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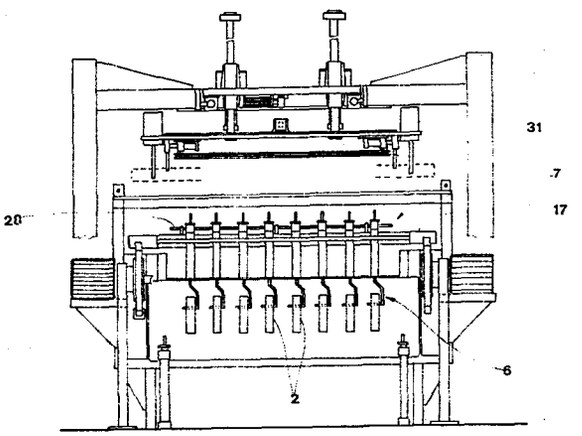
(54) Plant designed particularly for carrying out heat-treatment on crawler track-link.

(57) The invention relates to plant designed particularly for carrying out heat-treatment on crawler track-links. Links (2) are taken from being forged while still hot, and subjected to a hardening-and-tempering process taking place along a production line incorporating two furnaces, along which the links themselves are conveyed in orderly fashion, slung up each one on a single hook (6); there being a given number of such hooks for each carrier (7) used in the plant, each one of which capable of turning about its own axis, and of being locked into a given position with respect to the carrier (7) itself. Provision is made for the carriers' (7) being transferred along the line one behind the next, automatically, and in orderly fashion.



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Plant designed particularly for carrying out heat-treatment on crawler track-links

The invention described herein relates to plant designed particularly for carrying out heat-treatment on the links used in crawler tracks.

The invention sets forth automatic means for carrying into effect a heat-treatment process for track-links already disclosed in an application for Italian patent n° 48934A/81.

The object of the invention described herein is that of providing plant capable of carrying out the process aforesaid in endless cycle, the links themselves undergoing treatment through a succession of stages by being carried along a production line by a simple and functional means of conveyance.

An advantage of the invention described herein is that it makes provision for recovery of the gases given off in the hardening furnace, with the end in view of their being utilised in the subsequent tempering stage furnace. This and other advantages will be seen to be achieved by the invention, which relates to plant designed particularly for carrying out heat-treatment on crawler

track links by means of a process in which the links —picked up from being forged and still at high temperature— undergo a succession of stages in the following sequence:

a) initial cooling to a temperature of between 600 and 800° C for stabilisation purposes;
b) re-heating to stable hardening temperature;
c) rapid quenching (interrupted, so-called) to a temperature of between 350 and 550° C;
d) re-heating to tempering temperature;
e) cooling to ambient temperature;

the plant being characterised in that these stages are carried out along a production line incorporating two tunnel-type furnaces for the purpose of implementing stages b) and d), and along which the links themselves are conveyed in orderly fashion, each suspended from one of a number of identical hooks adjustable for direction and fitted in given number to respective bars, or carriers, in such a way that each may turn about its own axis during stages c) and e) only; provision being made for means by which to transfer said carriers the entire length of the line, automatically, and in orderly fashion.

An embodiment of the plant will now be described by way of example, with the aid of the accompanying

drawings, in which:

-fig 1 is a schematic representation of the plant, seen in plan;

-figs 2a and 2b show respective first and second parts of a longitudinal section through the plant's central vertical plane;

-fig 3 is the section through II-II in fig 2a;

-fig 4 shows a part of the section through III-III in fig 2a, seen on enlarged scale;

-fig 5 shows a view from the right-hand side, of the lower region of fig 4;

-fig 6 shows a section through IV-IV in fig 4, seen on enlarged scale;

-fig 7 shows a section through V-V in fig 4, which illustrates the same detail as in fig 6 in enlarged scale, and in a different working position.

With reference to the drawings, 1 denotes the press in which forging of the links 2 takes place, after which the links themselves are taken on to an infeed station 3 by a conveyor 4. Once at the infeed 3, the single links are arranged —slung up, in fact— by an automatic loader 5 onto respective hooks 6 disposed in the appropriate direction for carrying out this said loading operation. The single hooks 6 are fitted up to special carriers 7 in given number —8 per carrier, for instance— and each hook is able to turn about its own axis.

Each of the carriers 7 is provided with eight hollow supports 8 spaced apart at like distance one from the next and disposed on rectilinear and vertical axes, within which the cylindrical shanks 9 of the single hooks 6 are accommodated, coaxial therewith, and free to rotate therein. The bent portion of the hook itself, denoted 10, extends downward from each respective hollow support 8 aforesaid.

The carrier 7, which is to all intents and purposes a rectilinear bar, exhibits a cruciform cross-section throughout its rectilinear axial length, with the exception of the two ends 17, which are embodied cylindrically so as to enable both setting down and picking up of the carrier as a whole.

Empty carriers arrive at the infeed station 3 by way of a conveyor loop 11 along which they are borne singly by appropriate trolleys 12.

A loading-unit 13 provided with two prehensile elements 14 and 15, one following the other, is designed to carry through the following sequence of operations:

- pick-up of single carriers 7 discharged by trolley 12 by means of prehensile element 14;
- lifting, carrying forward one step, and setting down of the carrier onto bearer 16;

- receding by one step of the loading-unit 13 and orientation in the same direction of all hooks 6 suspended from the carrier already on bearer 16 by dint of its receiving a load of links, whilst a further trolley 12 arrives at the pick-up station with another empty carrier 7;
- lifting of the now loaded carrier by means of prehensile element 15, carrying forward one step of same, and setting down thereof onto a walking-beam type conveyor 19.

The operation by means of which the hooks 6 suspended from a single carrier 7 are caused to face in the same direction is brought about by a contrivance fitted to loading-unit 13 which comprises a number of orienting devices 18, each designed to work a single hook 6 suspended from the carrier 7 beneath. Each orienting device 18 comprises a shaft 20, this disposed with axis vertical and fitted at bottom with an eccentric pin 21 whose function is that of interacting with an angled appendage 22 offered by the uppermost part of each hook 6. The shafts of each of the orienting devices 18 are interconnected in reciprocal fashion for the purposes of rotation by way of chains 23 which engage with sprockets 24.

From its initial position A, the single eccentric

pin 21 travels to position B upon rotation of its shaft 20, and in so doing comés up against appendage 22 aforesaid offered by hook 6, whereupon the latter is carried along until coming up in its turn against afixed stop 25. It is envisaged that said angled appendage 22 lie within a vertical plane disposed at 90° to the vertical plane containing the bent portion 10 aforesaid of hook 6.

Full carriers 7 are transferred forward by said conveyor 19 through the entire length of the cooling area 26, wherein the links —hanging from their individual hooks 6 on carrier 7— undergo a first cooling designed to bring about a moderate reduction in temperature to between 600 and 800° C.

Provision is made for overhead guides 27 which, by coming into contact with appendages 22, maintain the hooks such that their bent portions 10 lie within the same plane as that which contains the axis of the carrier 7 itself from where they hang.

On exiting from the conveyor 19, all the hooks 6 of the single carrier 7 are locked into position by means of a bar 28 worked by an actuator. The locking movement comes about by simple axial traverse of said bar 28, which is prismatic, and paired up to lie parallel with the single carrier 7. The bar exhibits a number of notches 29 set apart

at like distance to that existing between hooks and hollow supports offered by the carrier 7; the depth of said notches 29 being calculated such as to avoid any contact with the single adjacent hook shanks 9 offered thereto when the bar 28 itself assumes a given axial position.

Locking-on of the hooks suspended from a single carrier 7 so as to face in an established direction is brought about by causing slight axial movement of said bar 28 such that it moves up beside the flat face 30 offered by shank 9 —provision being made for a certain amount of clearance therebetween— said face 30 disposed parallel with bent portion 10 of the hook itself.

The axial movement of bar 28 aforementioned is brought about by an ordinary linear actuator 54 at the point of exit from conveyor 19. Remembering that the bar is associated with carrier 7, the same operation will be brought about at the exit of furnace 33, where a further actuator 31 again moves bar 28 into the position described.

Provision is made for a lifting apparatus 32 which picks up the single carriers 7 from conveyor 19 and feeds them into the hardening furnace, which is a fluid-bed tunnel-type, denoted 33, and sets them down on a parallel-chain-pair conveyor 36,

this extending longitudinally through both furnace 33 and the subsequent tempering furnace 35 —likewise a tunnel. Carriers 7 are set down on the chains 36 in such a way that only links 2 and the lower end of hooks 6 will be totally submerged in the fluid 37. At the exit of furnace 33, wherein the appropriate envisaged hardening temperature will have been both reached and stabilised, the single carriers 7 are picked up by a first lifting unit 38 comprising two prehensile elements 39 and 40, these positioned such that one follows the other, of which element 39 lays hold on carrier 7 and draws it from the furnace 33, whereupon the entire lifting-unit 38 traverses in such a way as to bring the carrier thus picked up along to the quenching station 41. Lifting-unit 38 is lowered once more in such a way that the links —still hanging from the hooks associated with this same carrier picked up and held by prehensile element 39— are lowered into the tank denoted 42, which contains the appropriate quenching liquid.

Before actually descending into said tank 42, an actuator similar in all respects to actuator 31 unlocks hooks 6 by pushing forward on bar 28, and a further device 43 causes the hooks themselves, suspended from carrier 7, to turn about their own vertical axes. Device 43 comprises a looped chain 44 disposed parallel with the carrier and designed

to pair with the sprockets 45 fitted coaxially one to each hook 6 at the uppermost part of said cylindrical shank 9; the device itself being moved in toward said sprockets 45 by means of a hydraulic actuator cylinder 46. Being made thus to revolve while undergoing the quench, the single links are subjected to an even and balanced cooling on all their exposed surfaces.

With the hardening stage completed, lifting-unit 38 recedes one step, and the ends of the carrier are laid hold on by prehensile element 40 and lifted, whilst at the same, prehensile element 39 duly picks up and lifts another carrier exiting from the furnace 33 in similar fashion.

A further traverse forward by lifting-unit 38 as a whole, and the single carrier 7 is brought up to the tempering furnace entry. A further descent causes introduction of the carrier into the tempering furnace 35 and back onto the conveyor chains 36, and at the same moment, quenching of the carrier behind —this held by prehensile element 39— in tank 42.

Once again, entry of carrier 7 into the furnace 35 is preceded by locking-on of the hooks 6 by movement forward of bar 28 along its own axis. With the carrier set down thus on chains 36 and the interrupted-

quench cycle complete, the entire lifting-unit 38 rises clear of quenching station 41, recedes one step, and picks up the cycle as before.

Again, furnace 35 is embodied such that only links 2 and the lower end of hooks 6 remain totally submerged in the fluid-bed, whilst hollow supports 8 and carrier 7 ride above the level thereof.

At the exit of tempering furnace 35, a lifting-unit 47 identical in all respects to unit 38 and provided with prehensile elements 48 and 49 likewise arranged such that one follows the other, picks up the single carrier from the furnace and brings it into the final cooling station 50. A further actuator associated with lifting-unit 47 now releases hooks 6 by moving bar 28 in the appropriate axial direction, whilst a device 51 identical in all respects to device 43 aforementioned imparts rotation to the hooks 6, which duly turn about their own axes together with the links 2 suspended therefrom.

In this final cooling station 50, the revolving links are quenched with jets of liquid such as will bring them down to ambient temperature. This completed, lifting-unit 47 recedes one step, whereupon carrier 7 is grasped by prehensile element 49

and lifted, and the two move forward to where carrier 7 itself is set down on one of the trolleys 12 aforesaid, after which lifting-unit 47 duly recedes one step and takes up the cycle as before.

Movement forward of the carriers along the entire length of the production line thus described is brought about in a step-by-step fashion, the tempo of which determining the various work time-lapses relative to loading-unit 13, lifting apparatus 32, and lifting-units 38 and 47.

Once arrived at the final exit with its load of hardened and tempered links, the carrier is borne along the return stretch of conveyor-loop 11 aforementioned by trolley 12 as far as a discharge-point 52, where the single links are removed from their hooks automatically, emptying the carrier of its load. Guides 53 are located at the discharge-point 52 which branch off from the direction of flow of the conveyor 11 itself, these serving to steer away the links 2 while hollow supports 8 continue on their way, held in the vertical by further guides. Thus one has the necessary removal of links 2 from the respective bent portions 10 of each carrier's hooks 6.

Following the sequence through beyond discharge-

point 52, the single carrier 7 —now relieved of its load of links— continues along toward infeed station 3 where it will be picked up once more by loading-unit 13. The trolley 12, on the other hand, passes on down the forward stretch of loop 11 so as to arrive back at lifting-unit 47.

The plant thus described makes provision for recovery of the heat given off by gases produced in the first, hardening furnace 33, with the end in view of re-utilisation in the subsequent tempering-stage, carried out in tunnel 35. The adoption of spray-quenching with the links 2 revolving about their own axes, and of the special fluid-bed heating technique, makes it possible to achieve a degree of surface-conditioning for the links themselves which will render further cleansing operations quite unnecessary.

Claims

1) Plant, designed particularly for arrying out heat-treatment on crawler track-links, and embodied such as to carry into effect a process whereby links pickedup from being forged and still at high temperature undergo a succession of stages in the following sequence:

a) initial cooling-down to a temperature of between 600 and 800° C for stabilisation purposes;
b) re-heating up to stable hardening temperature;
c) interrupted —i.e. rapid, quenching;
d) re-heating to tempering temperature;
e) cooling to ambient temperature;

characterised

in that such stages are carried out along a production line incorporating two tunnel furnaces (33 & 35) for the purpose of implementing stages b) and d), and along which links (2) are conveyed in orderly fashion, each suspended from one of a number of identical hooks (6), these being adjustable for direction and fitted in given number to special carriers (7) in such a way as permits them to rotate about their own individual axes;
said line comprising the following, in sequence:

- an infeed station (3) to where links (2) are taken immediately after being forged in the press, and at which they are slung up singly on the hooks (6) of said carrier (7), these already caused to face in the same direction;
- a cooling area (26) through which links (2) travel while undergoing stage a), and are oriented in the same direction with respect to that of the forward movement of said carriers (7) from which they ared hung;
- a fluid-bed tunnel-furnace (33) in which links (2) are hardened, and through which they travel until reaching and stabilising-at the hardening temperature envisaged;
- a quenching station (41) where links suspended from a single carrier (7) undergo stage c) aforesaid;
- a fluid-bed tempering furnace (tunnel likewise)(35) in which links (2) undergo stage d) aforesaid while passing through;
- a final cooling station (50) where links (2) suspended from a single carrier (7) undergo stage e);
- and a discharge-point (52) where single links (2) are removed automatically from the hooks (6) of the single carrier hitherto affording support thereto;

provision being made for means by which to convey said carriers along the line automatically, and in orderly fashion.

2) Plant as in claim 1 characterised in that each said carrier (7) exhibits a number of hollow supports (8) having a rectilinear axis, these spaced apart at equal distance one from the next, and disposed parallel one with the other; each hollow support (8) designed to accommodate the cylindrical shank (9) of a hook (6) whose bent portion (10) extends downward therefrom, said shank disposed coaxially with said support and free to rotate therein.

3) Plant as in claim 1 characterised in that means for conveying said carriers (7) automatically along the production line comprise the following, in sequence:

- a loading unit (13) located at said infeed station (3) and designed to carry out the following sequence of operations:

1 pick-up of single empty carriers (7);

2 position correctly of the single carrier (7) and arrangement of the hooks (6) thereon so as to face in like direction —this as a result of loading and pick-up;

3 setting-down of the carrier (7);

- a walking-beam type conveyor (19) onto which single carriers (7) are transferred by said loading-unit (13), and on which said carriers (7) are borne along through the length of the cooling-area (26);
- a lifting apparatus (32) designed to pick up single carriers (7) at the exit of said walking-beam

conveyor (19) and feed them into the hardening tunnel-furnace (33);

- a parallel-chain conveyor (36) extending the entire length of both hardening (33) and tempering (35) furnaces, on which carriers (7) are set down at regular intervals of distance;

- a first lifting-unit (38) designed to carry out the following sequence of operations:

1 pick-up of single carriers (7) at the exit of said hardening furnace (33);

2 transfer and positioning of single carriers (7) to and at the quenching station (41);

3 setting-down of single carriers (7) once more onto the chain-conveyor (36) inside the successive tempering furnace (35);

a second lifting-unit (47) identical to the first, designed to carry out the following sequence of operations:

1 pick-up of single carriers (7) at the exit of said tempering furnace (35);

2 transfer of said carriers (7) to the final cooling station (50) ;

3 setting-down of each single carrier (7) onto a corresponding trolley (12) forming part of a conveyor-loop (11) along whose return stretch said carrier (7) is relieved of its load of links (2) and taken on thence back to the infeed station (3).

4) Plant as in claim 1 characterised in that the quenching station (41) comprises jets designed to spray liquid over links (2) suspended from the hooks (6) of a single carrier (7); provision being made for a device (43) which will cause said hooks (6) to turn about their own axes with the links (2) thus suspended; said device (43) comprising a looped chain (44) driven by a gearmotor and disposed parallel to the single carrier (7), which with the carrier in position at said quenching station (41), pairs with each of the single sprockets (45) fixed coaxially to respective hooks (6) and located at the uppermost part of the latters' cylindrical shank (9).

5) Plant as in claim 3 characterised in that arrangement of the single hooks (6) of a single carrier (7), such that all face in the same direction when being loaded with links, is brought about by means associated with the loading-unit (13) aforesaid which comprise a number of orienting devices (18), each of which designed to work one hook (6) of the carrier (7) beneath, and comprising a shaft (20) disposed with axis vertical whose bottom end is provided with an eccentric pin (21) destined to interact with an angled appendage (22) offered by the top end of each single hook (6); it being envisaged that said pin (21) will cause appendage-

and-hook to turn and come up against a fixed stop (25); it being envisaged further that the axis of said angled appendage (22) lie within a vertical plane disposed at 90° to the vertical plane with which the bent portion (10) of hook (6) lies concurrent.

6) Plant as in claim 1 characterised in that each carrier (7) is provided with a device for locking all of the hooks (6) associated therewith into position when facing in like direction; said device comprising a prismatic bar (28) joined with the carrier itself in such a way as to have a certain degree of freedom to move along its own axis; said bar (28) being caused to make contact with a flat face (30) offered by the cylindrical shank (9) of each hook (6) which lies parallel with bent portion (10) aforesaid —a given amount of clearance existing between face and bar; provision being made for a number of notches (29) located on said bar (28) giving out transversely with respect to the line-flow and spaced apart at like like reciprocal distance to that between hooks (6) of a single carrier (7), whose depth is such as to ensure no contact between the bar and the cylindrical shank (9) of the single hook (6) during the time in which said notch (29) is brought level with same, this by dint of the bar's (28) being made to travel through a pre-determined distance along its own axis.

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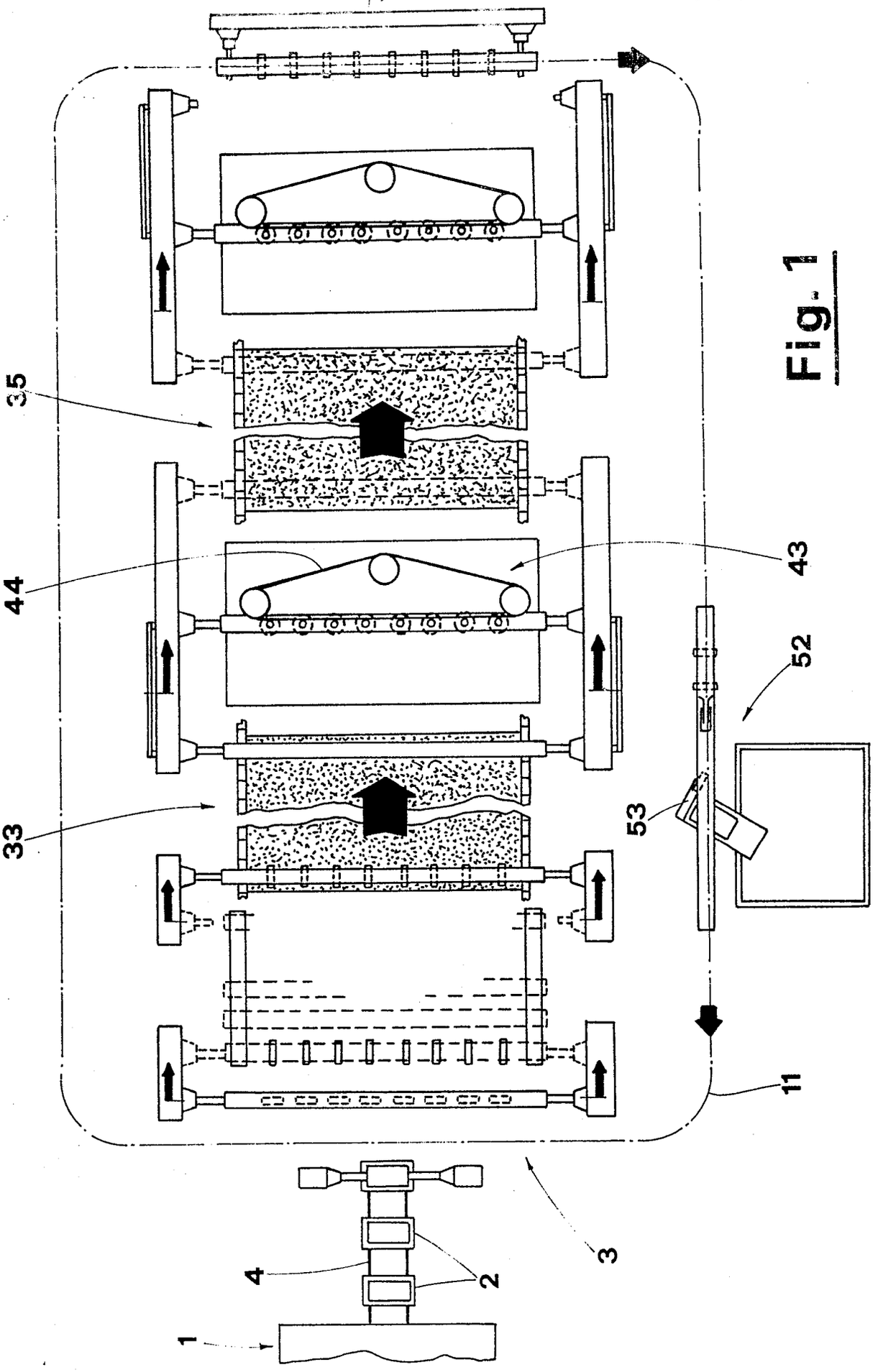

Fig. 1

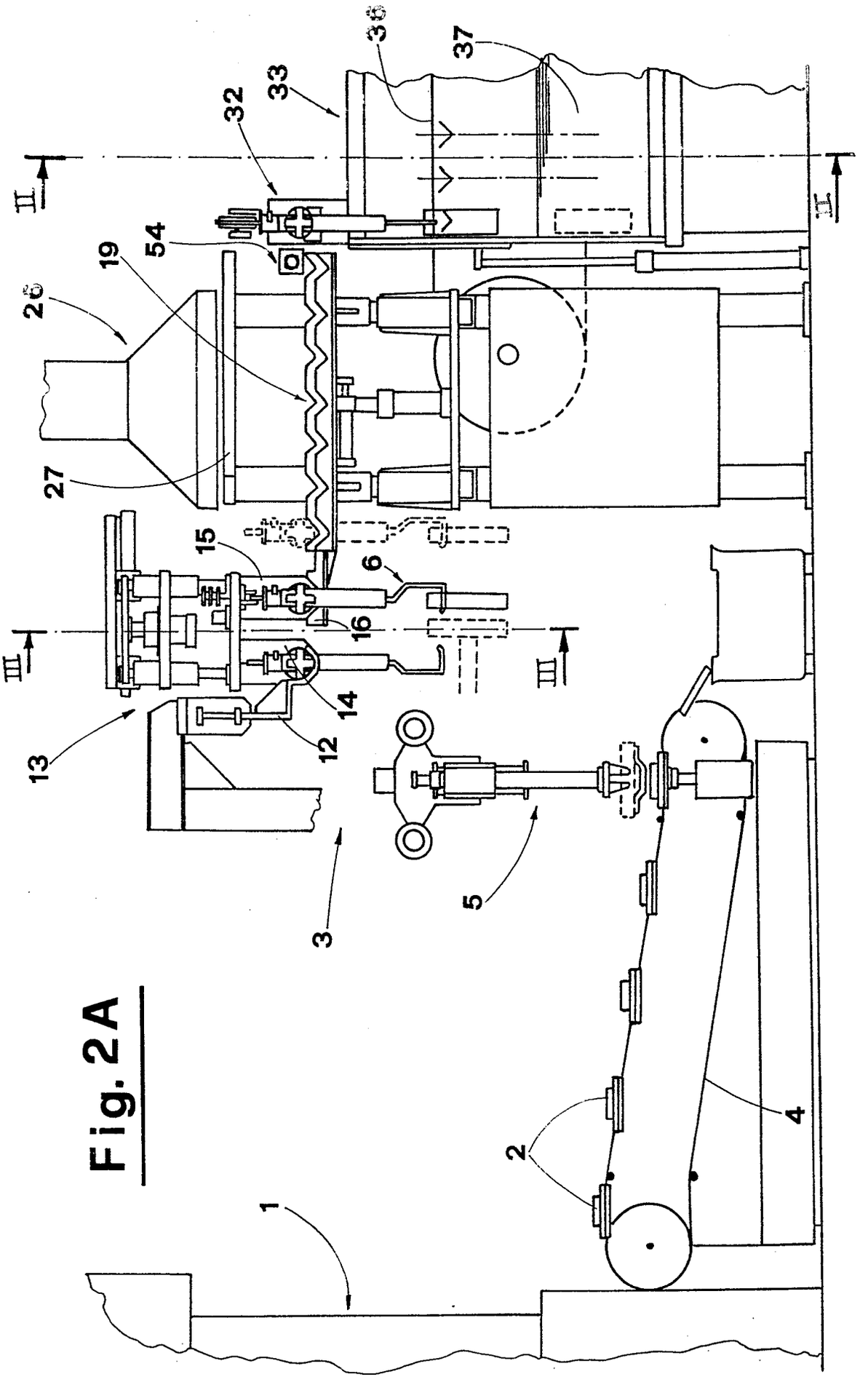

Fig. 2A

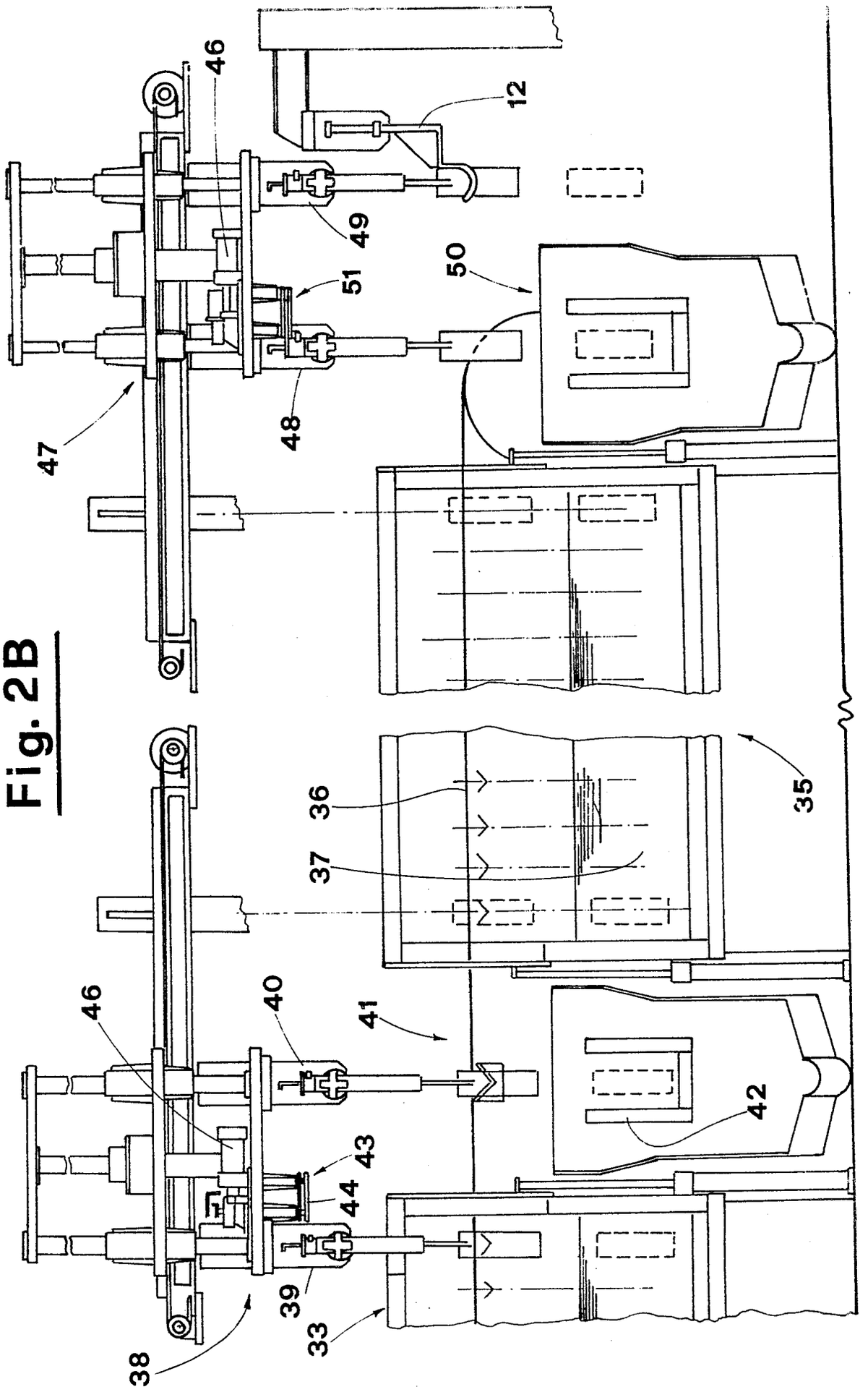

Fig. 2B

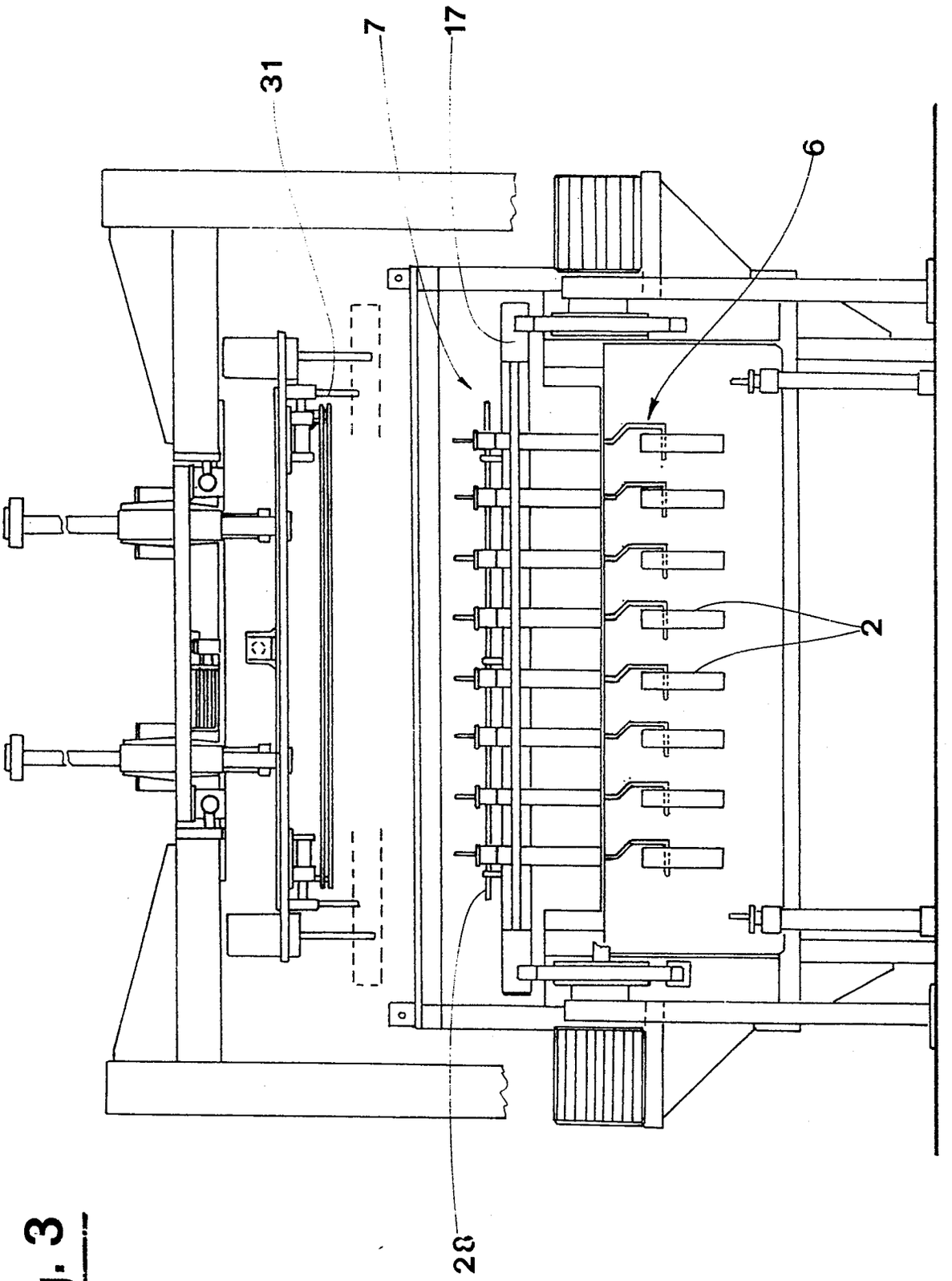

Fig. 3

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Fig. 6

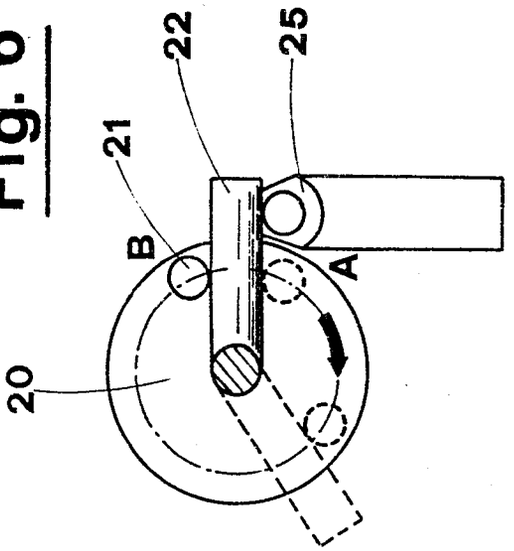

Fig. 7

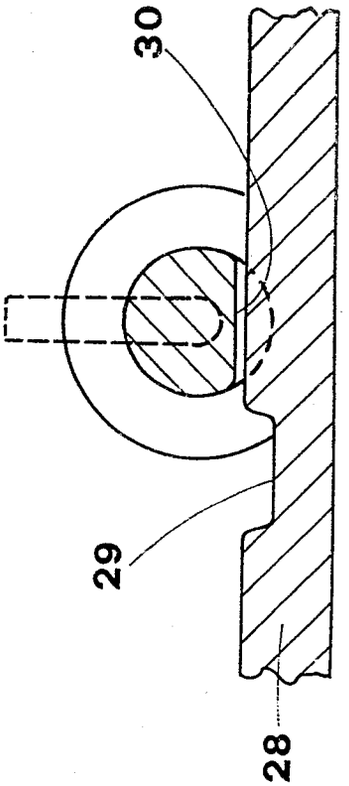

Fig.4

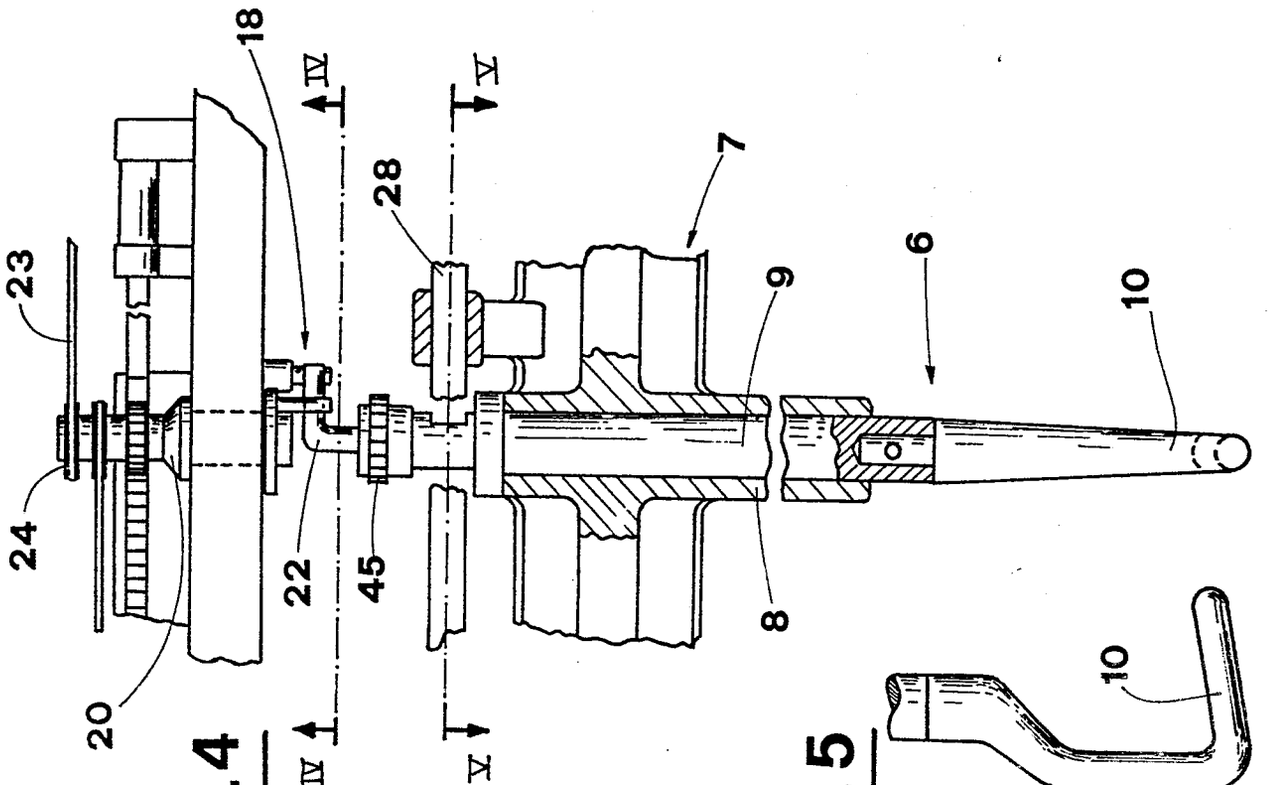

Fig.5