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(54) Automatic control system for the start-up and ending of the winding of metallic wire onto reels.

(57) Automatic control system for the start-up and ending of the winding of metallic wire onto reels, the system being applicable to processes for the hot or cold drawing or rolling of metallic wire, which may have a round, oval, three-lobed, square, rectangular, hexagonal, etc. section, the system being fitted to the wire feed side of a machine (10) to wind metallic wire (25) on reels and comprising the following operational assemblies:

- a first assembly of automatic devices including in succession a unit (31) to position the wire, a gripper unit (39), a bending unit (45) and a shears unit (50), these units (31-39-45-50) being able to act on wire (25) wound on a reel (11), so as to obtain the step of ending the winding automatically,
- a second assembly of automatic devices including an inserter unit (58) and a clamp (67), these units (58-67) being suitable to act on one end of the wire (25) so as to obtain the step of start-up of the winding automatically,

the first assembly (31-39-45-50) and the second assembly (58-67) of automatic devices cooperating in their respective operational steps with a wire-guide device (17) borne on a movable unit (21) and including means (27) to grip the wire.

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AUTOMATIC CONTROL SYSTEM FOR THE START-UP AND ENDING OF THE WINDING OF METALLIC WIRE ONTO REELS

This invention concerns an automatic control system for the start-up and ending of the winding of metallic wire onto reels.

To be more exact, the invention concerns devices fitted to machines that wind metallic wire, and suitable to make fully automatic the steps of start-up and ending of the winding of the metallic wire on reels in the process.

The automatic devices of the invention can advantageously cooperate directly with plants which draw or roll metallic wire with a hot or cold process.

The word " wire" in this invention is to be understood as being used in its widest meaning to cover products having a round, oval, three-lobed, square, rectangular, hexagonal, etc. section.

The invention can also be employed with other wire materials having suitable characteristics.

The state of the art covers the problems linked to the winding of metallic wire on reels. This operation is carried out on winding machines which are usually connected to upstream machines that feed the wire. These winding machines include a wire-guide device that distributes the wire in layers on reels set in rotation on suitable headstocks.

When the packaging on the reel has been completed, the reel is halted and the wire has to be sheared so that the full reel can be removed.

The end of the wire wound on the reel has to be suitably positioned thereon so that it can be retained, whereas the other end of the wire has to be suitably positioned on an empty reel so that a new winding operation can be started.

So far as the present applicant is aware, the operations of starting and ending the winding are carried out at the present time by hand or by using partly automatic auxiliary means.

This situation entails long machine downtimes, considerable use of labour, the possibility of operational mistakes and also an interruption of working upstream during the process of producing and feeding the metallic wire. In other words, the output is unsatisfactory and leads to increases of production costs.

The present applicant has the purpose of overcoming the problems of the state of the art by providing an automatic control system for the start-up and ending of the winding of metallic wire, whereby the winding itself is made fully automatic.

The invention is set forth in the main claim, while the dependent claims describe various features of the invention.

The automatic control system according to the invention consists of a series of operational units able to cooperate with a wire-guide device according to required sequences which can be and are pre-set.

For this purpose the wire-guide device is capable not only of the usual straight traversing movement to lay the wire on the reel but also of a transfer movement to be positioned in relation to the operational units with which it has to cooperate momentarily.

The wire-guide device also contains means suitable to carry out the automatic operations for the start-up and ending of the winding.

In the end-of-winding step the feed of metallic wire is halted automatically and, if so required, the wire-guide transfers the yarn and clamps it in a required position.

A positioner unit too takes part in this operation and acts as a guide and control of the segment of wire in question, namely the segment between the reel and the wire-guide.

The positioner unit brings this segment of wire to a substantially straight position so as to cooperate with the operational units arranged between the positioner unit and the wire-guide.

These operational units include a gripper unit, a bending unit and a shears unit arranged cascade-wise from the positioner unit onwards towards the wire-guide.

The shears unit has the task of shearing the wire, while the bending unit has the task of conforming in a required manner the sheared end of the wire belonging to the package on the reel and the gripper unit has the task of clamping the wire during the above operations.

According to a preferred embodiment of the invention the gripper unit is capable of a motion suitable to transfer the bent end of the wire onto a device able to retain the wire on each reel.

When this latter operation has been carried out, the packaged reel is discharged automatically or is brought to a discharge position, while an empty reel is brought to the position for winding.

The wire-guide device, which has retained the end of the wire arriving from the feed apparatus located upstream of the winding machine, is now brought into cooperation with a wire inserter unit that has the task of positioning the wire in a required manner on the empty reel so that a new winding operation can be started.

According to a preferred embodiment of the invention the end of the wire being fed is brought to a clamping means borne on the reel actuation unit in the vicinity of the central cylindrical body of the reel and is retained in that clamping means.

That end of the wire is suitably released thereafter from the clamping means when the winding operation has begun.

The start-up of winding is brought about automatically when the wire-guide device, which has always kept contact with the wire being fed during the above operations, is brought back to the position arranged for the start-up of winding onto the reel.

The above operational steps are obviously repeated with automatic methods whenever a packaged reel is replaced.

These and other special features of the invention will be made clearer in the description that follows:

The attached figures, which are given as a non-restrictive example, show the following:

- Fig.1 is a diagrammatic elevation of a winding machine having the automatic control system according to the invention;
- Fig.2 is a plan view of the winding machine of Fig.1;
- Fig.3 is a view along the line of the arrow "A" of Fig.1;
- Fig.4 is a view according to the arrow "B" of Fig.3, in which some units have been omitted for the sake of clarity;
- Fig.5 is a front view of a wire-guide device according to the invention;
- Fig.6 is a partial vertical section along the line A-A of the wire-guide device of Fig.5;
- Fig.7 is a side view of a wire positioner unit;
- Fig.8 is a front view of the wire positioner unit of Fig.7;
- Fig.9 shows a gripper unit from above;
- Fig.10 is a front view along the line of the arrow "C" of the gripper unit of Fig.9;
- Fig.11 is a partly cutaway side view of a bending unit;
- Fig.12 is a side view of a shears unit;
- Fig.13 is a diagrammatic side view of a wire inserter unit;
- Fig.14 shows a vertical section of a clamp to engage the inserted wire.

In Figs.1 to 4 a winding machine 10 comprises the normal means to support and actuate a reel 11 being packaged, such as a headstock and tailstock 12, actuation motor 13, a drive plate 14 to draw the reel 11, a platform 15 which in this case has three working positions, means 16 to rotate the platform and other means which belong to the state of the art.

A wire-guide device 17 can be moved vertically according to the arrows 18 by means of first sliders 19, which cooperate with vertical guides 20 borne on a movable turret 21, which is equipped with controls for the working of the wire-guide device 17.

The turret 21 can be moved with a straight motion in a direction according to the arrows 22 at a right angle to the direction 18 of the wire-guide device 17 by means of second sliders 23 cooperating with horizontal guides 24.

The turret 21 in its righthand position shown in Figs.1 to 3 is in the operational step corresponding to the end of winding a package of wire on the reel 11.

When the turret 21 has been brought substantially to a lefthand position on the horizontal guides 24, the system begins operating in the step of start-up of winding on the reel 11.

The winding position during the take-up of wire on the reel 11 can coincide with one of the intermediate positions between the righthand and lefthand positions described above, which have been indicated merely as examples and may be different according to different design parameters. In the figures a metallic wire 25 being fed is shown as cooperating with the wire-guide device 17, which comprises essentially a pair of guide rolls 26 to guide the wire 25 and a gripper device 27 to grip the wire 25.

Figs.5 and 6 show an embodiment of the wire-guide device 17 wherein it is possible to see that the gripper device 27 consists of a movable gripper element 28 actuated by a jack 29 and a stationary abutment element, which may be a gripper roll 30 for instance.

In Figs.5 and 6 the gripper device 27 is shown in its closed condition during clamping of the wire 25, as happens substantially during the ending of winding and the traversing of the turret 21.

In Figs.1 and 2 and in a preferred embodiment shown in Figs.7 and 8 a positioner unit to position the wire 25 is referenced with 31 and is located advantageously in the vicinity of the reel 11 and, at the end of winding, has the task of bringing the wire 25 to a position suitable for cooperation with other units which will be described hereinafter.

For this purpose the positioner unit 31 consists preferably of a fork 32 (shown with lines of dashes in its inactive position in Fig.7) rendered movable so that it can be positioned astride the wire and can drag the wire to a required position.

In this example the motion of the fork 32 is an oscillatory motion actuated by a first jack 34 about a first pivot 33 and an oscillatory motion actuated by a second jack 37 about a second pivot 36 together with a lever 35.

The positioner unit 31 is connected to a suitable support structure 38 secured to the frame of the winding machine 10.

A gripper unit 39 is located in a position sub-

stantially superimposed on the positioner unit 31 and is shown only diagrammatically in Fig.1 and in detail in Figs.9 and 10 in a preferred embodiment.

The fork 32 of the positioner unit 31 in its position to engage the wire 25 clasps both sides of the gripper unit 39 at the level of the grippers 40 so as to move the wire 25 between the grippers 40. During this movement of the wire 25 the gripper unit 39 is aligned with the wire-guide device 17, thus obtaining a substantially straight segment of wire 25.

The grippers 40 of the gripper unit 39 consist of a stationary element 140 and a movable element 240, which can be rotated about a pivot 41 by a small piston/cylinder actuator 42.

The grippers 40 are installed on a column 43 connected to a stationary support 44 borne on the frame of the winding machine 10. The column 43 can rotate in relation to the stationary support 44 in the manner and for the reasons which will be explained later.

A bending unit 45, an embodiment of which is shown in Fig.11, is positioned immediately upstream of the gripper unit 39 in the direction of feed of the wire 25 and is aligned with the gripper unit 39. This bending unit 45 consists of a bending roller 46 fitted eccentrically on a rotary support 47 and of an opposed roller 48; the method of working of the unit 45 is well known in the state of the art.

The rotary support 47 is rotated by a suitable motor 49, and the rotation enables the end of the wire 25, sheared beforehand as we shall explain, to be conformed in a required profile, U-shaped for instance.

A shears unit 50, which in this case is of the type shown in Fig.12, is included upstream of the bending unit 45 and aligned therewith. The shears unit 50 is arranged vertically and comprises a stationary blade 51 and a movable blade 52 actuated by its own actuator means 53 so as to shear the wire 25 positioned between the blades 51-52.

Introduction of the wire 25 between the blades 51-52 and between the bending roller 46 and opposed roller 48 is always carried out beforehand at the same time by the positioner unit 31.

The shearing is carried out while the wire 25 is held in the gripper device 27 of the wire-guide device 17 and in the gripper unit 39.

When shearing has taken place, the bending unit 45 is actuated, as we said earlier, to conform the sheared end of the wire 25 wound on the packaged reel.

When bending has been carried out, the gripper unit 39 takes action once more to take the suitably conformed sheared end of the wire 25 to a pre-set position near the reel 11. This is achieved by rotation of the column 43 according to the arrows 54, the column 43 being solidly fixed to a movable element consisting of a pair of connection plates 55 coupled by a vertical segment 47; the movable element can be rotated about a pivot 57 by means of its own hub 73.

Rotation according to the arrows 54 is achieved by actuation of a jack 56, which causes rotation (see the position, shown with lines of dashes, of the jack 56 in Fig.9) of the movable element about the pivot 57.

The end of the wire 25 can be engaged advantageously on an appropriate support included on the reel 11 at the time when the headstock and tailstock 12 of the winding machine 10 are withdrawn from the reel 11.

During this operation the reel 11 carries out a downward vertical travel so as to rest on the platform 15 and can engage the end of the wire 25 automatically in this way.

The above operations complete the end of winding and the reel thus packaged can be removed.

From here on we shall describe the arrival of an empty reel 11 at the winding position; the other end of the sheared wire still in the wire-guide device 17 has to be engaged on this empty reel 11. The engagement is performed by an inserter unit 58, to which the end of the wire 25 is brought by displacement of the movable turret 21 to its lefthand position in Fig.3.

In this position the end of the wire 25 is borne on an insertion gripper 59 belonging to the inserter unit 58, the wire 25 remaining also within the wire-guide device 17 and in an unclamped condition in the gripper device 27.

The inserter unit 58 is shown diagrammatically in Fig.4 in its inactive position (with continuous lines) and in its introduction position (with lines of dashes) while it is shown in detail in Fig.13.

The inserter unit 58 comprises a stationary base 60, on which is pivoted a first lever 61 actuated by its jack 62 so as to rotate about a pivot 63. A second lever 65 is pivoted at 64 on the first lever 61 and is secured to the insertion gripper 59.

The second lever 65 is rotated about the pivot 64 by a jack 66 secured to the first lever 61.

Fig.13 shows with lines of dashes the position taken up by the inserter unit 58 during operations. Such operations bring the end of the wire 25 to the reel 11, for instance in a clamp 67 borne on the drive plate 14 and arranged on the upper flange 68 in correspondence with the central cylindrical body of the reel 11.

The clamp 67 may be of a type shown in a vertical section in Fig.14, which shows jaws 69 that can be actuated laterally by means of rams 70 and a central return spring 71 when the jaws 69 are to be opened.

The clamp 67 is actuated when the end of the

wire 25 is inserted between the jaws 69 by the inserter unit 58; thereafter the clamp 67 keeps the wire 25 clamped during the first step of winding a required number of coils of wire onthe reel 11.

The clamp 67 can be opened thereafter at a required time, which in any case will be earlier than the start-up of the operations to end winding of the wire 25 on the reel 11.

When the step of introduction of the end of the wire 25 into the clamp 67 has ended, the movable turret 21 with the relative wire-guide device 17 is brought to the position for winding wire 25 on the reel 11.

The winding machine 10 of the invention is suitably equipped with appropriate devices to actuate and control the operational steps of the automatic cycle; this equipment can be governed advantageously by a computerized system.

We have described here a preferred embodiment of the invention, but it is clear that many changes and variants acn be applied and included by a person skilled in this field without thereby departing from the scope of the invention as claimed.

Claims

1. Automatic control system for the start-up and ending of the winding of metallic wire onto reels, the system being applicable to processes for the hot or cold drawing or rolling of metallic wire, which may have a round, oval, three-lobed, square, rectangular, hexagonal, etc. section, the system being characterized in that it is fitted to the wire feed side of a machine (10) to wind metallic wire (25) on reels and comprises the following operational assemblies:
   - a first assembly of automatic devices including in succession a unit (31) to position the wire, a gripper unit (39), a bending unit (45) and a shears unit (50), these units (31-39-45-50) being able to act on wire (25) wound on a reel (11), so as to obtain the step of ending the winding automatically,
   - a second assembly of automatic devices including an inserter unit (58) and a clamp (67), these units (58-67) being suitable to act on one end of the wire (25) so as to obtain the step of start-up of the winding automatically,

   the first assembly (31-39-45-50) and the second assembly (58-67) of automatic devices cooperating in their respective operational steps with a wire-guide device (17) borne on a movable unit (21) and including means (27) to grip the wire.

2. System as claimed in Claim 1, in which the unit (31) to position the wire consists of a fork (32) connected to means (33-35-36) that obtain a double oscillation.

3. System as claimed in Claim 1 or 2, in which the unit (31) to position the wire is actuated by jacks (34-37).

4. System as claimed in any claim hereinbefore, in which the gripper unit (39) consists of a stationary support (44) and a movable column (43) that bears grippers (40).

5. System as claimed in any claim hereinbefore, in which the movable column (43) can rotate (54) in relation to the stationary support (44).

6. System as claimed in any claim hereinbefore, in which the grippers (40) comprise reciprocally movable (42) means (140-240).

7. System as claimed in any claim hereinbefore, in which the gripper unit (39) is positioned substantially superimposed on the positioner unit (31).

8. System as claimed in any claim hereinbefore, in which the bending unit (45) consists of a bending roller (46) and an opposed roller (48).

9. System as claimed in any claim hereinbefore, in which the bending roller (46) is installed eccentrically on a rotary support (47) and has its own motor means (49).

10. System as claimed in any claim hereinbefore, in which the shears unit (50) consists of a stationary blade (51) and a movable blade (52) having its own actuation means (53).

11. System as claimed in any claim hereinbefore, in which the gripper unit (39), bending unit (45) and shears unit (50) are substantially aligned in their inactive position.

12. System as claimed in any claim hereinbefore, in which the gripper unit (39), bending unit (45) and shears unit (50) are arranged in reciprocal succession outwards, starting from the reel (11) of wire.

13. System as claimed in any claim hereinbefore, in which the inserter unit (58) consists of a pair of levers (61-65) connected to means (62-63-64-66) that provide a double oscillation thereof.

14. System as claimed in any claim hereinbefore,

in which one of the pair of levers (65) bears a gripper (59) to insert the wire (25).

15. System as claimed in any claim hereinbefore, in which a drive plate (14) to drive the reel (11) bears a clamp (67) that retains the wire (25).

16. System as claimed in any claim hereinbefore, in which the clamp (67) can be actuated (70) momentarily from outside.

17. System as claimed in any claim hereinbefore, in which the inserter unit (58) is arranged laterally to the first assembly (31-39-45-50) of automatic devices.

18. System as claimed in any claim hereinbefore, in which the movable unit (21) that bears the wire-guide device (17) comprises means (23-24) for its sliding movement (23-24) at a right angle (22) to the direction (18) of movement of the wire-guide device (17) on the movable unit (21).

19. System as claimed in any claim hereinbefore, in which the gripper device (27) to grip the wire (25) consists of a stationary abutment element (30) and of a movable gripper element (28) actuated by its own actuation means (29).

20. System as claimed in any claim hereinbefore, in which the wire (25) is kept positioned in the wire-guide device (17) during the steps of the ending and start-up of winding.

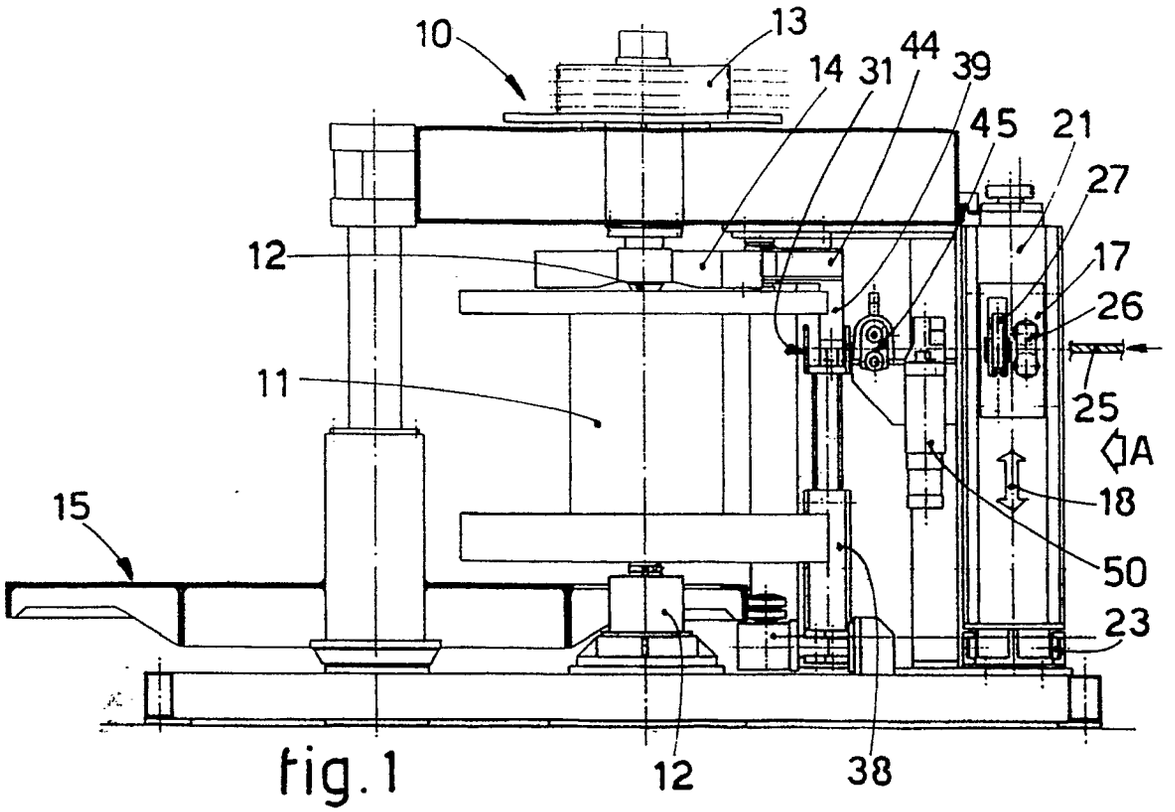
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fig.1

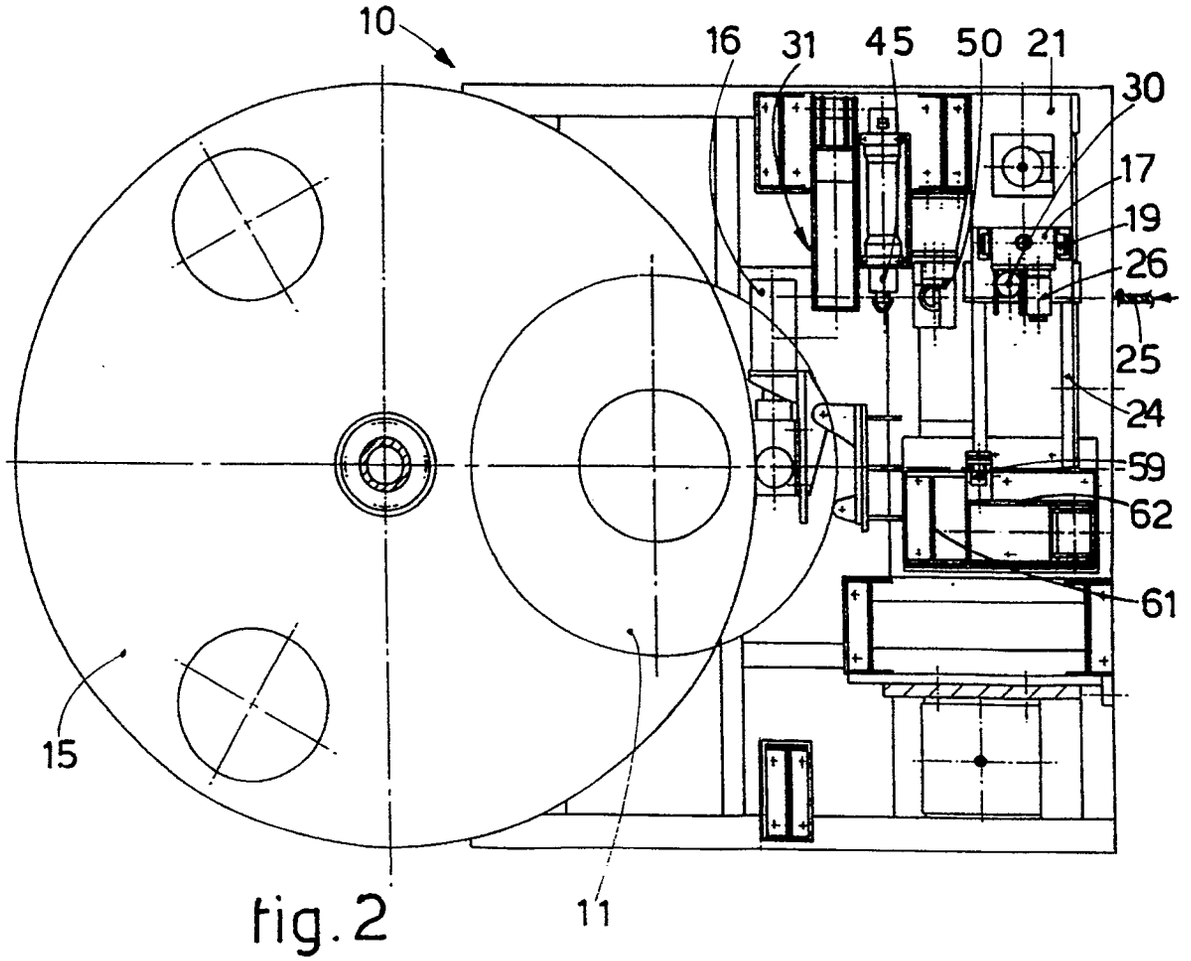
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fig.2

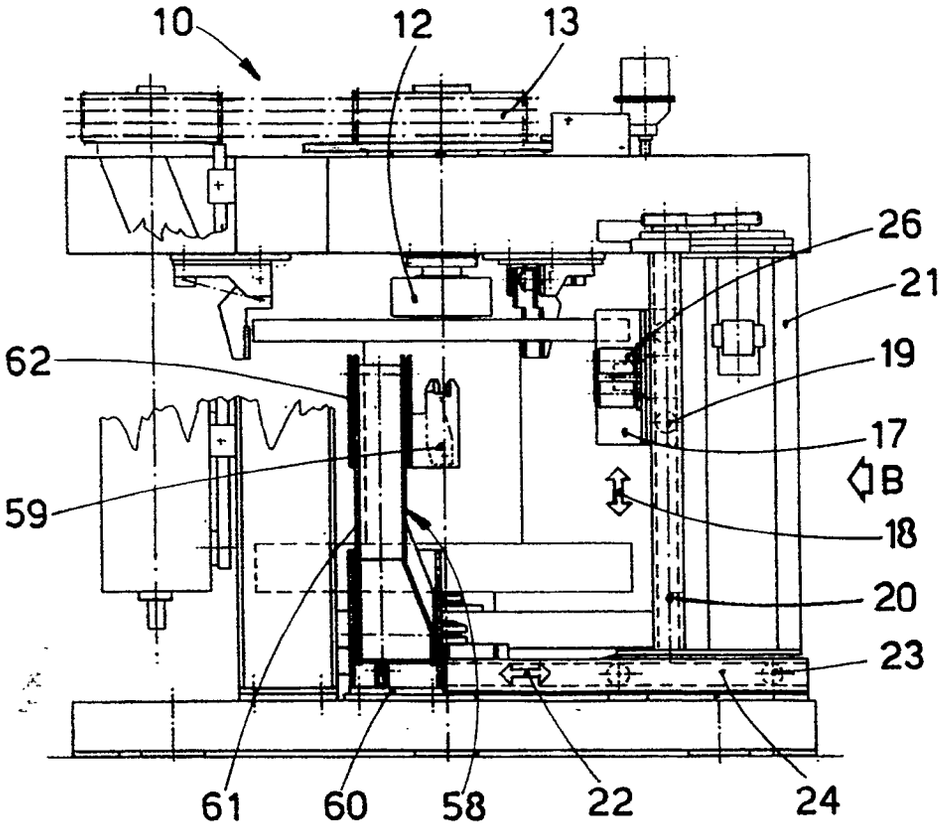
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fig.3

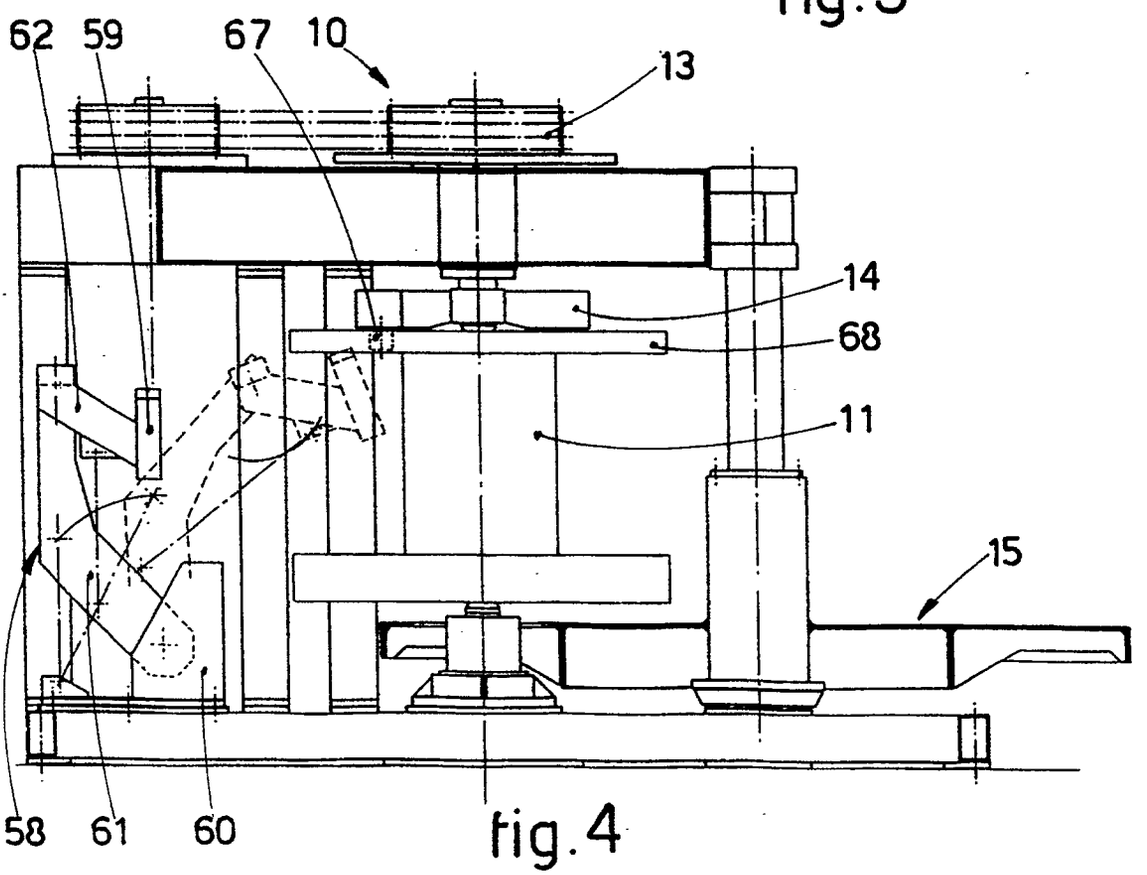
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fig.4

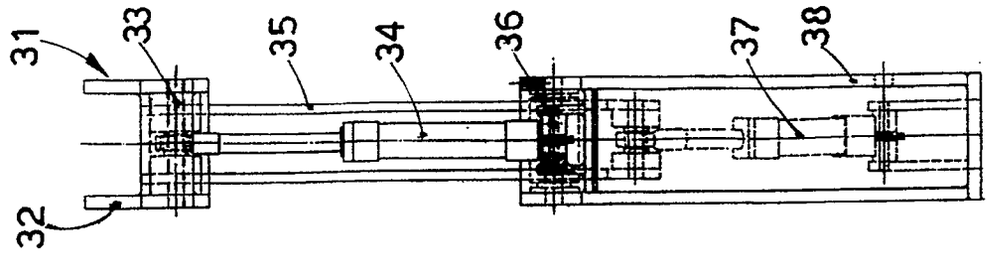


fig.8

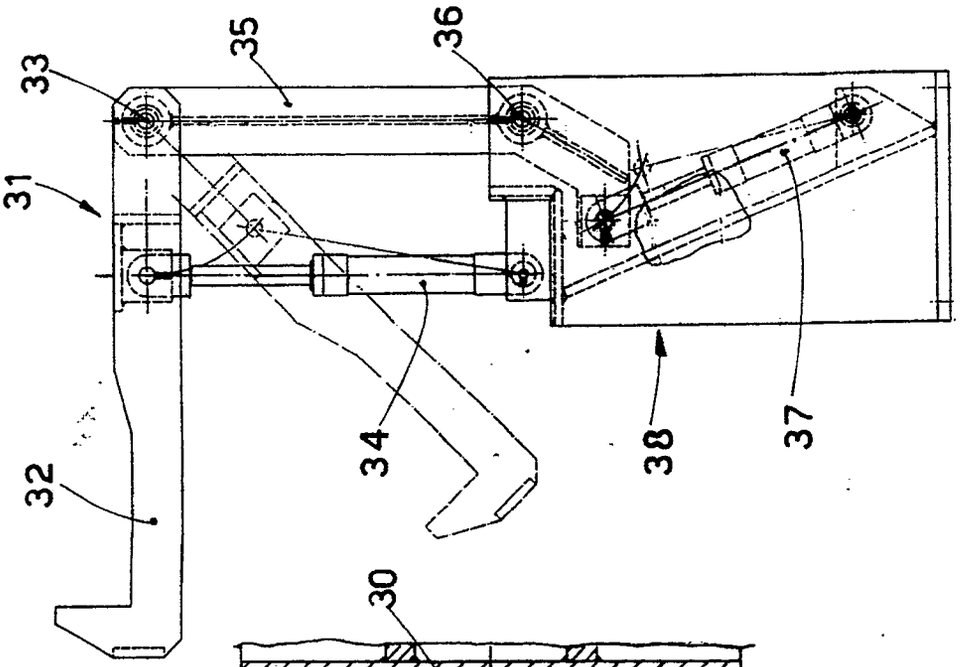


fig.7

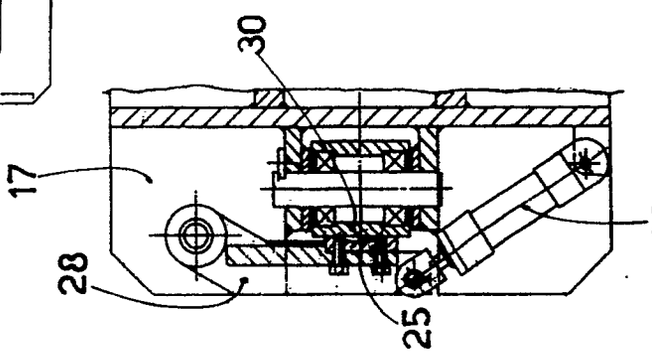


fig.6

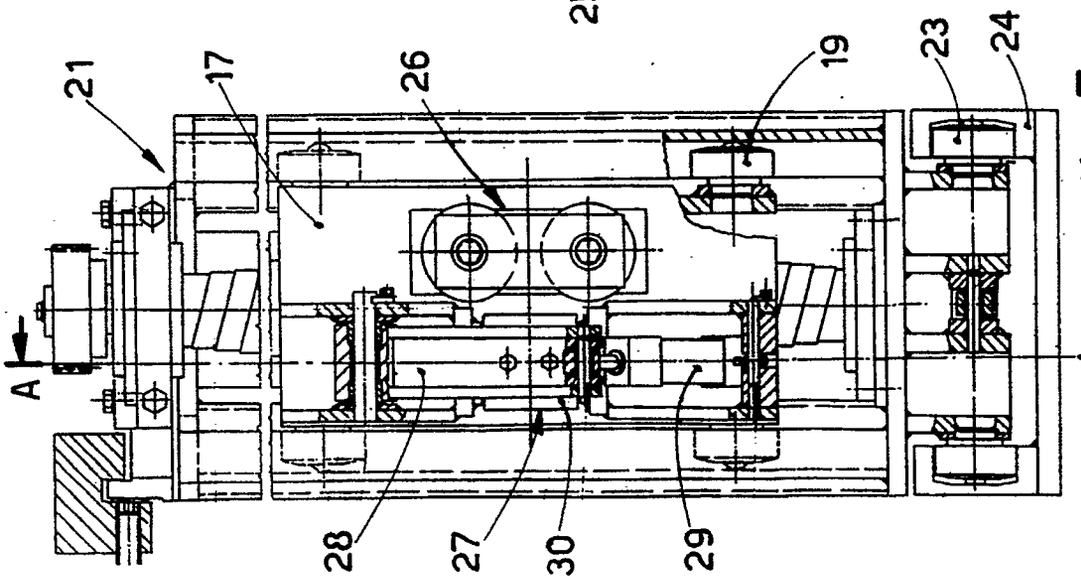


fig.5

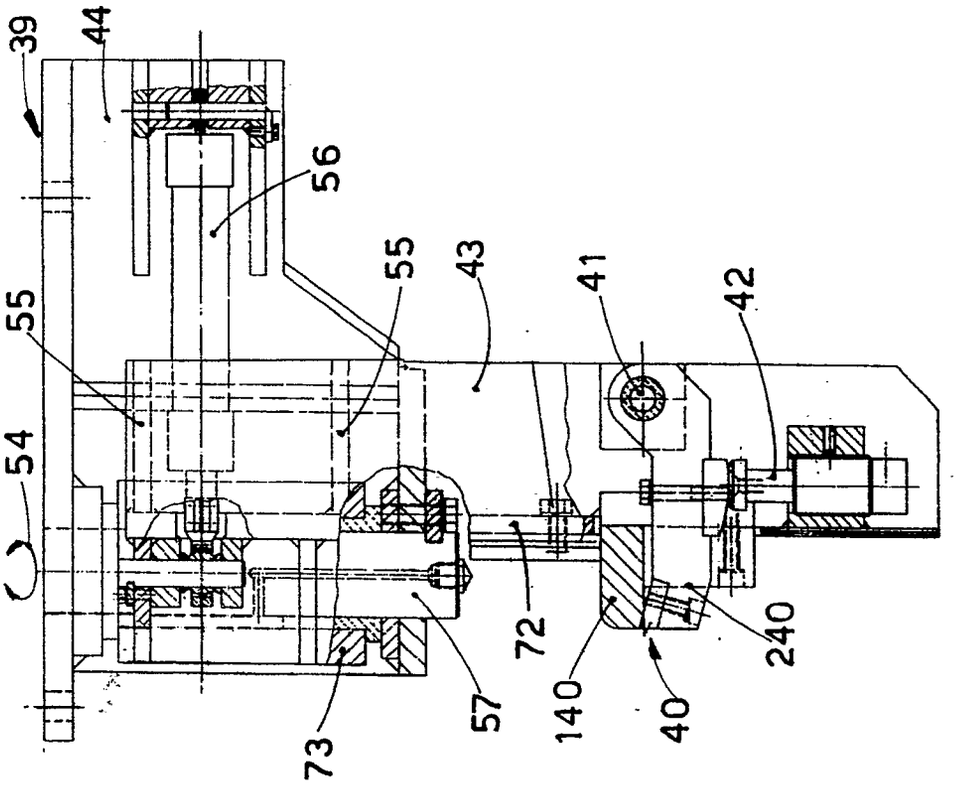


fig.10

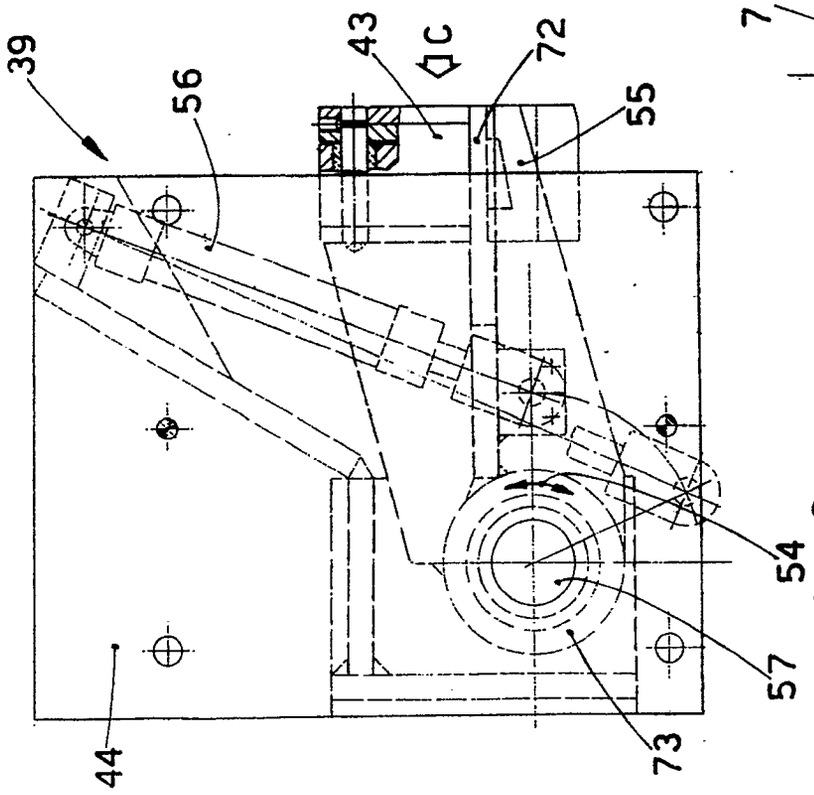


fig.9

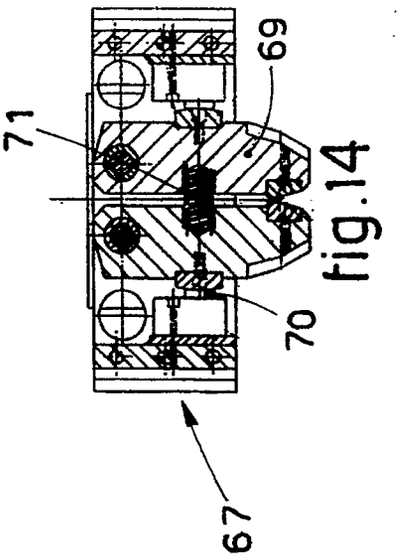


fig.14

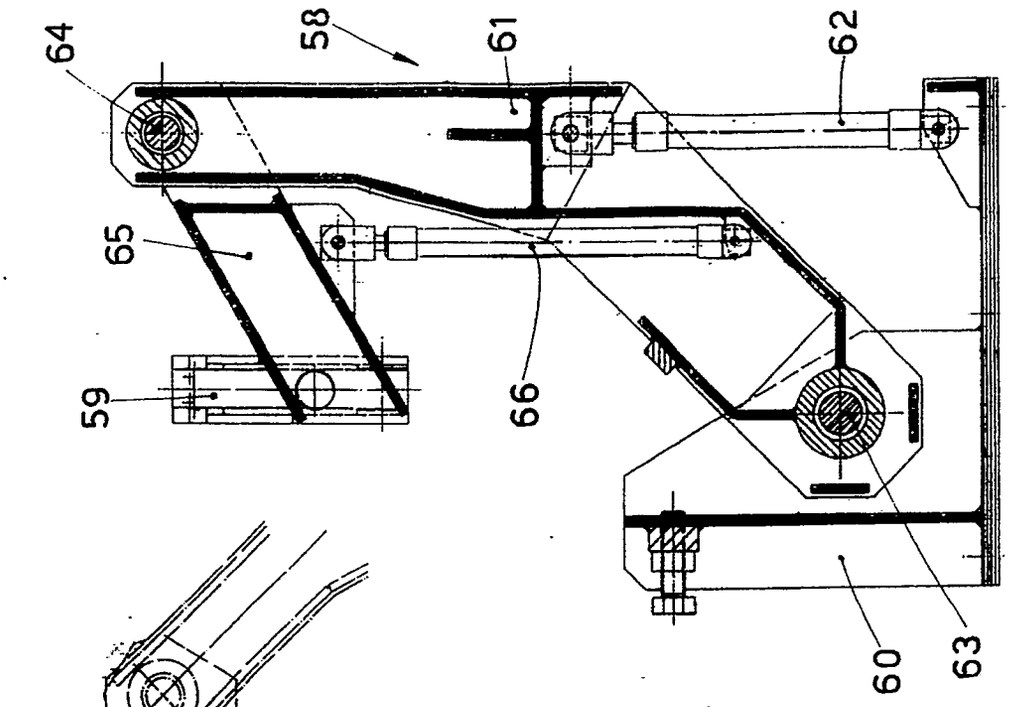
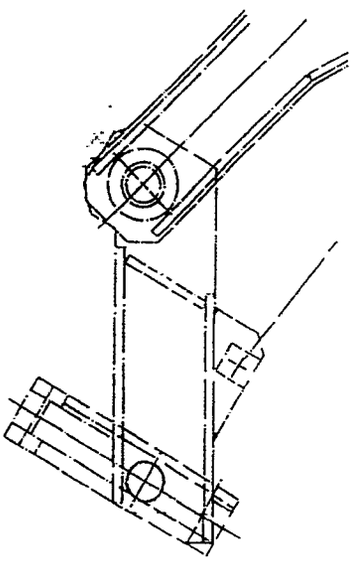


fig.13



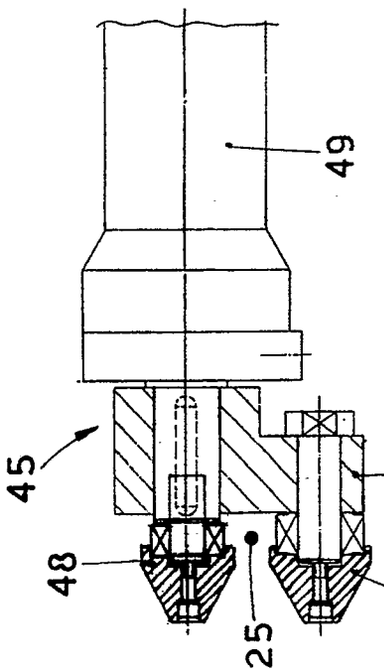


fig.11

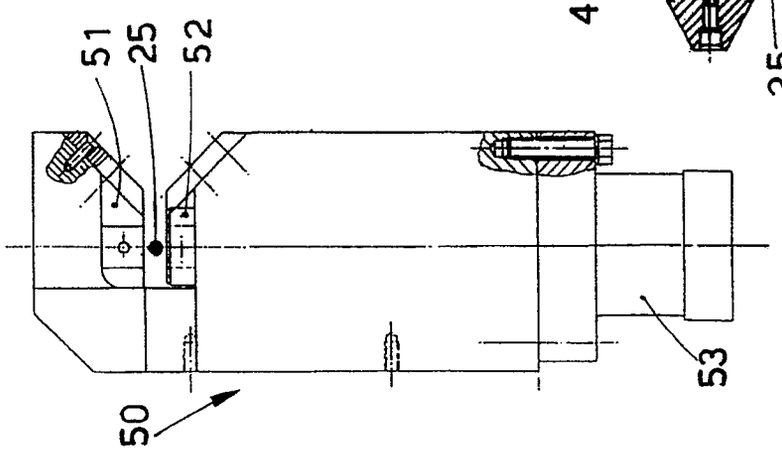


fig.12

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 12 5227

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.5)
A	PATENT ABSTRACTS OF JAPAN, vol. 9, no. 213 (M-408)[1936], 30th August 1985; & JP-A-60 71 468 (NICHIDEN KIKAI K.K.) 23-04-1985 * Abstract; figures 5-10 *	1,10-12	B 21 C 47/24 B 21 C 47/02
A	EP-A-0 142 813 (S.A.M.P.) * Page 13, lines 1-9; page 14, lines 9-29; page 15, lines 14-29; page 16, lines 6-23; claims 6,7,12,13; figures 10-18 *	1,4-7,10	
A	GB-A-1 152 698 (VSESOJUZNY NAUCHNO-ISSLEDOVATELSKY) * Claims 1,6; figures 1-6 *	1	
A	US-A-3 994 058 (SASAKI) * Abstract; claims 1-4; figures 15-16 *	1,13	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)
B 21 C B 65 H

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	10 May 91	THE K.H.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same catagory
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention

E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

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