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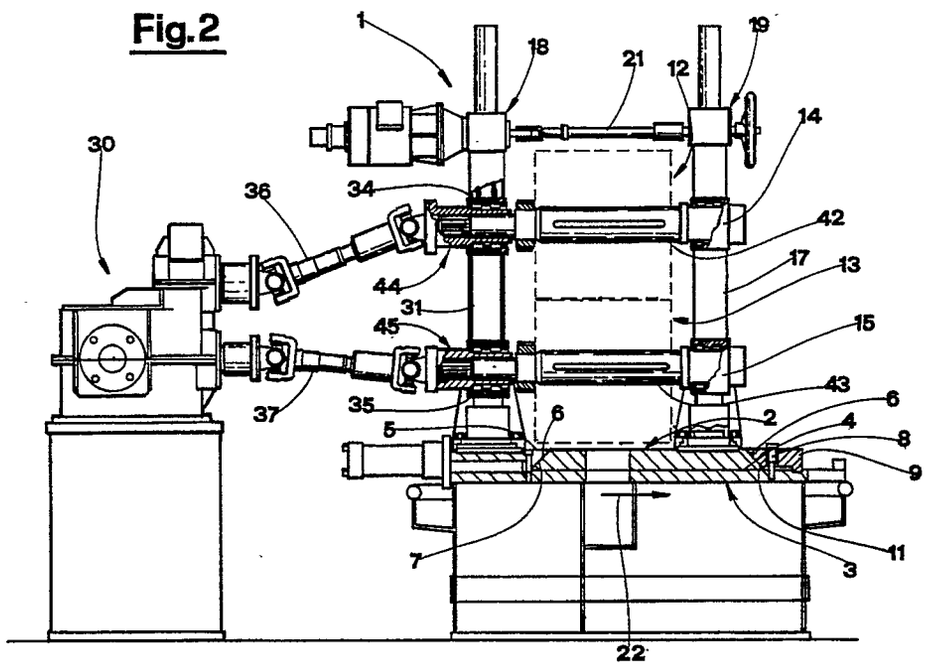
(54) A roll forming machine.

(57) The roll forming machine consists of a succession of stands, each equipped with at least two rolls (12, 13) disposed with axes parallel; the rolls of each stand are mounted to centre shafts (42, 43) journalled between two uprights (17, 31), one of which is associated permanently with a base (2) that can be fitted to and removed from the fixed bed (3) of the machine, whilst the other (31) is attached direct to the bed (3) and carries two sleeves (44, 45), turning in bearings (34, 35), which are aligned coaxially with the centre shafts. The sleeves (44, 45) are designed to engage the relative shafts (42, 43) in a coupling arrangement whereby both members can slide axially, though the one must turn with the other.

Fig.2



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The present invention relates to a roll forming machine.

Such a machine is intended specifically, though not exclusively, for use in the manufacture of metal products, in particular, welded tube and other sections.

The prior art embraces roll forming machines that consist in a plurality of stands arranged in succession, each of which equipped with at least two work rolls mounted to relative centre shafts and disposed with axes parallel; the shafts are supported in rotation at each end by bearings incorporated into sturdy uprights, and caused to revolve about their respective axes generally in opposite directions.

Each section to be formed requires a series of profiled rolls, of which the dimensions and shape will be determined by the dimensions and shape of the section itself. Thus, it happens that a change in the section to be rolled, i.e. of the particular item scheduled for production, dictates total or part replacement of the entire series of profiled rolls at the various stands.

Needless to say, such an operation must be effected with the machine at standstill, and its completion requires a considerable interval of time, during which the entire installation remains inactive. Accordingly, it can be readily appreciated that the facility of replacing forming rolls swiftly, to the end of ensuring that down time caused by inactivity of the installation is kept as brief as possible, represents an object of prime importance.

The prior art embraces a number of expedients aimed at achieving the object in question, an essential feature of which is that the single roll stands, or entire sets of stands, are mounted permanently to a base that can be fastened to and removed from the fixed bed of the machine. Replacement of this type of stand, whether singly or in sets, can therefore be effected swiftly by removing the relative base from the fixed bed and positioning another base with a further stand or set of stands in its place; the replacement stands will have been assembled and adjusted previously, away from the line, in such a way that their preparation does not interfere with production proper. Installation down time is thus limited to the amount of time needed to remove one stand or set of stands and fit the newly assembled and adjusted replacement stand, or set of stands. A problem arises with this type of arrangement, however, namely that of effecting a swift, and as far as possible, automatic disconnection of the power transmission shafts through which the centre shafts are coupled to the main drive unit (a geared motor), and an equally swift connection of these same shafts to the centre shafts of the replacement stand, or stands. Whilst it is evident, in effect, that the replacement of entire stands or sets of stands as complete units requires no more than a simple quick-couple manoeuvre in order to connect the ends of the power transmission shafts with the corresponding ends of the roll centre shafts, a specific operation is required nonetheless for the execution of such a manoeuvre.

The prior art embraces a further expedient aimed at overcoming this coupling problem, which consists in the adoption of a third, fixed upright installed permanently alongside each station occupied by a removable base carrying two replaceable uprights; the third upright affords two height-adjustable supports associated rotatably with and carrying two connecting shafts which are coupled to the power transmission shafts on the one hand, and aligned coaxially with the roll centre shafts on the other. The association between each centre shaft and the corresponding connecting shaft is brought about by way of a coupling, 'made' automatically when the centre shaft is positioned for operation; as the shaft is manoeuvred into place, its projecting end registers with the end of the connecting shaft, whereupon the two shafts turn as one. The coupling separates automatically when the rolls are changed, with removal of the stand naturally distancing each centre shaft from the relative connecting shaft. Whilst such an arrangement functions perfectly well in effect, there is nonetheless the drawback that it requires a third upright in addition to the two uprights of each stand, incorporating bearings for the connecting shafts, plus a system capable of positioning each support in such a way that the relative connecting shaft aligns coaxially with the corresponding roll centre shaft.

The object of the present invention is to overcome the various drawbacks and shortcomings described above.

The stated object is achieved with a roll forming machine as characterized in the appended claims, which features an essentially simple construction, and therefore enables swift replacement of the rolls each time the changeover to production of a different item so dictates.

The invention will now be described in detail, by way of example, with the aid of the accompanying drawings, in which:

-fig 1 is a schematic representation of the machine viewed in plan from above;

-fig 2 is an elevation of the machine viewed partly in section through II-II of fig 1;

-fig 3 is a further elevation viewed partly in section through III-III of fig 1;

-fig 4 shows a detail of fig 2, in axial section;

-fig 5 is the section through IV-IV of fig 4;

-fig 6 shows the elements of fig 4 in a different operating configuration.

With reference to the drawings, 1 comprehen-

sively denotes one of a train of roll stands making up a roll forming machine as utilized in the continuous production of metal sections, and in the case of the example illustrated, of metal tube. The single stand 1 is equipped with two work rolls 12 and 13, disposed with axes parallel and mounted to relative centre shafts 42 and 43 with which they rotate as one. The centre shafts 42 and 43 are permanently associated with and supported, both free to rotate about their respective axes, in bearings 14, 34 and 15, 35 afforded by two massive vertical columns, or uprights 17 and 31. The distance between centres of the rolls 12 and 13 is selected utilizing a screw mechanism 19, by means of which one bearing 14 can be adjusted for height on the relative upright 17; the height of the corresponding bearing 34 on the other upright 31 is adjusted by way of a similar mechanism denoted 18. The two mechanisms 18 and 19 are interconnected through a shaft 21, by means of which a movement identical in direction and degree can be transmitted to both bearings 14 and 34 on their respective uprights 17 and 31.

The upright denoted 17 is rigidly attached to a base 2 that can be fastened to and removed from a fixed bed 3. In effect, the removable base 2 rests on a horizontal table 4, across which it can be traversed through a short distance, guided in a direction parallel to the axes of the roll centre shafts 42 and 43, and to which it can be clamped with the assistance of a fixed stop 5. The base 2 is clamped securely both in the direction parallel to the shafts 42, 43 and in the vertical direction, registering as it does with an inclined surface 7 of the stop 5 that forms an acute angle with the table 4; the corresponding edges 6 of the base will be seen to be complementarily angled.

9 denotes a movable stop located at the side of the base 2 opposite from the side engaged by the fixed stop 5, which affords an angled surface 11 that engages the relative angled edge 6 of the base 2 and is screwed to the bed 3 by means of suitable fasteners 8. Traversing movement of the base 2 in the direction of the arrow 22, parallel to the axes of the shafts 42 and 43, is produced by a device operating in conjunction with the table 4; such a device comprises a double acting ram 23, and a rod denoted 24, axially reciprocated by the ram and affording two vertical projections 25 and 26 set apart one from the other at a prescribed distance greater than the width of the base 2 and designed to interact with its two opposite sides.

More exactly, the projection denoted 25 engages the corresponding side of the base 2 during the stroke that distances the stand from the fixed stop 5 and thus enables its removal from the bed 3, whereas the remaining projection 26 engages the opposite side of the base 2 during the stroke that brings the stand toward the fixed stop 5 and thus enables its being clamped to the bed 3.

Unlike the upright denoted 17, which is associated permanently with the removable base 2, the upright denoted 31 is fastened permanently to the bed 3, and therefore fixed. The two bearings 34 and 35 carried by the fixed upright 31 accommodate two coupling sleeves 44 and 45, freely rotatable about parallel axes, which are disposed horizontal and aligned respectively with the roll centre shafts 42 and 43 and set in motion by two drive shafts 36 and 37 coupled to a geared motor 30. The one sleeve 44 presents an internally splined profile 46 designed to accept the projecting end of the corresponding centre shaft 42, which is provided with a matching externally splined profile 48, such that sleeve and shaft can engage in an axially slidable fit while being obliged to rotate as one. The other sleeve 45 likewise affords an internally splined profile 47, and the end of the corresponding centre shaft 43 an externally splined profile 49, such that these two parts also are axially slidable in relation to one another while forced to rotate as one.

To enable alignment of the internal profiles 46 and 47 with the external profiles 48 and 49 of the two centre shafts 42 and 43, each coupling incorporates a device comprising a ball 56, of given diameter, seated in a radial socket 57 afforded by the sleeve 44 and 45. The ball 56 is biased toward the axis of rotation by a spring 58, and projects in relation to the root circle of the internal splines 46; in addition, the dimensions of the ball 56 are such that it can be part-inserted into the space between two adjacent splines 51 of the externally splined profile 48. The ball 56 is seated in and guided by the radial socket 57 in such a way that its centre coincides permanently with the median radial plane passing through one of the internal splines 46. Alignment is brought about between the projecting end of the shaft 42 (and 43) and the corresponding sleeve 44 (and 45) as the one approaches the other: initially, the ball 56 will enter into contact with a frusto-conical end section 52 of the shaft 42, the tapered profile of which facilitates its entry; thereafter, as insertion commences, the sleeve 44 maintains a slow rotation, and the ball 56, urged by its spring 58 against the tapered end of the external profile 48, eases into one of the spaces between two relative splines 51. Once the ball 56 finds a space between two splines 51 and locates against the relative flanks, alignment between the internally and externally splined profiles 46 and 48 is assured even before the splines enter into mutual contact; thus, as the insertion manoeuvre continues, no problems whatever are experienced in producing the axially slidable coupling.

The alignment expedient thus described is identical in the case of the end 49 of the remaining

centre shaft 43 and the relative sleeve 45, and a similar system is used also for the shaft denoted 21. In the event of switching to a new production run requiring different forming rolls 12 and 13, the single stand 1 or set of stands currently in use can be replaced swiftly and simply by substitution with a stand or corresponding set of stands that will have been assembled and adjusted previously at a location remote from the production line.

The removal of the stand 1, or set of stands, is accomplished with ease by detaching the movable stop 9 to release the base 2, and then causing the base itself to traverse from left to right in the direction of the arrow 22 by actuating the ram 23 and producing a movement sufficient to slide the roll centre shafts 42 and 43 axially clear of the sleeves 44 and 45, separate the two parts of the bearing height adjustment shaft 21, and distance the edge 6 of the base 2 from the fixed stop 5. At this juncture, the entire assembly comprising base 2 and upright 17, standing free with centre shafts 42 and 43 and respective forming rolls 12 and 13 cantilevered from the bearings 14 and 15, can be removed from the bed 3 and replaced with an assembly similar in all respects save for the fact of being fitted with two rolls suitable for the changeover product. The replacement roll stand is installed by lowering the base 2 onto the table 4 and actuating the ram 23, whereupon the projection denoted 26 will traverse the base into contact with the angled surface 7 of the fixed stop 5; during this movement, the splined ends 48 and 49 of the new shafts 42 and 43 will locate in the sleeves 44 and 45, and engage subsequently to the point where, fully inserted, shafts and sleeves rotate as one. The journals of the roll centre shafts 42 and 43 and of their respective bearings 14 and 15 will be proportioned such that deflection at the projecting ends 48 and 49, produced by bending stress, is kept within limits that can still ensure effortless location of the ends in the sleeves 44 and 45. Thus, the operation of replacing forming rolls in readiness for a change in production is effected speedily and simply; likewise, the construction of the stand is substantially simple.

Claims

1) A roll forming machine comprising a plurality of stands (1) arranged in succession, each of which equipped with at least two work rolls (12, 13) disposed with axes parallel and mounted to centre shafts (42, 43) journalled at each end to bearings carried in massive uprights (17, 31) and driven in rotation about their axes in opposite directions, characterized
in that one upright (17) of at least one stand (1) is mounted rigidly to a base (2), and the base in turn fitted to and removable from a fixed bed (3); in that the remaining upright (31) of the stand (1) is mounted permanently to the fixed bed (3) and affords two bearings (34, 35) accommodating two sleeves (44, 45), coaxially aligned with the roll centre shafts (42, 43) of the stand (1) and set in rotation by a geared motor (30) through relative drive shafts (36, 37), and designed to receive the projecting ends of the corresponding coaxially aligned roll centre shafts (42, 43) in a coupling arrangement whereby sleeve and shaft are capable of sliding axially one in relation to the other while obliged to rotate as one.

2) A roll forming machine as in claim 1, wherein the base (2) to which the one upright (17) of the stand (1) is rigidly mounted is fitted to and removable from the bed (3) by means of a clamping device that comprises:
-a table (4), on which the base (2) is positioned and traversed guidedly in a direction parallel to the axis of the roll centre shafts (42, 43);
-a fixed stop (5), against which the base (2) is located and clamped in such a way as to ensure a correct and predetermined axial position of the centre shafts (42, 43) in relation to the sleeves (44, 45) with which they are ultimately coupled;
-a movable stop (9) positioned at the side of the base (2) opposite to that locating against the fixed stop (5);
-locating surfaces (7, 11), afforded respectively by the fixed and movable stops (5, 9) and angled acutely in relation to the table (4), by way of which the stops engage the complementarily angled opposite edges (6) of the base (2).

3) A roll forming machine as in claim 2, comprising a device, associated with the table (4), that serves to traverse the base (2) in one direction and the other parallel to the axes of the sleeves (44, 45) and the centre shafts (42, 43) and operates through the interaction with either side of the base (2), according to whether the stand is being fitted or removed, of two relative projections (25, 26) that rise vertically above the level of the table (4) and are fitted to a rod (24) reciprocated axially by means of a ram (23).

4) A roll forming machine as in claim 1, the sleeves (44, 45) of which are provided with internally splined profiles (46, 47) and a female locating taper (54), and the projecting ends of the roll centre shafts (42, 43) with externally splined profiles (48, 49) and a male locating taper (52), in such a way as to create a coupling that allows axial movement of the sleeve and centre shaft in relation to one another while obliging both to rotate as one; further comprising a device capable of ensuring the alignment of the single internally splined profiles (46, 47) and the corresponding externally splined

profiles (48, 49), consisting in a ball of given diameter seated in a socket afforded by each sleeve (44, 45) and spring-biased toward the axis of rotation in such a way as to project partly from the root circle of the internal splines (46, 47), wherein the diameter of the ball is proportionate to the dimensions of the spaces of the externally splined profiles (48, 49), thereby enabling part-insertion in any given space between two adjacent external splines (51) and subsequent contact with the relative spline flank on either side, and wherein the position and guided movement of the ball are such that its axis coincides permanently with the median radial plane passing through one spline of the internally splined profile (46, 47).

Fig.1

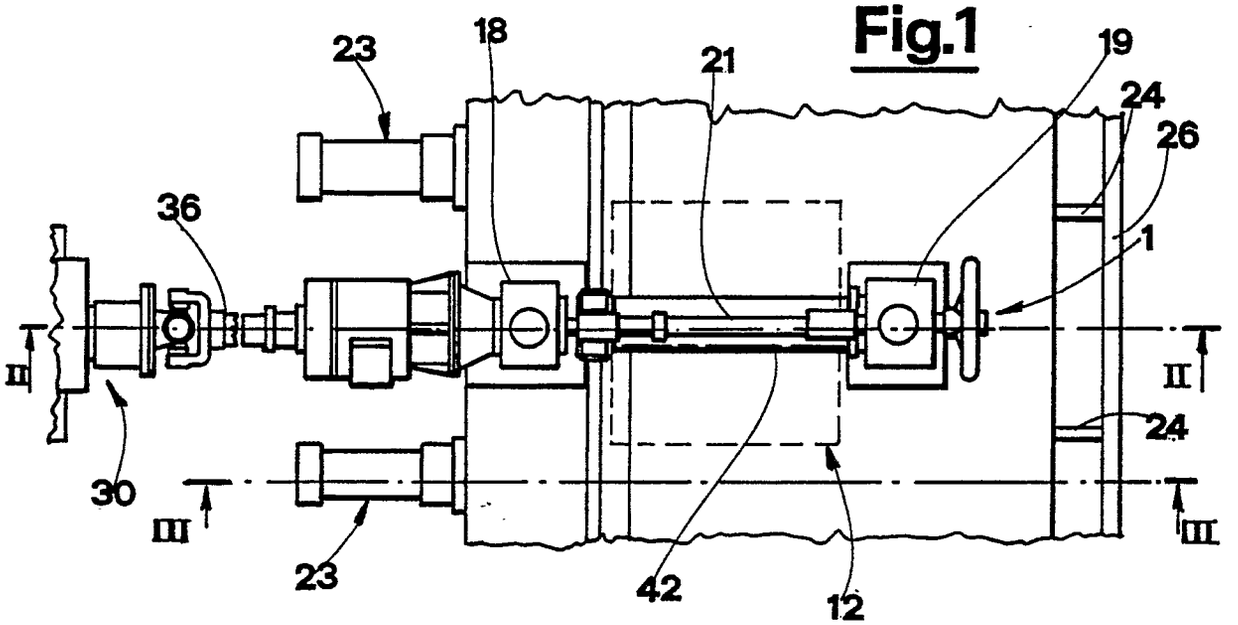
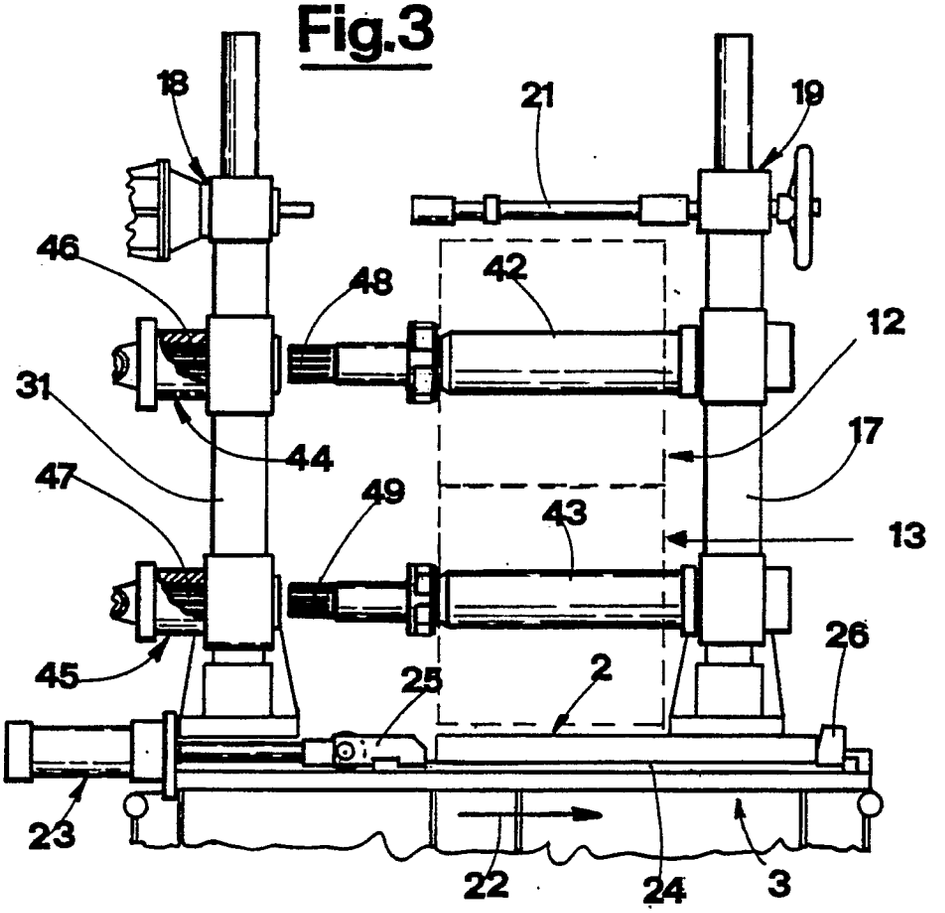

23
18
21
19
24
26
36
1
II
II
30
III
III
24
23
42
12

Fig.3


18
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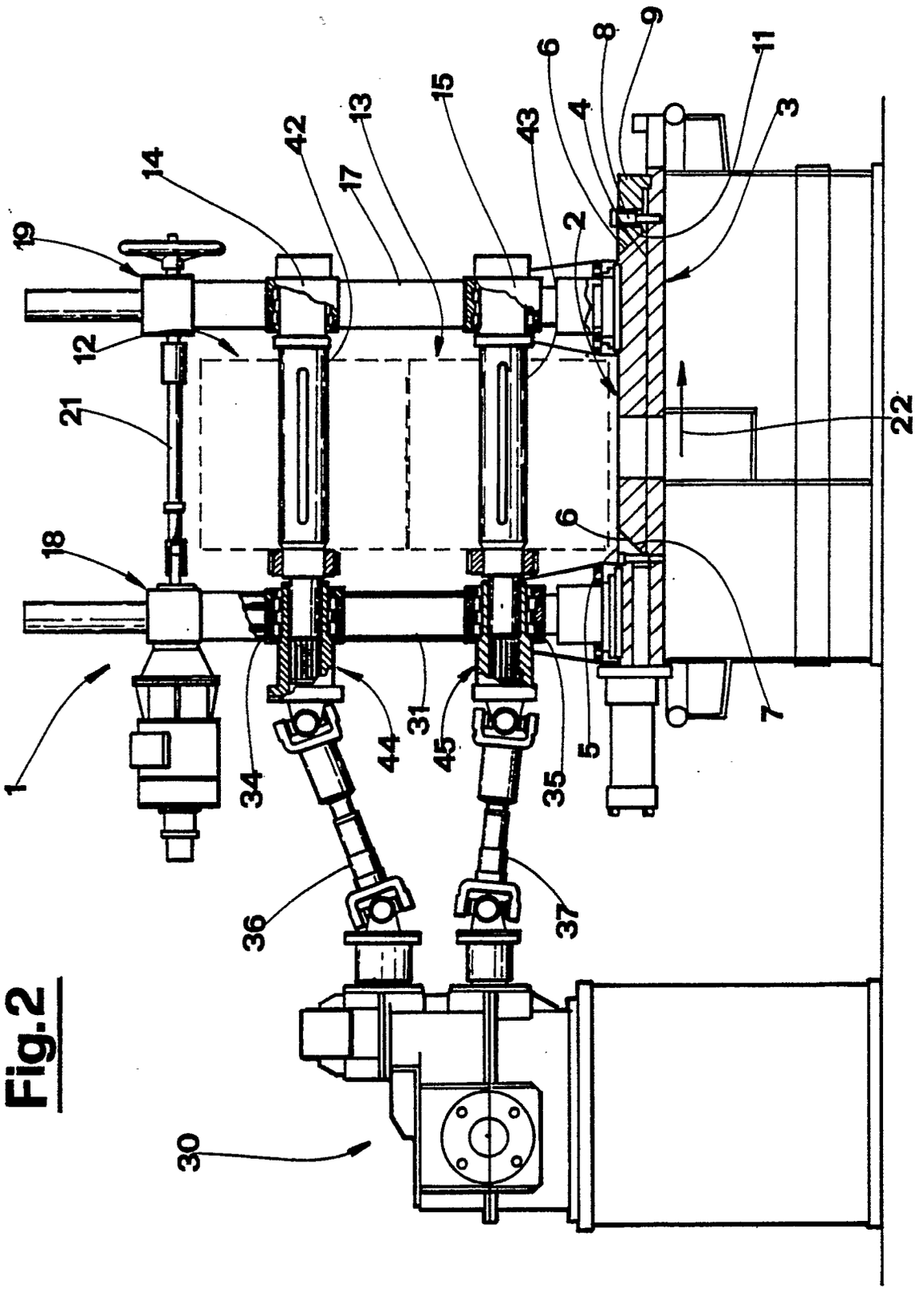


Fig.2

Fig.4

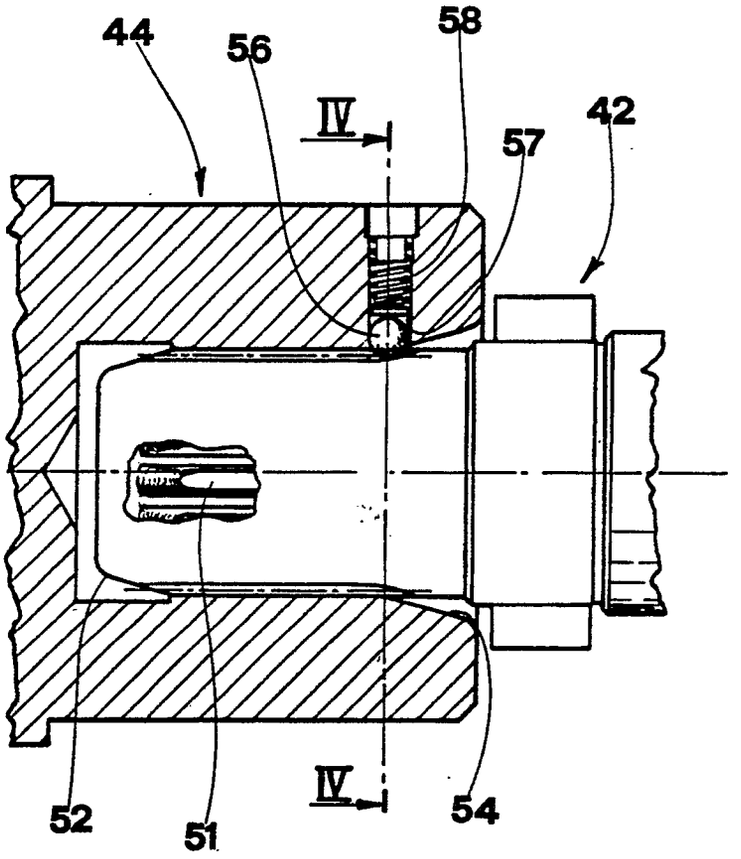
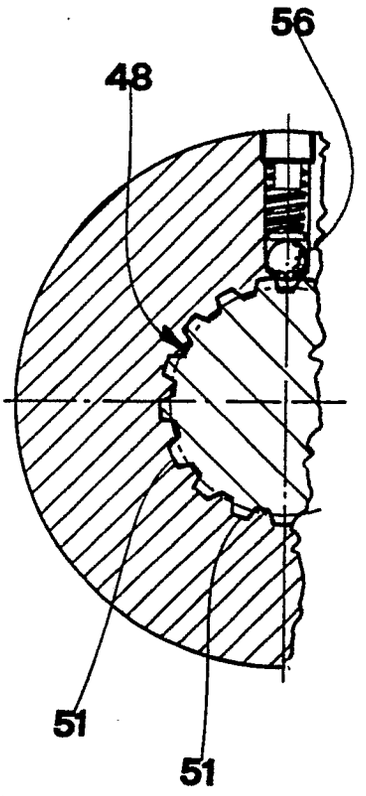


Fig.5



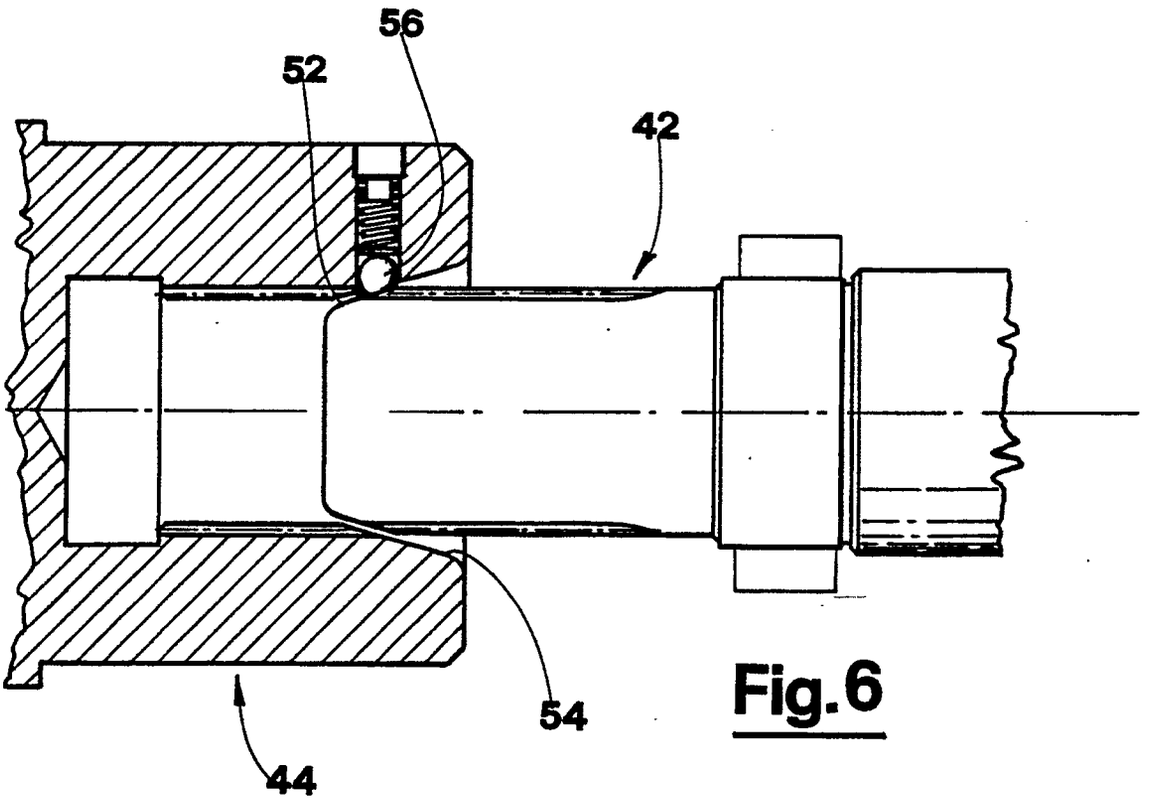


Fig.6