(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 712 674 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
22.05.1996 Bulletin 1996/21

(51) Int. Cl.[6]: **B21B 31/26**, B21B 31/18, B21D 5/08

(21) Application number: **95117509.0**

(22) Date of filing: **07.11.1995**

(84) Designated Contracting States:
DE ES FR GB

(30) Priority: **11.11.1994 IT PD940198**

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(54) Roll forming machine

(57) A roll forming machine that comprises at least one pair of motorized forming rolls (12,13) supported by a frame (11), the metal sheet to be formed being passed between the rolls. At least one first roll (12) of the pair has a respective roll supporting shaft (15) that is rotatably coupled and supported eccentrically within a corresponding cylindrical tubular bush (18). The bush (18) is in turn rotatably coupled to the frame (11), and a second roll (13) of the pair has a respective roll supporting shaft (28) that is rotatably coupled to the frame (11). Bush movement means are also provided.

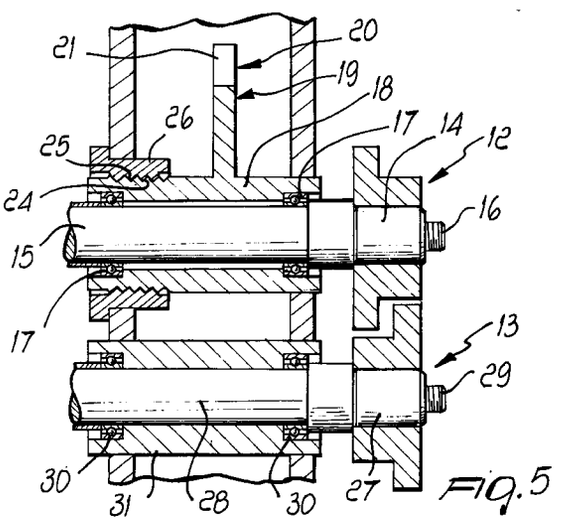

Fig. 5

EP 0 712 674 A1

Description

The present invention relates to a roll forming machine.

Conventional roll forming machines for forming sheet metal commonly have a structure that is constituted by two series of rolls, between which the sheet to be formed is passed.

With reference to figures 1 to 3, which illustrate the device according to the prior art, the operation of said conventional forming machines is described in greater detail.

Figure 1 illustrates two forming rolls A and B, each of which is keyed on a corresponding roll supporting shaft C and D.

A metal sheet E having a certain thickness is passed between the two rolls A and B and is forced to assume the shape of the passage gap that is indeed defined by the rolls A and B.

The above-mentioned passage gap is adjusted by the distance between the roll supporting shafts C and D and by the shapes of the rolls A and B, and its value is determined both according to the shape to be given to the sheet E and according to the thickness of said sheet.

When it is necessary to process a metal sheet having a different thickness, designated by F (and in this case thinner than the sheet E), it is necessary to adjust the gap between the rolls A and B.

Since the forming to be performed by means of the rolls A and B affects only the transverse cross-section of the metal sheet F, the overall compensation required to adjust the gap between the rolls A and B can be split into a direction that is substantially parallel to the axes of the roll supporting shafts D and C, which is termed "axial compensation" herein, and a direction that lies at right angles to said first one and substantially corresponds to the variation of the longitudinal axes of the roll supporting shafts C and D.

Figure 2 illustrates the shafts C and D after performing distance compensation between their longitudinal axes, and figure 3 illustrates how the axial compensation is performed.

Actually, both compensations do not always have to be performed, but a forming machine must allow to perform them both.

In any case, it should be noted that the axial compensation is actually necessary only in certain applications, and therefore it is possible to find on the market machines that only allow to compensate the distance between the longitudinal axes of the roll supporting shafts.

From a point of view based on geometric considerations, the axial compensation is greater as the bending angle of the profile approaches 90 sexagesimal degrees.

In any case, the bending angle, due to practical requirements, is substantially never attained with a single bending operation and is instead produced gradually by means of passes between successive forming roll pairs, and therefore the extent of the axial compensation varies from pass to pass.

The graduality of the extent of the axial compensation causes considerable complexity in the manufacture of the devices that provide it.

The distance between the longitudinal axes of the roll supporting shafts is currently compensated by means of an actuation screw that moves mutually closer or further apart the supporting blocks inside which said shafts are rotatably coupled.

If it is necessary to adjust the height of a plurality of supports simultaneously or independently, a plurality of actuation screws is commonly installed, optionally connected by transmissions, shafts, joints, etcetera.

This adjustment system is very complicated and expensive and also requires skilled personnel to perform it.

Axial compensation is currently performed in two different ways: in a first one, the forming rolls are not provided as single blocks but are substantially constituted by mutually adjacent disk-like elements, which can be appropriately added or removed in order to form spacers that indeed produce axial compensation; in a second method, it is possible to axially move the lower or upper mandrel, related to the roll supporting shaft, by virtue of its sliding in a bush that lies inside the support, where the bearing systems of the roll supporting shaft are mounted.

In this case, too, highly complicated devices are obtained, especially if there are series linkages, which have high costs; these costs rise further when it is necessary to produce, as mentioned, a gradual axial movement in the series of rolls.

As regards both compensation of the distance between the axes of the roll supporting shafts and axial compensation, it should also be noted that in conventional methods the constructive complexity also entails quality mechanical machining operations, such as for example milling and grinding, of the flat surfaces of the supports and of other components, and, if automation of the machine is sought, a large number of axes to be controlled, with corresponding further complications.

The aim of the present invention is to provide a roll forming machine that compensates the distance between the axes of the roll supporting shafts and performs axial compensation simply and practically without mechanical complexity.

In relation to this aim, an object of the present invention is to provide a roll forming machine in which mechanical simplicity is matched by an overall compensation of the sheet metal passage gap that is reliable, fast, and accurate.

Another object of the present invention is to provide a roll forming machine in which overall compensation can be automated, since it is necessary to control a limited number of axes.

Another object of the present invention is to provide a roll forming machine the cost whereof is significantly lower than the one related to conventional machines.

Another object of the present invention is to provide a roll forming machine the operation whereof can be optimized even by personnel that is not assigned specifically to it.

Another object of the present invention is to provide a roll forming machine that can be manufactured with conventional technologies and requires limited maintenance and also has an aesthetic appearance, in relation to its constructive simplicity, that is effective and straightforward to understand structurally for the operator.

This aim, these objects, and others which will become apparent hereinafter are achieved by a roll forming machine that comprises at least one pair of motorized forming rolls supported by a frame, the metal sheet to be formed being passed between said rolls, said forming machine being characterized in that at least one first roll of said at least one pair of forming rolls has a respective roll supporting shaft that is rotatably coupled and supported eccentrically within a corresponding cylindrical tubular bush, said bush being in turn rotatably coupled to said frame, a second roll of said at least one pair of forming rolls having a respective roll supporting shaft that is rotatably coupled to said frame, movement means for said bush being provided.

Further characteristics and advantages of the present invention will become apparent from the description of an embodiment thereof, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figures 1, 2, and 3 relate to the process for forming the metal sheet, as disclosed in the description of the state of the art;

figure 4 is a front view of a roll forming machine according to the invention;

figure 5 is a partially sectional view of the roll forming machine according to the invention, related to figure 4;

figures 6, 7, and 8 are schematic and partially sectional views of the detail related to figure 5 in three operating conditions.

With reference to figures 4 to 8, a roll forming machine, according to the invention, is generally designated by the reference numeral 10.

The forming machine 10 comprises, in this case, a first series of rolls 12 and a second series of rolls 13 that are supported by a frame 11.

The first series of rolls 12 is located above the second series of rolls 13 and the metal sheet to be formed, not shown in the figures, is passed between them.

Each one of the rolls 12 is keyed to the cantilevered end 14 of a corresponding roll supporting shaft 15.

A threaded pivot 16 extends axially from the end 14, and a locking element, not shown in the figures, for the corresponding roll 12 is fixed to said pivot once assembly is completed.

Each one of the roll supporting shafts 15 is mounted on respective bearing systems 17, and is rotatably coupled and eccentrically supported, by means of said bearing systems, inside a corresponding tubular cylindrical bush 18 that is in turn rotatably coupled to the frame 11.

A linkage 19 extends in the upper part of the bush 18 and in this case is substantially monolithic; it has a free end 20 that is shaped so as to form a cavity 21 that engages a corresponding pivot 22 that is in turn fixed to a traction element 23.

The traction element 23, with the respective pivots 22 engaged in the corresponding slots 21, produces the simultaneous movement of the bushes 18.

Each one of the bushes 18 also has an outer surface region 24, related to its opposite end relative to the corresponding roll 12, that is shaped so as to form a thread that couples, upon assembly, to a corresponding thread 25 formed in the internal surface of a case 26 that is fixed to the frame 11.

Each one of the rolls 13 is keyed on the cantilevered end 27 of a corresponding roll supporting shaft 28.

A threaded pivot 29 extends from the end 27, and a retainer for the corresponding roll 13, not shown in the figures, is fixed on said pivot.

Each one of the roll supporting shafts 28 is rotatably supported by bearing systems 30 and, by means of said bearing systems, by bushes 31 that are fixed to the frame 11.

In practice, operation is as follows: when the gap between the rolls 12 and 13 is to be varied by performing axial compensation and compensation of the distance between the longitudinal axes of the roll supporting shafts 28 and 15, one acts, in this case by means of the traction element 23, on the linkages 19, which turn the corresponding bushes 18.

The rotation of the bushes 18 entails substantially two effects: a first one is that the corresponding roll supporting shafts 15 are mounted eccentrically on said bushes, and thus their rotation causes a variation in the distance between the axes of the roll supporting shafts 15 and the axes of the roll supporting shafts 28.

A second effect is that their rotation entails mutual screwing or unscrewing between the region 24 and the thread 25, thus causing axial compensation.

In practice, it has been observed that the intended aim and objects have been achieved; in particular, the constructive simplicity with which axial compensation and compensation of the distance between the axes of the roll supporting shafts have been achieved should be noted.

Axial compensation is in fact performed in practice by the relative motion of two threads, and this allows, in addition to considerable strength, also considerable precision in execution, whereas compensation between the distance of the longitudinal axes of the roll supporting shafts is performed by means of the simple eccentric arrangement of the roll supporting shafts of one of the two series or, in other cases, of both series in the respective bushes.

The two compensations are also performed simultaneously, and this significantly reduces the axes to be driven in an optional automatic adjustment.

The simplicity with which series compensations are performed, for example by means of simple traction elements as disclosed in the description, should also be noted.

In view of the constructive simplicity, the considerable reduction in the manufacturing costs of the forming machine is therefore evident; in addition, said reduction has no negative effect on the quality of the machining, which is at least equal to that of currently commercially available machines.

The present invention is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept.

All the details may furthermore be replaced with other technically equivalent elements.

The materials employed, as well as the dimensions, may be any according to the requirements.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A roll forming machine (10) that comprises at least one pair of motorized forming rolls (12,13) supported by a frame (11), the metal sheet to be formed being passed between said rolls, said forming machine (10) being characterized in that at least one first roll (12) of said at least one pair of forming rolls (12,13) has a respective roll supporting shaft (15) that is rotatably coupled and supported eccentrically within a corresponding cylindrical tubular bush (18), said bush being in turn rotatably coupled to said frame (11), a second roll (13) of said at least one pair of forming rolls (12,13) having a respective roll supporting shaft (28) that is rotatably coupled to said frame (11), movement means (19) for said bush (18) being provided.

2. A forming machine according to claim 1, characterized in that said bush (18) has a threaded outer surface region (24) that is coupled to a thread (25) formed on an internal surface of a case (26) that is fixed to said frame (11).

3. A forming machine according to claim 2, characterized in that said threaded outer surface region (24) is arranged at one of the ends of said bush (18).

4. A forming machine according to claim 3, characterized in that said outer threaded surface region (24) is formed at the end of said bush (18) that lies opposite to the corresponding one (12) of said rolls (12,13) upon assembly.

5. A forming machine according to claim 1, characterized in that said movement means comprise a linkage (19) that has one end fixed to said bush (18) and another end (20) that is available for the actuation of actuation means (22,23).

6. A forming machine according to claim 1, characterized in that it comprises two series of forming rolls (12,13), between which the metal sheet to be formed is passed.

7. A forming machine according to claim 6, characterized in that a first one (12) of said two series of rolls (12,13) has respective roll supporting shafts (15) that are rotatably coupled and eccentrically supported inside corresponding cylindrical tubular bushes (18) that are in turn rotatably coupled to said frame (11) and are each moved by a corresponding linkage (19).

8. A forming machine according to claim 7, characterized in that the linkages (19) related to said bushes (18) are actuated simultaneously by a traction element (23), to which they are connected by their free ends (20).

9. A forming machine according to claim 7, characterized in that each one of said bushes (18) is engaged by threaded coupling to a corresponding case (26), along a region of its outer surface (24) that is shaped so as to form a thread.

10. A forming machine according to claim 6, characterized in that a second one (13) of said at least two series (12,13) is rotatably coupled to said frame (11).

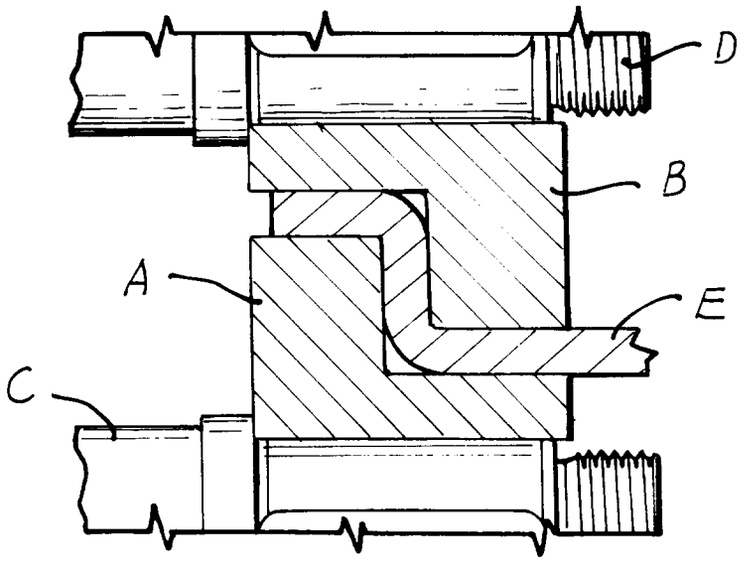

FIG.1

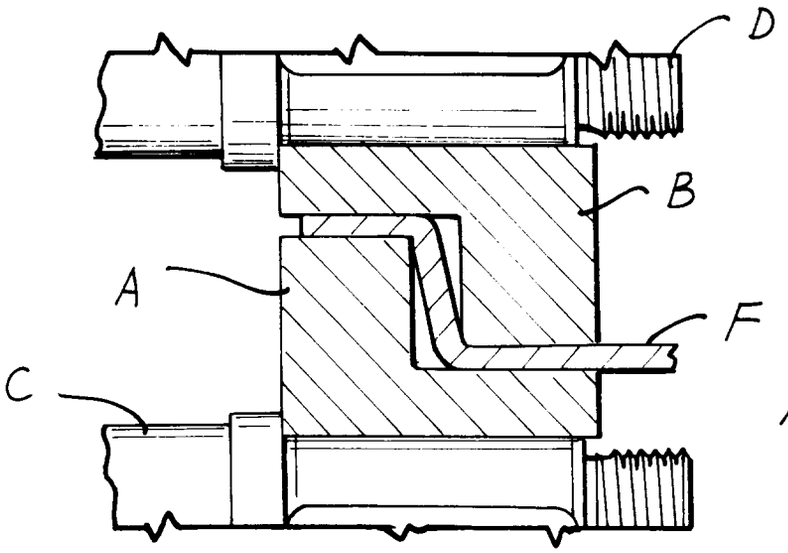

FIG.2

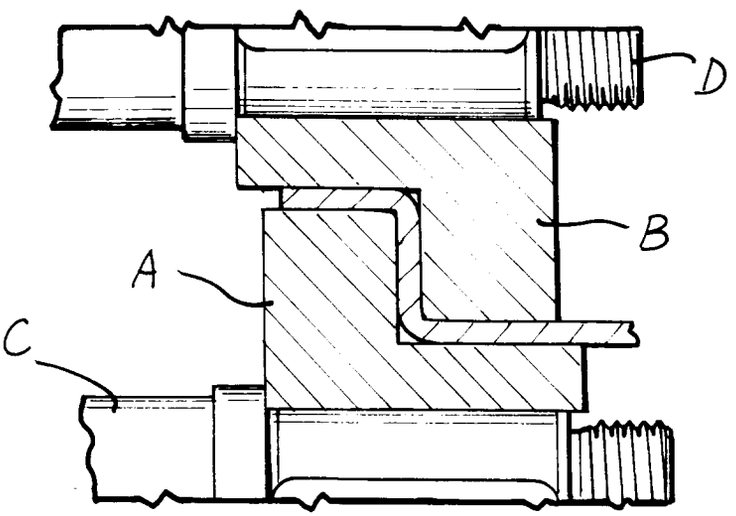

FIG.3

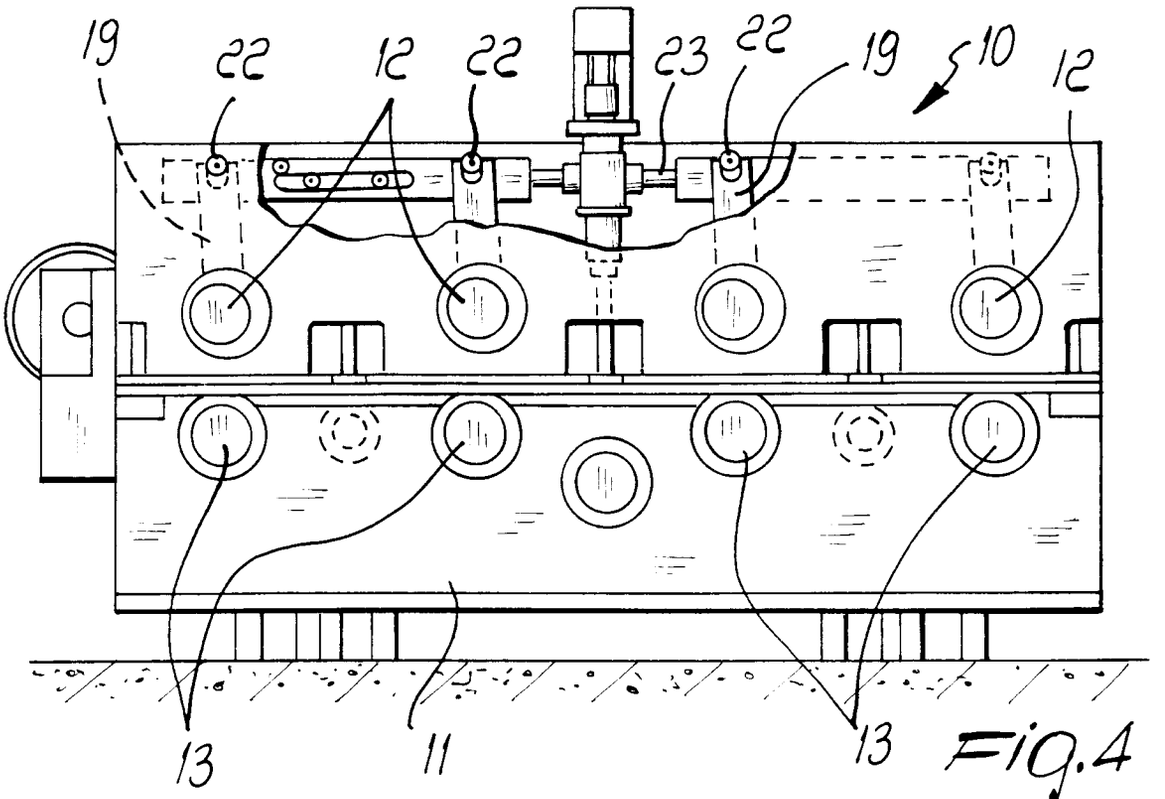
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Fig.4

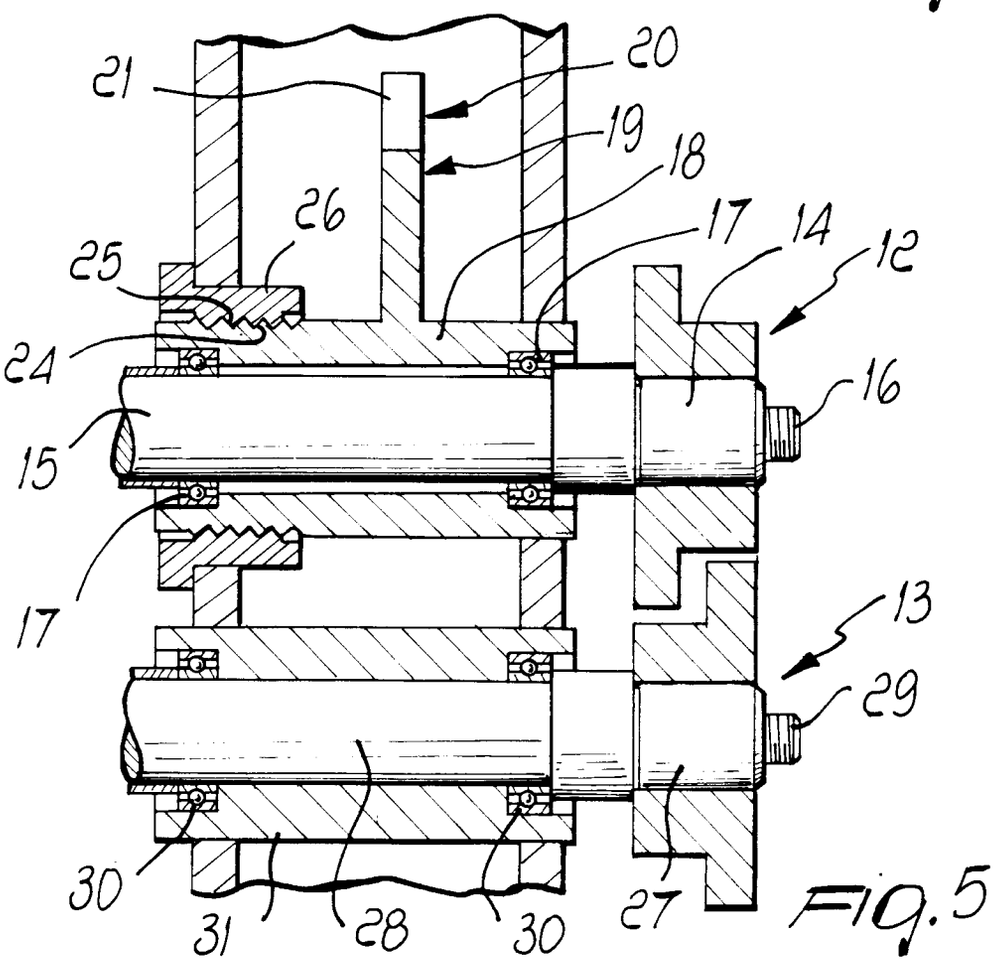
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Fig.5

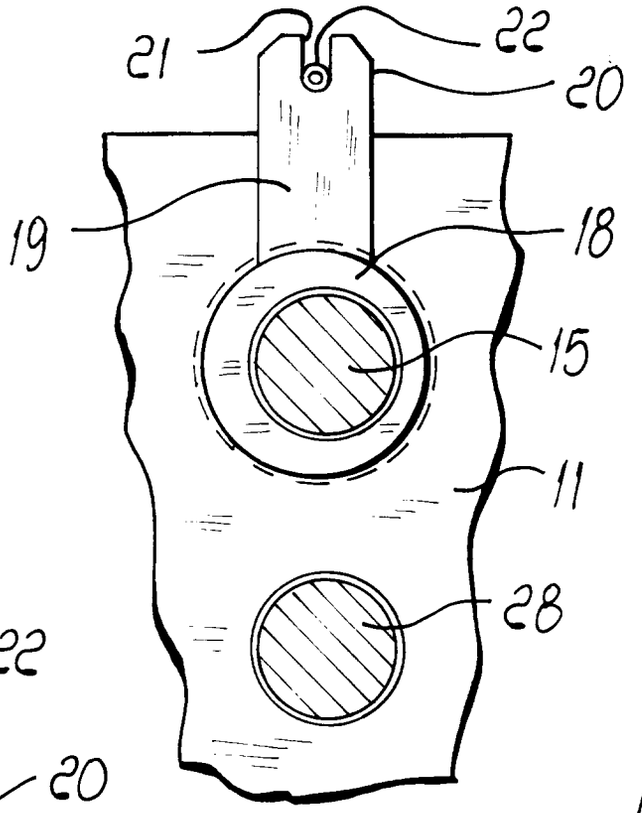

Fig. 6

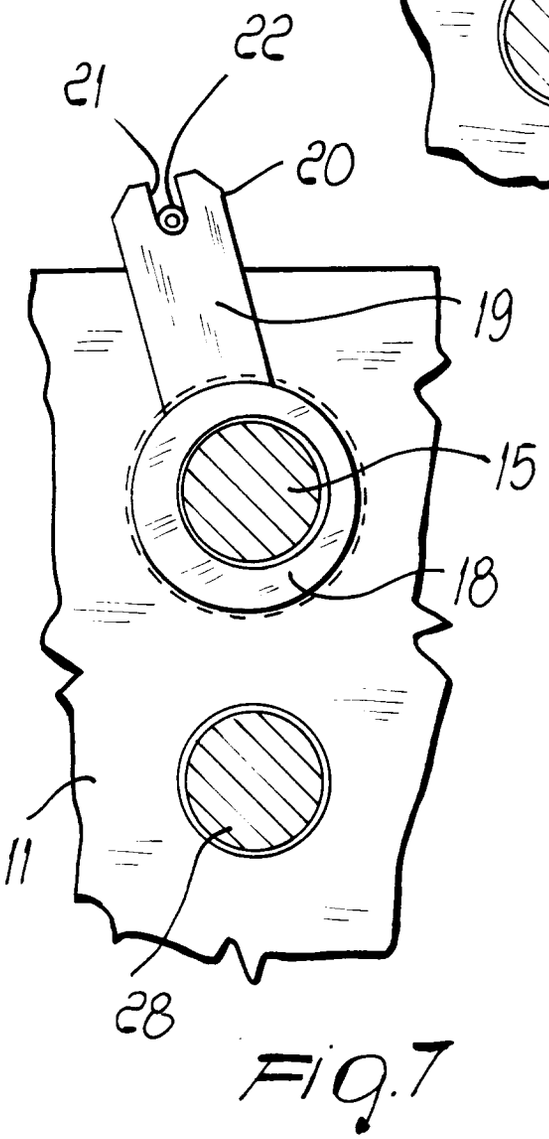

Fig. 7

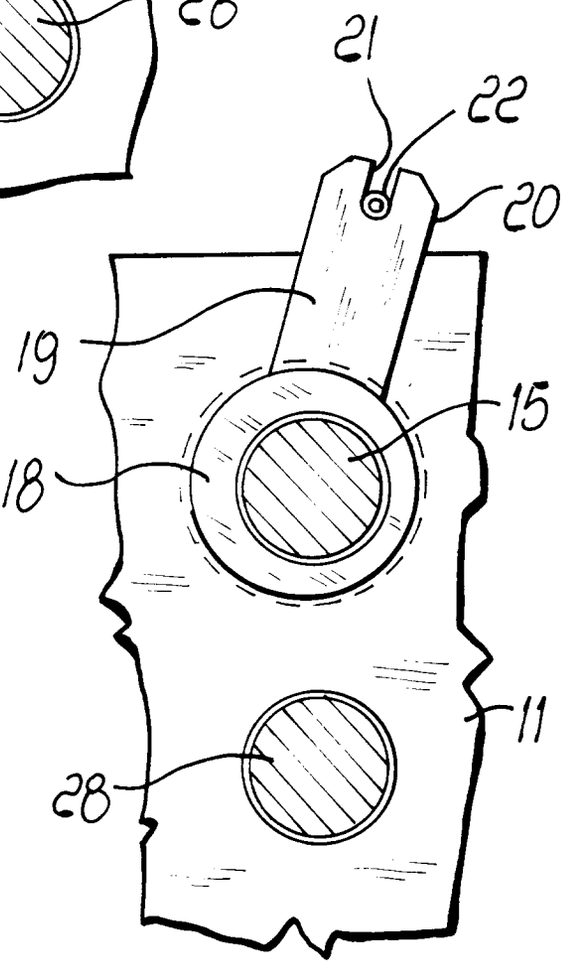

Fig. 8

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 11 7509

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X A	EP-A-0 328 645 (NIPPON KOKAN KABUSHIKI KAISHA) 23 August 1989 * the whole document *	1 2,9	B21B31/26 B21B31/18 B21D5/08
X	US-A-3 691 810 (SENDZIMIR) 19 September 1972 * column 1, line 64 - column 3, line 55; figures 1-4 *	1,5	
X	US-A-3 910 090 (KIESERLING & ALBRECHT) 7 October 1975 * figure 2 *	1,8	
X	GB-A-1 559 084 (SVENSKA ROTOR MASKINER) 16 January 1980 * the whole document *	1	
X	US-A-3 776 014 (FRIED. KRUPP GMBH) 4 December 1973 * column 2, line 53 - column 4, line 4 *	1	
A	US-A-4 191 042 (MORGAN CONSTRUCTION COMPANY) 4 March 1980 * column 3, line 37 - column 4, line 6 *	2,9	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B21B B21D
A	EP-A-0 370 995 (LISEC, PETER) 30 May 1990 * figure 1 *	1,6,10	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	15 February 1996	Vinci, V

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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