subsequently the bending operation itself is effected by a suitable combined translational and rotational movement of the support platforms about their respective pivots.

In practice, the rotational movement allows the desired curvature to be obtained, whilst the translational



movement, which takes place contemporaneously with the rotational movement, causes the curved element to yield so that it can no longer reassume its original, undeformed configuration as a result of the elastic restoring forces, once the bending stress has been released.

The present invention also comprehends a machine for bending elongate elements including a tool support and positioning structure of the type indicated above.

Advantages and characteristics of the present invention will become apparent from the following detailed description made with reference to the appended drawings, provided by way of non-limitative example, in which:

Figure 1 is a perspective view of the structure of the invention;

Figure 2 is a side view of the structure of the invention;

Figure 3 is a plan view of the structure of the invention; and

Figure 4 is a perspective view of a bending machine which utilises a structure of the type illustrated in the preceding figures.

A universal support and positioning structure for tools used by a bending machine (Figures 1 to 3) includes a

pair of slides 2 slidably mounted on a support frame 4.

Each slide 2 comprises a flat base body 6 connected to a first plate 8 slidable on a second plate 10 by means of a pair of projections 12 which fit into respective grooves 14 formed in the second plate 10.

This latter is in turn slidable on the frame 4 by means of a pair of terminal coupling elements 16 which engage respective guides 18 of the frame 4.

Fixed to each first plate 8 is a first feed nut 20 associated with a first lead screw 22 extending transverse the frame. Similarly, each second plate 10 has a second feed nut 24 fixed thereto and associated with a second lead screw 26 mounted to lie along the longitudinal axis of the frame 2, substantially perpendicular to the first screw 22.

The base body 6 of each slide 2 supports a pin 28 and carries a rack 30, shaped in the manner of a circumferential arc on a portion of its outer perimeter. A table 32 is rotatable about each pin 28 and supports a hydraulic motor 34 which drives a pinion 36 which meshes with the respective rack 30. Each table 32 further supports a pair of guide elements 38 on which protuberances 42 which project downwardly from a

respective support platform 43 are slidably retained. Each of these latter is fixed to an actuator cylinder 44 having a piston 46 the free end of which is fixed to the associated table 32.

Furthermore, a cam follower roller 48 projects downwardly from each support platform 43 and cooperates with a shaped cam element 50 keyed to the respective pin 28.

The operation of the device is as follows.

Depending on the type of elongate element which it is intended to bend and the curvature which it is intended to impart thereto, the base bodies 6 of the two slides 2 are positioned relative to the frame 4 by translational movement in two orthogonal directions. For this purpose the second screws 26 are rotated and cooperate with the second feed nuts 24 which cause the second plates 10 to move longitudinally, these carrying the first plates 8 mounted thereon with them in their movement (this movement is indicated by the arrows 52 in Figures 1 and 3).

The turning of the first screws 22, which cooperate with the first feed nuts 20, then drives a transverse translational movement of the first plate 8 relative to the frame 4, with the definitive positioning of the base

bodies 6 with respect to the frame (this movement, orthogonal to that indicated by the arrows 52, is indicated by the arrows 54 in Figures 1 and 3).

At this point the tools 56 necessary to support and clamp the elongate elements 58 during the bending operation itself are positioned in a known manner on the support planes 43 of the slides 2 (Figure 4).

The bending operation takes place thanks to a combined translational and rotational movement of the platforms 43, which support the tools 56 and the elongate elements 58, with respect to the pins 28.

In fact, the rotation allows the desired curvature to be obtained whilst the translation, which takes place simultaneously with the rotation, causes the curved element 58 to yield so that it can no longer reassume its original, undeformed configuration as a result of the resilient restoring forces once the bending stress has been released.

The rotation of the platforms 43 about the pins 28 (indicated by the arrows 60 in Figures 1 and 3) is driven by the hydraulic motors 34 which, by rotating the respective pinions 36 which mesh with the associated racks 30, cause the associated tables 32 which carry the

support platform 43 to rotate about the pins 28.

The radial translational movement of the platforms 43 with respect to the pins 28 (indicated by the arrows 62 in Figure 1) takes place simultaneously with the rotation thanks to the action of the actuator cylinders 44 or to the engagement existing between the cam follower rollers 48 and the shaped cam elements 50 keyed to the pins 28.

The coordination and control of the rotational and translational movements is achieved by an apparatus control computer, not illustrated in the drawings, to which the individual actuator devices are connected in a manner known per se.

Figures 1 to 3 of the appended drawings illustrate both types of device for enabling the radial translation mounted on the same machine. Obviously, in practice, use will be made of only one of these depending on the specific applicational requirements. In fact, the cam and cam follower roller device is more economical but requires longer to be adapted to a different bending process, whilst the actuator cylinder system (illustrated only in Figure 4) is more expensive but more rapidly adaptable to different uses.

The versatility of the apparatus of the invention is

evident from what has been described above in that, by simple adjustment of the screws 22, 26 and feed nuts 20, 24, the position of the base bodies 6 of the slides 2 with respect to the frame 4 can be adjusted and by making the support platforms 43 perform different translational and rotational movements with respect to the pins 28 one can obtain the most varied bending shapes.

Naturally, the principle of the invention remaining the same, the details of construction and the embodiments can be widely varied with respect to what has been described and illustrated without thereby departing from the scope of the present invention.

For example, the apparatus of the invention may include a single slide movable on the support frame. Such apparatus is adapted to bending elongate elements, which can be clamped between a vice not mounted on the support structure and tools supported by the support platform of the single slide, into shapes which are not excessively complicated.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A universal support and positioning structure for tools ^{usable} ~~used~~ by a machine for clamping and bending elongate elements such as tubes or profiled sections,
 5 including at least one base body and a support platform for said tools movably mounted on the base body and provided with means for rotating the support platform circumferentially with respect to a pivot fixed to the base body and further including means for displacing the support platform radially with respect to the pivot contemporaneously to its rotation.
- 10 2. A structure according to Claim 1, characterised by the fact that said base body and said support platform form part of a slide movably mounted on a support frame, means being provided for moving the slide relative to the frame in at least one direction.
3. A structure according to Claim 2, characterised by the fact that it includes
 15 two slides movably mounted on a single support frame and each including a respective base body and a respective support platform.
4. A structure according to Claim 2 or Claim 3, characterised by the fact that said slide is provided with means for displacing it relative to the frame in two different directions, preferably orthogonal to one another.
- 20 5. A structure according to Claim 4, characterised by the fact that the said means for displacing the body of the slide relative to the frame include a first plate to which is fixed a first feed nut associated with a first lead screw mounted on the frame, the first plate being slidable relative to a second plate to which a second feed nut associated with a second lead screw is fixed, said second plate being
 25 slidable on the support frame in a direction substantially perpendicular to the direction of sliding of the first plate relative to the second plate.
6. A structure according to Claim 5, characterised by the fact that the first plate is slidably mounted on the second plate by means by a pair of projections which engage in respective grooves in the second plate, and by the fact that the
 30 second plate is slidably mounted on the support frame by means of a pair of terminal coupling elements which engage with respective guides of the frame.



7. A structure according to any preceding Claim, characterised by the fact that said means for rotating the support platform circumferentially with respect to the pivot includes a table rotatable about the pivot and on which there are located the support platform and a hydraulic motor which drives a pinion engagable with a rack shaped in the form of a circumferential arc and carried by the base body to which the pivot is fixed.

8. A structure according to Claim 7, characterised by the fact that said means for displacing the support platform radially with respect to the pivot includes a cam-shaped element keyed to the pivot and arranged to cooperate with a cam follower roller which projects below the support platform, said platform being slidable relative to the table by means of a pair of protuberances which engage with guide elements fixed to the table.

9. A structure according to Claim 7, characterised by the fact that said means for displacing the support platform radially with respect to the pivot includes an actuator cylinder mounted on the support platform and having a piston the free end of which is fixed to the table, said support platform being slidable relative to the table by means of a pair of protuberances which engage with guide elements fixed to the table.

10. A machine for bending elongate elements, characterised by the fact that it includes a universal support and positioning structure for tools according to any preceding claim.

11. A universal support and positioning structure for tools substantially as herein described with reference to the accompanying drawings.

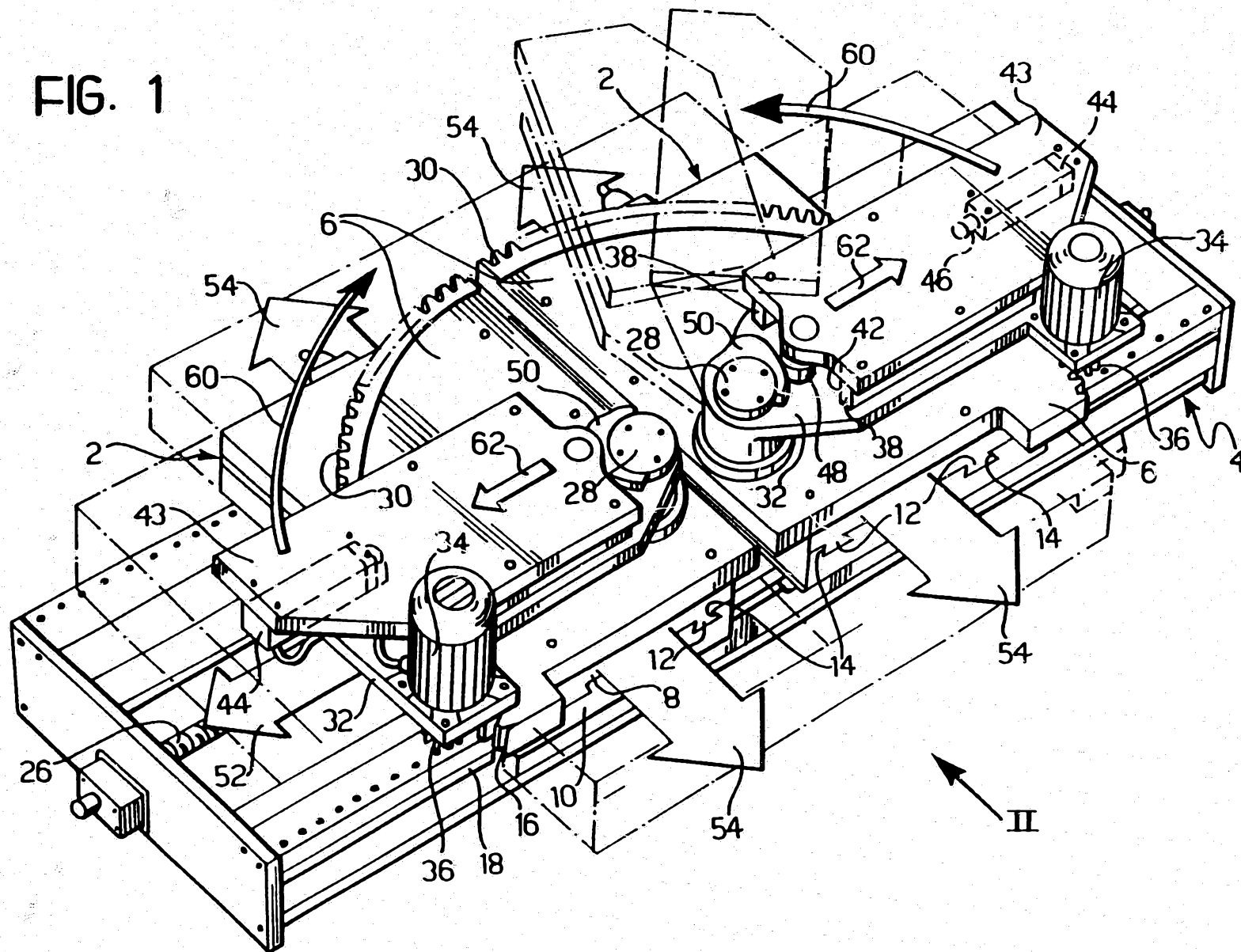
DATED: 3 April, 1995.

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FIG. 1



II

FIG. 2

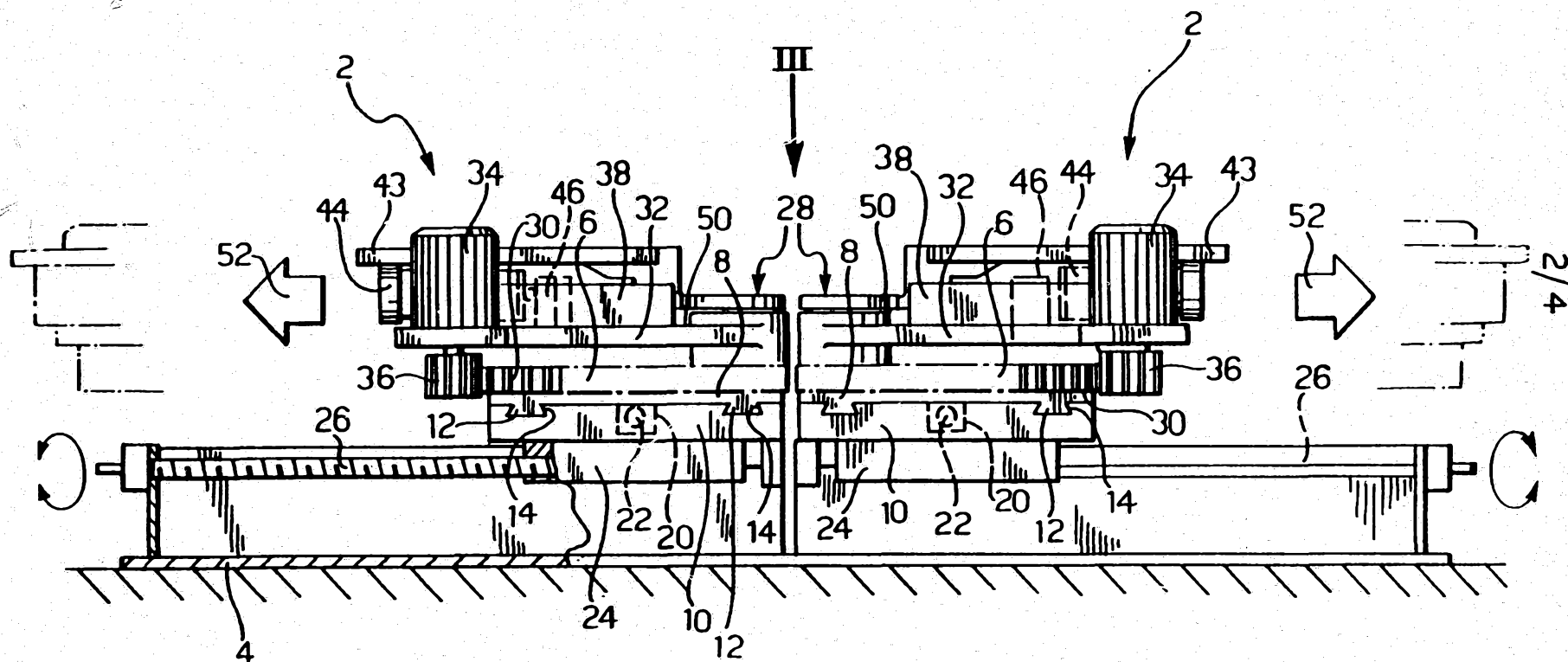


FIG. 3

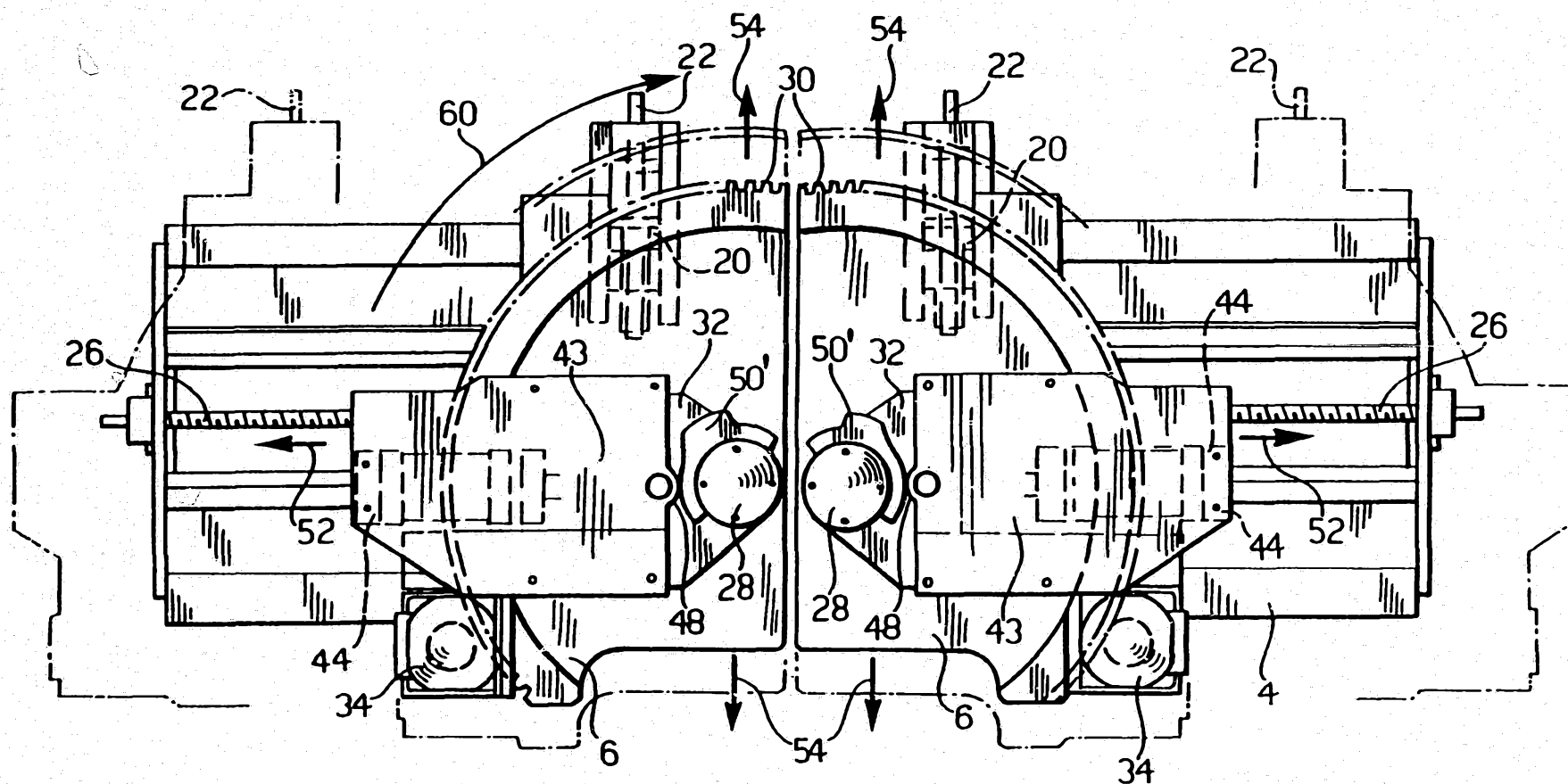
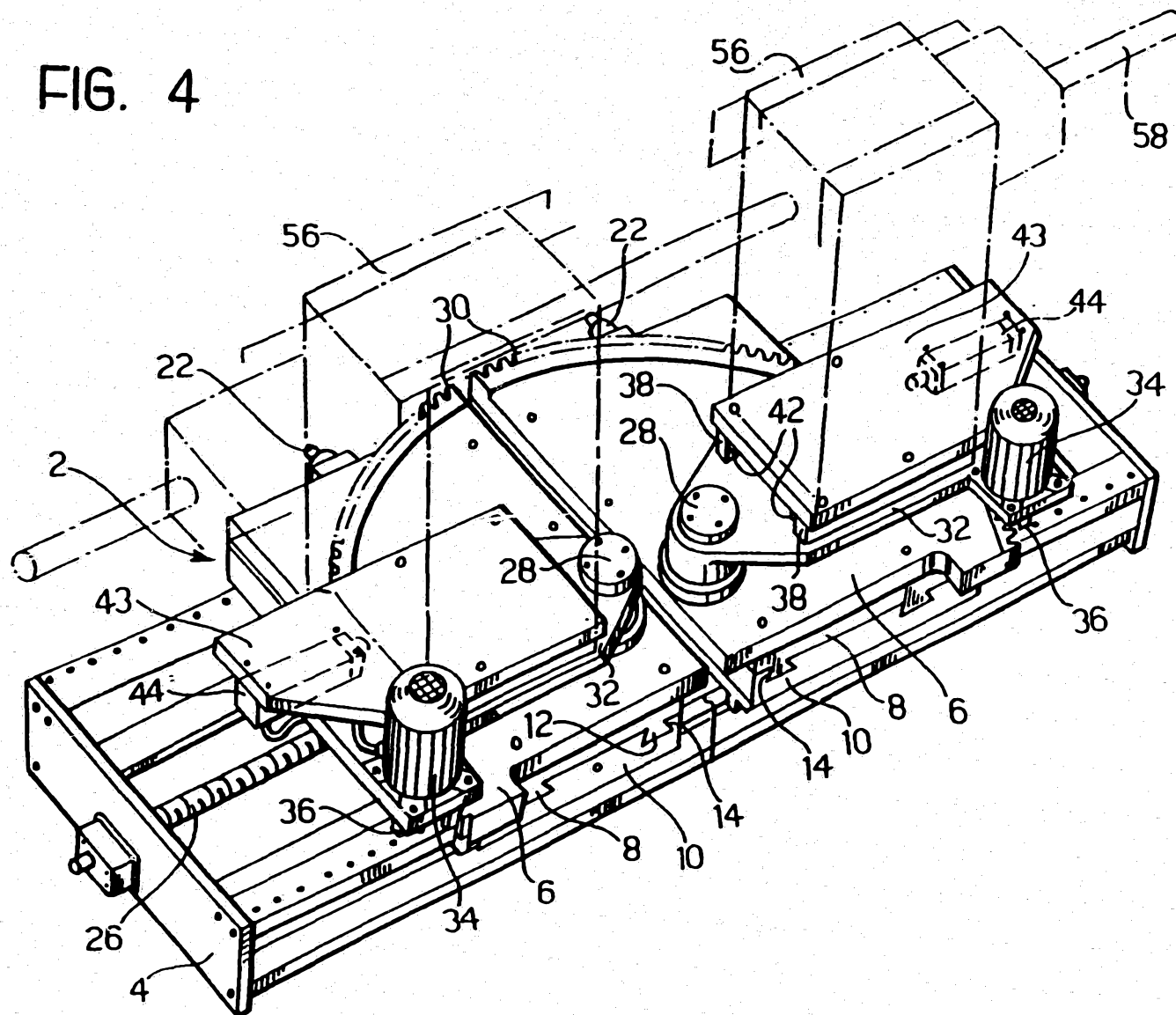


FIG. 4



INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 93/00813

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		
Int.C1. 5 B2107/022		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.C1. 5	B210	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	US,A,2 884 987 (SHAW) 5 May 1959 see the whole document	1,7,10
Y	---	2-6,9
Y	US,A,4 351 178 (UEHARA) 28 September 1982 see column 2, line 61 - column 3, line 36; figures 5,6,8	2-6
Y	FR,A,1 378 361 (HEINRICH BARTZ KOMMANDITGESELLSCHAFT) 5 October 1964 see page 3, right column, line 7 - line 61; figures 1,2	9
¹⁰ Special categories of cited documents: ¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "A" document member of the same patent family		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search		Date of Mailing of this International Search Report
23 JUNE 1993		13.07.93
International Searching Authority		Signature of Authorized Officer
EUROPEAN PATENT OFFICE		GERARD O.

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

EP 9300813
SA 72538

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
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23/06/93

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-2884987		None	
US-A-4351178	28-09-82	None	
FR-A-1378361		None	