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(54) Method for bending metal profiles in bar form and machine for performing the method

(57) The method for bending metal profiles in bar form is performed in a machine that includes a line (3) for feeding the profiles in the form of bars to be bent, along which there are devices (4) for driving the bars, a cropping assembly (5) and at least one bending assembly (6). The method entails: processing the end portion of the bars by performing the advancement of the end portion of the bars by virtue of the driving devices (4), and stopping the end portion of the bars in a preset position, according to the dimensions of the shaped articles to be produced and to the fixed stroke of an extraction assembly (8). The end portion of the bars is gripped by virtue of the extraction assembly (8), which is provided with a clamp-type grip device (9) suitable to be actuated with a reciprocating motion. The end portion of the bars is then subjected to a translational motion, for an advancement stroke of fixed extent, to complete the dimensions of the shaped articles to be provided, then the shaped articles are cropped to size.

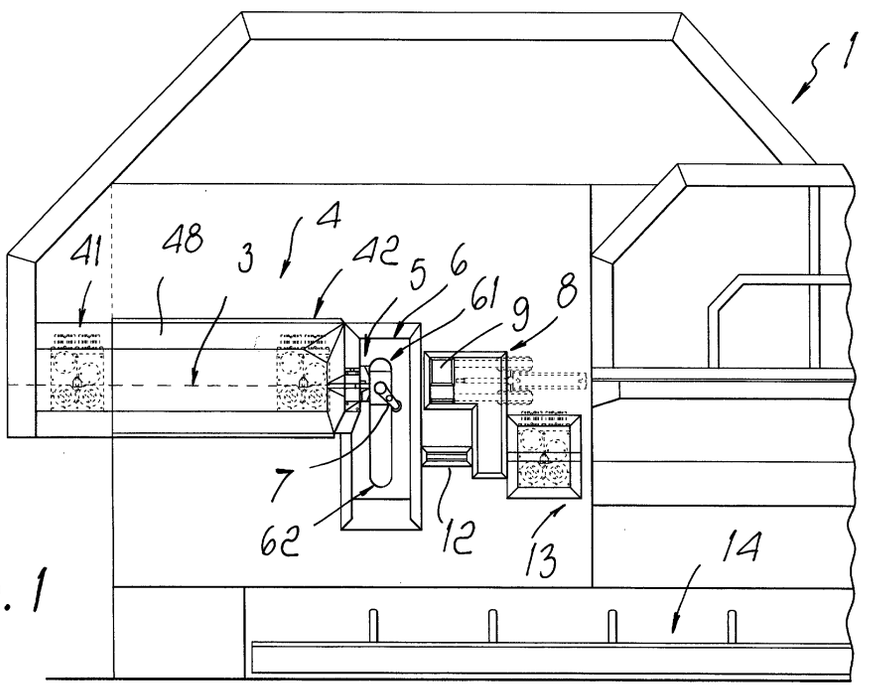

Fig. 1

EP 1 247 595 A2

Description

[0001] The present invention relates to a processing method performed in machines for the automatic bending of metal profiles in bar form, particularly iron rods for reinforced concrete, and to a machine for performing the method.

[0002] It is known that shaped rods, used for example to produce reinforced-concrete frames, are generally obtained by means of machines that subject the iron rod, in coil or bar form, to a series of bending operations.

[0003] More particularly, various bending machines are currently known which allow to produce the finished products, such as stirrups and shaped rods, starting from metal profiles in bar form. These bending machines generally have a series of devices for driving the bars along a feed line, an assembly for cropping the bars in order to obtain the rods to be bent, cut to size, and one or more bending assemblies arranged in series. The finished products are unloaded onto the ground.

[0004] The method of processing metal profiles in bar form does not have the diameter and availability limitations typical of material in coils, but it has the drawback of considerable waste. A series of rods to be used directly or to be bent is in fact obtained from the individual bars by means of successive cropping steps, but the end portion of the bars, which is often quite long, is wasted.

[0005] In order to reduce the dimensions of the waste, it is possible to manage the work cycle so as to obtain, from each bar, a series of rods of different size, i.e., combining the various batches of parts to be produced so as to utilize in an optimum manner the length of the bars. The various batches are then collected and sorted.

[0006] In known bending machines, however, there is a physical limitation that cannot be overcome in the utilization of the length of the bars; this limitation is determined by the distance between the bar driving devices and the bending and/or cropping assembly. The driving devices must in fact engage the bars in order to be able to move them appropriately.

[0007] Accordingly, an end portion of the bars, which after leaving the grip of the driving devices remains inside the machine and would instead contribute to reaching a length sufficient to complete an additional product (stirrup or shaped rod), cannot be processed and therefore constitutes waste. This limitation obviously has a financial effect that increases with the size of the unusable end portion of the bars.

[0008] The aim of the present invention is to solve the above cited problem, by providing a processing method that avoids having a non-workable portion of metal profiles in bar form in machines for processing these profiles, particularly allowing full workability of the end portion of the bars in order to obtain an additional shaped article or a larger one.

[0009] An object of the present invention is to provide a machine that performs the automatic bending of metal profiles in bar form with a structure that is simple and functional, safely reliable in operation, and highly flexible in use.

[0010] This aim and this object are achieved by a method for bending metal profiles in bar form, and by a machine as claimed in the appended claims.

[0011] Further details of the invention will become apparent from the detailed description of a preferred embodiment of the method and of the machine for bending metal profiles in bar form, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a general front view of a machine for bending metal profiles in bar form, operating according to the method of the invention;
Figure 2 is a front view of the assembly for extracting the end portion of the bars to be bent;
Figures 3 and 4 are respectively a sectional view, taken along a transverse plane, and a plan view of the extraction assembly;
Figures 5 and 6 are respectively a front view and a plan view of the bar driving devices;
Figure 7 is a general front view of a further embodiment of the machine for bending metal profiles in bar form.

[0012] With particular reference to the above cited figures, the reference numeral 1 generally designates the machine for bending metal profiles 2 in bar form, for example iron rods for reinforced concrete and the like. The machine has a line 3 for feeding the bars 2 to be bent, along which the driving devices 4, protected by a covering housing 48, are arranged. The driving devices 4 have a first driving assembly 41 and a second driving assembly 42, which are arranged in series and are preferably constituted by pairs of counter-rotating wheels 43 which preferably have identical characteristics.

[0013] As shown in detail in Figures 5 and 6, the driving assemblies 41 and 42 are actuated by a single motor 40 arranged in a central position between the driving assemblies. The driving assemblies 41 and 42 are actuated by respective chain-type transmission members 44 and 45, which wind around a double pinion 46 mounted on the output shaft of the motor 40 and around a respective pinion 47 of a wheel 43 of each driving assembly. At the output of the driving devices 4, along the feed line 3, there is a cropping assembly 5 which can be a conventional, and per se know, cropping assembly.

[0014] The bending machine then has, in front of the cropping assembly 5, a bending assembly 6 provided with a bending head 7 of a known type, which is suitable to bend the bars 2.

[0015] The bending head 7 of the bending assembly 6 can move between a first upper bending station 61, arranged at the feed line 3, and a second lower bending station 62, as described in detail in Italian Patent No. 1292692 to Schnell S.p.A. Otherwise, there are two

bending heads, an upper one and a lower one, which are respectively arranged at the bending stations 61 and 62.

[0016] Downstream of the bending assembly 6, along the line 3 for feeding the bars 2, the bending machine has an extraction assembly 8, which is adapted to grip, during an operating step, the portion of the bars 2 that protrudes forward from the bending assembly 6. More particularly, as detailed hereinafter, the extraction assembly 8 is adapted to extract the end portion of the bars 2.

[0017] The extraction assembly 8 has a clamp-type grip device 9, which can move with a reciprocating motion under the actuation of a first actuator 10 along an axis that is longitudinal with respect to the advancement direction of the bars 2, with a fixed stroke (Figure 3). The clamp 9 can furthermore move, on the working plane and along an axis that is perpendicular to the advancement direction of the bars 2, under the actuation of a second actuator 11, between an upper position and a lower position, which correspond respectively to the first bending station 61 and the second bending station 62.

[0018] The clamp 9 is constituted by a lower fixed jaw 91, which is rigidly coupled to a frame 90, and by a movable jaw 92, which is suitable to be actuated by a corresponding actuator 93, which is in turn rigidly coupled to the frame 90 (Figure 3).

[0019] The first actuator 10 is rigidly coupled to a structure 80, which forms a pair of sleeves 81 in which respective guiding stems 82 are slidingly mounted. The axis of the stems is parallel to the actuator 10 (Figure 4). The guiding stems 82 support, at a rear end, a box 84 on which the frame 90 of the clamp 9 is guided.

[0020] The structure 80 is mounted so that it can slide on a pair of columns 83, which are rigidly coupled to the fixed framework of the machine, with an axis that is perpendicular to the feed direction of the bars 2, and is actuated, with a reciprocating motion, by the second actuator 11.

[0021] The box 84 is provided with sleeves 85 in which two additional guiding stems 86 are slidingly inserted and support, at one end, the frame 90 of the clamp 9.

[0022] The frame 90 of the clamp 9 can move, with a reciprocating motion, along an axis that is transverse to the feed direction of the bars 2 and to the working plane of the machine, under the actuation of a third actuator 87, which is supported by the box 84 and is rigidly coupled to the guiding stems 86.

[0023] The machine also comprises, at the lower bending station 62, a retractable abutment 12, which is arranged in an intermediate position between the bending assembly 6 and the extraction assembly 8 (Figure 1). In front of the extraction assembly 8, at the lower bending station 62, there can be an additional driving assembly 13 constituted by pairs of contrarotating wheels. The machine can be provided with a carriage 14 with compartments for selectively collecting the finished products or another similar collection means.

[0024] The operating method and the machine according to the present invention are used to process only the end portion of profiles in the form of bars 2, which otherwise would not be fully usable, because a final unusable portion, at least equal to the distance between the second driving assembly 42 and the bending head 7, would remain in any case. The method and the machine essentially entail processing the end portion of the bars 2 by performing, by means of the driving devices 40, the partial advancement of the end portion of the bars 2 and stopping the end portion of the bars 2 in a preset position, which is determined automatically according to the dimensions of the shaped articles to be produced and to the fixed stroke that the clamp is capable of performing.

[0025] Then, the end portion of the bars 2 is extracted by means of the longitudinal translational motion of the clamp 9 of the extraction assembly 8. The clamp 9 grips the bars 2 at a portion that protrudes forward from the bending assembly 6. The preset movement by the driving devices 4 is calculated by subtraction, so that the clamp 9, which can move, as specified in greater detail hereinafter, with a stroke of fixed extent, is such as to complete the dimensions of the shaped articles to be produced.

[0026] More particularly, the end portion of the bars 2 performs, under the actuation of the driving devices 4, a first advancement stroke whose extent is variable according to the dimensions of the shaped articles to be produced and is equal, in particular, to the difference between the dimension to be provided and the fixed stroke of the clamp 9.

[0027] In other words, the advancement performed by the driving devices 4 stops in a preset position, determined by the difference between the dimensions of the shaped articles to be produced and the fixed stroke of the clamp 9.

[0028] The subsequent movement of the bars 2 by the clamp 9, which performs a fixed stroke, allows to complete exactly the intended dimensions of the shaped articles, using fully or partially the end portion, which would otherwise remain unusable by an extent equal to the distance between the second driving assembly 42 and the bending head 7.

[0029] The fact is stressed that the vertically movable wheel of the first driving assembly 41 is also meant to check for the presence of the bars 2, so as to detect the end portion of the bars and activate the above described operating cycle. When the bars 2 exit from the first driving assembly 41, the fact that there is a remaining length of bar equal to the distance between the two driving assemblies 41 and 42 is in fact detected. This also allows to check the correctness of the length optionally set by the operator with the initial data.

[0030] The end portion of the bars 2 is placed in the preset position by the second driving assembly 42.

[0031] The clamp 9 is adapted to grip the bars 2 between the jaws 91 and 92 at a portion that protrudes

forward from the bending assembly 6 by means of the actuation of the movable jaw 92 of the clamp on the part of the actuator 93 (Figure 3).

[0032] The wheels of the driving assembly 42 are then opened so as to release the end portion of the bars 2, and the longitudinal translational motion of the end portion of the bars 2 is produced by the actuation of the clamp 9 of the extraction assembly 8, whose advancement stroke has a fixed extent, in order to complete the intended dimensions, as already explained. The translational motion of the clamp 9 is performed by the actuator 10 by sliding on the guiding stems 82 rigidly coupled to the box 84 that supports the frame 90 of the clamp 9.

[0033] At the end of the fixed-extent stroke of the clamp 9, cropping of the bars 2 to size is actuated by means of the cropping assembly 5 and the optional completion of the article with subsequent processes is actuated.

[0034] In order to perform the optional bending of the rear portion of relatively long bars 2 after they have been cropped to size, the bending head 7 of the bending assembly 6 is moved from the upper bending station 61 to the lower bending station 62. This movement can be associated with the movement of the clamp 9 that retains the bars 2 at the lower bending station 62. The movement of the clamp 9 is actuated by the actuator 11 by the sliding of the structure 80 on the columns 83, which are rigidly coupled to the fixed framework of the machine, with an axis that is perpendicular to the advancement direction of the bars 2 and parallel to the working plane.

[0035] The clamp 9 can move, under the actuation of the actuator 87, to a retracted position with respect to the working plane of the machine, so as to not be a hindrance during machining.

[0036] The clamp 9 can also feed the semifinished articles to the lower driving assembly 13, which moves them in order to perform the intended bending operations in the rear portion of the bars.

[0037] Finally, the finished products are unloaded into the optional underlying trolley 14, which is provided with compartments for selectively collecting the finished products.

[0038] If instead the end portion of the bars 2 is not long enough to obtain the shaped part being machined, the clamp 9 removes it and places it among the waste.

[0039] The method and the machine according to the invention therefore achieve the aim of making the end portion of metal profiles in bar form still workable in machines for bending these profiles, allowing full utilization of the end portion of the bars in order to obtain an additional shaped article or a larger article.

[0040] This is achieved in particular by appropriately combining the motion produced by the driving devices 4 with the extraction stroke, of fixed extent, of the clamp 9, so as to obtain any required dimension. More specifically, the intended dimension is obtained by stopping the driving devices 4 with an advance that is exactly equal to the extent of the fixed stroke of the clamp 9.

[0041] By way of example, if 200 cm of profile are left over from a bar and one has to produce a 180 cm part, the material would be more than sufficient in theory, but in practice a conventional machine would not be able to produce it, since owing to the physical dimensions of the mechanical parts the last 40 cm cannot be handled and therefore this length remains inside the machine, forcing to reject not only the last 40 cm but also the entire 200 cm part. According to the present invention, instead, assuming that the clamp has a fixed stroke of 30 cm, driving stops at 150 cm and the clamp 9 then extracts from the machine, with its fixed stroke, the length of 30 cm in order to complete the intended length of 180 cm.

[0042] This result is achieved by a simple and inexpensive solution.

[0043] The extraction device 8 does not require movement measurement devices, which would complicate its construction and increase its cost, and is instead provided simply with a fixed-stroke clamp 9.

[0044] It should also be noted that the extraction device 8 is activated only, if necessary, to move the end portion of the bars 2 and is instead inactive during the processing of the bar portions that precede the end portion.

[0045] Figure 7 illustrates a further embodiment of the machine, in which the extraction assembly 8 is arranged at the output of the cropping assembly 5, to the rear of the bending assembly 6, between the cropping assembly and the bending station, along the line 3 for feeding the bars 2. In this solution, the clamp 9 is adapted to grip the bars 2 during bending, so as to act as abutment for the bending in the upper bending station 61.

[0046] In the practical embodiment of the invention, the materials used, as well as the shapes and the dimensions, may be any according to the requirements.

Claims

1. A method for bending metal profiles in bar form, in machines of the type comprising a line (3) for feeding the profiles in the form of bars (2) to be bent, along which there are devices (4) for driving said bars (2), a cropping assembly (5) and at least one bending assembly (6), **characterized in that** it also comprises: processing the end portion of the profiles in the form of bars (2) by performing the advancement of said end portion of the bars (2) by virtue of said driving devices (4); stopping said end portion of the bars (2) in a preset position, with respect to the dimension of the shaped articles to be produced and to the fixed stroke of an extraction assembly (8); gripping, by means of said extraction assembly (8) provided with a clamp-type grip device (9) adapted to be actuated with a reciprocating motion, said end portion of the bars (2) at a portion that protrudes at the front from said bending assembly

(6); performing the longitudinal translational motion of said end portion of the bars (2), for an advancement stroke of fixed extent, under the actuation of said extraction assembly (8); and subsequently cropping to size said end portion of the bars (2) moved by said extraction assembly (8).

2. The method according to claim 1, **characterized in that** it comprises: actuating, by means of said driving means (4), a first stroke for the advancement of said end portion of the bars (2) whose extent is variable with respect to the dimension of said shaped articles to be produced and is equal to the difference between said dimension to be provided and said fixed-extent stroke of said extraction assembly (8); stopping said end portion of the bars (2) in said preset position, determined by said difference between the dimension of the shaped articles to be produced and said fixed-extent stroke of the extraction assembly (8); completing the dimensions of said shaped articles by virtue of the subsequent longitudinal translational motion of said end portion of the bars (2), under the actuation of said extraction assembly (8) which performs said advancement stroke of fixed length.

3. The machine for bending metal profiles in bar form, of the type comprising a feed line (3) for the profiles in the form of bars (2) to be bent, along which driving devices (4) for said bars (2), a cropping assembly (5) and at least one bending assembly (6) are arranged, **characterized in that** it comprises an extraction assembly (8) provided with a clamp-type grip device (9) which is adapted to grip, during an operating step, the end portion of the bars (2), is carried to a preset position by said driving devices (4), protrudes forward from said bending assembly (6), and is movable with a reciprocating motion, under the actuation of an actuation means (10), along an axis that is longitudinal with respect to the advancement direction of said bars (2), in order to perform the translational motion of said end portion of the bars (2) for an advancement stroke of fixed extent.

4. The machine according to claim 3, **characterized in that** said clamp-type grip device (9) can move, along an axis that is perpendicular to said advancement direction of the bars (2), under the actuation of a second actuation means (11), between an upper position and a lower position, which correspond respectively to a first bending station (61), arranged along said feed line (3), and an underlying second bending station (62), at which at least one bending head (7) of said bending assembly (6) is adapted to work.

5. The machine according to claim 4, **characterized in that** said clamp-type grip device (9) is adapted to feed said bars (2) to a lower driving assembly (13) arranged at said lower bending station (62).

6. The machine according to claim 4, **characterized in that** it comprises, at said lower bending station (62), a retractable abutment (12), which is arranged in an intermediate position between said bending assembly (6) and said extraction assembly (8) and is adapted to cooperate during the bending of the rear end of said bars (2).

7. The machine according to claim 3, **characterized in that** said clamp-type grip device (9) can move with a reciprocating motion along an axis that lies transversely to said bar advancement direction (2), under the actuation of an additional actuation means (87), between a position that is retracted with respect to the working plane of the machine and a position that protrudes externally with respect to said working plane.

8. The machine according to claim 7, **characterized in that** said clamp-type grip device (9) is supported by a frame (90) which can slide, by means of guiding stems (86), along said axis that lies transversely to the advancement direction of the bars (2), on a box (84) to which said additional actuation means (87) is rigidly coupled, said box (84) being able to slide, by means of guiding stems (82) that are longitudinal to said advancement direction of the bars (2), on a structure (80) to which said actuation means (10), adapted to actuate the translational motion of said end portion of the bars (2) for an advancement stroke of fixed extent, is rigidly coupled.

9. The machine according to claim 8, **characterized in that** said structure (80) can slide on columns (83), which are rigidly coupled to the fixed framework of the machine, on the working plane and with an axis that is perpendicular to said advancement direction of the bars (2), and is adapted to be actuated, with a reciprocating motion, by an actuation means (11), between an upper position and a lower position, which correspond respectively to a first bending station (61), arranged along said feed line (3), and an underlying second bending station (62), at which at least one bending head (7) of said bending assembly (6) is adapted to work.

10. The machine according to claim 3, **characterized in that** said driving devices (4) have a first driving assembly (41) and a second driving assembly (42), which are spaced along said feed line (3), and a motor (40), which is arranged in a central position between said first and second driving assemblies (41, 42) and is connected to them by respective transmission members (44, 45) of equal length.

11. The machine according to claim 10, **characterized in that** said first driving assembly (41) and said second driving assembly (42) are constituted by pairs of counter-rotating wheels (43) actuated by an actuation means having the same characteristics.

12. The machine according to claim 3, **characterized in that** it is provided in a downward region with a carriage (14) provided with compartments for selective collection of the finished products.

13. The machine according to claim 3, **characterized in that** said extraction assembly (8) is arranged in front of said bending assembly (6), along said line (3) for feeding the bars (2).

14. The machine according to claim 3, **characterized in that** said extraction assembly (8) is arranged at the output of said cropping assembly (5), to the rear of said bending assembly (6), along said line (3) for feeding the bars (2), with said clamp-type grip device (9) suitable to grip said bars (2) during bending, in the first upper bending station (61), so as to act as an abutment for said bending.

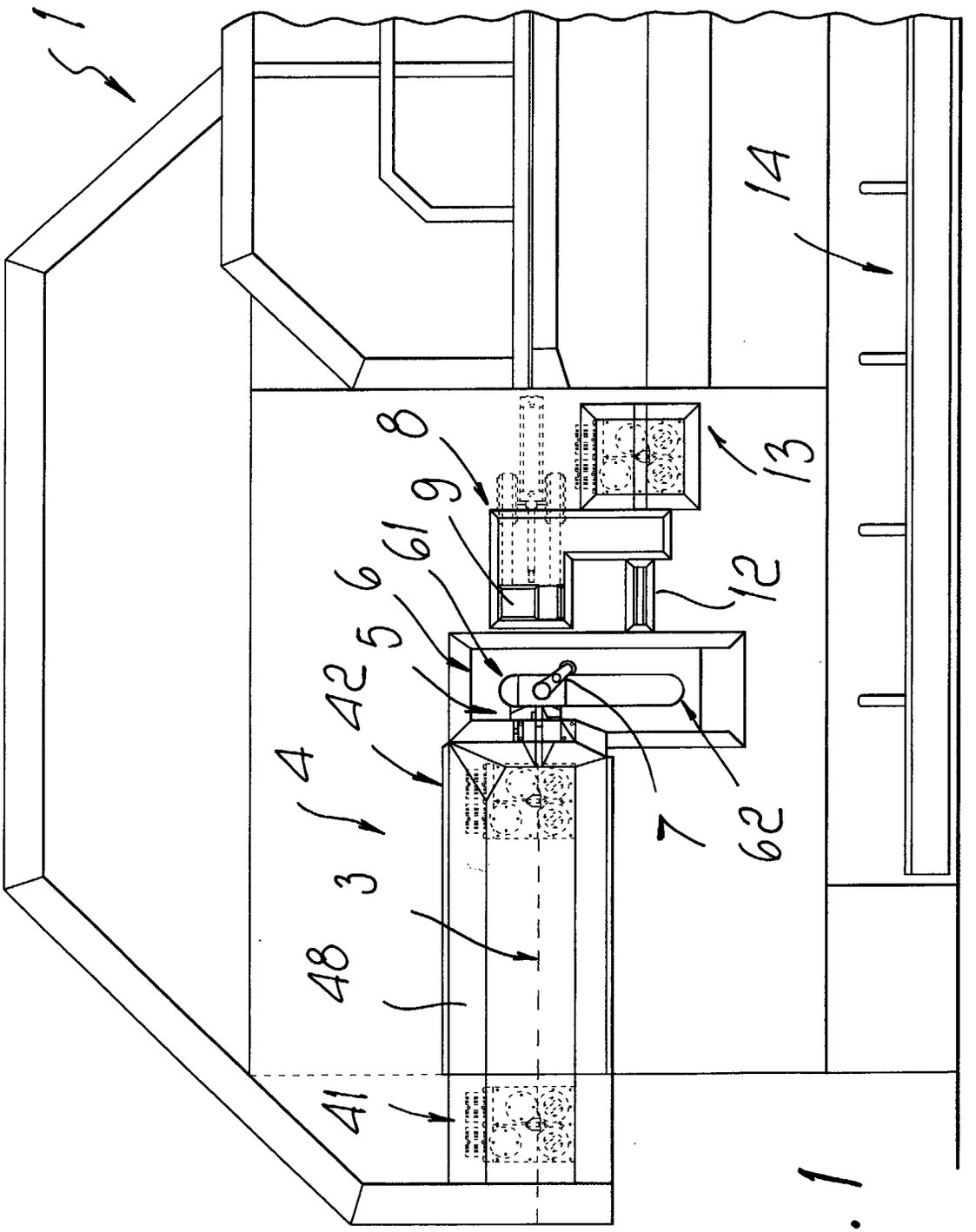

Fig. 1

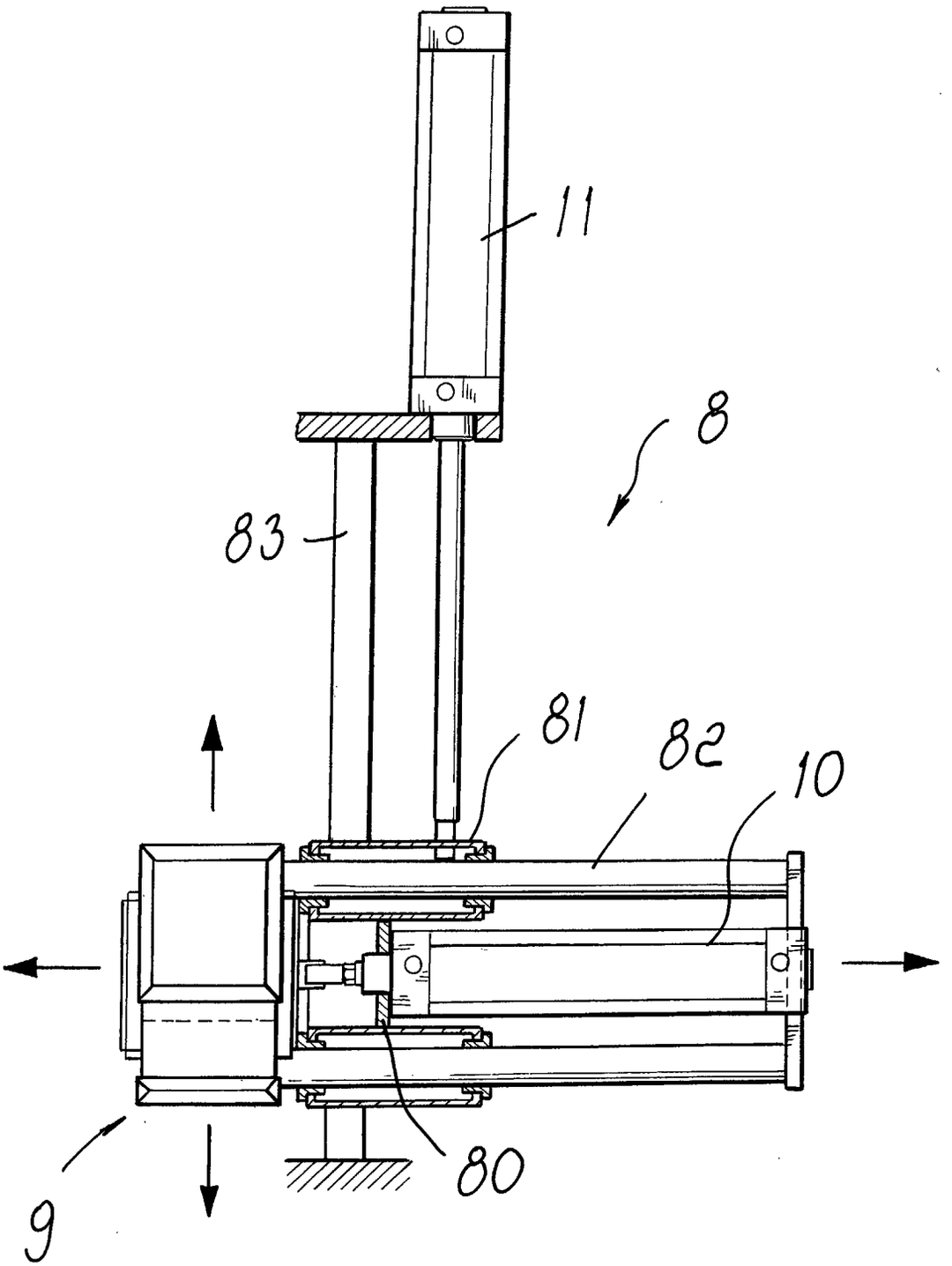

Fig. 2

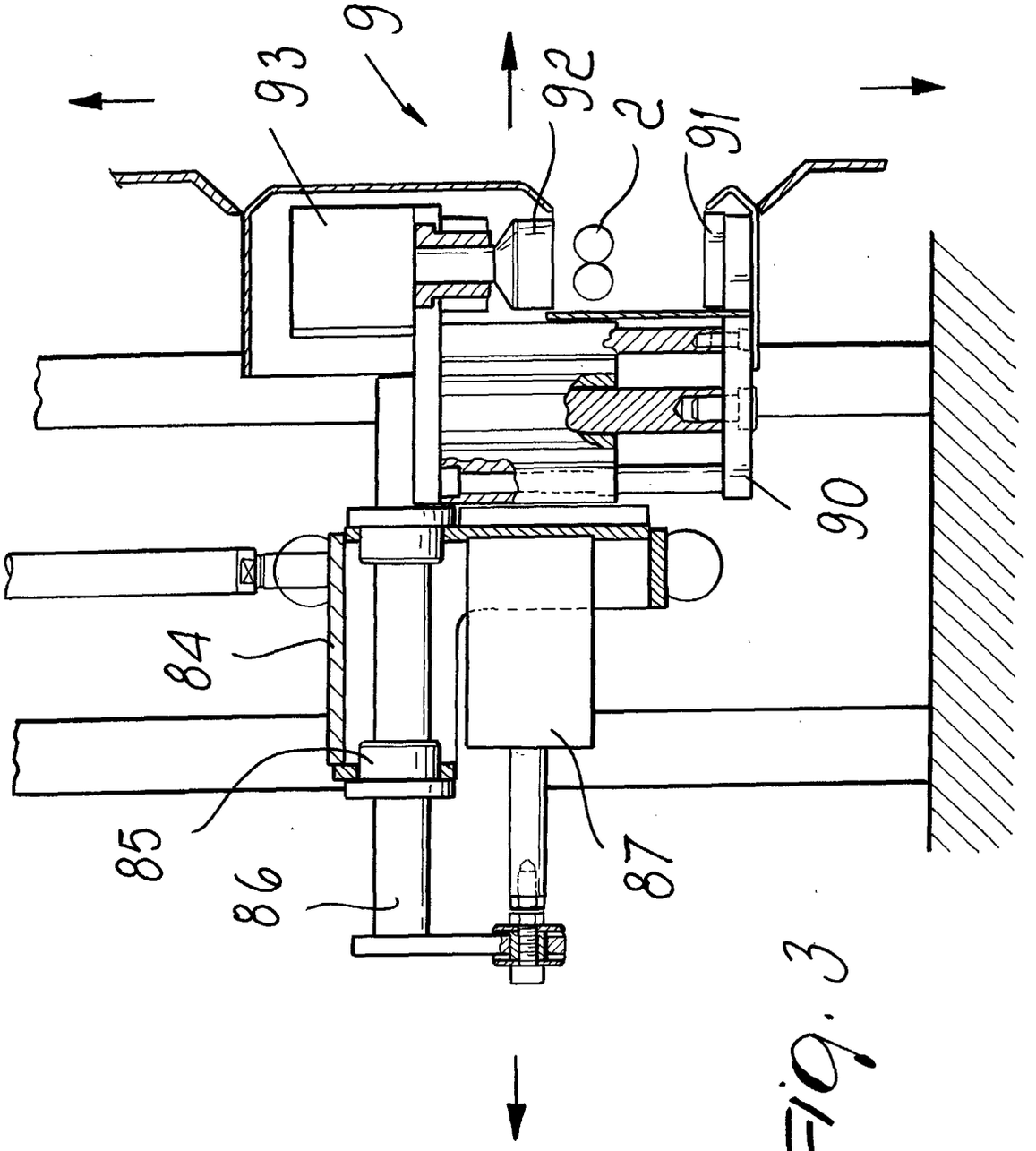

Fig. 3

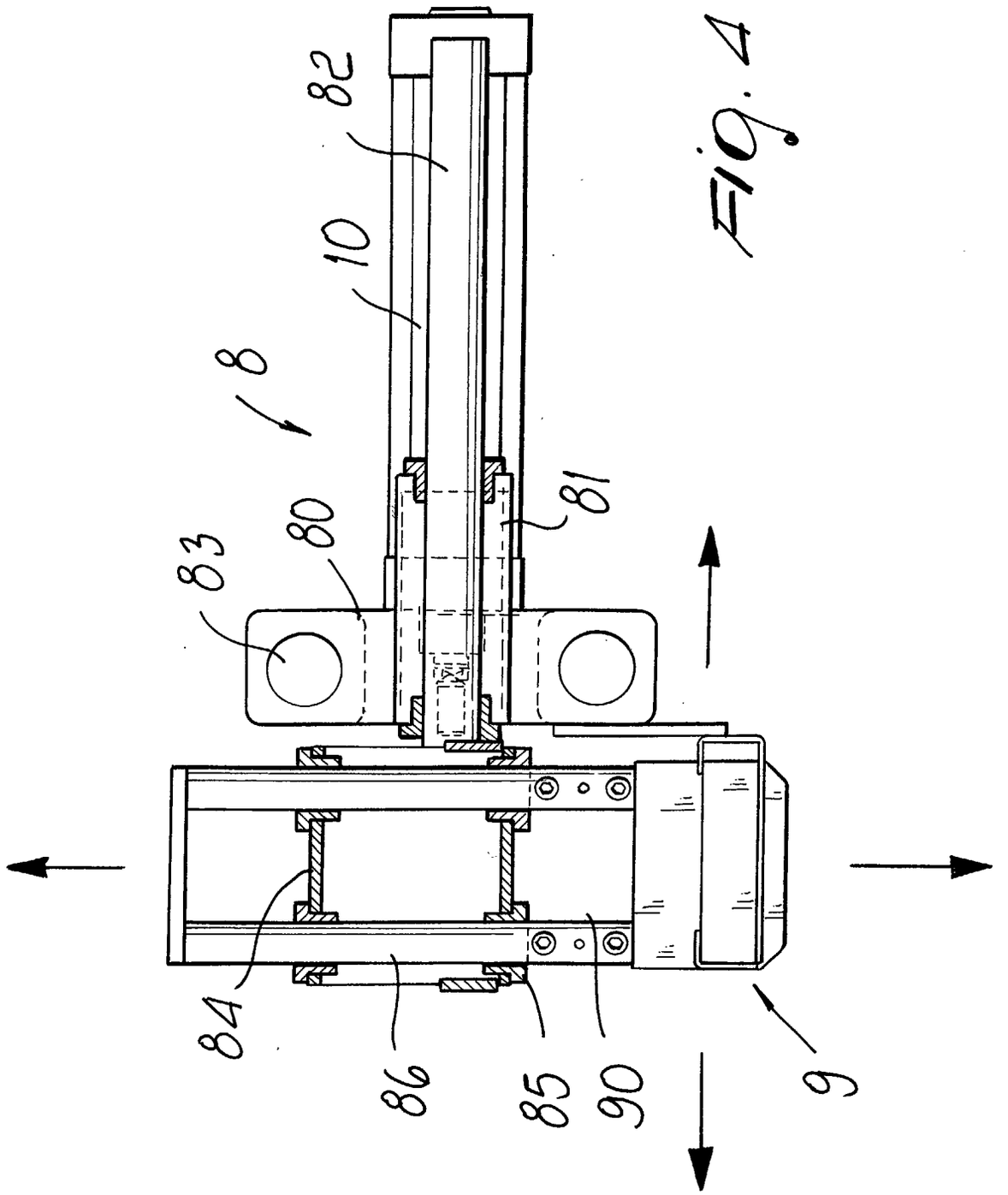

Fig. 4

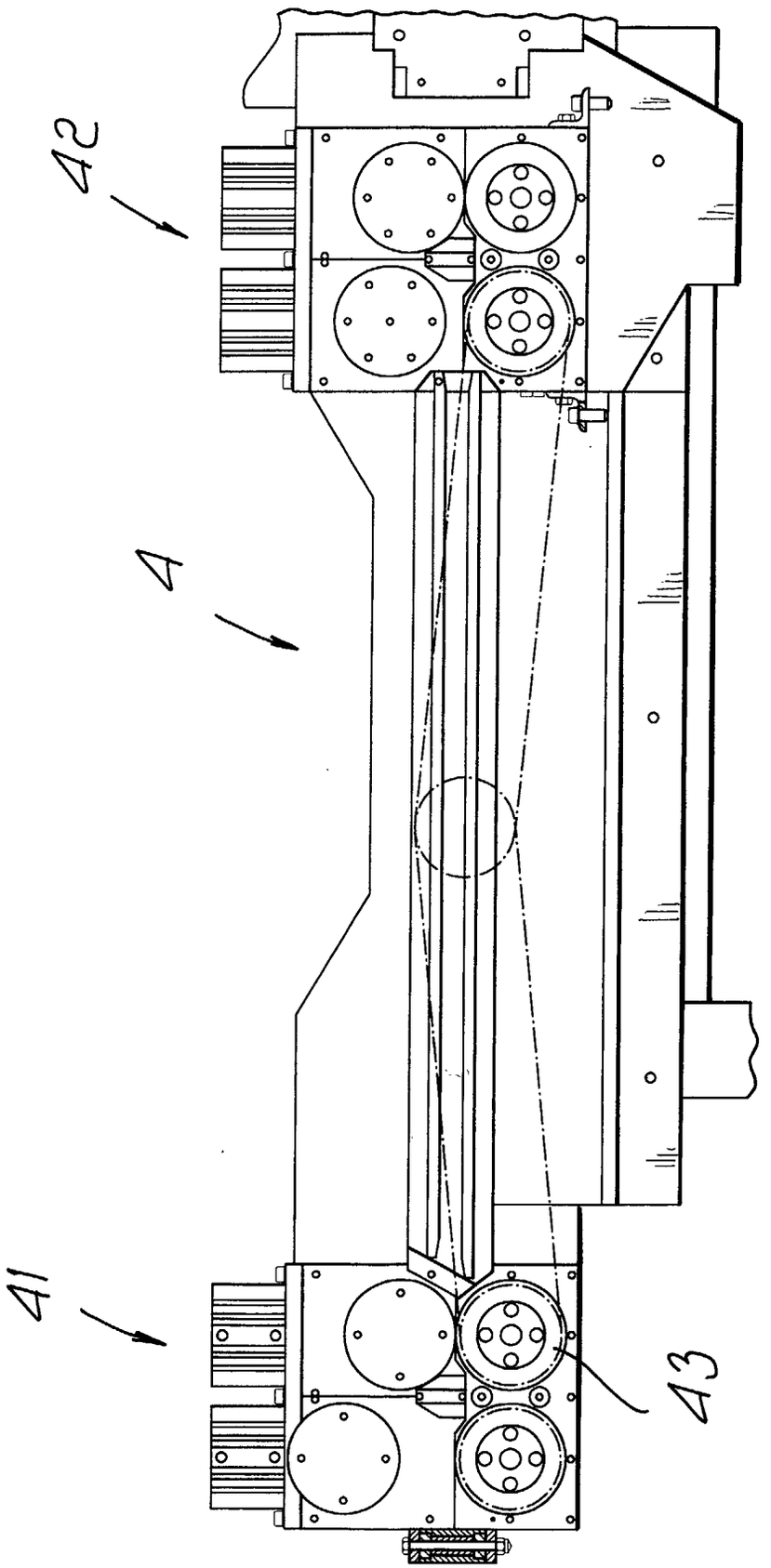

Fig. 5

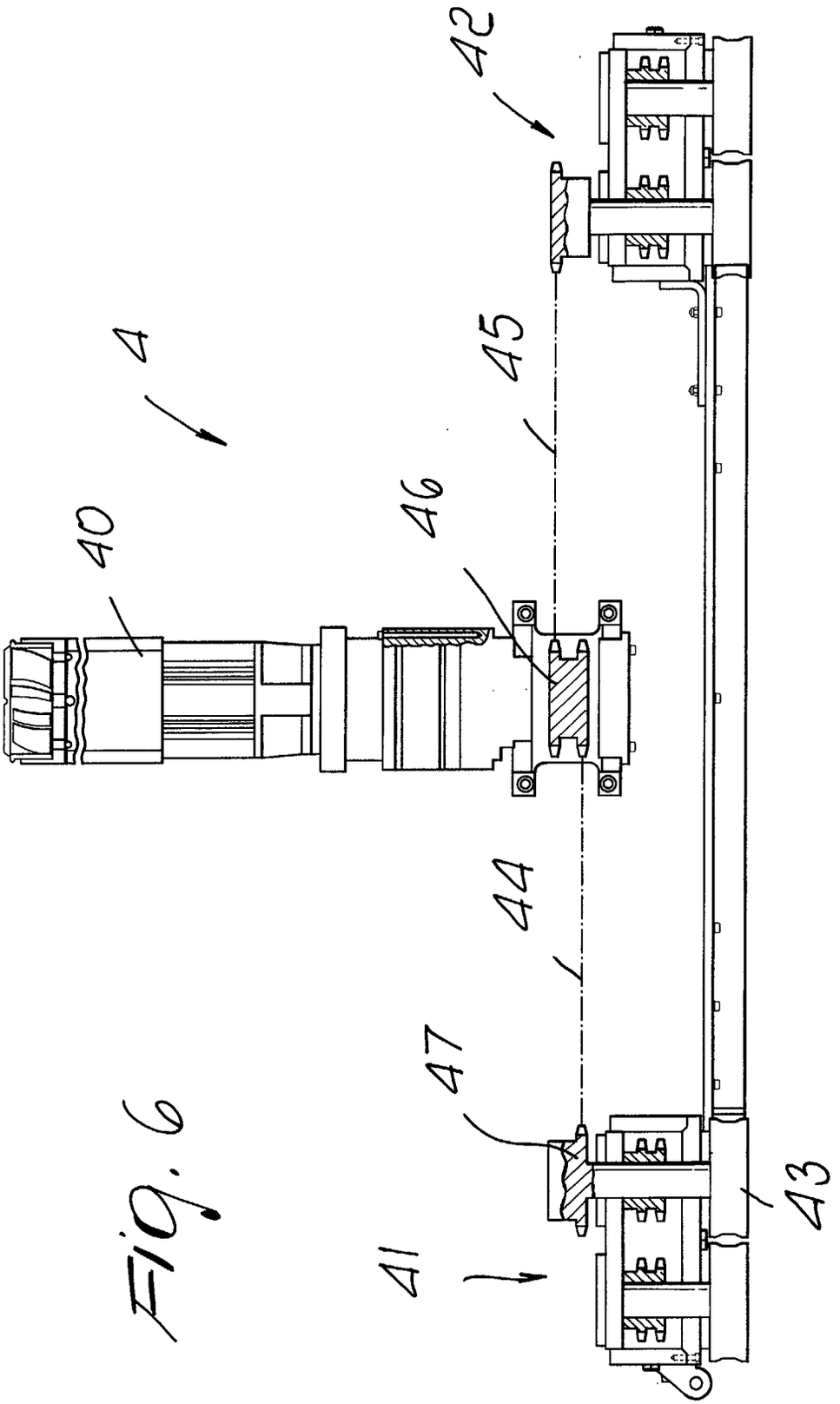

Fig. 6

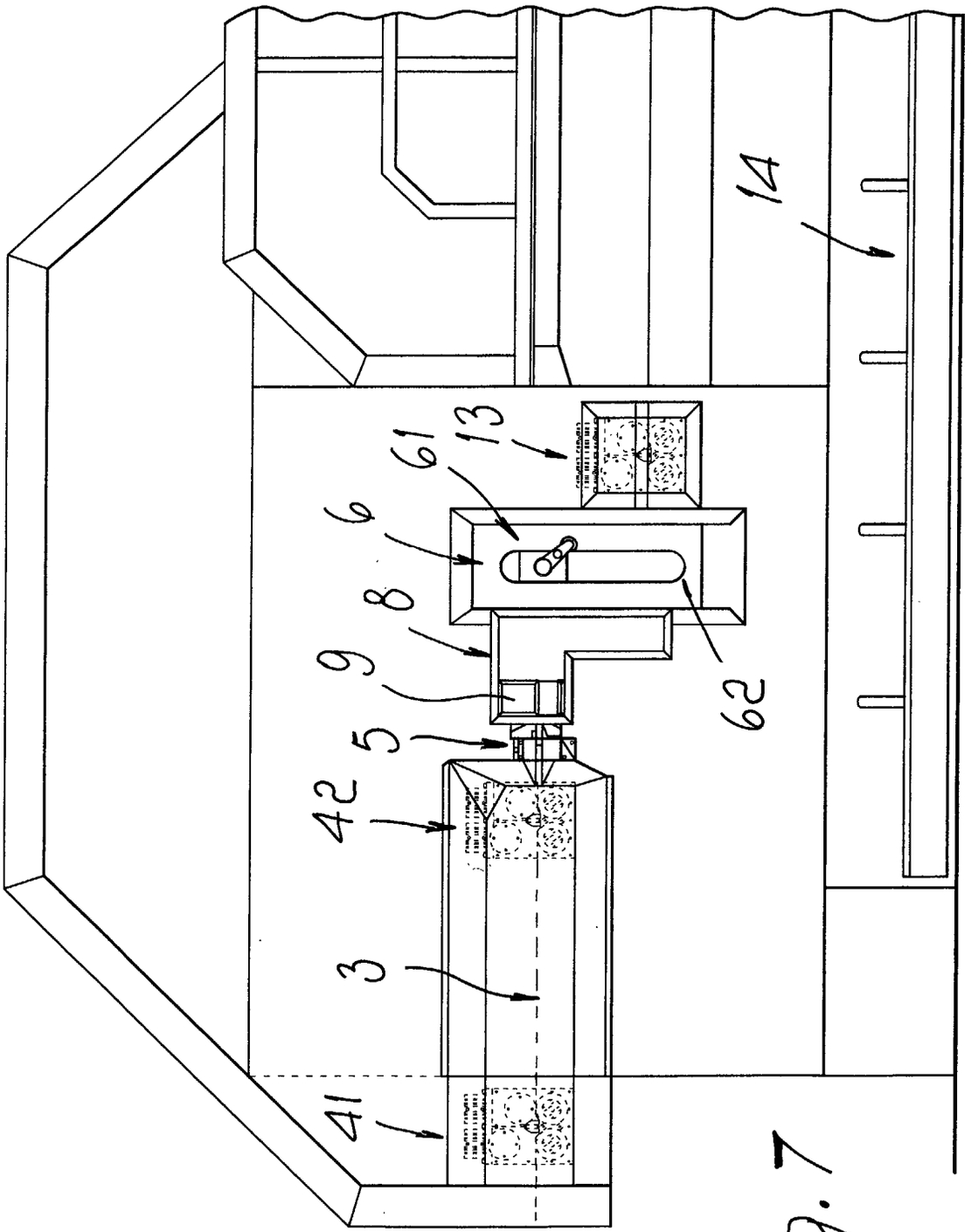

Fig. 7