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(54) Method and apparatus for roll forming strip material.

(57) A method and apparatus for roll forming strip material in which the strip material 30 is first fed into a feed and cutting unit 14 in which a predetermined length of material is fed and cut off, and is then fed into a roll forming unit 16 which is driven at at least the same speed as the feed unit 14. The cut material is discharged onto a table 18. An alternative roll forming unit 17 can be employed instead of the unit 16.

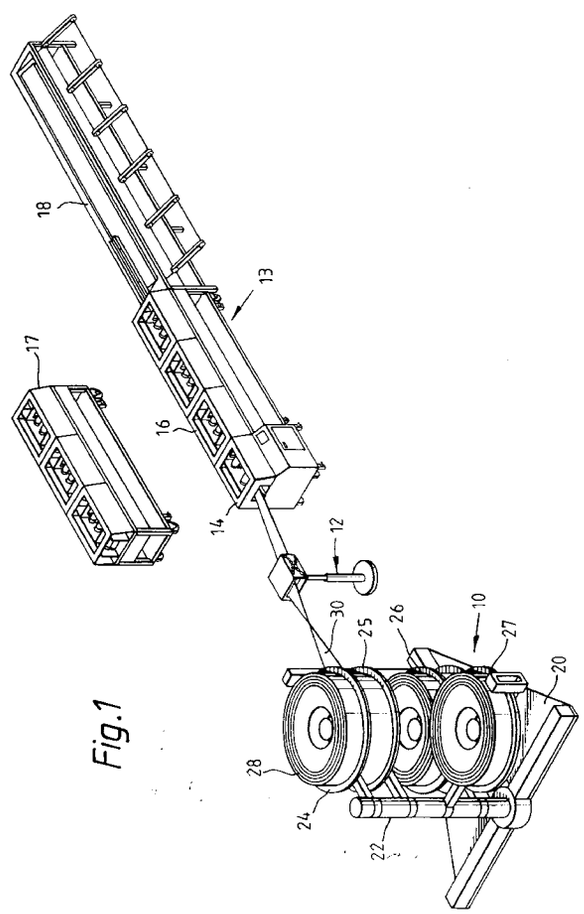

Fig.1

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The invention relates to a method and apparatus for a roll forming strip material.

Roll forming is used extensively for shaping strip metal material, particularly aluminium alloy material, which is used in a large variety of ways. Strip material is used for venetian blinds slats and for panelling materials and often it is necessary to effect quite marked deformations of the strip material during the roll forming process. The roll forming apparatus must be capable of being changed over from making one product to making another. For example, it is quite common for the strip material to be available in a number of different finishes and a number of different widths and when one particular production run has been completed, it is necessary to change over to another stock of strip material or to adapt the forming rolls for other shapes of product and in order to vary the length of the finished products to be cut off.

In practice, it is not unusual for such operations to occur more than 15 times in a single working day, and the delays that are necessary can often lose production time of as much as 50% or more.

It is now proposed, according to one aspect of the present invention, to provide a method of roll forming strip material comprising continuously feeding the strip material from a coil thereof by means of a strip feed unit, cutting off a predetermined length thereof as the strip is fed and continuing to feed the cut length of strip material through at least one roll form unit, the drive of the rolls of which is arranged to feed the strip material at least as fast as the rate at which the strip feed unit feeds the material.

It has been found that by cutting off a predetermined length of strip material as it is fed and then continuing to feed the cut lengths of the strip material through the roll form unit, at least at the speed of the feed unit, that better production speed can be achieved.

With the invention it is possible for the at least one roll form unit to comprise one of a set of such units and, when it is desired to change the profile of a rolled strip material, the roll form unit is disconnected from the strip feed unit and it is replaced by a different one of the set. It has been found that this can be carried out very rapidly, particularly as the rolls of the roll form unit themselves do not have to be changed, but merely the whole unit has to be changed.

Preferably the length of the strip material fed into the strip unit is sensed by means of a strip length recording unit, and a signal from the recording unit is used to trigger the cutting off of the strip material. This cutting is advantageously carried out by a rotary cutter mounted on the strip feed unit and the signal from the recording unit triggers a clutch to operate the rotary cutting unit.

In some instances it is desirably that the strip material should be punched, to provide apertures, notches, tabs etc., in the finally rolled strip material. It is contemplated that this could be effected by interposing between the strip feed unit and said at least one roll form unit, a punching unit which is advantageously designed to punch the cut strip material as it is fed therethrough, without interrupting the supply of the cut strip material to the roll form unit.

According to a second aspect of the present invention, there is provided a strip forming apparatus comprising a support for at least one coil of strip material, a strip feed unit including feed rollsfor feeding strip material from a coil thereof mounted on said support, a cutter on said strip feed unit for cutting off a predetermined length of strip material as the strip material is fed, at least one roll form unit mounted adjacent said strip feed unit to receive cut strip material lengths therefrom, forming rolls mounted in said at least one roll form unit, and means to drive the feed rolls of the strip feed unit and the forming rolls of said at least one roll form unit, whereby the peripheral speed of the rolls of the roll form unit is at least the same as the peripheral speed of the rolls of the strip feed unit.

Preferably the drive means is mounted on the feed unit and causes the rolls of the at least one roll forming unit to be driven at the same peripheral speed as that of the rolls of the strip feed unit.

In a preferred construction the feed unit which includes a drive pinion, driven by said drive means, said drive pinion being engageable with a driven pinion mounted on the roll forming unit, with the pitch circles of the pinions have a common tangent lying on the abutting end faces of the feed unit and the roll forming unit respectively.

The drive means may include a motor driving a flexible drive element, e.g. a double-sided toothed belt, which passes around wheels,e.g. toothed wheels, mounted to rotate with the feed rolls and the drive roll.

The cutter may be a rotary cutter assembly and, if desired, this may be driven by the flexible drive element and thus may itself include a further wheel, e.g. a toothed wheel.

As indicated above, the feed unit may further comprise a strip length recording unit which gives a signal when a predetermined length of strip material has been fed into the feed unit.

A clutch may be associated with the cutter, the clutch being operable by a signal. Where a rotary cutter is used, it may comprise a first roll with a blade on its periphery, a second roll with a complementary groove on its periphery, means mounting said rolls for counter-rotation, one of said rolls being eccentrically mounted so that, in one rotational position, strip material can pass freely between the first and second rolls and, upon rotation from that position, the blade is brought into contact with the strip material to cut it.

Additionally the feed unit may be provided with means signalling an obstruction of the strip feed and

disengaging the drive in case of malfunction.

As indicated above, it is contemplated that there should be a set of roll forming units, one of which may selectively be mounted in abutting relation to the strip feed unit to form a different profile of the rolled strip material.

The support for the coil of strip material advantageously comprises a generally horizontal support surface on which the strip coil is mounted, with its axis vertical, this has the advantage that the strip can uncoil in an orderly manner, because gravity urges it towards the supporting surface. Furthermore, the coils of strip material are held in position on the coil holder by gravity without requiring any further positioning means.

With such an arrangement, preferably a guide means is provided to change the orientation of the strip material so that it lies in a horizontal plane as it is fed into the feed unit. With the horizontal arrangement of the support surface, a plurality of horizontal supports may be provided, to support a plurality of coils from which a selected strip may be fed.

Because roll forming strip material may be of different widths, from time to time one needs to provide rolls which are of a different axial length in the same roll forming unit, rather than supply a different roll forming unit. Conventionally this is done by having each roll formed by two end portions and a centre portion. Removing or replacing the centre roll portion can be time consuming.

It is therefore now proposed, according to the present invention, to provide a roll form unit comprising at least one pair of co-operable rolls, wherein at least one of the rolls of said at least one roll form unit comprises a shaft having an axial key thereon, two end roll portions each having a keyway co-operable with said key, means to releasably lock said end roll portions onto said shaft to allow said portions to be moved axially, at least two pairs of semi-cylindrical centre shell portions mounted on said shaft between said end roll portions, the shell portions of one pair each having a semi-circular ridge at one axial end and the shell portions of the other pair having a semi-circular cavity at the end facing the shells of said one pair, and keyways in said shell portions offset by 90°, whereby when said pairs of shell portions are clamped between said end roll portions, the rims engage in the grooves to lock said shell portions in place.

With such a structure one can relatively rapidly remove the centre roll portion and replace it when desired.

In order that the present invention may more readily be understood, the following description is given, merely by way of example, reference being made to the accompanying drawings in which:-

Figure 1 is a perspective view of one embodiment of apparatus according to the present invention;

Figure 2 is an enlarged perspective view of the feed unit and a roll forming unit of the apparatus of Figure 1;

Figures 3 and 4 are a schematic top plan view and side elevation of the cutting and in-feed unit of the apparatus of Figures 1 and 2;

Figures 5 and 6 are a schematic top plan view and side elevation of the cutting and in-feed unit and of the roll forming unit of the apparatus of Figures 1 and 2;

Figure 7 is a perspective view of the cutting and in-feed unit;

Figure 8 is an enlarged cross-section of the cutting and in-feed unit taken along the line VIII-VIII of Figure 6;

Figures 9A and 9B are cross-sections taken along the lines IX-IX of Figure 8 showing the cutting rollers in an activated and deactivated position respectively;

Figure 10 is an enlarged section taken along the line X-X of Figure 6;

Figure 11 is a partial side elevation of the portion of the forming section illustrated in Figure 10;

Figure 12 is a section taken along the line XII-XII in Figure 11 with one of the shafts in a demounted position;

Figure 13 shows a first embodiment of forming rolls for mounting on the shafts of Figure 12; and

Figure 14 shows a second embodiment of forming rolls for mounting on the shafts of Figure 12.

Referring first to Figure 1, the apparatus illustrated includes several basic assemblies. Thus there is a support assembly 10 followed by a guide assembly 12, a working assembly 13 and an out-feed table 18. The working assembly 13 includes a cutting and in-feed unit 14 and a roll forming unit 16. This may be one of several roll forming units and a second unit 17 may be used to replace the unit 16.

The support assembly illustrated comprises a base 20, having an upstanding pillar 22 on which are pivotally mounted four support tables 24,25,26,27. On at least one of these is mounted a coil 28. In the illustrated construction the coil 28 which is being used is that on the top table 24 and the strip material 30 is fed from this via the guide assembly 12 so that the orientation of the strip material is changed from the vertical plane to the horizontal plane as the material is fed into the feed unit 14. Each of units 14,16 have trolley wheels 32 (see Figure 2) and retractable support legs 34 which are used when the unit has been rolled on the wheels 32 to its desired position.

The roll forming unit 16 includes a main frame 36, a form roll assembly 38 and covers 40.

If reference is now made to Figure 3 to 6, it can be seen that the cutting and feed unit 14 is provided with a drive motor 42 having a drive pulley 44 thereon around which is passed a flexible drive element 46, for example, a drive chain or a double-sided toothed flexible belt.

The drive element 46 takes drive to the shaft 48 of the in-feed unit, to a disengageable clutch device 50 and to a drive pinion 52. The end face 54 of the unit 14 is located so as to be a tangent to the pitch circle of the pinion 52 for a reason to be explained below. Associated with the end face 54 are connectors 56 which are used to cooperate with further connector elements on the roll forming unit 16.

When the connectors 56 are engaged, the pinion 52 meshes with a driven pinion 58 on the roll form unit 16, the abutting end face of which is a tangent to the pitch circle of the pinion 58 so that the two pinions 52,58 accurately mesh with one another. Associated with the driven pinion 58 is a pulley 60 or the like around which passes a further flexible drive element 62 which again may be a chain, a drive belt or in particular a double-sided toothed drive belt. This is used to drive the roller shaft 43 of the roll form unit 16.

In this way the drive from the single drive motor 42 is used to drive the rolls of the cutting and feed unit 14 and of the roll form unit 16. In the construction shown the rolls are driven at the same peripheral speed. It will also be possible for the rolls of the roll forming unit 16 to be driven at a higher peripheral speed than those of the unit 14. The actual drive arrangement for the unit 16 is fairly standard and further description of that is not thought necessary.

If reference is now made to Figure 7 further details of the feed and cutting unit 14 are given. Many of the parts have been omitted for the sake of clarity. Lower and upper in-feed rolls 64,66 are provided, the upper one of these being mounted for limited vertical movement and being mounted on the drive shaft 48 previously described. A length recording unit 67 of a commercially available the supplies appropriate signals to an electronic control device, also of a commercially available type, which triggers the operation, after a predetermined interval, of the clutch device 50 (not shown in Figure 7) through which the shafts 68,70 can be driven to rotate the cutter wheels or rollers 72,74 through a full turn. The structure of the cutter wheels is illustrated in Figures 8 and 9.

It will be appreciated that the structure described is a rotating cutter arrangement. However, equally a conventional reciprocating cutter arrangement could be applied, such as an arrangement in which eccentric means effect a combined reciprocating and travelling movement of floating blades.

In the actual cutter arrangement shown in Figures 8 and 9, the drive motor 42 is shown with its toothed wheel 44 which drives a belt which in turn drives a driven wheel 45 associated with the clutch 50. The driven wheel 45 can thus either free wheel or the clutch can engage the shaft 76 and the gear wheel 78. The gear wheel 78 would drive the gear wheel 80 which, in turn, will rotate the upper shaft 82, so that the upper and lower shafts 76,82 always rotate together.

Figures 9A and 9B show the cutter rollers 72,74 in their operative and inoperative positions. At least one of the rollers, in this case the lower roller 72, is mounted eccentrically on its shaft 76, so that upon rotation it moves towards the other roller if rotated from the inoperative position of Figure 9B to the opposite position of Figure 9A. It can be seen that the lower roller 72 is provided with a generally axially extending cavity 84 and the upper roller 74 with a complementary generally axially extending knife-blade 86. It will be appreciated that these could be mounted the other way round.

Upon actuation of the clutch 50, the cutter rollers will always rotate through a full turn in the direction of the arrows 88,90 whereupon they will again stop rotating when in a position as illustrated in Figure 9B. Thus, each time the rollers rotate from the Figure 9B position back to the Figure 9B position via the Figure 9A position, the strip material will pass from right to left, as viewed in these figures, and will be cut by the blade 86.

A similar arrangement, not shown, can be provided in a punching unit which has not been illustrated and in which one or more holes, notches, recesses, tabs or the like may be formed in the strip material. Such a punching unit could be placed between the in-feed and cutter unit 14 and the roll forming unit 16 so that it punches unrolled material.

The actual form of the roll assembly 38 illustrated in Figures 10, 11 and 12 includes a machine frame having a base 92, side walls 94 and a cross-brace member 96. Figure 10 also shows the roller shafts 43 which are each driven through a toothed wheel 98. The roll shafts are mounted in bearings 100, one of which, here the upper one, being adjustable to take into account the distance between the opposing shafts of a pair.

Figure 12 illustrates in more detail the bearing arrangement for the shafts and shows how the shafts are specifically adapted to allow instant accurate relocation of the shafts with respect to the form roller frame upon each removal. In fact removal of the roller shafts is necessary to arrange the form rollers thereon or any fresh form rollers when that is desired. The usual form of such roller 102 is illustrated in Figure 13 and is seen to comprise several separate parts 104,106,108. This arrangement allows different widths of profile to be formed with the same set of roller parts. If a middle roller part 106 is removed between the rim forming roller part 104,108, then a panel can be obtained with a narrower web profile. It will be appreciated that re-engaging of the roller parts to give the different width requires the shafts 43 to be removed.

Figure 14 shows an alternative arrangement. Here the parts 104,108 are as in Figure 13 from which it will be seen that the central portion is made up of three units 110,112,114 each formed in two parts 110a,110b; 112a,112b; 114a,114b respectively, each

of semi-annular form. The parts 110a,110b as well as the parts 114a,114b are each formed with semi-annular grooves 116. The central parts 112a,112b are formed with complementary semi-annular ridges 118 on each axial end. The parts 110,114 are also provided with a complementary half-keyways which are aligned with the keyway 122 of the central part 112. It will be seen that the keyway 122 is angularly displaced from the complementary half-keyways 120.

In order to assemble such a construction all that is necessary is to slack off the end portions 104,108 and move them a short axial distance. The parts 110,114 can then be pulled slightly axially outwardly and the two halves 110a,110b and 114a,114b can then be purled apart whereupon the two parts 112a,112b will be released and can equally be pulled apart. Since the keyways 120,122 are off-set by 90°, the rims 118 and the grooves 116 co-operate in retaining the central roller portion 112 in a locked position once closed. Rearranging of the roller portions now only requires unlocking the outer members as indicated above and thence release of the central parts which is a much less time consuming job.

As indicated earlier, should one decide to have a plurality of roll forming units so that one has at least one unit 16 and a unit 17, then this is not necessary and all that one then has to do is to disengage the unit 16 from the unit 14 and insert in its place the unit 17. Equally one can readily change the stock material being fed in by choosing a different one of the coils mounted on one of the supports 24,25,26,27.

Claims

1. A method of roll forming strip material comprising continuously feeding the strip material from a coil thereof by means of a strip feed unit, cutting off a predetermined length thereof as the strip is fed and continuing to feed the cut length of strip material through at least one roll from unit, thereby re-shaping the cross-section of the strip material, the drive of the roll form unit being arranged to feed the strip material at least as fast as the rate at which the strip feed unit feeds the material.

2. A method according to claim 1, and further comprising the step of sensing the length of strip material fed into the strip feed unit by means of a strip length recording unit and using a signal from the recording unit to trigger the cutting of the strip material.

3. A method according to claim 2, wherein the cutting is carried out by a rotary cutter mounted on the strip feed unit and wherein the signal from the recording unit triggers a clutch to operate the rotary cutting unit.

4. A method according to any preceding claim, wherein the at least one roll form unit comprises one of a set of such units and, when it is desired to change the profile of the rolled strip material, the roll form unit is disconnected from the strip feed unit and is replaced by a different one of the set.

5. A strip forming apparatus comprising a support for at least one coil of strip material, a strip feed unit including feed rolls for feeding strip material from a coil thereof mounted on said support, a cutter on said strip feed unit for cutting off a predetermined length of strip material as the strip material is fed, at least one roll form unit mounted adjacent said strip feed unit to receive cut strip material lengths therefrom, forming rolls mounted in said at least one roll form unit, and means to drive the feed rolls of the strip feed unit and the forming rolls of said at least one roll form unit, whereby the cross-section of the strip material is re-shaped and the peripheral speed of the rolls of the roll form unit is at least the same as the peripheral speed of the rolls of the strip feed unit.

6. Apparatus according to claim 5, wherein the drive means is mounted on the feed unit and causes the rolls of the at least one roll forming unit to be driven at the same peripheral speed as that of the rolls of the strip feed unit.

7. Apparatus according to claim 6, wherein the feed unit includes a drive pinion, driven by said drive means, said drive pinion being engageable with a driven pinion mounted on the roll forming unit, with the pitch circles of the pinions have a common tangent lying on the abutting end faces of the feed unit and the roll forming unit respectively.

8. Apparatus according to claim 7, wherein the drive means includes a motor driving a flexible drive element which passes around wheels mounted to rotate the feed rolls and the drive roll.

9. Apparatus according to claim 8, wherein the cutter is a rotary cutter assembly.

10. Apparatus according to any one of claims 5 to 9, wherein the feed unit further comprises a strip length recording unit which produces a signal when a predetermined length of strip material has been fed into said feed unit.

11. Apparatus according to claim 10, and further comprising a clutch associated with said cutter, said clutch being operable by said signal.

12. Apparatus according to claim 9 or 11, wherein said rotary cutter comprises a first roll with a blade

on its periphery, a second roll with a complementary groove on its periphery, means mounting said rolls for counter-rotation, one of said rolls being eccentrically mounted so that, in one rotational position, strip material can pass freely between the first and second rolls and, upon rotation from that position, the blade is brought into contact with the strip material to cut it.

13. Apparatus according to any one of claims 5 to 12, wherein said at least one roll forming unit comprises one of a set of such units, which may selectively be mounted in abutting relation with the strip feed unit to form a different profile of the rolled strip material.

14. Apparatus according to any one of claims 5 to 13, wherein the support for a coil of strip material comprises a generally horizontal support surface on which the strip coil is mounted, with its axis vertical.

15. Apparatus according to claim 14, wherein a plurality of horizontal supports are provided, to support a plurality of coils from which a selected strip material may be fed.

16. Apparatus according to claim 14 or 15, wherein a strip guide is provided to change the orientation of the strip material so that it lies in a horizontal plane as it is fed into the feed unit.

17. Apparatus according to any one of claims 5-16 wherein at least one of the rolls of said at least one roll forming unit comprises a shaft having an axial key thereon, two end roll portions each having a key way co-operable with said key, means to releasably lock said end roll portions on to said shaft to allow said portions to be moved axially and at least one centre cylindrical portion mounted on said shaft between said end roll portions having a key way co-operable with said key.

18. A roll form unit apparatus comprising at least one pair of co-operable rolls wherein at least one of the rolls of said at least one roll forming unit comprises a shaft having an axial key thereon, two end roll portions each having a key way co-operable with said key, means to releasably lock said end roll portions on to said shaft to allow said portions to be moved axially and at least one centre cylindrical portion mounted on said shaft between said end roll portions having a key way co-operable with said key.

19. Apparatus according to claim 17 or 18 wherein said at least one centre cylindrical portion comprises one pair of semi-cylindrical centre shell portions, each having, at one axial end thereof, a protrusion or recess and wherein the face of an end roll portion corresponding to said one axial end has a corresponding recess or protrusion respectively whereby when said pair of shell portions is clamped against said end roll portion, the protrusions engage in the recesses to lock said shell portions in place.

20. Apparatus according to claim 17, 18 or 19 comprising at least two pairs of semi-cylindrical centre shell portions mounted on said shaft between said end roll portions, wherein the shell portions of one pair each has a protrusion at one axial end and the shell portions of the other pair each has a recess at the end facing the shells of said one pair, and key-ways in said shell portions offset by 90°, whereby when said pairs of shell portions are clamped between said end roll portions, the protrusions engage in the recesses to lock said shell portions in place.

21. Apparatus according to claim 19 or 20 wherein said protrusions and recesses comprise semi-circular rims and grooves respectively.

22. A strip forming apparatus substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

23. A method of roll forming strip material, said method being substantially as hereinbefore described with reference to and as illustrated in the accompany drawings.

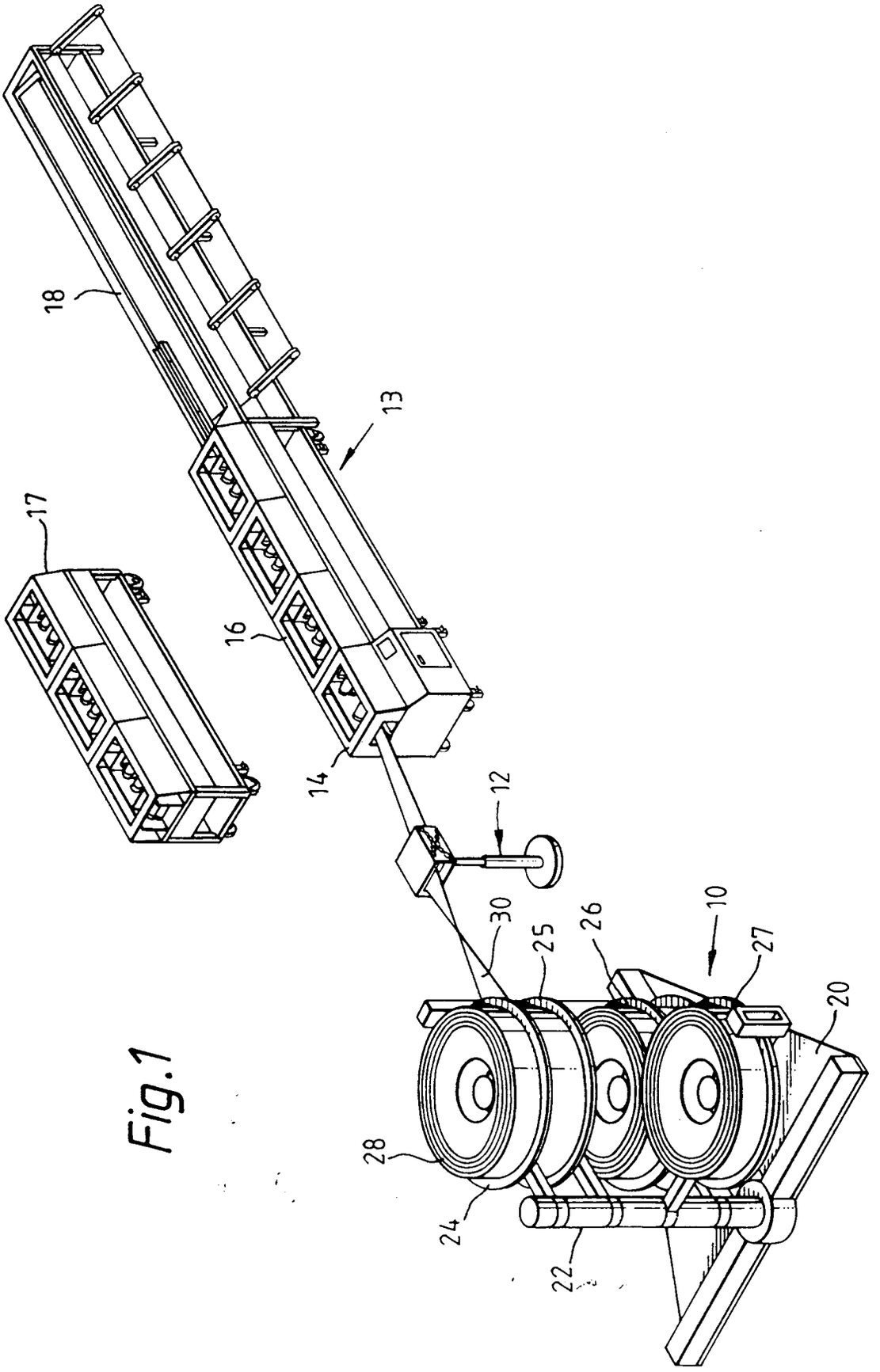


Fig.1

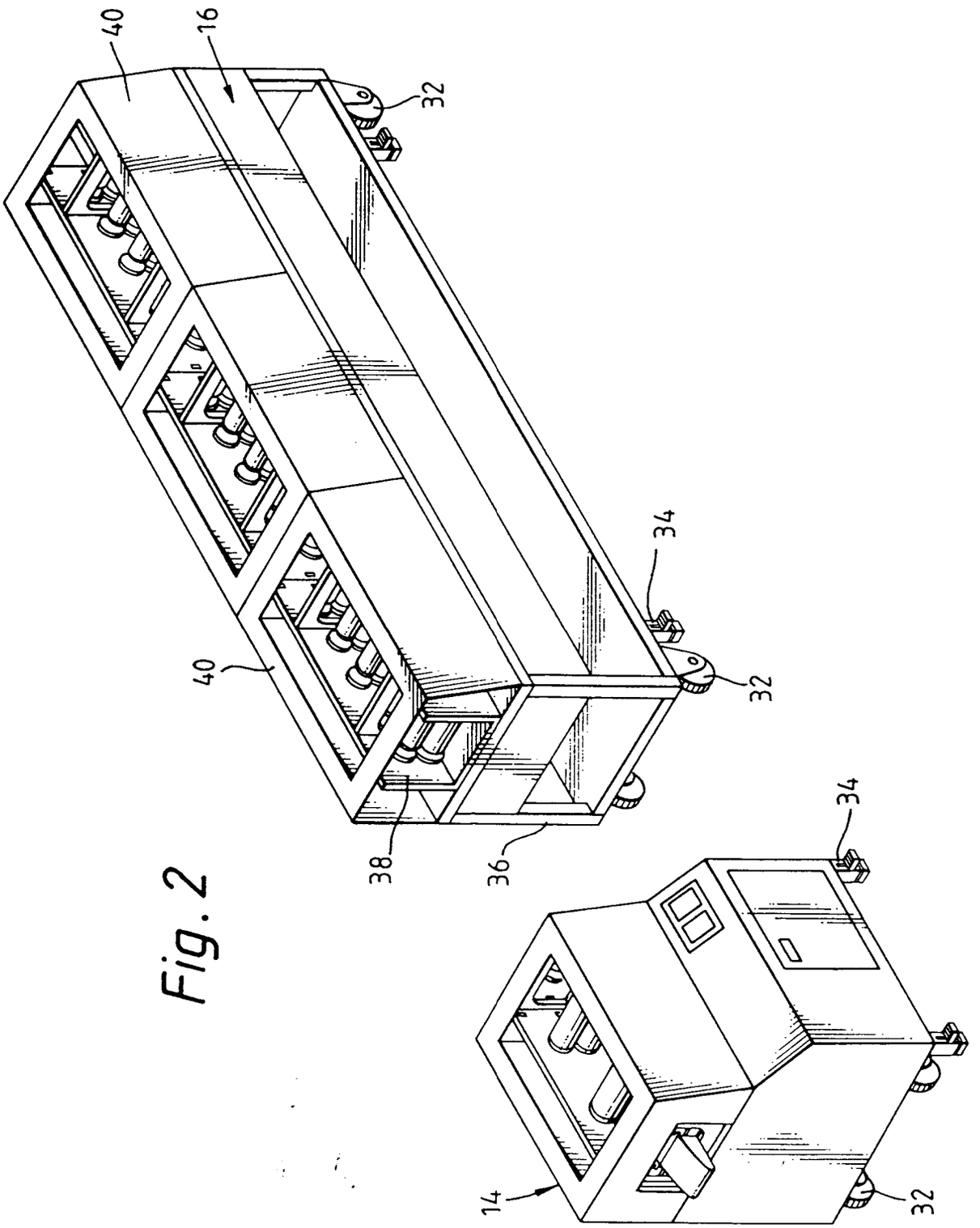


Fig. 2

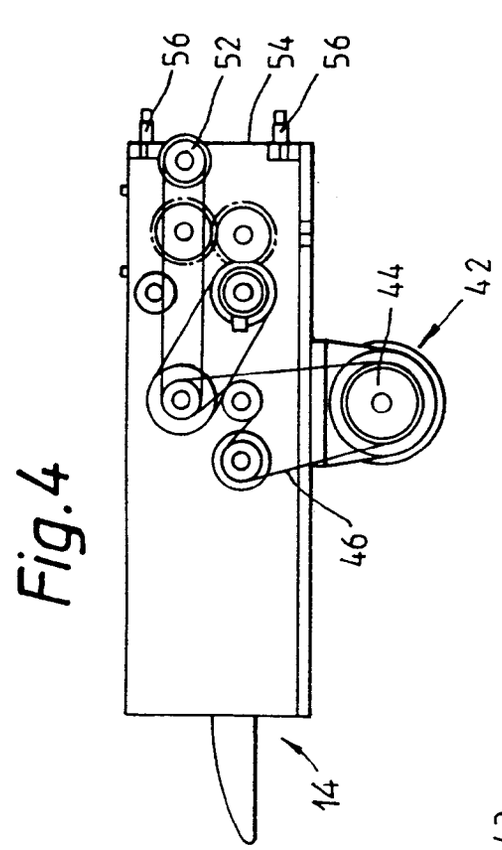


Fig.4

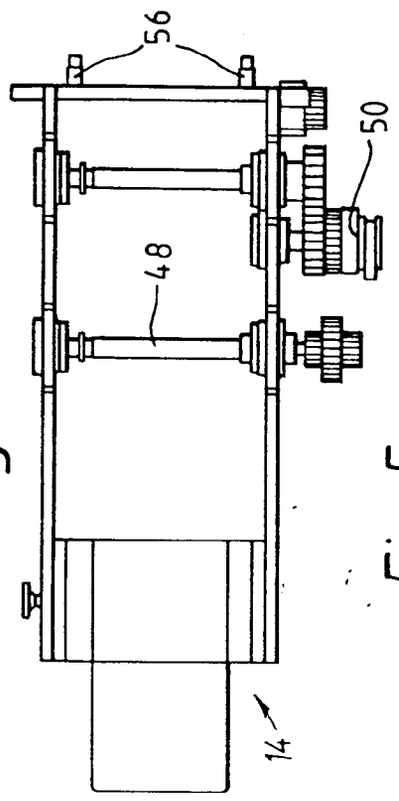


Fig.3

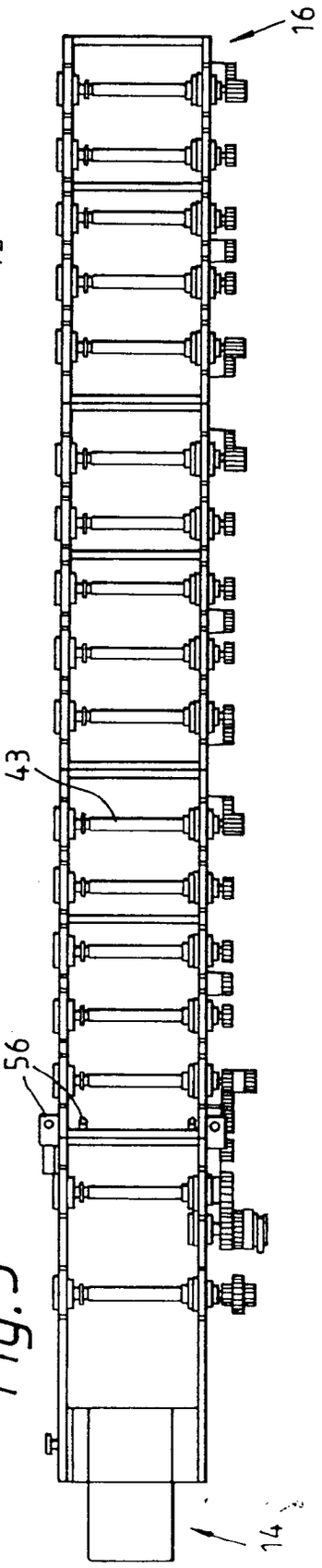


Fig.5

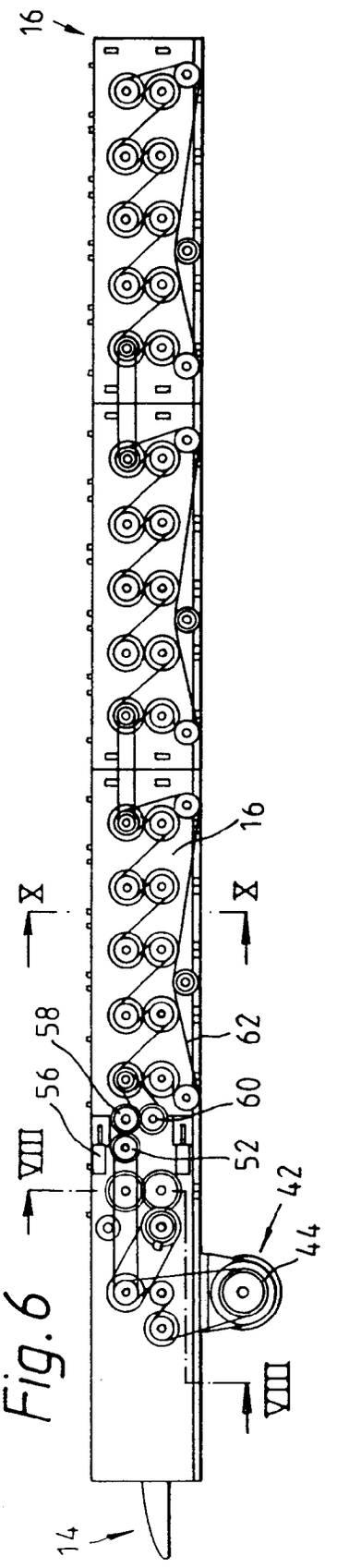


Fig.6

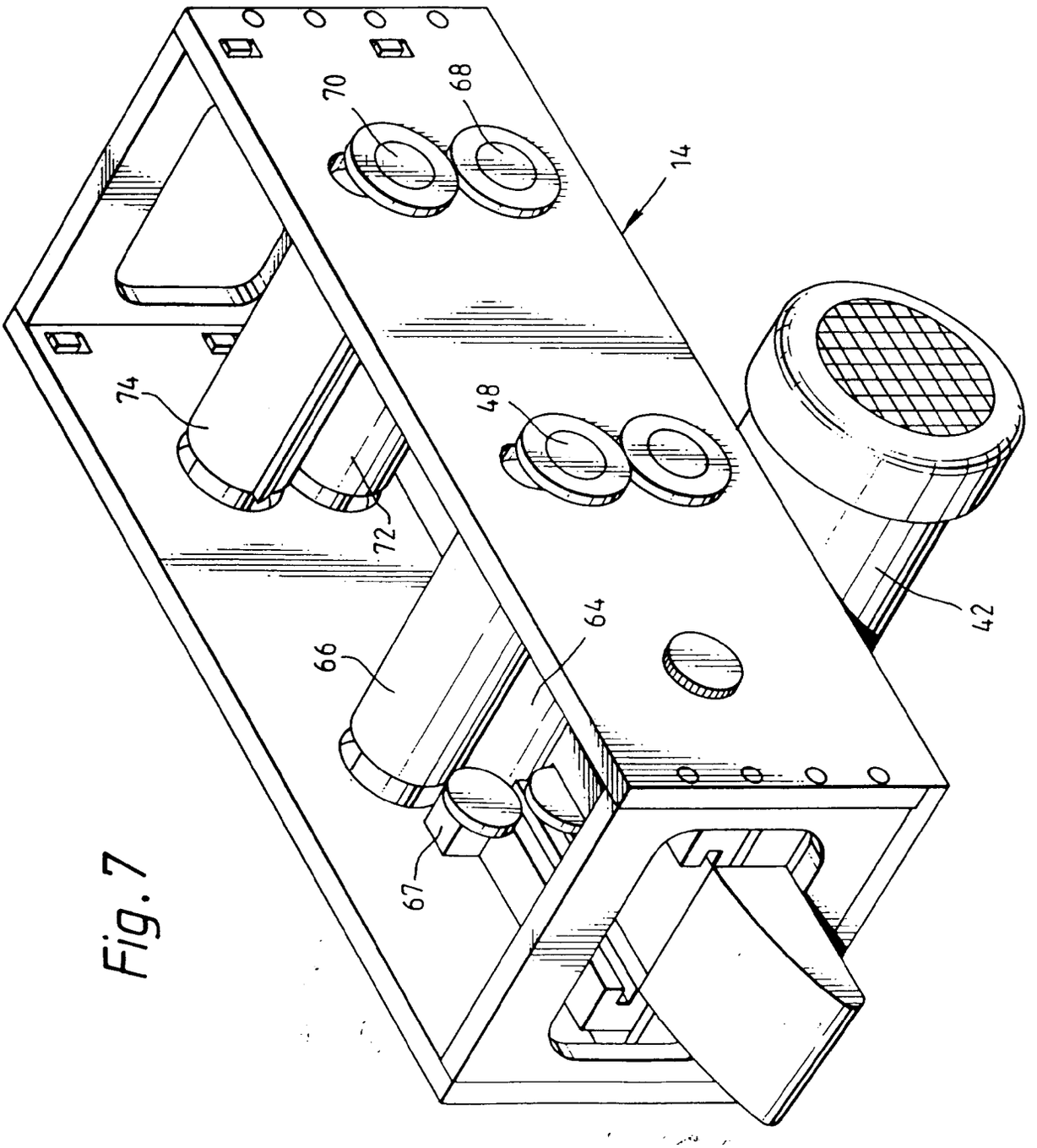


Fig. 7

Fig.8

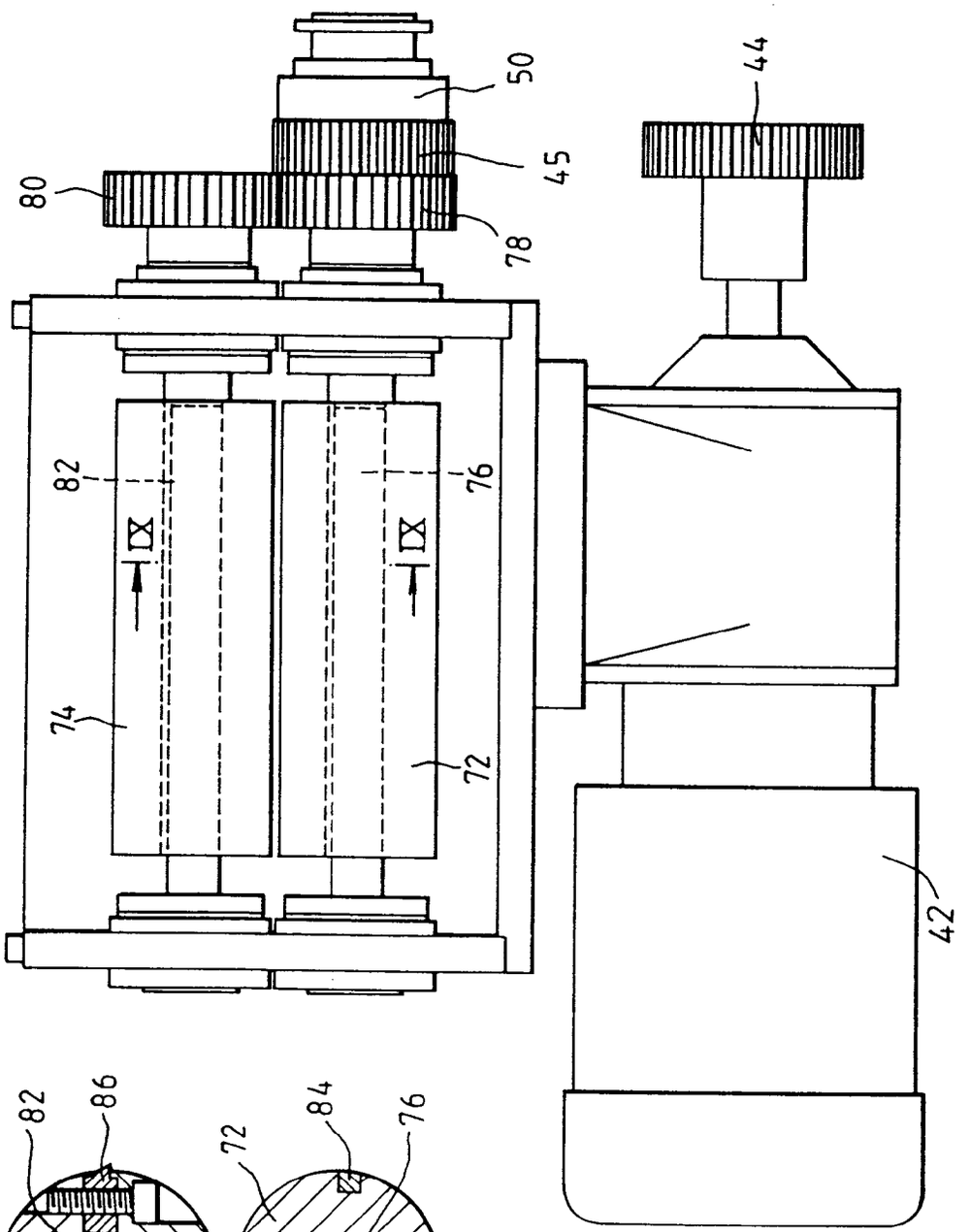


Fig.9B

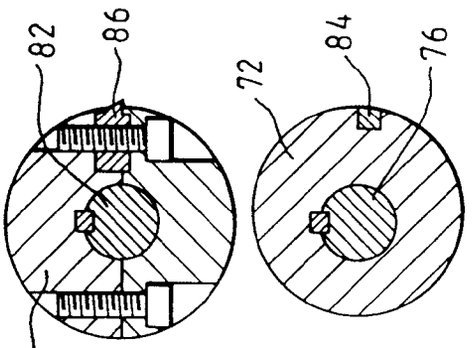


Fig.9A

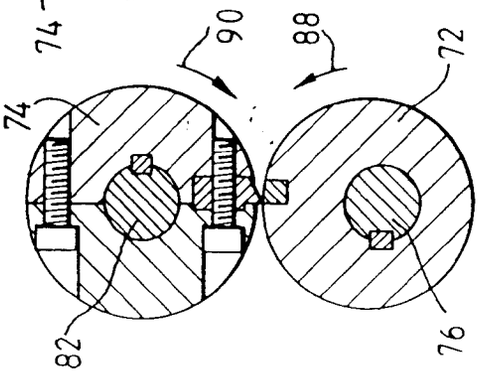


Fig.10

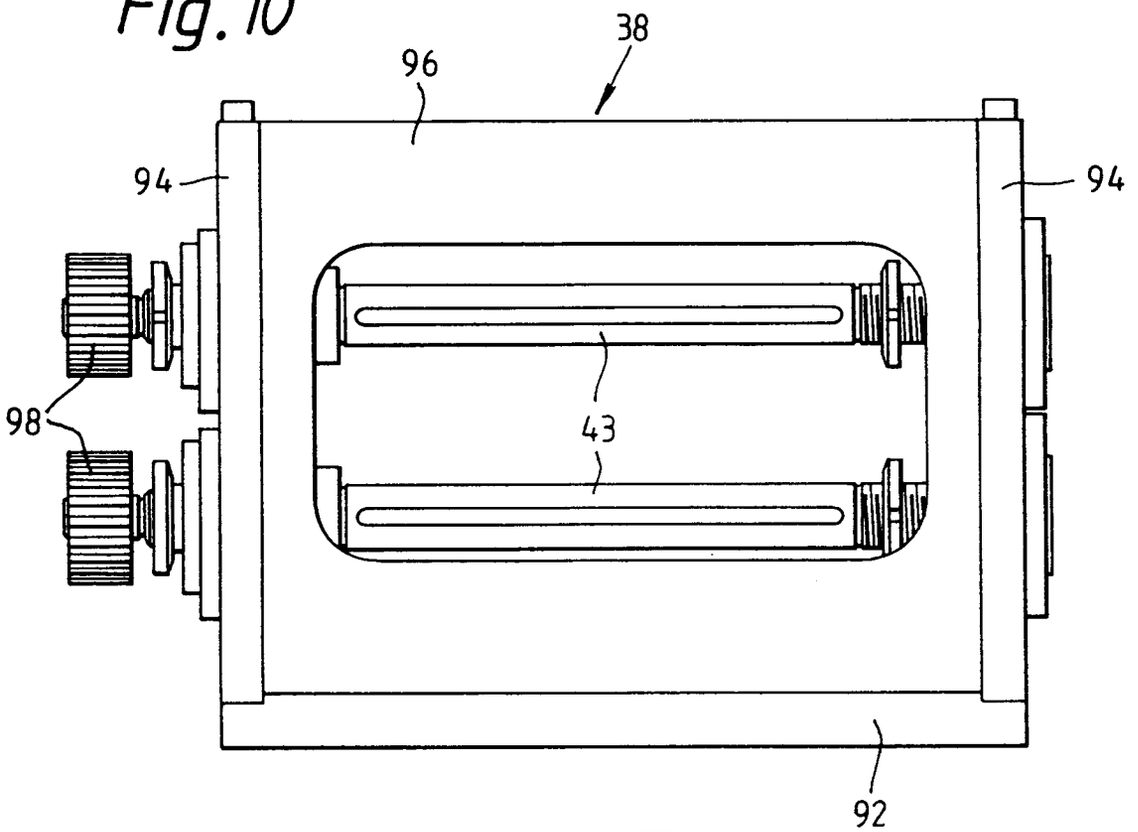
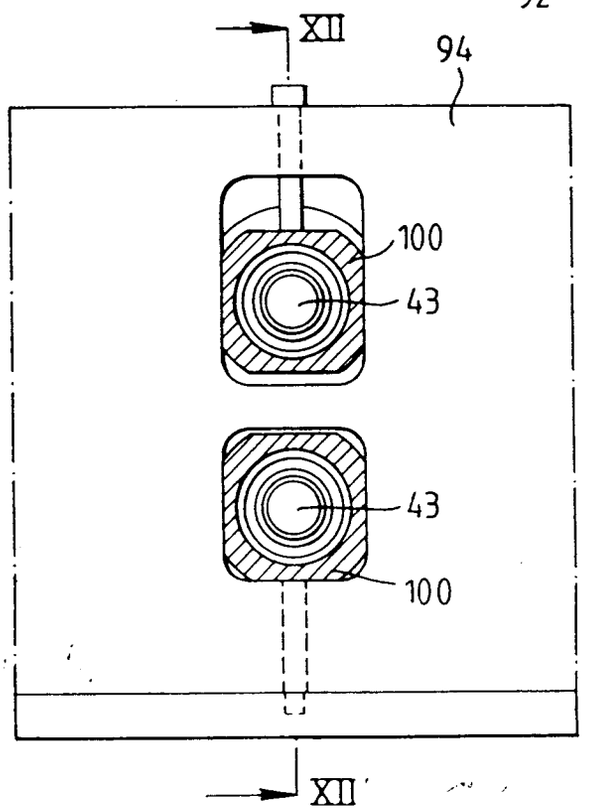


Fig.11



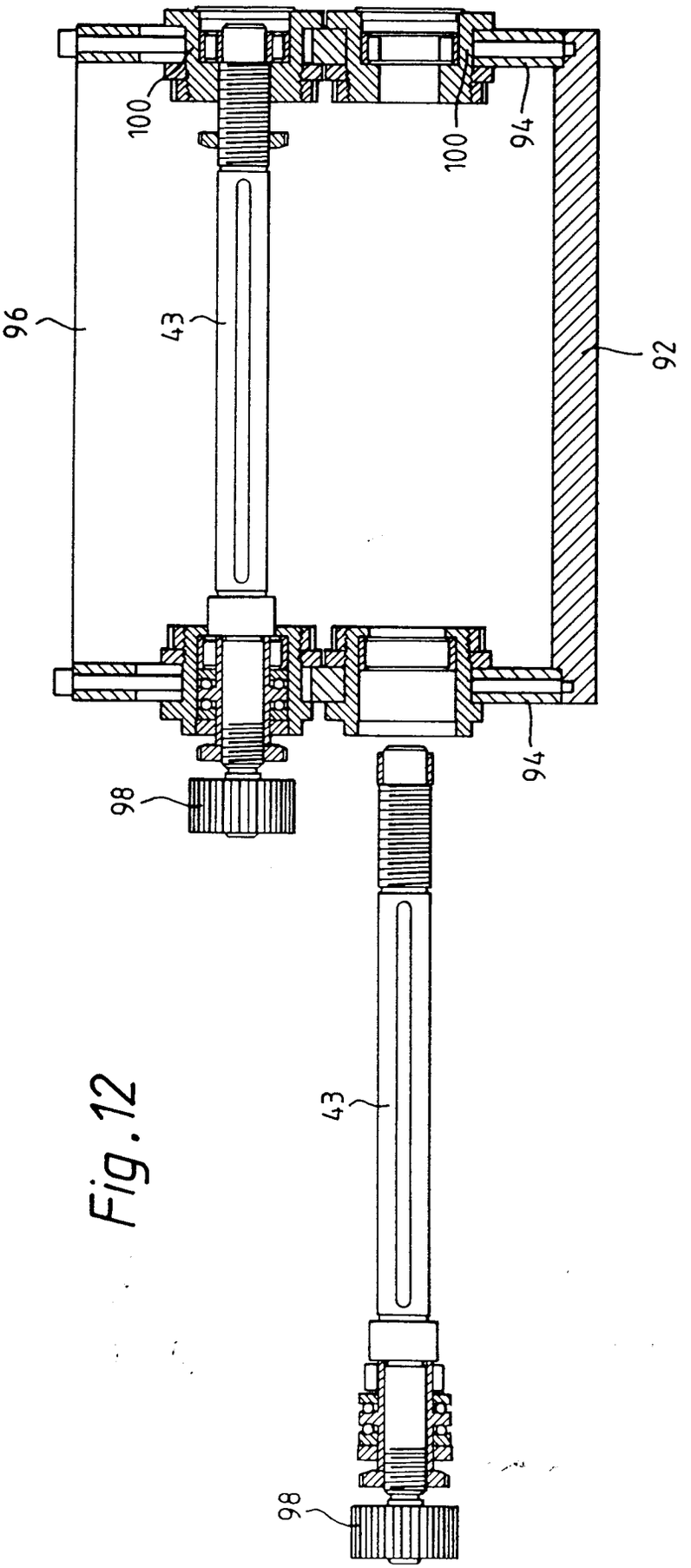
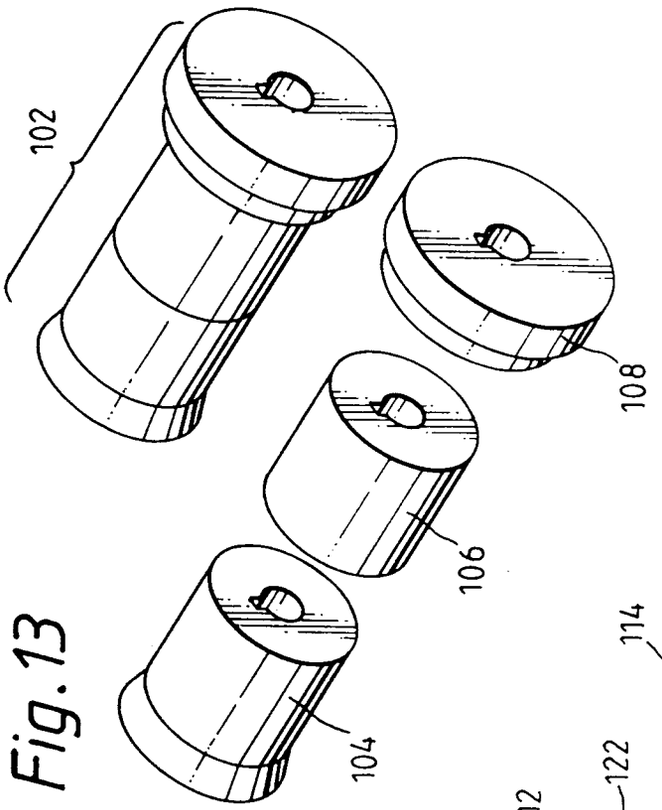


Fig. 12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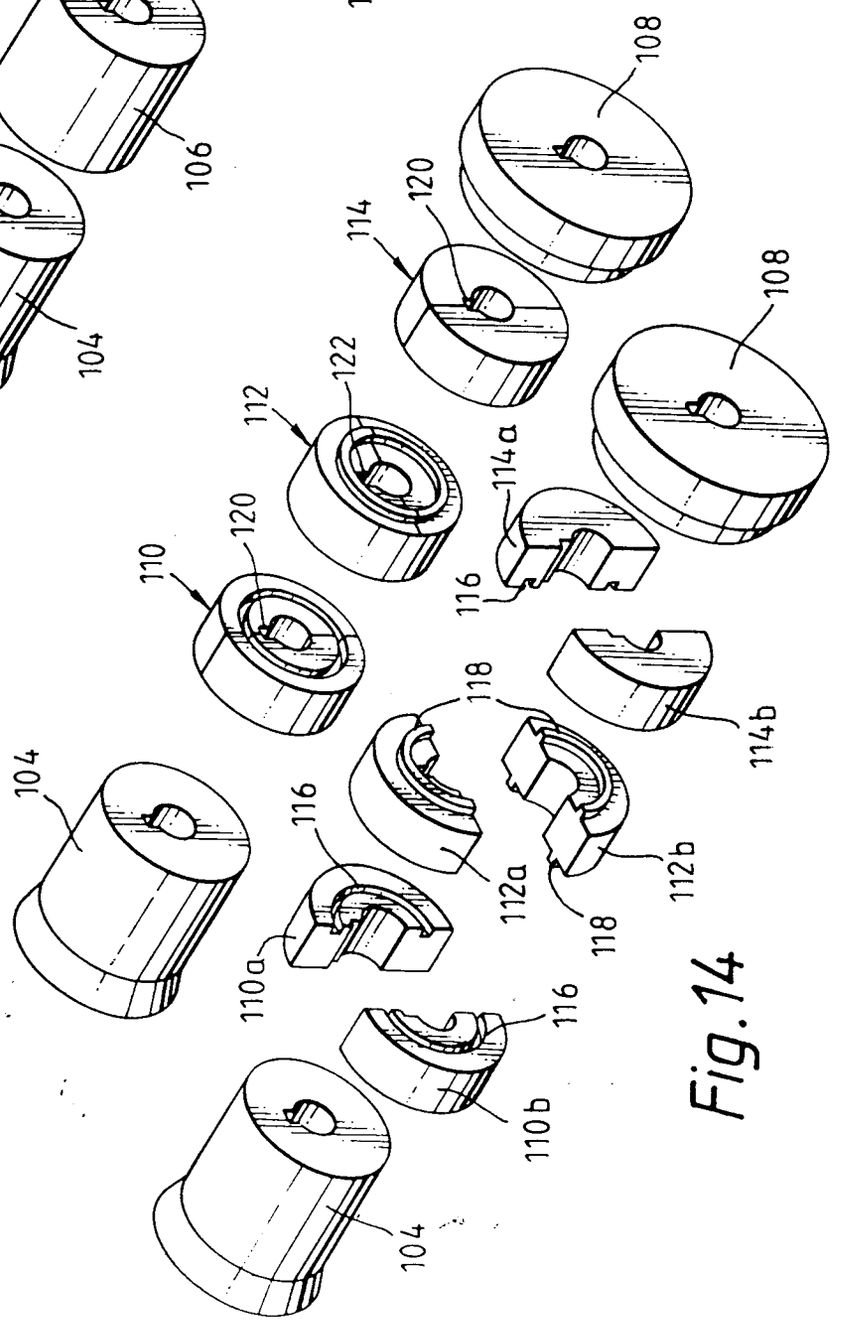
104

Fig. 13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110b
104

Fig. 14