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(54) MACHINE AND METHOD FOR BOARDING TUBULAR KNITTED ARTICLES

MASCHINE UND VERFAHREN ZUR FORMGEBUNG FÜR SCHLAUCHFÖRMIGE STRICKWAREN

MACHINE ET PROCÉDÉ DE MISE EN FORME D'ARTICLES TRICOTÉS TUBULAIRES

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(56) References cited:
EP-A1- 0 677 608
EP-A1- 1 460 165
WO-A1-01/77432
WO-A1-02/18696
GB-A- 2 181 465
GB-A- 2 374 090
US-A1- 2004 154 510
US-A1- 2005 173 476

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Description

TECHNICAL FIELD

[0001] The present invention relates to the field of machines for hosiery and knitting industry. More in particular, the invention relates to improvements to machines for handling tubular knitted articles, such as socks, stockings and the like. Embodiments described herein relate in particular to methods and devices for handling, orienting and boarding tubular knitted articles provided with an elastic edge.

BACKGROUND TO THE INVENTION

[0002] In the hosiery and knitting industry, circular knitting machines are used for producing tubular garments, for instance socks and stockings, which are provided with an elastic edge, at one end, and with a toe, usually closed by means of sewing or linking, at the opposite end. The articles are packaged after having been boarded and folded.

[0003] The term "boarding" is used in the hosiery industry to mean the steaming and/or heat treatment of hosiery for the purpose of removing creases in the hosiery after manufacture prior to packaging.

[0004] For boarding purposes, usually, socks are loaded onto so-called boarding forms in order to be boarded through heat and to take the flat shape that allows the subsequent packaging thereof. The article are usually loaded onto the boarding forms manually; this is a very onerous work from a physical point of view, as the operator shall take the single tubular knitted articles, load them onto the boarding form and orient them correctly before the boarding form moves through a heat-treatment chamber or oven where the tubular knitted article is heat-treated and boarded.

[0005] The tubular knitted articles, such as in particular socks and stockings, are shaped and are characterized by pockets of fabric that form the toe and the heel. These parts of the tubular knitted article shall be oriented correctly with respect to the shape of the boarding form, otherwise it is not possible to package the article correctly. In particular, depending upon the type of article, the orienting may be done so that the two longitudinal folding lines are arranged on the back and on the sole of the foot. In other cases, the folding is performed so that the two longitudinal folding lines are arranged on the sides of the foot.

[0006] The tubular article shall be oriented before being loaded onto the boarding form; this requires a significant work by workforce, or the use of very complex machines, able to orient the tubular knitted article before it is loaded onto the boarding form.

[0007] WO-02/18696 discloses a method and device for automatic orientation of hosiery articles. These known device and method are used to angularly orient a tubular garment, such as a sock, in preparation for a subsequent finishing or steaming operation, for instance in order to subsequently load the sock on a steaming form.

[0008] GB 2181465 discloses an automatic hose fitting apparatus, for inspecting and boarding pairs of hose. The machine comprises flat boarding forms on which the hoses are loaded for boarding purposes.

[0009] EP 0677608 discloses a machine for controlling and boarding stockings and tights. The machine is provided with flat boarding forms, whereon the socks are automatically loaded.

[0010] WO 01/77432 discloses a method and apparatus for opening positioning and loading socks on boarding forms. Also in this known machine flat, i.e. planar boarding forms are provided.

[0011] US 2005/0173476 discloses a sock boarding machine with means for removing the socks from the boarding forms. Flat forms are used. The socks are removed from the flat forms by means of a pair of conveyor belts which are pressed against the opposing planar surfaces of the form.

[0012] GB 2374090 further discloses an apparatus for boarding hosiery. The apparatus comprises flat boarding forms, wherefrom the hosiery articles are removed by means of opposing conveyor belts, which are pressed against the two opposing flat surfaces of the boarding form.

[0013] EP 1460165 discloses an apparatus for manufacturing garments starting of tubular knitted textiles. This known apparatus provides for a tubular support whereon a raw tubular semifinished garment is loaded. Once loaded on the tubular support the garment is steamed and dried by air suction to cause the garment to closely adhere against the outer surface of the tubular support. Once the semi-finished garment is tightly adhering against the outer surface of the tubular support, the garment is laser-cut to obtain the final garment. After cutting the garment is unloaded from the tubular support to be further handled.

[0014] Automatic boarding machines of the current art are complex and expensive. A need therefore exists for machines and methods that allow to simplify the above mentioned operations, reducing the use of workforce and lightening the work for the operator.

SUMMARY OF THE INVENTION

[0015] According to one aspect, a machine for boarding tubular knitted articles, such as socks and stockings, is described, comprising in combination: at least one tubular boarding form with a longitudinal axis; a heat treatment chamber where the tubular boarding form can be introduced for heat-treating the tubular knitted article; a pick-up device to take tubular knitted articles and load them on the tubular boarding form.

[0016] The machine further comprises a final boarding and removing unit for removing the tubular knitted articles from the tubular boarding form and pressing them, thus boarding them, during extraction or removal from the tu-

bular boarding form. The final boarding and removing unit may be advantageously provided near the heat treatment chamber, so that the tubular knitted article is handled by the final boarding and removing unit when the fibers of the yarn composing it are still hot, and possibly wet. In this way a final boarding effect is obtained, for example by pressing the tubular knitted article between two opposite conveyor belts, pressed against each other.

[0017] The tubular boarding form, herein also called "boarding form" or "tubular form", may have a substantially cylindrical shape. The tubular boarding form has preferably a round cross-section, which provides particular advantages, described below in greater detail. It is however possible to use tubular boarding forms having a non-round cross-section, for instance having an elliptical cross-section. In this case, the difference between major axis and minor axis of the ellipse defining the cross-section of the tubular boarding form is preferably limited, for instance equal to or lower than 30%, preferably equal to or lower than 20% and more preferably equal to or lower than 10%.

[0018] The tubular knitted article inserted onto the tubular boarding form is stretched uniformly, without concentration of yarn tensions and deformations, as instead occurs with the flat forms of the current art. The more uniform the cross-section of the tubular boarding form, the more uniform is the distribution of tension in the yarn forming the tubular knitted article. For this reason, according to some aspects using tubular boarding forms with round cross-section is preferred.

[0019] The use of tubular boarding forms, preferably with round or slightly elliptical cross-section, also allows greater easiness in angularly orienting the tubular article. In fact, by using flat boarding forms it is necessary to insert the tubular knitted article in a well-defined angular position with respect to the edges of the flat boarding form. In particular, it is necessary to precisely orient the toe and heel pockets, so that, after boarding, the folding lines obtained in correspondence of the edges of the boarding form have a precise position with respect to the heel.

[0020] Vice-versa, by using a tubular boarding form, once the tubular knitted article has been inserted onto the tubular boarding form, it is possible to angularly orient the tubular knitted article with respect to the axis of the tubular boarding form, in order to perform, after the angular orienting step, a final boarding step, by pressing the tubular knitted article between the two conveyor belts pressed against each other.

[0021] The machine may be also provided with an angular orientation device for angularly orienting the tubular boarding form. The machine may further comprise a plurality of stations, for instance for loading the tubular knitted article onto the tubular boarding form, for angularly orienting it and for heat-treating it in the heat treatment chamber; for unloading and final boarding. Advantageously, the tubular boarding form may be mounted on a conveyor that transfers the board from one to the other of a plurality of stations for handling, processing or treating the tubular knitted article, including any loading and unloading stations.

[0022] The heat treatment chamber may comprise a heating unit, for instance through electrical resistors, and an air circulation system, which is preferably closed or partially closed, so as to reduce power consumption. A fan may be provided for circulating air in the closed circuit. To reduce fire risks, filters may be provided for removing impurities like powders or fibers, thus avoiding the contact thereof with the electrical resistances.

[0023] The air temperature may be kept, for instance, between 50°C and 100°C, preferably between 60°C and 90°C, and more preferably approximately 75°C-85°C.

[0024] The air may be dry. In other embodiments use of wet air can also be envisaged.

[0025] In some embodiments, the time the tubular knitted article remains in the heat treatment chamber may be comprised between 10 seconds and 60 seconds, preferably between 20 seconds and 30 seconds.

[0026] With this type of process parameters, thanks to the temperature that is slightly lower than that used in the normal boarding machines, there is the advantage of reducing or preventing the dissolution of the softeners used, thus obtaining a final product of higher quality.

[0027] In order to increase machine productivity, more than one tubular boarding form may be mounted on the conveyor, for instance a number of tubular boarding forms equal to, or greater than, the number of stations of the machine.

[0028] The conveyor may be a flexible conveyor, i.e. a chain or a belt. In other embodiments, the conveyor may be rigid, for instance a rotating table or a rotating carousel.

[0029] The tubular boarding forms are preferably arranged with their axes parallel to one another. In case a rotating conveyor is used, the rotation axis of the conveyor may be parallel to the axes of the tubular boarding forms.

[0030] In some embodiments the tubular knitted article inserted onto the tubular boarding form may be angularly oriented by making it slide on the surface of the tubular boarding form, for instance by pinching the article with radial outer pads which rotate around the axis of the tubular boarding form, thus drawing the tubular knitted article by means of friction and making it rotate.

[0031] However in some embodiments of the machine, in order to have a gentler treatment of the tubular knitted article avoiding having tensions in the textile structure, the tubular boarding form, or each tubular boarding form with which the machine is provided, may be mounted rotatable around its own longitudinal axis. It is thus possible to angularly orient the tubular knitted article with respect to the axis of the tubular boarding form by rotating the whole tubular boarding form, with the tubular knitted article inserted onto it, around the longitudinal axis of the tubular knitted article.

[0032] In this way it is possible to avoid tensions, due

to compression or to friction, in the textile structure of the tubular article.

[0033] The machine may comprise a heat treatment chamber for dry or wet treatment, or a chamber suitable to perform different heat treatments, for example both dry and wet according for instance to the type of yarn or to other characteristics of the tubular knitted article. It is also possible to provide a multiple heat treatment chamber, or more heat treatment chambers, preferably arranged in sequence, in each of which it is possible to use different operating parameters, such as different temperature degrees and/or humidity.

[0034] In some embodiments, in order to facilitate the removal of the tubular knitted article from the tubular boarding form, the tubular boarding form or each tubular boarding form comprises an extractor that is extractable and insertable with respect to an end of the tubular boarding form. The tubular knitted article may be inserted onto the tubular boarding form so that the closed toe thereof covers the distal end of the tubular boarding form, i.e. the end that is distant with respect to the point where the tubular boarding form is connected for instance to a conveyor moving it through the different machine stations. The extractor is extracted from the distal end of the tubular boarding form, thus pushing the tubular knitted article from the inside of the toe thereof, starting to remove it from the tubular boarding form. In this way, the two conveyor belts can more easily engage the tubular knitted article between two opposite branches thereof, pressing against the extractor.

[0035] According to a further aspect, a method for boarding a tubular knitted article is provided according to claim 9.

[0036] Further advantageous features and embodiments of the machine and the method according to the present invention are described hereunder with reference to the attached drawings and in the appended claims, which form an integral part of the present description.

[0037] In the description below, the boarding machine and the related method are described in combination with a device that automatically opens the elastic edge of the tubular knitted articles and inserts them automatically on the tubular boarding form. This allows particular advantages in terms of cycle automation. However, a different system for loading the tubular knitted articles may be associated with the tubular boarding form, or it is possible to manually load the tubular knitted article. Anyway, also in this case the operator's work is simplified, as he/she does not have to manually orient the tubular knitted article.

[0038] Substantially, the machine and the method described herein allow subdividing the boarding operations for boarding the tubular knitted articles into two steps: in a first step, performed on the tubular boarding form, the tubular knitted article is heat-treated, without being folded. Only after this step, the tubular knitted article is picked up and taken off from the tubular boarding form, and pressed to be folded, for example by means of two opposite conveyor belts.

[0039] This method allows many advantages. In addition to the already mentioned simplification of the tubular knitted article orientation step, it is possible to board the tubular knitted article by positioning the fold in any position with respect to the fabric pocket (heel and toe) according to the production needs. No mechanical or adjustment intervention are required for this purpose:, only a suitable setting of the orienting members is required.

[0040] The tubular shape, with preferably round cross-section, of the tubular boarding forms allows orienting the tubular knitted article in any defined angular position, so as to fold the boarded tubular knitted article along folding lines oriented in any position with respect to the heel. The folding lines may be positioned, for example, so as to extend along the foot back and the foot sole, folding the heel pocket and the toe pocket of the tubular knitted article in the middle. In other operating modes, the orientation may be done so that the fold is made along the flanks of the foot.

[0041] The orientation may be done by rotating the tubular boarding form and identifying, by means of any angular detection system, the angular position of the tubular article with respect to a reference system. The angular detection system may be so configured as to "see" the position of the fabric pocket of the toe and/or of the heel or, more simply, a drawing or any other optical mark may be provided on the tubular knitted article that is clearly visible by means of a vision system. The optical mark may be applied, for instance, during knitting on a circular knitting machine, in a precise angular position with respect to the fabric pockets.

[0042] The use of tubular boarding forms further allows performing the heat-treatment with the fabric stretched uniformly, without areas with concentrations of tensions and/or deformations of the knitted fabric. The textile fibers are arranged uniformly on all the surface of the tubular knitted article.

BRIEF DESCRIPTION OF THE DRAWINGS

[0043] The invention will be better understood by following the description and the accompanying drawings, which show non-limiting practical embodiments of the invention. More particularly, in the drawing:

Fig. 1 is a schematic plan view of a machine for boarding tubular knitted articles, such as stockings or socks, provided with an elastic edge at one end thereof;

Fig. 2 shows a schematic of the pneumatic pipe for feeding the tubular knitted articles to the boarding members;

Figs. 3 and 4 are axonometric views of the device for opening the elastic edge of the tubular knitted article and of the pick-up member transferring the tubular knitted articles onto the tubular boarding

forms;

Figs. 5 and 6 show two cross-sections according to the longitudinal planes, orthogonal to each other, of the device and the related pick-up member of Figs. 3 and 4;

Fig. 7 is an axonometric view of a tubular boarding form;

Figs. 8A and 8B illustrate longitudinal cross-sections of the upper end and the lower end of the tubular boarding form of Fig. 7;

Figs. 9A and 9B illustrate the unit for rotating the tubular boarding forms in two different operating conditions;

Fig. 10 illustrates an axonometric view and the area where the tubular boarding forms enter the heat-treatment chamber;

Figs. 11A and 11B show a side view of the pick-up station for the tubular knitted articles boarded by means of the tubular boarding forms;

Figs. 12A to 12S show an operating sequence of opening the elastic edge of a tubular knitted article and loading the tubular knitted article on a tubular boarding form;

Figs. 13A to 13D show unloading steps of a tubular knitted article in a situation wherein the opening of the elastic edge failed.

DETAILED DESCRIPTION OF EMBODIMENTS

[0044] The following detailed description of the exemplary embodiments refers to the accompanying drawings. The same reference numbers in different drawings identify the same or similar elements. Additionally, the drawings are not necessarily drawn to scale. Also, the following detailed description does not limit the invention. Instead, the scope of the invention is defined by the appended claims.

[0045] Reference throughout the specification to "one embodiment" or "an embodiment" or "some embodiments" means that the particular feature, structure or characteristic described in connection with an embodiment is included in at least one embodiment of the subject matter disclosed. Thus, the appearance of the phrase "in one embodiment" or "in an embodiment" or "in some embodiments" in various places throughout the specification is not necessarily referring to the same embodiment(s). Further, the particular features, structures or characteristics may be combined in any suitable manner in one or more embodiments.

[0046] Fig. 1 schematically illustrates a plan view of a machine 1 for boarding tubular knitted articles, such as stockings and socks provided with an elastic edge. Schematically, the machine 1 comprises a rotating carousel 3 with a substantially vertical rotation axis 3A. Tubular boarding forms 5 are provided on the rotating carousel 3, arranged around the rotation axis 3A of the carousel 3. The number of boarding forms 5 may vary, for example depending on the size of the machine 1. Greater details on the boarding forms 5 will be described below. It should be noted that, in the illustrated embodiment, the boarding forms 5 have a circular cross-section rather than a flat cross-section as usually occurs in the prior art boarding machines.

[0047] A pneumatic pipe, indicated as a whole with number 7, is associated with the machine 1 for feeding individual tubular knitted articles to the boarding machine 1; greater details of the pneumatic pipe will be described below.

[0048] The boarding machine 1 comprises a plurality of stations, and more particularly a first station 9, where tubular knitted articles coming from the pneumatic pipe 7 are opened by stretching, i.e. by annularly enlarging the elastic edge, and are loaded on the tubular boarding forms 5. The boarding machine 1 also comprises a second station 11 for orienting the boarding form 5 around a vertical rotation axis (B-B) of the boarding form 5, substantially parallel to the rotation axis 3A of the carousel 3. Reference number 12 generally indicates an angular orientation device for angularly orienting the boarding forms 5. The boarding machine 1 also comprises an boarding station 13, comprising an oven or heat-treatment chamber 15, which can extend according to a portion of circular ring around the rotation axis 3A of the carousel 3. A station 17 is also provided for removing or picking up the individual tubular knitted articles from the boarding forms 5 and for feeding them to a packing machine, not shown.

[0049] Fig. 2 illustrates in greater detail the configuration of the pneumatic feeding pipe for feeding the tubular knitted articles towards the machine 1. The pneumatic pipe 7 comprises an entrance end 7A and an exit end 7B, the latter being fluidly coupled with an opening device for opening the elastic edge of the tubular knitted articles, which will be described in greater detail with reference to the following Figs. 3 to 6. Between the entrance opening 7A and the exit opening 7B, the pneumatic pipe 7 is provided with a series of elements subdividing the same pneumatic pipe 7 into sections. Starting from the entrance end 7A, along the pneumatic pipe 7 there are provided a first closing gate 21, a first air intake 23 and a first passage sensor 25 for detecting the passage of the tubular knitted article along the pneumatic pipe 7, a first suction mouth 27, a second gate 29, a second air intake 31, a second passage sensor 33. A branch line 35 is associated with the pneumatic pipe 7; the branch line ends with a discharge bell 37 fluidly coupled, through a third gate 39, to a second suction mouth 41, for the purposes described below.

[0050] Each air intake 23 and 31 has a respective opening and closing gate 23A and 31A, respectively. The suction mouth 27 has an opening and closing gate 27A. In the illustrated embodiment, the individual tubular knitted articles are inserted manually, according to a preset orientation, inside the entrance end 7A of the pneumatic pipe 7, and are conveyed towards the exit end 7B of the pneumatic pipe 7, in order to be introduced in the opening

device for opening the elastic edge of the tubular knitted article and allow then to load it onto the boarding form 5.

[0051] The sequence of feeding the individual tubular knitted articles inside the pneumatic pipe 7 will be described with reference to the sequence of Figs. 12A- 12S.

[0052] The opening device for opening the elastic edge of the tubular knitted article is arranged in the station 9 of machine 1, where the tubular knitted article is conveyed by means of the pneumatic pipe 7 and is loaded onto one of the boarding forms 5 of the machine 1.

[0053] The structure of the opening device for opening the elastic edge of the tubular knitted article is illustrated in detail in Figs. 3 to 6. The device is indicated as a whole with number 43. The device 43 is connected to the pneumatic pipe 7 by means of a connection 7C. The connection 7C is arranged approximately coaxially with a hollow body 45, with a longitudinal axis A-A. Between the hollow body 45 and the tubular connection 7C a feeding device is provided, indicated as a whole with number 47.

[0054] In the illustrated embodiment, the feeding device 47 comprises a pair of rollers 49 rotating around axes 49A, which are substantially parallel to each other and orthogonal to the axis A-A of the hollow body 45. In Figs. 3 and 4, number 51 indicates an electric motor that controls the rotation of at least one of the rollers, and preferably both the rollers 49 of the feeding device 47. The rotation of the rollers 49 can be controlled clockwise or counterclockwise depending on the handling steps for the tubular knitted article, as described in greater detail below. The rollers 49 are counter-rotating, so that a tubular knitted article inserted in the nip defined between the rollers can be moved forward or backward depending on the direction of rotation of the rollers 49.

[0055] In some embodiments an actuator, for example a cylinder-piston actuator 89, may be provided to move the rollers 49 of the feeding device 47 towards and away from each other, with a movement orthogonal to the rotation axes 49A of the rollers.

[0056] The terminal part, i.e. the part closer to the rollers 49, of the tubular connection 7C can be provided with holes 7D fluidly coupling the inside of the tubular connection 7C to a suction mouth 91, for purposes that will be explained below.

[0057] The hollow body 45 has an inner volume 53 delimited by a wall 55, which may have a substantially axial-symmetrical shape with respect to axis A-A. The inner volume 53 of the hollow body 45 may have a first converging portion 53A and a second diverging portion 53B. The two portions 53A and 53B of the inner volume 53 of the hollow body 45 may have a substantially frustum-conical shape and be connected at an intermediate position of the longitudinal extension of the hollow body 45. In the illustrated embodiment, the converging portion 53A has a greater longitudinal extension, approximately twice the longitudinal extension of the diverging portion 53B. In other embodiments, the lengths of the converging portion 53A and the diverging portion 53B can be different than those represented.

[0058] The hollow body 45 has an entrance opening 45A and an exit opening 45B for the tubular knitted article. The entrance opening 45A and the exit opening 45B are preferably coaxial with each other and longitudinally spaced from each other along the axis A-A of the hollow body 45. The cross-section of the inner volume 53 and of the entrance and exit openings 45A and 45B may be circular.

[0059] The wall 55 of the hollow body 45, delimiting the inner volume 53, has an entrance edge 55A surrounding the entrance opening 45A and an exit edge 55B surrounding the exit opening 45B.

[0060] A suction arrangement is associated with the hollow body 45. In the illustrated embodiment, around the hollow body 45 a first suction chamber 57 is provided, which forms part of the suction arrangement and which can be delimited by a wall 59. The first suction chamber 57 is provided with one or more suction mouths 58, see in particular Fig. 6. In the illustrated embodiment two suction mouths 58 are provided, diametrically opposite to each other. It is also possible to provide a different number of suction mouths.

[0061] The first suction chamber 57 has a downwards facing air passage, which can be selectively opened and closed by means of a closing member 61, which may form an openable wall. The closing member 61 may comprise a plurality of leaves, for example two leaves 61A and 61B, movable with respect to each other. In the drawing, the double arrows f61A and f61B indicate the opening and closing movement of the two leaves 61A, 61B to open and close the first suction chamber 57. Numbers 63A and 63B indicate two actuators, for example two pneumatic or hydraulic cylinder-piston actuators used to control the movement of the two leaves 61A, 61B forming the closing member 61. In other embodiments, the closing member 61 may have a different shape, for example it may comprise only one leaf or can be shaped like and openable and closable diaphragm, like an optical diaphragm.

[0062] In Figs. 5 and 6 the closing member is shown in a closed position, with the two leaves 61A and 61B forming a wall arranged in front of the exit opening 45B of the hollow member 45, at a certain distance from the edge 55B.

[0063] The distance between the exit edge 55B of the wall 55 and the surface of the leaves 61A and 61B facing the hollow member 45 is such as to leave a gap I between the exit edge 55B of the wall 55 and the closing member 61. Through the gap I, that substantially forms an annular space surrounding the longitudinal axis A-A of the hollow member 45, the first suction chamber 57 is fluidly coupled to the inner volume 53 of the hollow body 45.

[0064] Near the exit opening 45B and the exit edge 55B, the hollow body 45 is provided with radial suction ports 65 that, together with the suction chamber 57, form part of the suction arrangement. In the illustrated embodiment, the ports 65 have a substantially circular cross-section, but this is not binding. They are constituted by

through holes which extend through the whole thickness of the wall 55. The ports 65 are arranged preferably as close as possible to the exit edge 55B and, anyway, in the diverging portion 53B of the inner volume 53. The ports 65, arranged circumferentially or annularly around the longitudinal axis A-A, fluidly couple the inner volume 53 of the hollow member 45 to the first suction chamber 57.

[0065] Forks 67 may be arranged between the rollers 49 of the feeding device 47 and the entrance opening 55A of the hollow member 55; these forks can move towards and away from each other under the control of linear actuators, for example cylinder-piston actuators 69. Reference f67 indicates the opening and closing movement of the forks 67.

[0066] A pick-up member, indicated as a whole with number 71, is arranged under the hollow member 45. The pick-up member 71 is shown in two different operating positions in Figs. 3 and 4. In the illustrated embodiment, the pick-up member 71 has a stretching device which can be formed by four fingers 73 movable with respect to one another so as to take a spread-apart position and a position close to one another. In Figs. 5 and 6, the fingers 73 of the pick-up member 71 are illustrated in the close to one another, i.e. in a position of minimal distance with respect to the longitudinal axis A-A. Vice-versa in Fig. 4 the fingers 73 are shown in spread-apart position. Actuators 75 may be provided, carried for example by a plate 77, to control the spread-apart movement and the movement towards one another of the fingers 73.

[0067] In the illustrated embodiment, the pick-up member 71 also comprises a second suction chamber 79 fluidly coupled to one or more suction mouths 80. The second suction chamber 79 is carried by the plate 77.

[0068] The plate 77 forms a slide and may be provided with shoes 81 (see in particular Figs. 3 and 4) which slidably engage on linear guides 83 having a longitudinal extension substantially parallel to the longitudinal axis A-A. The movement of the slide 77 according to f77 along the guides 83 may be controlled by means of a motor 85 (Figs. 3 and 4).

[0069] Through the movement according to the double arrow f77 of the slide 77, the pick-up member 71 can be moved from one to the other of the two positions illustrated in Figs. 3 and 4, and can be also carried in a position even lower than the one shown in Fig. 4, to load single tubular knitted articles onto the boarding forms 5 according to an operating cycle that will be described with reference to the sequence of Figs. 12A to 12S.

[0070] Figs. 7 and 8 show respectively an axonometric view and a longitudinal cross-section of a tubular boarding form 5. In the illustrated embodiment, the boarding form 5 comprises an outer sleeve 93 of substantially cylindrical shape, which can be supported, for example by means of bearings 95, on a central support 97 extending inside the sleeve 93 according to a longitudinal axis B-B of the boarding form 5. The central supports 97 of the various boarding forms 5 carried by the rotating carousel 3 can be fixed with respect to the rotating carousel 3. In advantageous embodiments, the outer sleeve 93 is integral with an inner sleeve 99 which forms a friction wheel 101, radially projecting with respect to the cylindrical sleeve 93. The support 97 is integral with a tubular body 103 with a flange 105 for anchoring the support 97 to the rotating carousel 3.

[0071] The described structure allows the sleeve 93 forming the outer surface of the boarding form 5 to rotate around the longitudinal axis B-B on the bearings 95 with respect to the inner support 97.

[0072] Coaxially to the support 97 and to the outer sleeve 93, inside the boarding form 5, and preferably inside the support 97, a stem 107 is provided, ending with an extractor 109 of flat shape, for example approximately rectangular, which can axially project from an upper closing disc 111 of the boarding form 5, fixed with respect to the support 97. The stem 107 is provided with an axial extraction and retraction movement according to the double arrow f107 to extract the extractor 109 through the closing disc 111. In some embodiments, the stem 107, which may be internally hollow, may have a lower end 107A opposite to the extractor 109, to which a feeler 115 is attached that co-acts with a cam or with an actuator that controls the movement according to the double arrow f107 for the extraction and retraction of the stem 107 and of the extractor 109.

[0073] The friction wheel 101 is configured to co-act with a driving friction wheel 121, shown in particular in Figs. 9A and 9B of the angular orientation device 12 for angularly orienting the boarding forms 5. The friction wheel 121 is arranged in the station 11 of the boarding machine 1 and controls the rotation of each boarding form 5 around its own longitudinal rotation axis B-B in order to angularly position the outer sleeve 93 and the tubular knitted article inserted thereon with respect to the inner support 97 and thus with respect to the extractor 109. As schematically shown in Fig. 1, the station 11 comprises an optical reader or other reader schematically indicated with 123, detecting the angular position of the boarding form 5 with the tubular knitted article inserted thereon, in order to angularly orient the tubular knitted article, orienting it as required for the subsequent packing operation.

[0074] In some embodiments, the motorized friction wheel 121 can be driven into rotation by an electric motor 123, through a pair of pulleys 125, 127 and a belt 129. In some embodiments, the friction wheel 121, the motor 123 and the transmission members 125, 127, 129 are carried by a slide 131 sliding along a guide 133 radially oriented with respect to the rotating carousel 3. As can be easily understood by comparing Figs. 9A and 9B, a movement according to the double arrow f131 of the slide 131 can bring the motorized friction wheel 121 alternately in a position of contact with the friction wheel 101 of an boarding form 5 (Fig. 9A) or in a cleared position, where the motorized friction wheel 121 does not obstruct the

passage of the boarding forms 5 moved along a circular trajectory by means of the rotating carousel 3 that rotates around the axis 3A according to the arrow f3.

[0075] Fig. 10 shows an axonometric view of the entrance area of the heat-treatment chamber or oven 15 arranged in the boarding station 13 of the boarding machine 1. The heat-treatment chamber 15 comprises an entrance 15A, which can be closed by flexible sheets 132 that can be deformed when the boarding forms 5 pass, so as to allow the boarding forms 5 to pass avoiding excessive heat loss through the entrance opening 15A. A similar arrangement can be provided on the opposite side where the boarding forms exit the heat-treatment chamber 15.

[0076] Pipes 134, 135 for hot air circulation, a fan 137 for hot air circulation, and a filter 139 are schematically indicated in Fig. 10. The air may be heated through electrical resistances, not shown. In some embodiments, the heat-treatment may be dry, while in other embodiments moist air or steam can be used. The time the boarding forms 5 and the tubular knitted articles remain in the heat-treatment chamber may vary depending on the temperature inside the heat-treatment chamber. For example, with temperatures in the order of about 75°-85°C, this time may be comprised between 20 and 30 seconds.

[0077] In some embodiments, not shown, the tubular knitted article M may be moistened before entering the heat-treatment chamber 15. To this end, a specific station may be provided, for example provided with nozzles that spray atomized water onto the tubular knitted article M.

[0078] In the station 17 of the boarding machine 1 a final boarding and removing unit may be arranged for boarding and removing the tubular knitted article from the boarding forms 5, the final boarding unit removing the tubular knitted articles from the tubular boarding forms 5 after the heat-treatment in the heat-treatment chamber 15, and downloading them onto an exit conveyor 141 (Figs. 11A, 11B) which carries the boarded tubular knitted articles toward a packing machine, not shown.

[0079] Figs. 11A and 11B show the final boarding and removing unit for boarding and removing the boarded tubular knitted articles. The unit is indicated as a whole with number 151. The final boarding and removing unit 151 may comprise two conveyor belts 153, 155 controlled by a motor 157 and driven around wheels 159, 161 carried by arms 163, 165. As can be seen by comparing Figs. 11A and 11B, the arms 163 and 165 are movable, for example pivotally, in order to take a first position (Fig. 11A), where the conveyor belts 153, 155 are mutually spaced, at least in the area of the wheels 159, 161, and a closed position, where the conveyor belts 153 and 155 are close to each other at least along a substantially vertical rectilinear segment (Fig. 11b). The reciprocating pivoting movement of the arms 163 and 165 according to the double arrows f163 and f165 can be controlled by means of an actuator 169, and by means of tie rods 171, 173, connecting the two oscillating arms 163, 165 to a rotating member 175 provided with alternate reciprocating rotation movement that can be seen by comparing Figs. 11A and 11B.

[0080] As shown in broken line in Fig. 11A, each boarding form 5 passes under the final boarding and removing unit 151 with the extractor 109, extending between the arms 163, 165, in extracted position. When a tubular knitted article is inserted onto the boarding form 5 and partially lifted by the extractor 109, the closure of the arms 163, 165 causes the movement of the conveyor belts 153, 155 towards the extractor 109 and the tubular knitted article is thus pinched and pressed between the extractor 109 and the two conveyor belts 153, 155. The subsequent actuation of the conveyor belts according to the double arrows f153 and f155 causes the removal of the tubular knitted article from the boarding form 5 and the feeding thereof towards the exit conveyor 141. Since the tubular knitted article is still hot due to the heat-treatment in the heat-treatment chamber 15, the pressure of the two conveyor belts 153, 155 boards and stabilizes the fold of the tubular knitted article before it is downloaded onto the exit conveyor 141.

[0081] Having described the main members of the boarding machine 1, with reference to the sequence of Figs. 12A- 12S, a work cycle will be now described in detail for loading a tubular knitted article onto an boarding form 5, which will move the tubular knitted article through the stations 11-13 and 17, for boarding the tubular knitted article and removing it from the boarding form 5 in order to deliver it to the packing machine.

[0082] Figs. 12A to 12G illustrate the sequence of inserting a tubular knitted article into the pneumatic pipe 7 and of feeding the tubular knitted article along the pneumatic pipe 7 up to the opening device 43 for opening the elastic edge of the tubular knitted article.

[0083] In Fig. 12A, the tubular knitted article is schematically indicated with M. It has a closed toe P at a first end and an elastic edge E at a second end. In some embodiments, on the tubular knitted article M writing or other elements can be provided in a given position with respect to the shape of the tubular knitted article M. These elements are schematically indicated with S. The tubular knitted article M can be a sock or a stocking, which may have a heel T. The angular orientation elements S have a predetermined position with respect to the shape of the toe P and the position of the heel T, if any.

[0084] The tubular knitted article is inserted, for example manually, into the entrance end 7A and is sucked inside the pneumatic pipe 7. In this operating phase, the first gate 21 is in open position, the first air intake 23 is closed by means of the gate 23A, while the first suction mouth 27 is open and air is sucked (arrow A) through said first suction mouth 27, so as to generate an air flow C1 flowing from the entrance end 7A up to the suction mouth 27.

[0085] When the tubular knitted article M is inserted at the entrance end 7A, it is drawn due to the suction effect towards the first suction mouth 27. The passage sensor 25 detects passage of the tubular knitted article M and

causes the closing of the gate 21, the opening of the first air intake 23 and, after a given time, the stopping of the suction through the first suction mouth 27. The tubular knitted article M continues its movement along the pneumatic pipe 7 due to inertia after the closing of the first suction mouth 27, beyond the point where the latter is arranged, to enter (as shown in Fig. 12C) in the pneumatic pipe portion between the first suction mouth 27 and the closing gate 29 that, in this step, is closed. The gate 29 is subsequently opened, and the tubular knitted article passes through the gate 29 to pass beyond the second passage sensor 33, which generates a signal when the tubular knitted article M passes, said signal causing the first air intake 23 and of the gate 29 to close (see Fig. 12E). Also the second air intake 31 is opened by opening the gate 31A. The tubular knitted article M continues its travel towards the device 43 due to inertia up to the device 43, arranging itself in the end part of the tubular connection 7C (Fig. 12F).

[0086] In the first section of the pneumatic pipe 7, upstream of the gate 29, a second tubular knitted article M can enter, as described above, which will be arranged to be subsequently fed to the device 43, when the elastic edge of the already introduced tubular knitted article M has been opened and the article removed from the device 43.

[0087] In Fig. 12G suction has been activated through the branch 35 of the pneumatic pipe 7 by opening the gate 39 and generating in this way an air flow represented by the arrow A in Fig. 12G. Air flow A stretches the tubular knitted article M upstream of the rollers 49 of the device 43. In fact, when the tubular knitted article arrives in the lower part of the tubular connection 7C, the elastic edge E thereof is caught in the nip between the rollers 49, the rotation whereof (arrow f49 in Fig. 12H) causes the forward movement of the tubular knitted article, and in particular of the elastic edge E thereof, up and beyond the nip between the rollers 49, downstream whereof a photocell or other sensing member 191 is provided.

[0088] When the elastic edge E of the tubular knitted article M covers the photocell 191, the signal from the photocell causes the suction activation through the branch 35 and the second suction mouth 41, so as to stretch upward the portion of the tubular knitted article M tube upstream of the nip between the rollers 49.

[0089] When the tubular knitted article M is stretched due to the suction effect (arrow A in Figs. 12H and 12I), the suction through the first suction chamber 57 can be activated. Continuing the rotation of the rollers 49 according to the arrow f49, the elastic edge E of the tubular knitted article M moves forwards towards the inner volume of the hollow body 45, as shown in the following Fig. 12J. In order to facilitate this forward movement of the elastic edge E, air is sucked through the suction mouths 58, the first suction chamber 57, the ports 65, the gap I, the inner volume 53 of the hollow body 45, and the entrance opening 45A, as shown by the arrows A1 in Fig. 12J.

[0090] The air flow generated in the inner volume 53 of the hollow body 45 causes stretching or opening of the elastic edge E of the tubular knitted article M, which moves gradually forwards inside the hollow body 45.

[0091] Fig.12K shows the effect of the forward movement of the tubular knitted article M with its elastic edge E toward the exit opening 45B of the hollow body 45, under the effect of the continuous suction through the first suction chamber 57, the radial ports 65 and the gap I. This suction causes the elastic edge E to adhere initially to the inner surface of the diverging portion 53B of the inner volume 53 of the hollow body 45, and subsequently to enter the gap I.

[0092] When the tubular knitted article M with its elastic edge E is arranged as illustrated in Fig. 12K, the radial suction ports 65 are substantially closed by the fabric of the tubular knitted article and the annular gap I is at least partially blocked by the fabric of the elastic edge E. Consequently, the suction inside the first suction chamber 57 causes a pressure drop, which is detectable by a vacuum switch (not shown). When the vacuum switch detects a certain degree of vacuum, i.e. a pressure lower than the atmospheric pressure in the first suction chamber 57, this means that the tubular knitted article M is properly arranged as shown in Fig. 12K, blocking for the most part the gap I and the radial suction ports 65. When the underpressure has been achieved inside the suction chamber 57, suction can be interrupted.

[0093] In the next step shown in Fig. 12L, the rollers 49 stop rotating, keeping in the nip therebetween the end part, i.e. the part adjacent to the toe P, of the tubular knitted article M. The closing member 61 is opened and, continuing the suction through the first suction chamber 57, air begins to enter from the outside, according to the arrows A3, through the air passage opened by the moving away of the leaves 61A, 61B forming the closing member 61. This causes the elastic edge E, brought into contact with the wall 55 of the hollow body 45, to remain adhering to the exit edge 55B of the wall 55.

[0094] In the next step, shown in FIG. 12M, the pick-up device 71 is lifted to bring the fingers 73 thereof partially inside the inner volume 53 of the hollow body 45, passing through the exit opening 45B. Conveniently, the fingers 73 may be so shaped as to have a distal tapered portion, which can be easily inserted into the diverging portion 53B of the inner volume 53 of the hollow body 45. By lifting the pick-up member 71 in the position shown in Fig. 12M, the second suction chamber 79 is fluidly coupled to the first suction chamber 57 and to the inner volume 53 of the hollow body 45 through a suction inlet of the second suction chamber.

[0095] At this point, air suction through suction mouths 80 can be initiated. The air flow, represented by the arrows A4 in Fig. 12N, flows through the inner volume 53 of the hollow body 45 entering through the entrance opening 45A, exits the inner volume 53 of the hollow body 45 through the exit opening 45B, enters the second suction chamber 79 and exits through the suction mouths 80.

The air flow that is generated in the narrow passage left between the inner surface of the wall 55 of the hollow body 45 and the fingers 73 draws the tubular knitted article M detaching it from the exit edge 55B and bringing the elastic edge E of the tubular knitted article M to surround the fingers 73 and to slide along them until it reaches the position shown in Fig. 12N. The air flow A4 required for this purpose is conveyed towards the bottom of the second suction chamber 79 by means of a collar 82 approximately coaxial with the fingers 73 of the pick-up member 71, wherein said collar 82 extends toward the bottom of the suction chamber 79 partially covering the suction mouths 80 so that the air flow A4 flows along the pin formed by the fingers 73 adjacent to one another and generates the force required to insert the elastic edge E of the tubular knitted article M onto the fingers 73 that are adjacent to one another.

[0096] Figure 12O is an axonometric view of the device 43 with the pick-up member 71 in this operating step. Fig. 12P shows the next step, wherein the closing member 61 returns in the closed position after the pick-up member has started its downward movement (arrow f71 in Fig. 12P), removing the fingers 73 from the inside of the hollow body 45. At this point, a next tubular knitted article M1 can enter the nip between the rollers 49, which start again to rotate to initiate a new processing cycle, while the tubular knitted article M inserted onto the fingers 73 of the pick-up member 71 can be brought downwards and loaded onto an boarding form 5 which is positioned coaxial to the device 43 and the pick-up member 71.

[0097] Fig. 12Q schematically shows an boarding form 5 in a position coaxial to the pick-up member 71, the fingers 73 whereof have been spread-apart.

[0098] Continuing its downward movement according to arrow f71, the pick-up member 71 loads the tubular knitted article M onto the boarding form 5, having previously opened the fingers 73. The fingers are arranged at such a mutual distance as to allow the insertion of the tubular form 5 between the four spread-apart fingers 73. By continuing the lowering movement of the pick-up member 71 according to the arrow f71, the fingers 73 are removed from the tubular knitted article M, which is gradually loaded onto the boarding form 5, until the position of Fig. 12R is achieved. Now the tubular knitted article M is completely loaded onto the boarding form 5, and the pick-up member 71 with the fingers 73 is below the elastic edge E of the tubular knitted article M loaded onto the upper part of the boarding form 5.

[0099] Fig. 12S is an axonometric view of the device 43 with the pick-up member 71 and the boarding form 5 in the position achieved in this step. At this point, movement of the pick-up member 71 can be reversed, and can be brought to a level above the distal end of the boarding form 5. This latter can thus move angularly, drawn by the rotating carousel 3 towards the subsequent angular orientation station 11. In the station 11, by means of the friction wheel 101 integral with the outer sleeve 93 of the boarding form 5 and the motorized friction wheel 121 (Figs. 9A and 9B), the tubular knitted article M can be rotated, together with the external sleeve 93 of the boarding form 5, so as to bring the tubular knitted article M in the desired angular position with respect to the extractor 109. In this step, the extractor is completely withdrawn inside the boarding form 5, below the upper surface of the disc 111. The angular orientation may be also performed in a step following boarding inside the heat-treatment chamber 15.

[0100] In the sequence described with reference to Figs. 12A-12S it has been observed that the correct and complete opening of the elastic edge E, as well as the adhesion thereof to the inner surface of the wall 55 of the hollow member 45, is determined by detecting the pressure in the first suction chamber 57. If the tubular knitted article fails to position itself correctly, i.e. if the elastic edge E thereof does not properly cover the suction ports 65 and/or is not inserted in the gap I, inside the first suction chamber 57 there will not be a sufficient degree of vacuum, i.e. a sufficient negative pressure with respect to the external ambient pressure. This condition is detected by the vacuum switch (not shown).

[0101] Since the stretching, i.e. the opening of the elastic edge E of the tubular knitted article M up to close the suction ports 65 and the gap I requires a certain time, if the pressure within the first suction chamber 57 does not decrease below a predetermined threshold within a given time interval, this is interpreted by a control unit (not shown) of the boarding machine 1 as a non-opening or a partial opening of the elastic edge E of the tubular knitted article M; consequently, a procedure is initiated for repeating the opening, or a discharge cycle for discharging the tubular knitted article which has not been properly opened.

[0102] In the first case (repeating of the opening operations), the rotational motion of the rollers 49 is reversed to bring the elastic edge E of the tubular knitted article M back at the level of the photocell 191 and the cycle described with reference to the sequence of Figs. 12H to 12S is repeated.

[0103] Alternatively, or if, despite the repetition of the opening operations, a fail in the opening and stretching of the elastic edge E of the tubular knitted article M is detected, the tubular knitted article M which has been not properly opened can be discharged. This may occur according to the sequence illustrated in figures 13A-13E.

[0104] Fig. 13A schematically shows a situation in which the tubular knitted article has not been properly arranged inside the hollow member 45. The elastic edge E of the tubular knitted article M has adhered to only a portion of the inner surface of the wall 55 of the hollow body 45, blocking only some of the suction ports 65 and only a part of the gap I. Inside the suction chamber 57 the necessary vacuum degree, which is required for the subsequent loading the tubular knitted article M onto the boarding form 5, has not been generated. Consequently, the motion of the rollers 49 is firstly stopped and then reversed, as shown by the arrows f49X in Fig. 13B. Si-

multaneously, suction through the second suction mouth 41 is actuated by opening the gate 39. The air flow, indicated by the arrow A6, which is generated in the tubular connection 7C, draws the tubular knitted article M upwards once this latter has been released by the rollers 49. The air flow A6 draws the tubular knitted article M inside the discharge bell 37. From here, the tubular knitted article is removed by interrupting the suction by closing the gate 39. Due to the weight of the tubular knitted article M, a bottom closing door 37A of the discharge bell 37 is opened, thus discharging the tubular knitted article M, for example into a container below (not shown).

[0105] While the disclosed embodiments of the subject matter described herein have been shown in the drawings and fully described above with particularity and detail in connection with several exemplary embodiments, it will be apparent to those of ordinary skill in the art that many modifications, changes, and omissions are possible without materially departing from the novel teachings, the principles and concepts set forth herein, and advantages of the subject matter recited in the appended claims. Hence, the proper scope of the disclosed innovations should be determined only by the broadest interpretation of the appended claims so as to encompass all such modifications, changes, and omissions.

Claims

1. A machine for boarding tubular knitted articles (M), comprising in combination:

- at least one tubular boarding form (5) with a longitudinal axis (B-B);
- a heat treatment chamber (15), the tubular boarding form (5) being insertable in, and extractable from, the heat treatment chamber (15);

characterized by further comprising:

- a pick-up device (71) for picking up a tubular knitted article (M) and loading the tubular knitted article on the tubular boarding form (5);
- a final boarding and removing unit (151), for removing the tubular knitted articles (M) from the tubular boarding form (5); wherein the final boarding and removing unit comprises a pair of adjacent and opposite conveyor belts (153, 155) defining a path for removing the tubular knitted articles (M) from the tubular boarding form (5).

2. Machine according to claim 1, wherein the tubular boarding form (5) comprises an extractor (109) extractable from and retractable in an end of the tubular boarding form (5).

3. Machine according to claim 2, wherein the extractor (109) has a flat shape.

4. Machine according to claim 2 or 3, wherein the opposing conveyor belts (153, 155) and the extractor (109) are configured and controlled such that when the extractor is extracted from the tubular boarding form (5) with the tubular knitted article partially lifted by the extractor (109) from the tubular boarding form (5), the conveyor belts (153, 155) pinch and press the tubular knitted article (M) between the extractor (109) and the two conveyor belts (153, 155).

5. Machine according to one or more of the previous claims, wherein the tubular boarding form (5) is carried by a conveyor (3) configured and controlled so as to insert the tubular boarding form (5) into, and extract it from, the heat treatment chamber (15).

6. Machine according to one or more of the previous claims, further comprising an angular orientation device (12) for angularly positioning the tubular boarding form (5).

7. Machine according to one or more of the previous claims, comprising a plurality of said tubular boarding forms (5).

8. Machine according to claim 7, wherein said tubular boarding forms (5) are carried by a common conveyor, preferably shaped in the form of a carousel (3) rotating around an axis that is preferably parallel to the longitudinal axes of the tubular boarding forms (5).

9. Method for boarding a tubular knitted article (M) comprising the following steps:

- inserting a tubular knitted article (M) to be boarded on a tubular boarding form (5);
- heat-treating the tubular knitted article when the tubular knitted article (M) is arranged on the tubular boarding form (5);

characterized by further comprising the following steps:

- engaging the tubular knitted article (M) by means of a pair of opposite conveyor belts (153, 155) pressed against each other;
- removing the tubular knitted article (M) from the tubular boarding form (5) by means of the two conveyor belts (153, 155) and performing a final boarding step of the tubular knitted article (M) by pressing the two conveyor belts (153, 155) against each other.

10. Method according to claim 9, wherein the step of engaging the tubular knitted article (M) by means of the pair of opposite conveyor belts (153, 155) comprises the steps of:

- lifting the tubular knitted article (M) from an end of the tubular boarding form (5) by means of an extractor (109) housed in the tubular boarding form (5) and extractable therefrom; and
- pressing the two conveyor belts (153, 155) against each other with the extractor (109) and the tubular knitted article (M) interposed between the two conveyor belts (153, 155).

Patentansprüche

1. Maschine zur Formgebung von schlauchförmigen Strickwaren (M) mit, in Kombination:

- mindestens einer rohrförmigen Glättform (5) mit einer Längsachse (B-B),
- einer Wärmebehandlungskammer (15), wobei die rohrförmige Glättform (5) in die Wärmebehandlungskammer (15) eingebracht und daraus herausgebracht werden kann,

gekennzeichnet durch ferner:

- eine Aufnahmevorrichtung (71) zum Aufnehmen einer schlauchförmigen Strickware (M) und zum Laden der schlauchförmigen Strickware auf die rohrförmige Glättform (5),
- eine finale Formgebungs- und Abnahmeeinheit (151) zum Abnehmen der schlauchförmigen Strickwaren (M) von der rohrförmigen Glättform (5), wobei die finale Formgebungs- und Abnahmeeinheit ein Paar von benachbarten und gegenüberliegenden Förderbändern (153, 155) aufweist, die einen Weg zur Abnahme der schlauchförmigen Strickwaren (M) von der rohrförmigen Glättform (5) definieren.

2. Maschine nach Anspruch 1, wobei die rohrförmige Glättform (5) einen Abzieher (109) aufweist, der von einem Ende der rohrförmigen Glättform (5) ausfahrbar und darin einziehbar ist.

3. Maschine nach Anspruch 2, wobei der Abzieher (109) eine flache Form aufweist.

4. Maschine nach Anspruch 2 oder 3, wobei die gegenüberliegenden Förderbänder (153, 155) und der Abzieher (109) so ausgebildet sind und gesteuert werden, dass, wenn der Abzieher aus der rohrförmigen Glättform (5) ausgefahren ist, wobei die schlauchförmigen Strickware teilweise durch den Abzieher (109) von der rohrförmigen Glättform (5) angehoben ist, die Förderbänder (153, 155) die schlauchförmigen Strickwaren (M) zwischen dem Abzieher (109) und den beiden Förderbändern (153, 155) einklemmen und pressen.

5. Maschine nach einem oder mehreren der vorstehenden Ansprüche, wobei die rohrförmige Glättform (5) durch einen Förderer (3) getragen wird, der so ausgebildet ist und gesteuert wird, um die rohrförmige Glättform (5) in die Wärmebehandlungskammer (15) einzubringen und daraus zu entfernen.

6. Maschine nach einem oder mehreren der vorstehenden Ansprüche mit ferner einer Winkel-Ausrichtungsvorrichtung (12) zum winkelmäßigen Positionieren der rohrförmigen Glättform (5).

7. Maschine nach einem oder mehreren der vorstehenden Ansprüche mit einer Anzahl der rohrförmigen Glättformen (5).

8. Maschine nach Anspruch 7, wobei die rohrförmigen Glättformen (5) durch einen gemeinsamen Förderer getragen werden, der vorzugsweise in Form eines Karussells (5) ausgebildet ist, das um eine Achse dreht, die vorzugsweise parallel zu den Längsachsen der rohrförmigen Glättformen (5) ist.

9. Verfahren zur Formgebung für eine schlauchförmige Strickware (M) mit den folgenden Schritten:

- Einbringen einer schlauchförmigen Strickware (M), die zu glätten ist, auf eine rohrförmige Glättform (5),
- Wärmebehandlung der schlauchförmigen Strickware, wenn die schlauchförmige Strickware (M) auf die rohrförmige Glättform (5) aufgebracht ist,

gekennzeichnet durch die folgenden Schritte:

- Ergreifen der schlauchförmigen Strickware (M) mittels eines Paares von gegenüberliegenden Förderbändern (153, 155), die gegeneinander gepresst werden,
- Entfernen der schlauchförmigen Strickware (M) von der rohrförmigen Glättform (5) mittels der beiden Förderbänder (153, 155) und Durchführung eines finalen Formgebungsschrittes der schlauchförmigen Strickware (M) durch Pressen der beiden Förderbänder (153, 155) gegeneinander.

10. Verfahren nach Anspruch 9, wobei der Schritt des Ergreifens der schlauchförmigen Strickware (M) mittels des Paares von gegenüberliegenden Förderbändern (153, 155) die Schritte aufweist:

- Anheben der schlauchförmigen Strickware (M) von einem Ende der rohrförmigen Glättform (5) mittels eines Abziehers (109), der in der rohrförmigen Glättform (5) aufgenommen ist und daraus ausgefahren werden kann, und

- Pressen der beiden Förderbänder (153, 155) gegen einander, wobei der Abzieher (109) und die schlauchförmige Strickware (M) zwischen den beiden Förderbändern (153, 155) eingefügt sind.

Revendications

1. Une machine pour mettre en forme des articles tubulaires tricotés (M), comprenant en combinaison :

   - au moins une forme tubulaire de mise en forme (5) ayant un axe longitudinal (B-B) ;
   - une chambre de traitement thermique (15), la forme tubulaire de mise en forme (5) pouvant être introduit dans, et extrait de la chambre de traitement thermique (15),

   caractérisée en ce qu'elle comprend en outre :

   - un dispositif de prélèvement (71) pour prélever un article tubulaire tricoté (M) et mettre l'article tubulaire tricoté sur la forme tubulaire de mise en forme (5) ;
   - une unité de mise en forme finale et de retrait (151), pour retirer les articles tubulaires tricotés (M) de la forme tubulaire de mise en forme (5) ; l'unité de mise en forme finale et de retrait comprenant une paire de bandes transporteuses adjacentes et opposées (153, 155) formant un chemin pour retirer les articles tubulaires tricotés (M) de la forme tubulaire de mise en forme (5).

2. Machine selon la revendication 1, dans laquelle la forme tubulaire de mise en forme (5) comprend un extracteur (109) qui peut être extrait de, et rétracté dans une extrémité de la forme tubulaire de mise en forme (5).

3. Machine selon la revendication 2, dans laquelle l'extracteur (109) a une forme plane.

4. Machine selon la revendication 2 ou 3, dans laquelle les bandes transporteuses opposées (153, 155) et l'extracteur (109) sont configurés et commandés de telle sorte que lorsque l'extracteur est extrait de la forme tubulaire de mise en forme (5) avec l'article tubulaire tricoté partiellement soulevé par l'extracteur (109) hors de la forme tubulaire de mise en forme (5), les bandes transporteuses (153, 155) pincent et pressent l'article tubulaire tricoté (M) entre l'extracteur (109) et les deux bandes transporteuses (153, 155).

5. Machine selon une ou plusieurs des revendications précédentes, dans laquelle la forme tubulaire de mise en forme (5) est portée par un transporteur (3) configuré et commandé de manière à introduire la forme tubulaire de mise en forme (5) dans, et à l'extraire de la chambre de traitement thermique (15).

6. Machine selon une ou plusieurs des revendications précédentes, comprenant en outre un dispositif d'orientation angulaire (12) pour positionner angulairement la forme tubulaire de mise en forme (5).

7. Machine selon une ou plusieurs des revendications précédentes, comprenant une pluralité desdites formes tubulaires de mise en forme (5).

8. Machine selon la revendication 7, dans laquelle lesdites formes tubulaires de mise en forme (5) sont portées par un transporteur commun, de préférence sous la forme d'un carrousel (3) tournant autour d'un axe qui est de préférence parallèle aux axes longitudinaux des formes tubulaires de mise en forme (5).

9. Procédé de mise en forme d'un article tubulaire tricoté (M), comprenant les étapes suivantes :

   - insertion d'un article tubulaire tricoté (M) à mettre en forme sur une forme tubulaire de mise en forme (5) ;
   - traitement thermique de l'articule tubulaire tricoté lorsque l'article tubulaire tricoté (M) est disposé sur la forme tubulaire de mise en forme (5) ;

   caractérisé en ce qu'il comprend en outre les étapes suivantes :

   - mettre en prise l'article tubulaire tricoté (M) au moyen d'une paire de bandes transporteuses opposées (153, 155) pressées l'une contre l'autre ;
   - retirer l'article tubulaire tricoté (M) de la forme tubulaire de mise en forme (5) au moyen des deux bandes transporteuses (153, 155) et exécution d'une étape de mise en forme finale de l'article tubulaire tricoté (M) en pressant les deux bandes transporteuses (153, 155) l'une contre l'autre.

10. Procédé selon la revendication 9, dans lequel l'étape de mise en prise de l'article tubulaire tricoté (M) au moyen de la paire de bandes transporteuses opposées (153n 155) comprend les étapes consistant à :

    - soulever l'article tubulaire tricoté (M) depuis une extrémité de la forme tubulaire de mise en forme (5) au moyen d'un extracteur (109) logé dans la forme tubulaire de mise en forme (5) et pouvant en être extrait ; et
    - presser les deux bandes transporteuses (153, 155) l'une contre l'autre avec l'extracteur (109) et l'article tubulaire tricoté (M) disposés entre

les deux bandes transporteuses (153, 155).

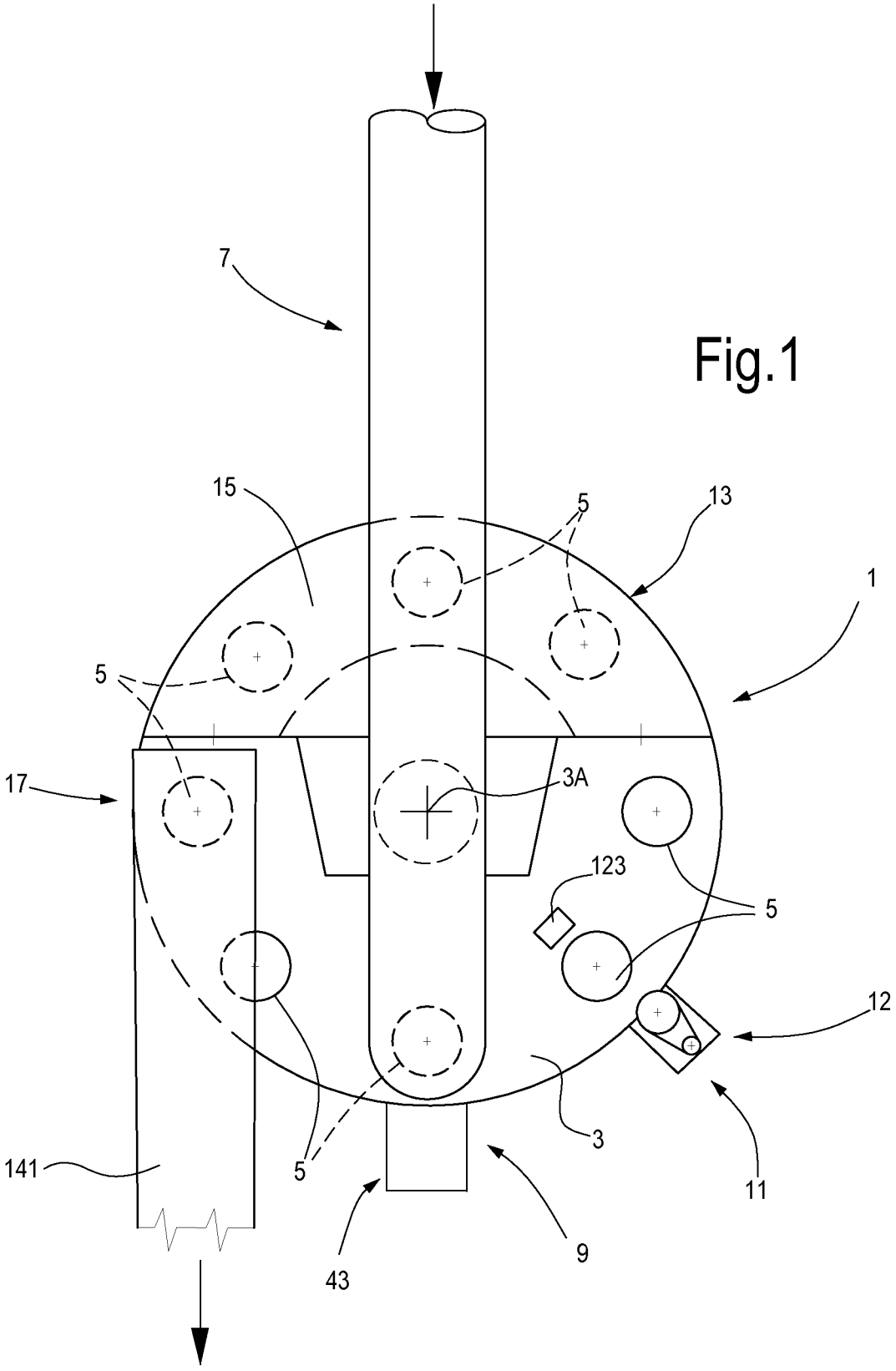

Fig.1

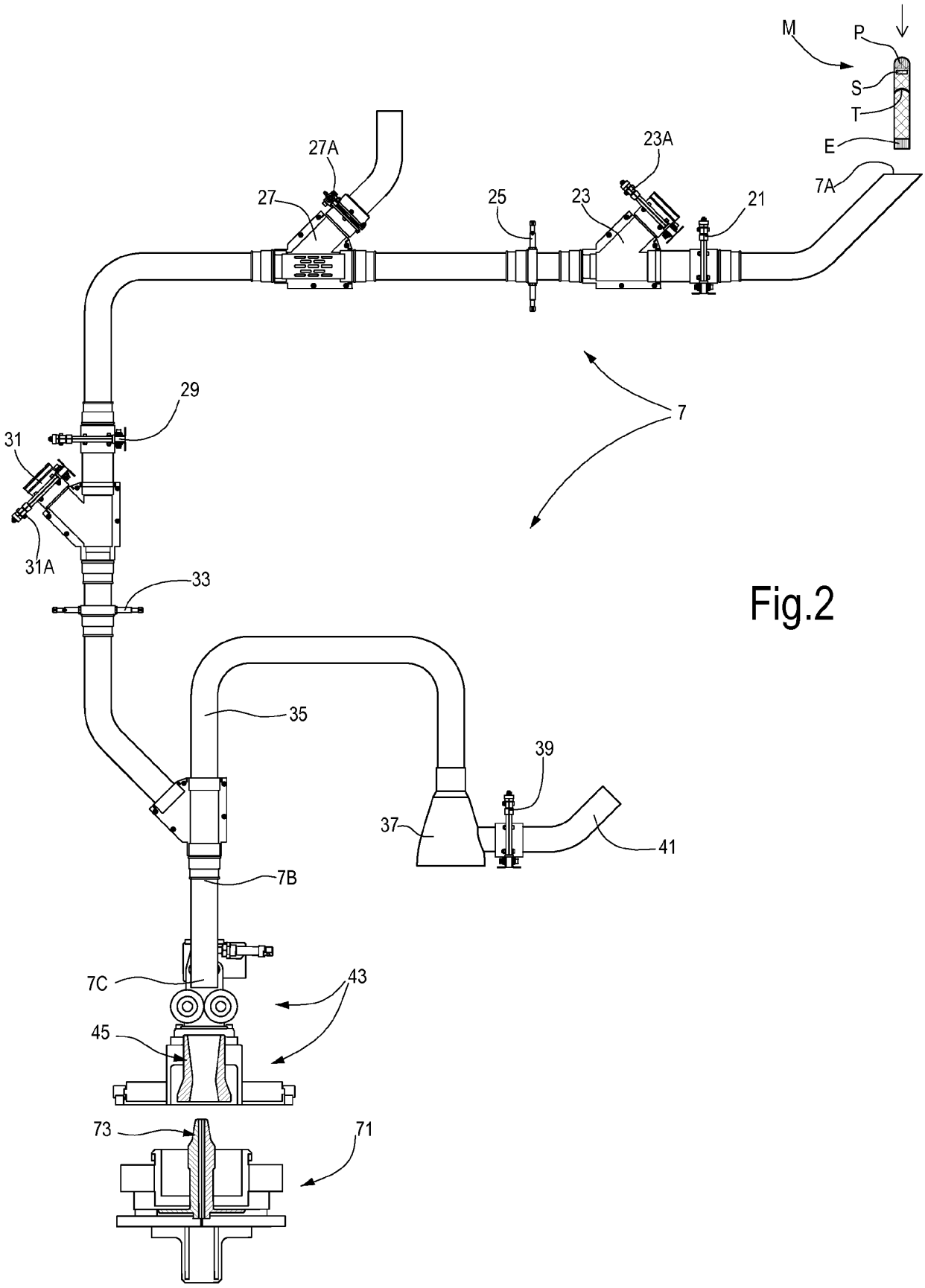
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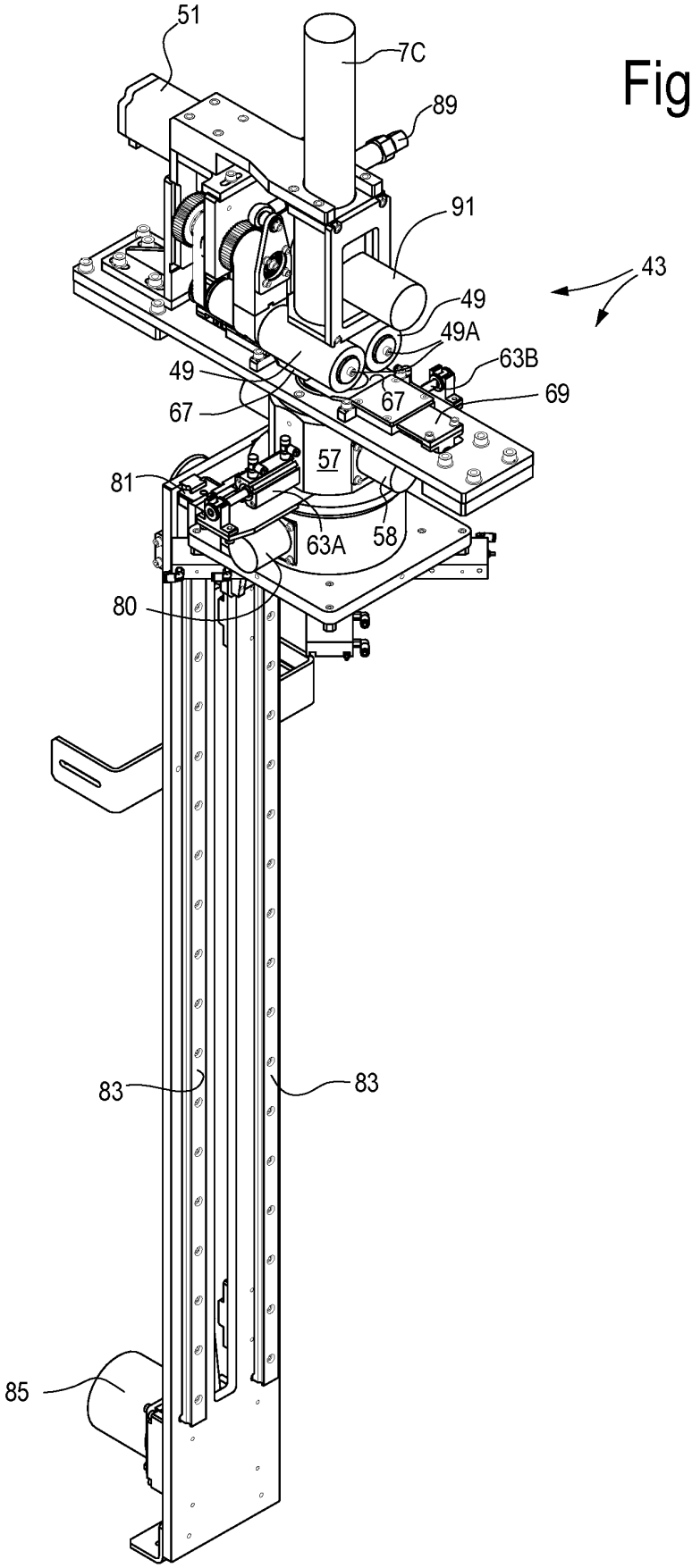
Fig.2



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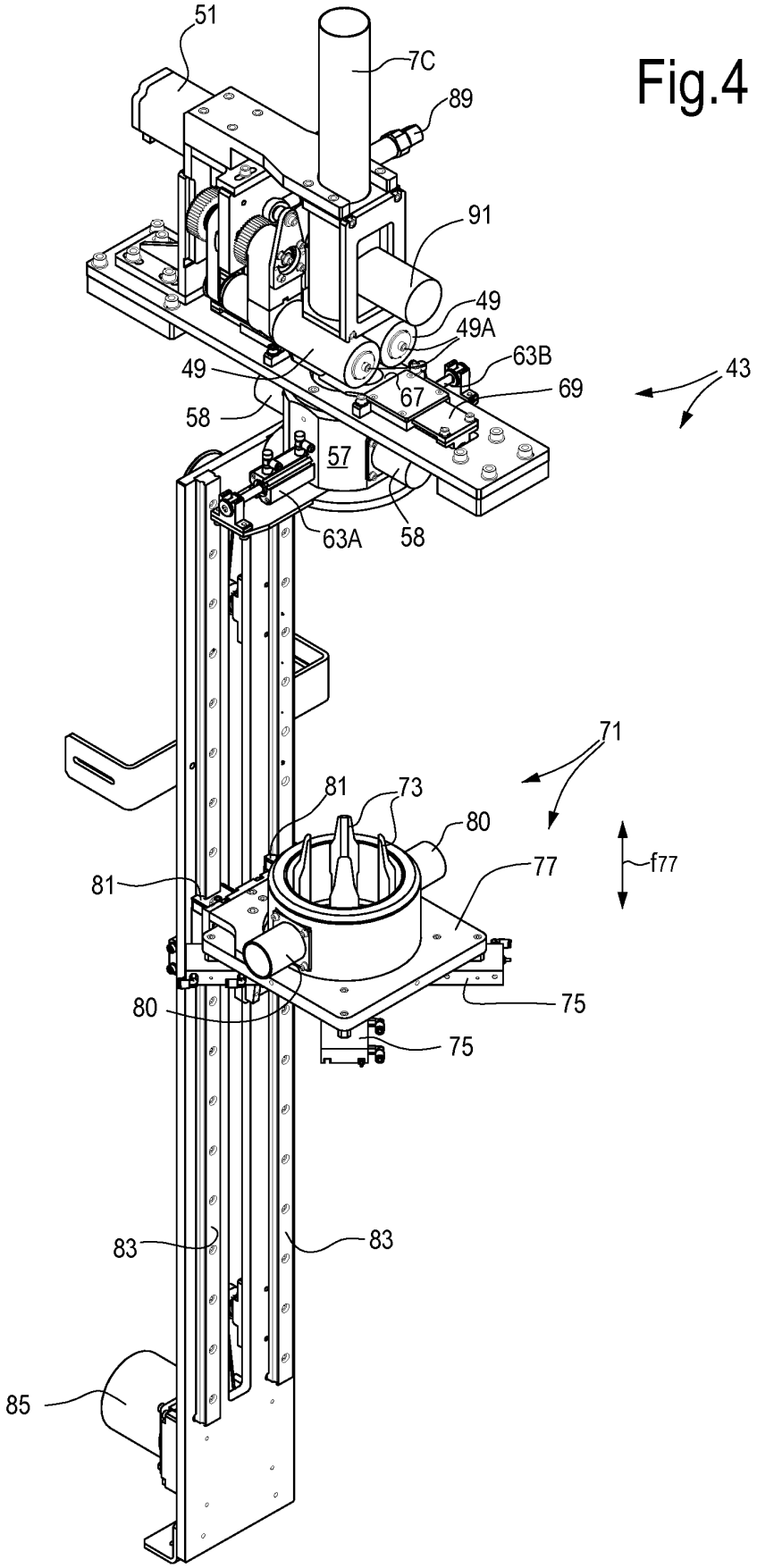
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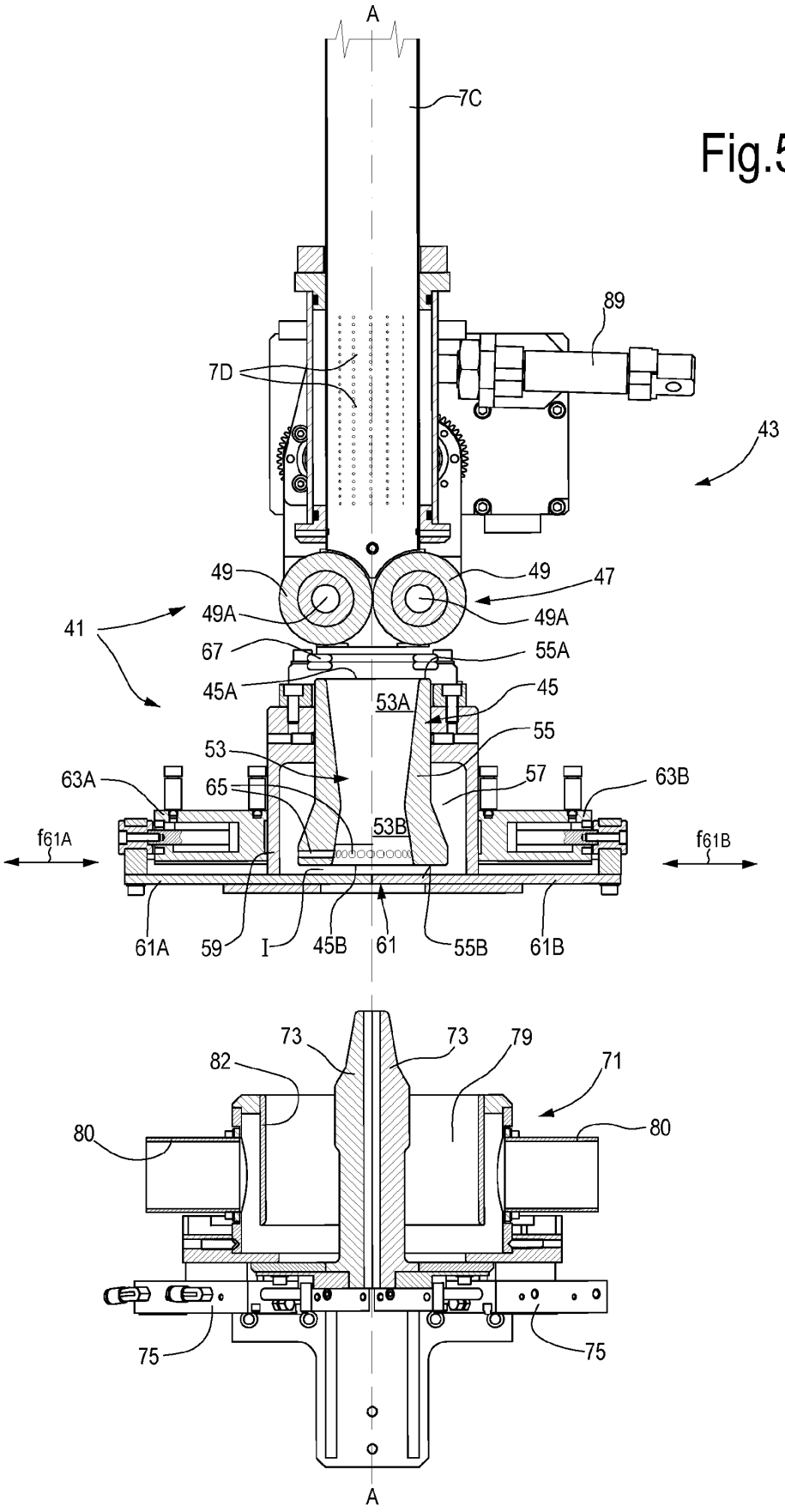
Fig.4

Fig.5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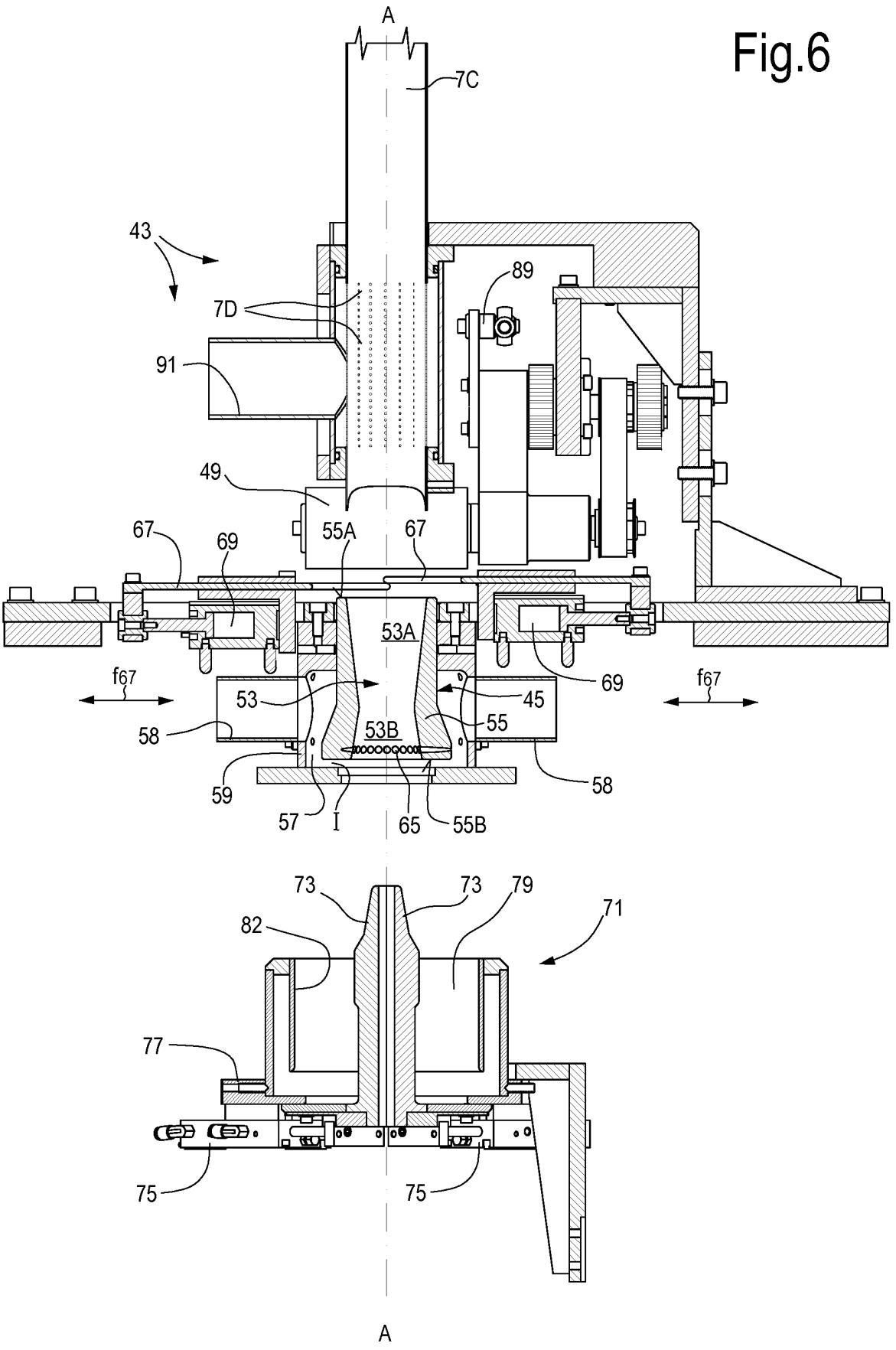
A

Fig.6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A

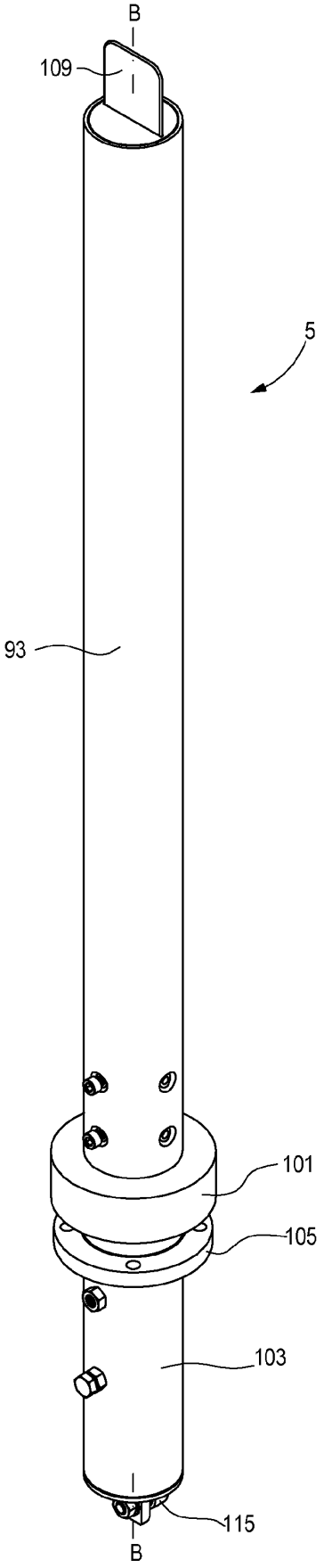
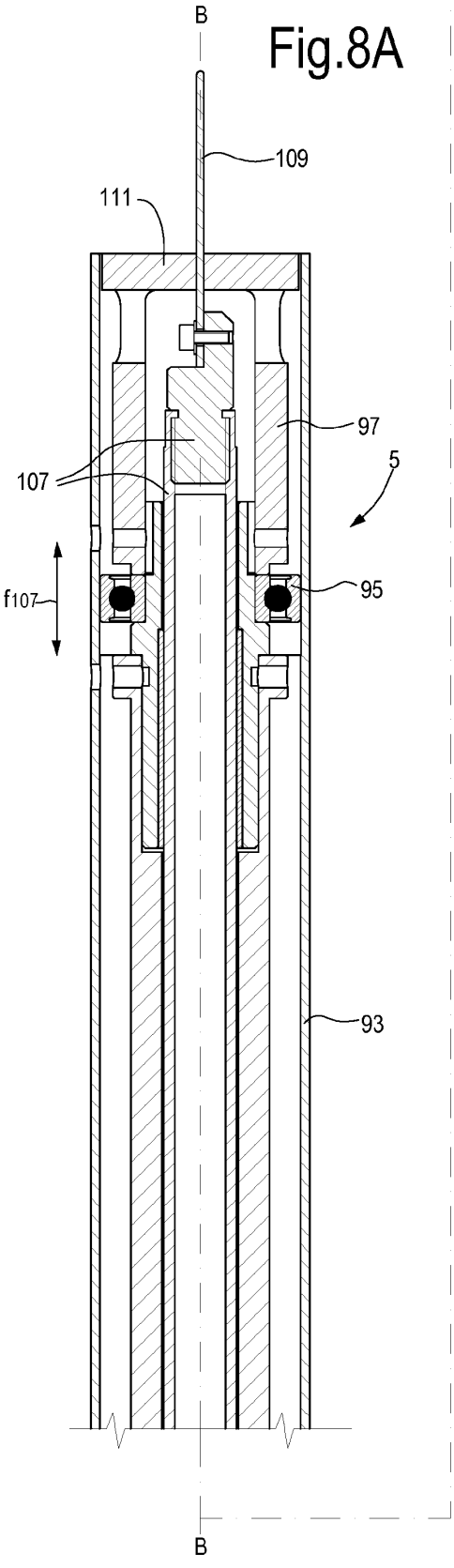


Fig.7

Fig.8A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109
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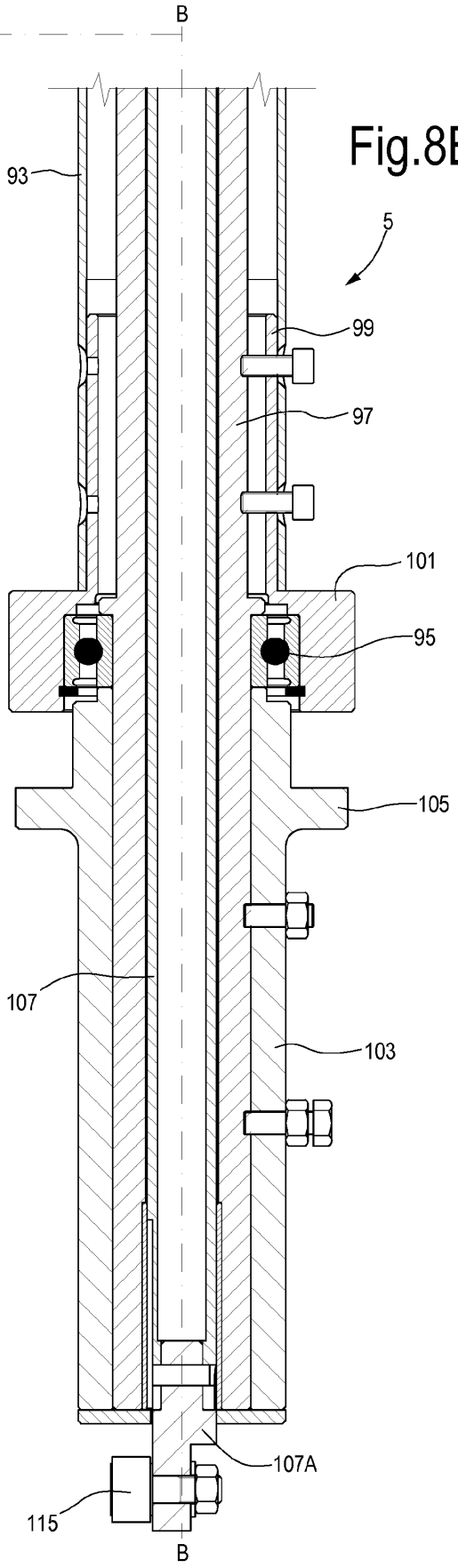
93
B

Fig.8B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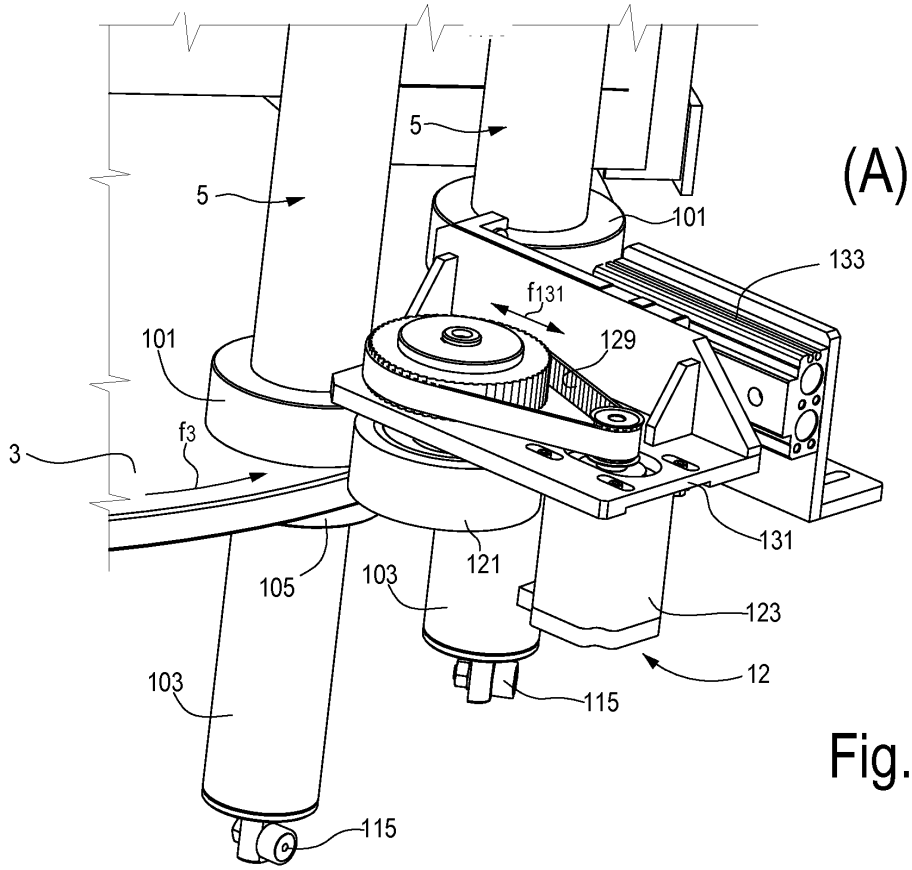
103
107A
115
B


(A)
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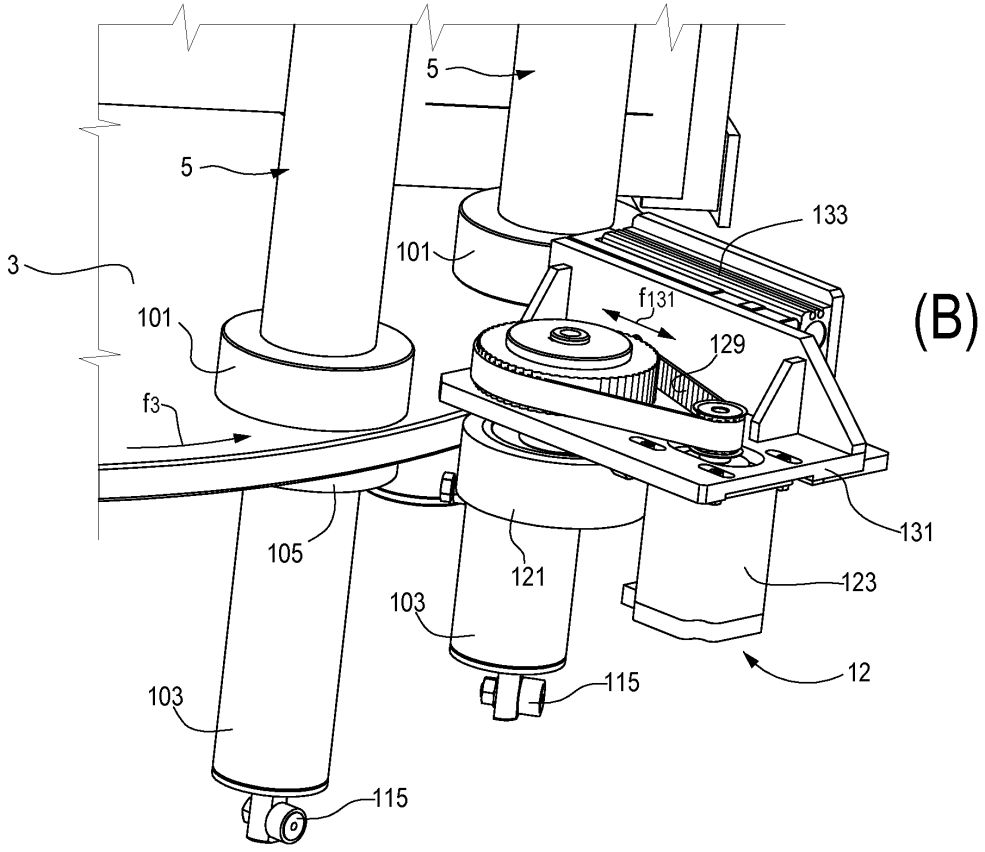
5
101
133
f131
129
101
f3
3
131
105
121
103
123
12
103
115
115

Fig.9


(B)
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103
115

Fig.10

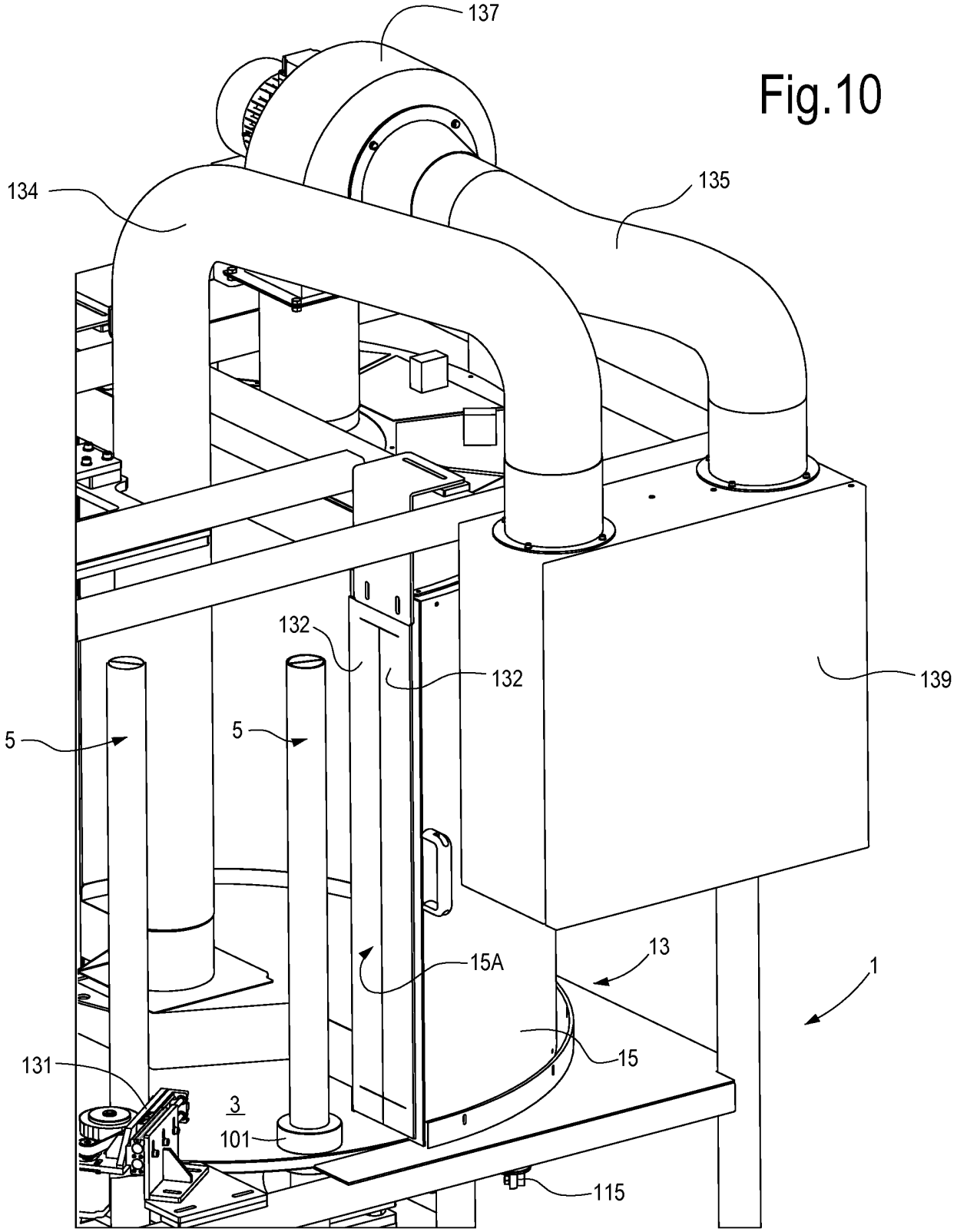
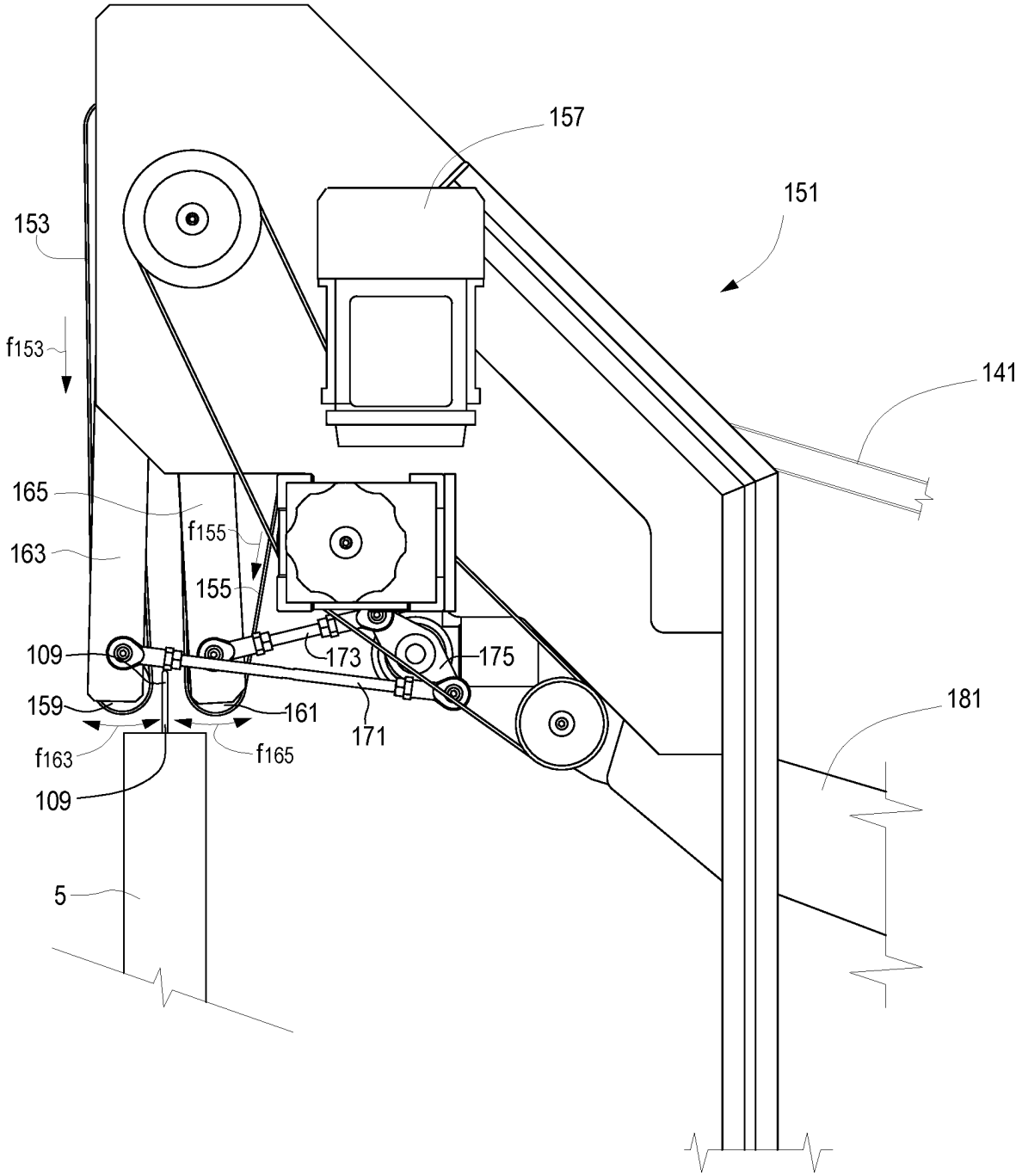


Fig.11A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f165
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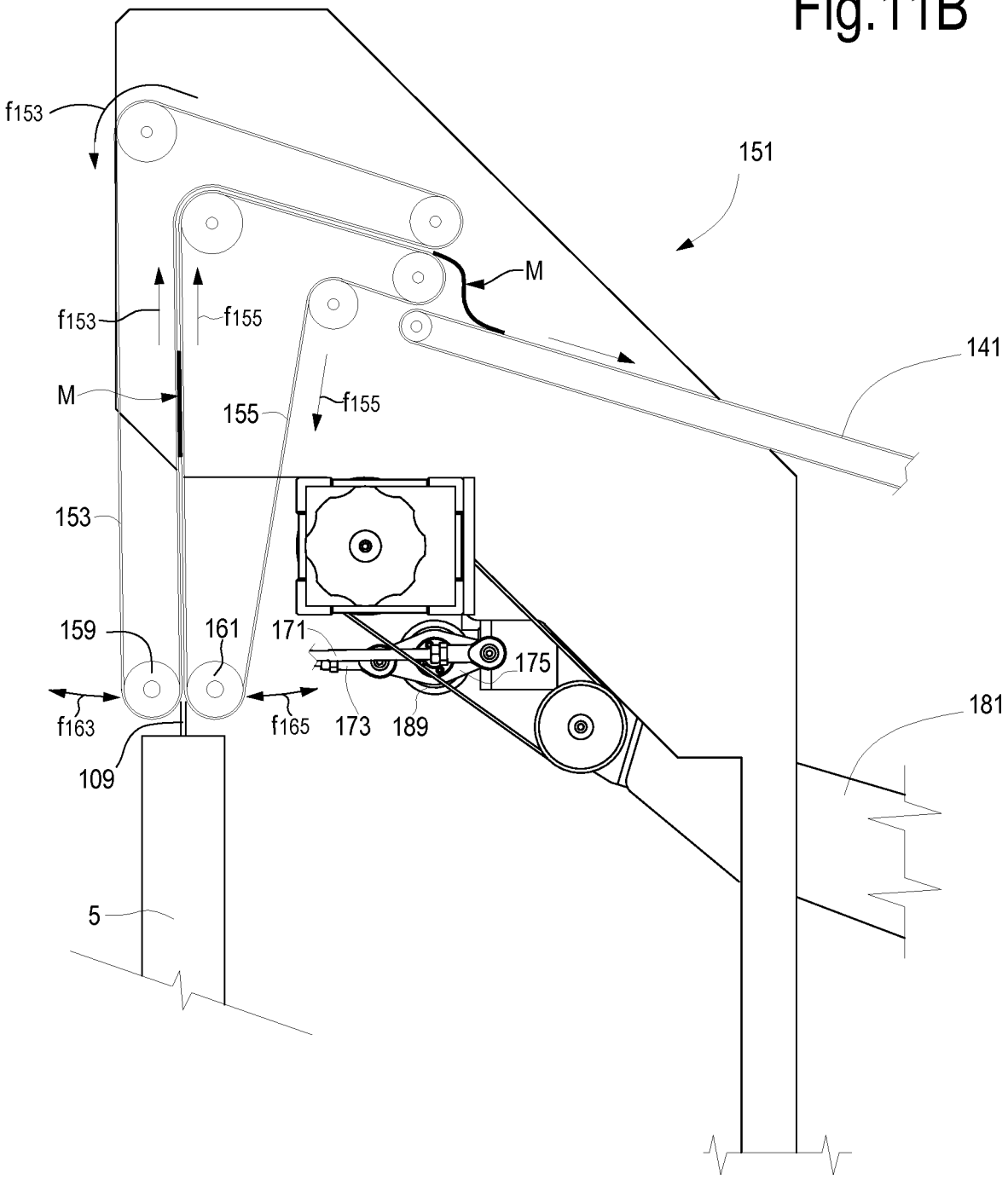
5

Fig.11B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109
5

Fig.12A

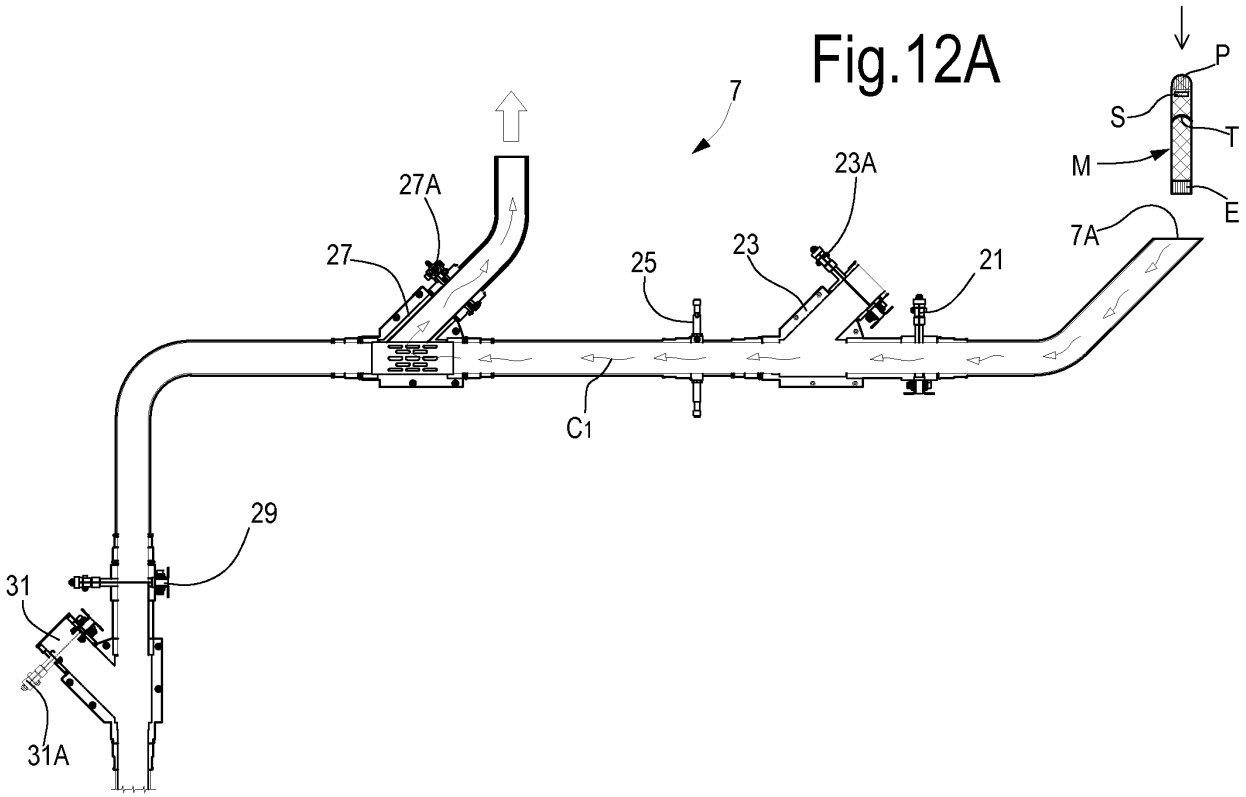


Fig.12B

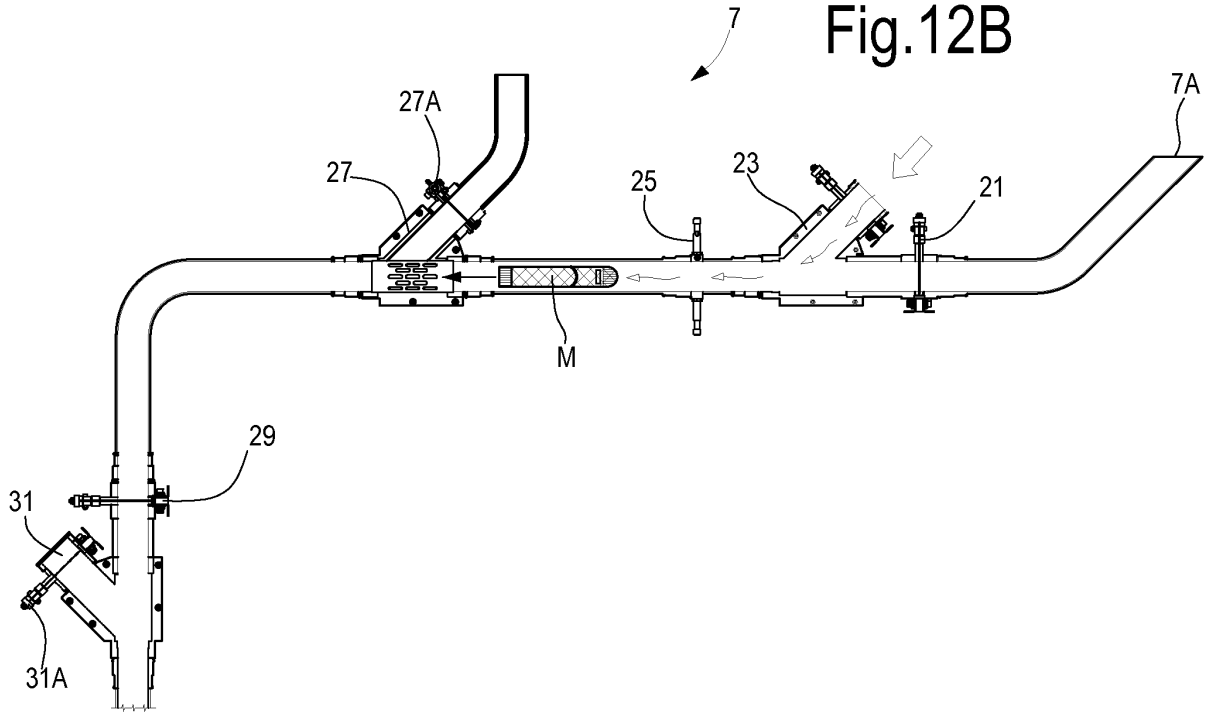
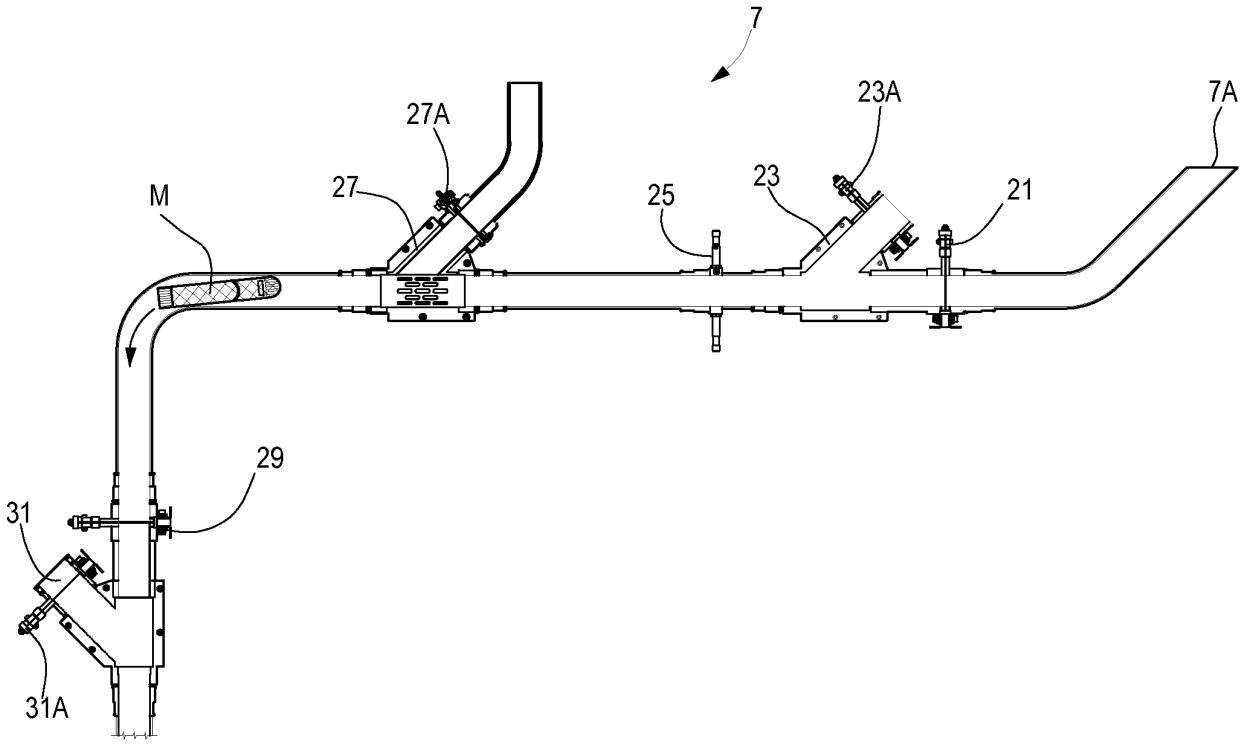


Fig.12C



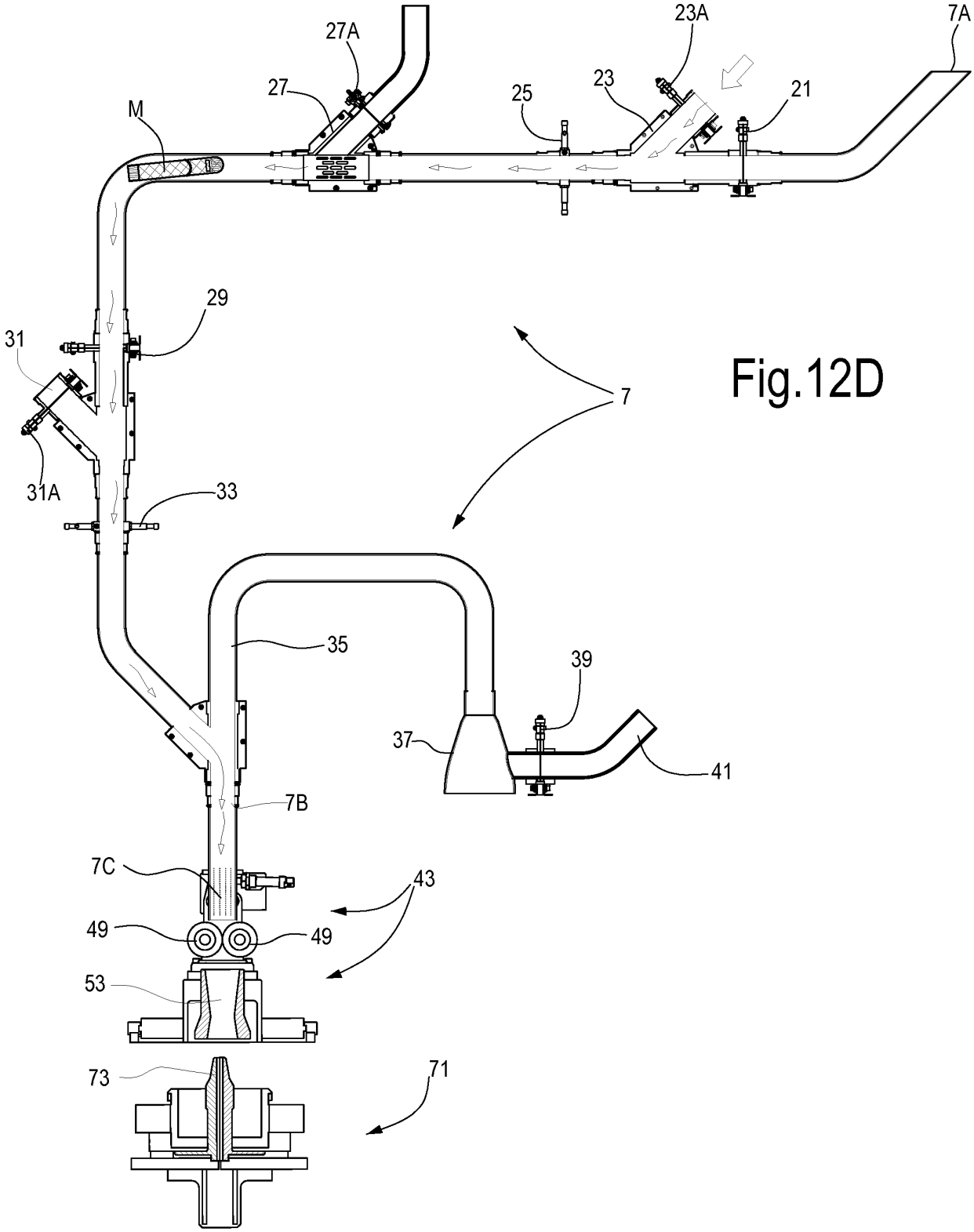

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Fig.12D

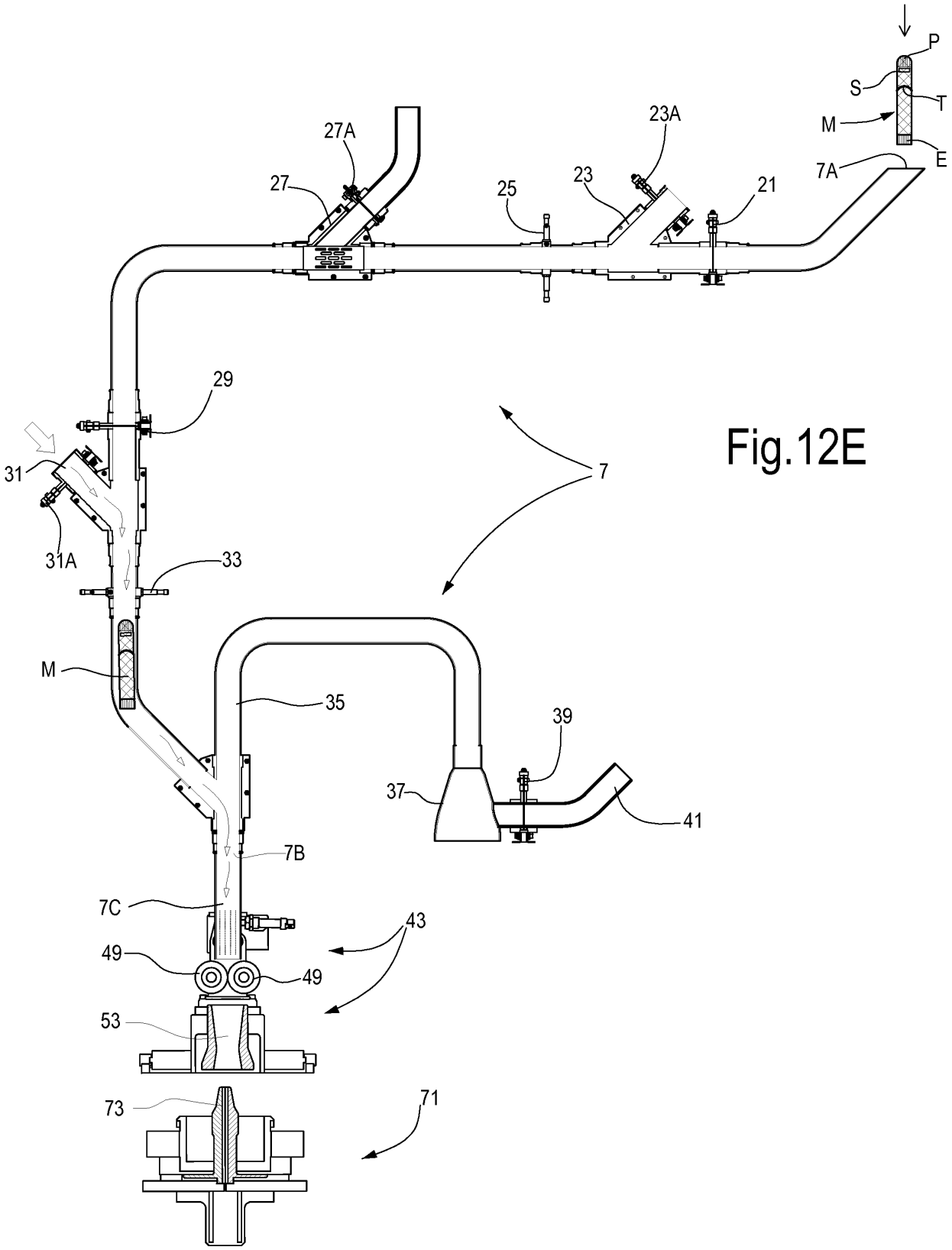
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Fig.12E

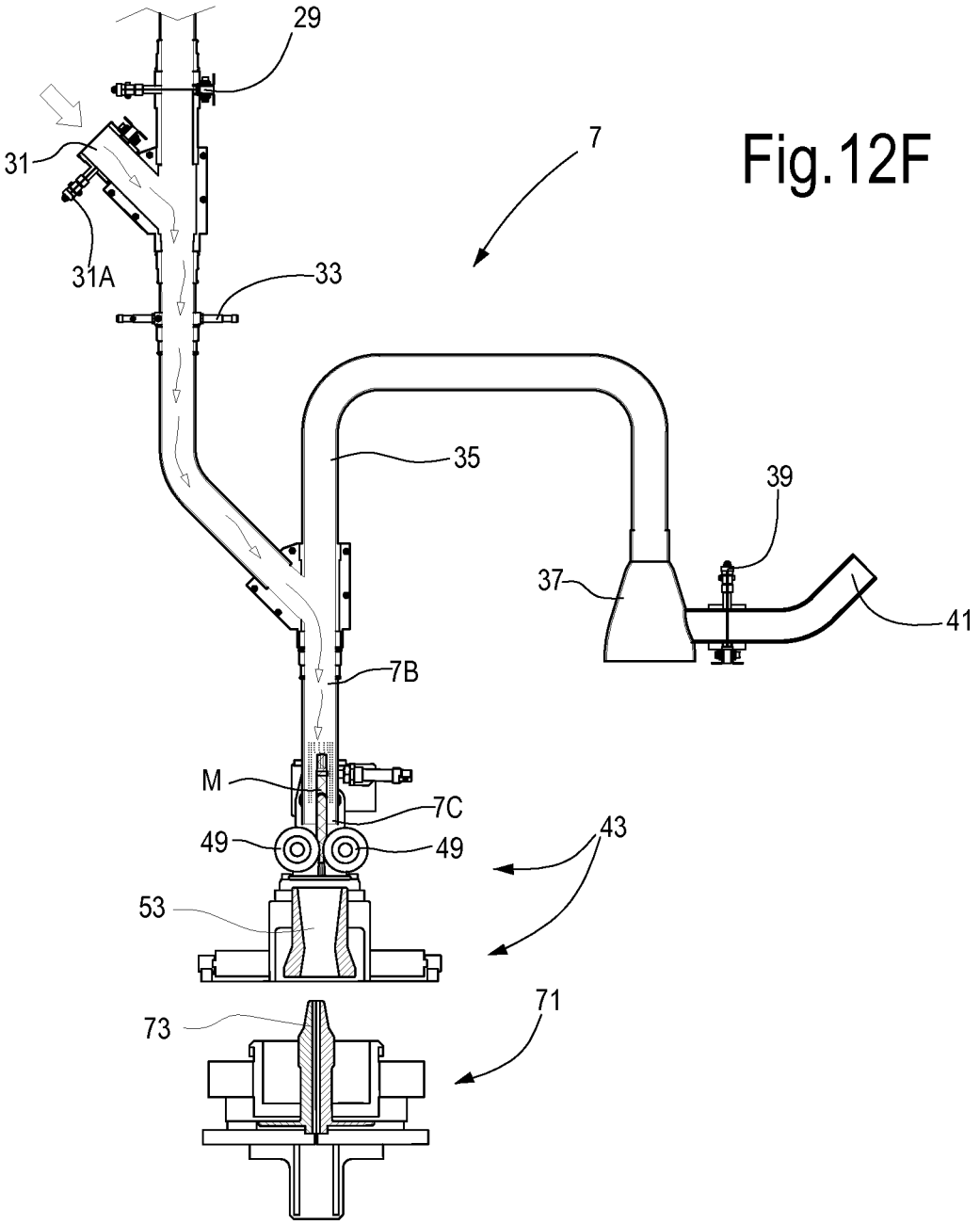

Fig.12F

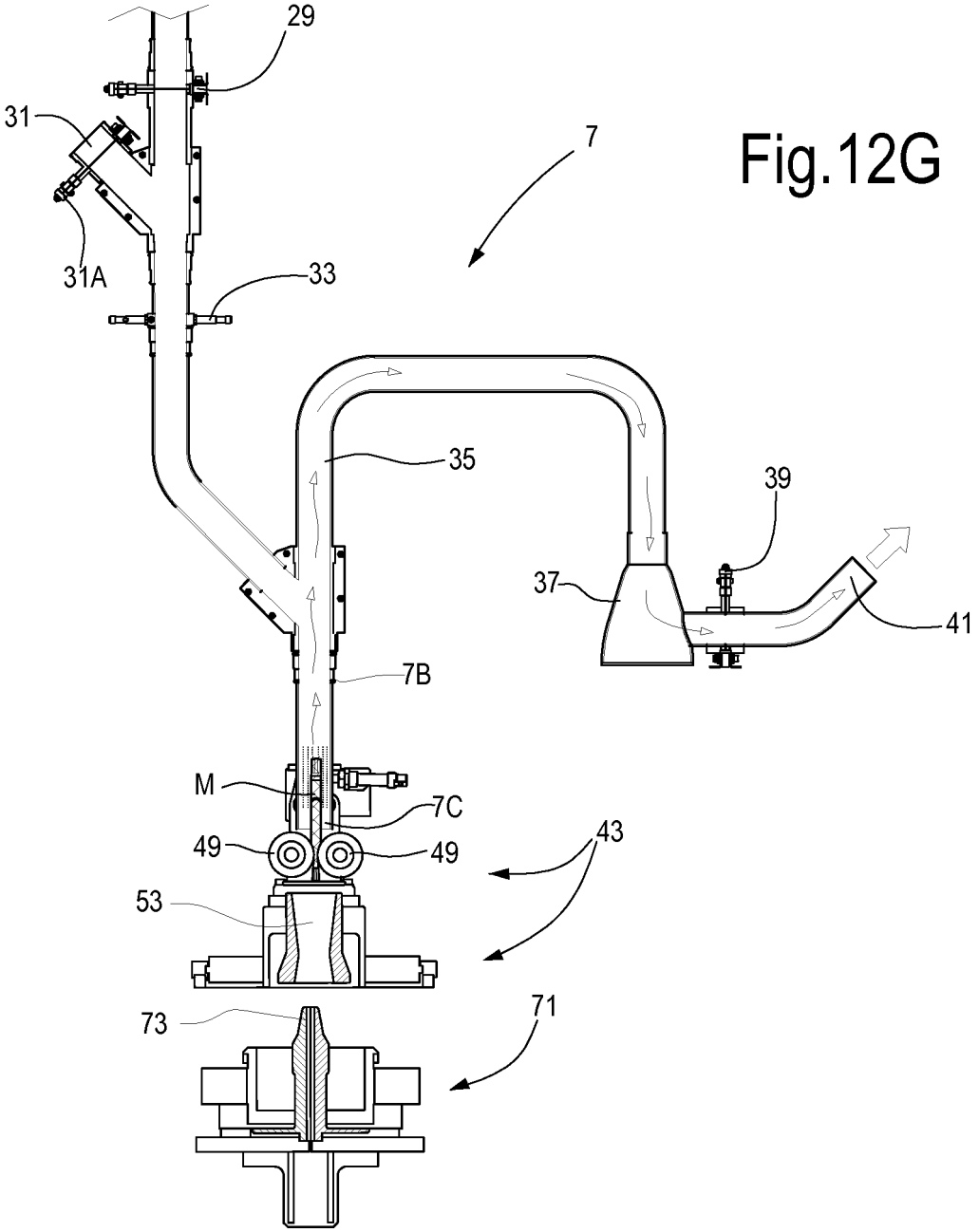

Fig.12G

Fig.12H

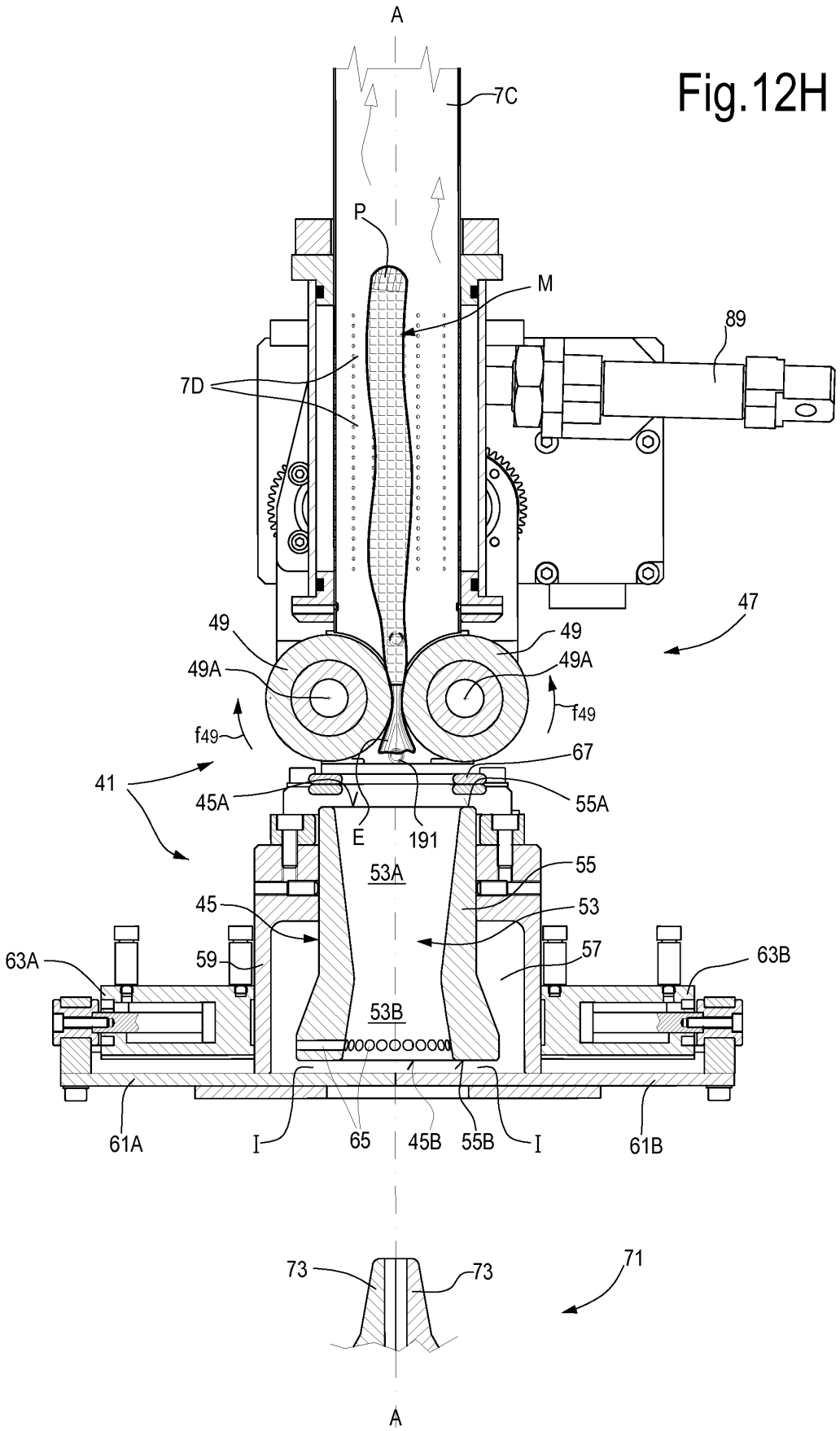
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Fig.12I

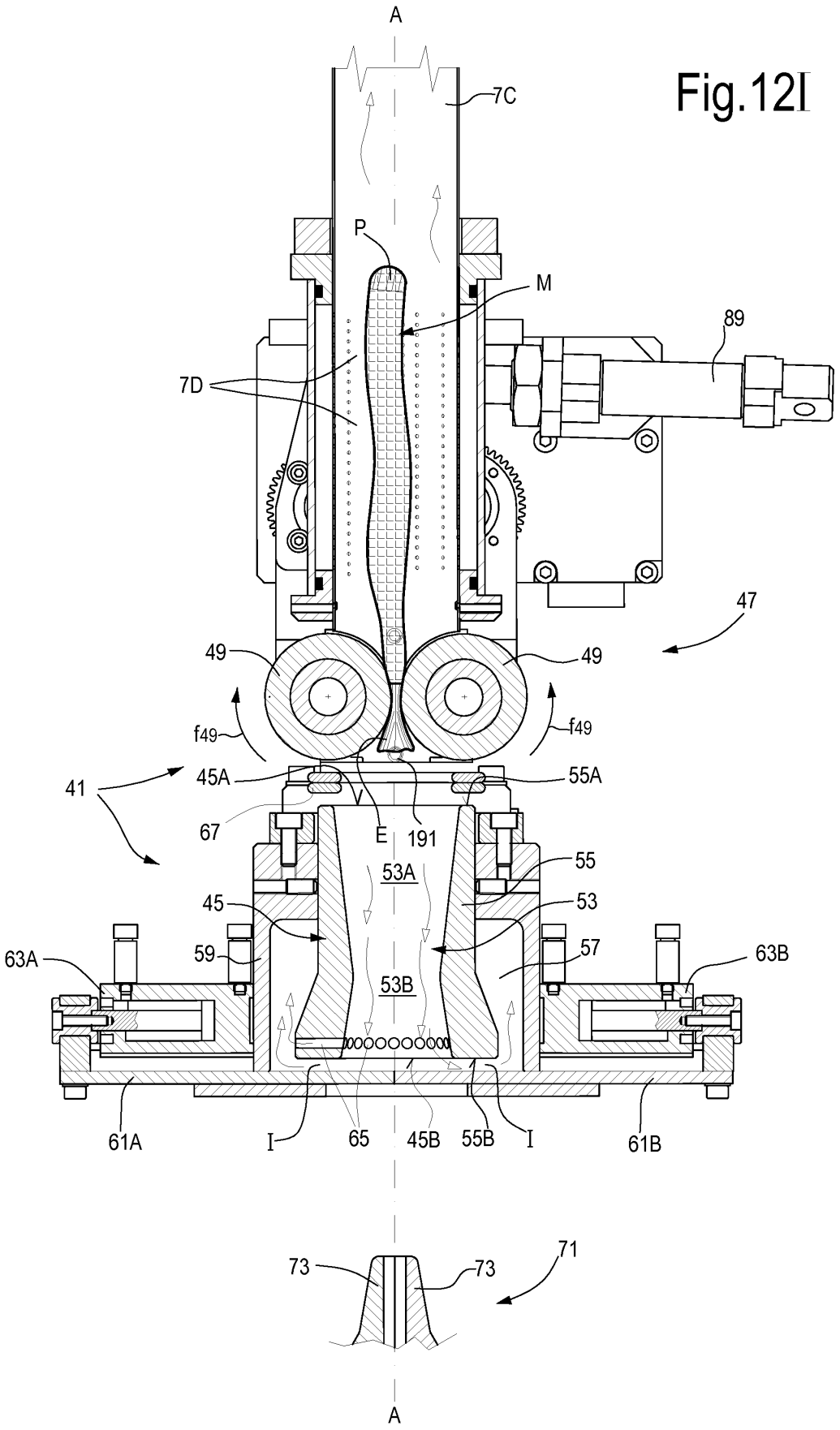
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Fig.12J

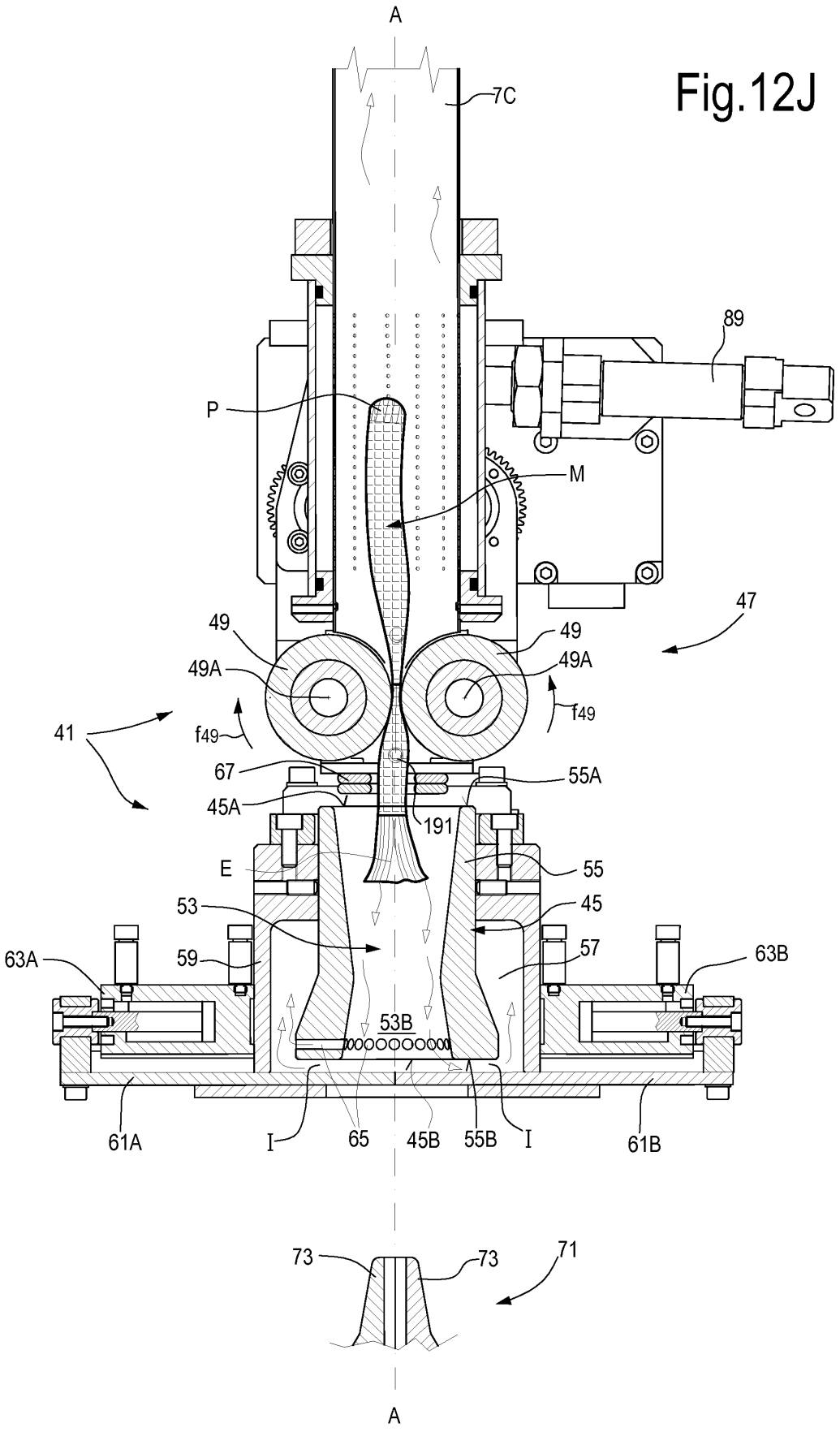
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Fig.12K

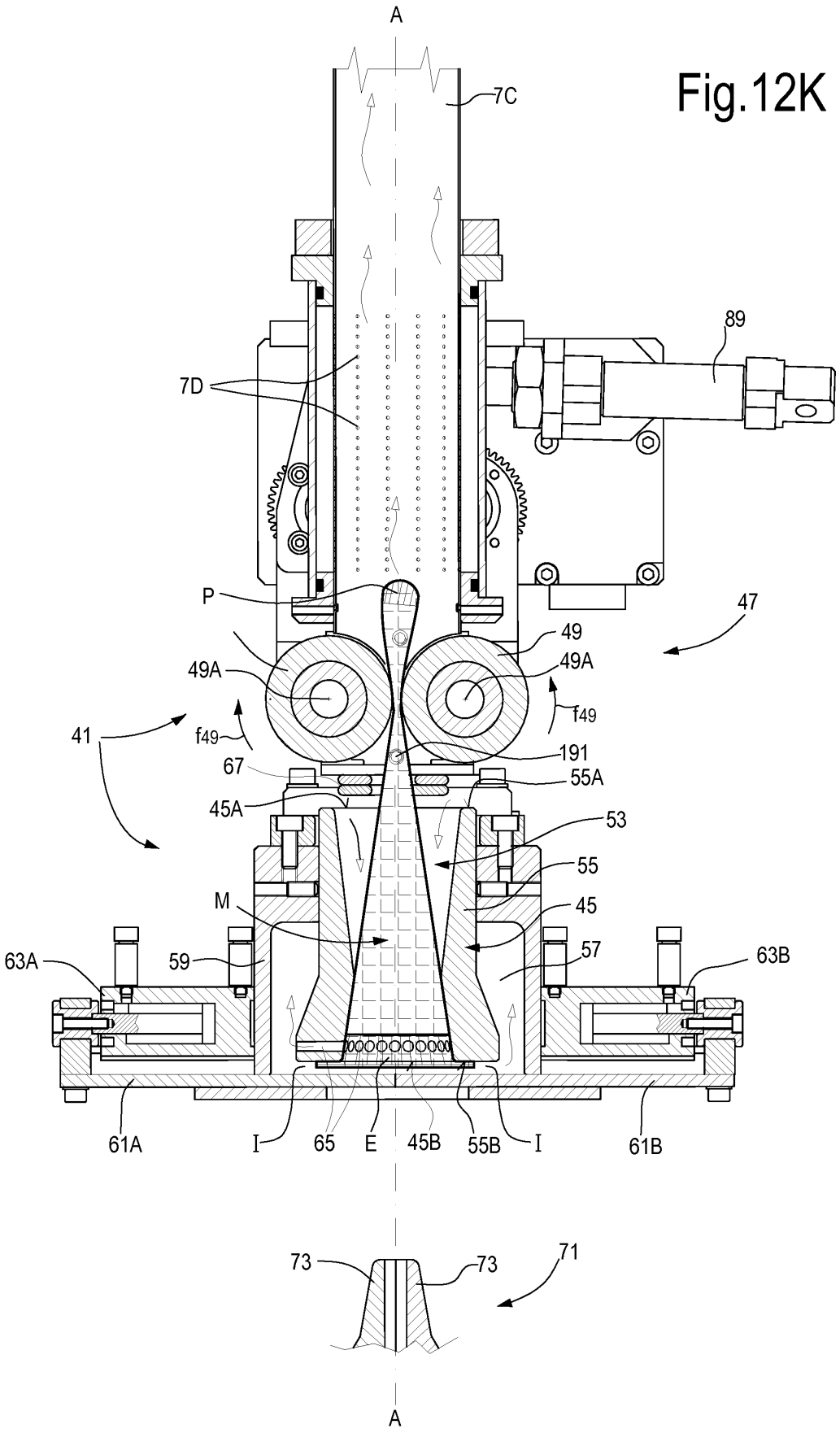
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Fig.12L

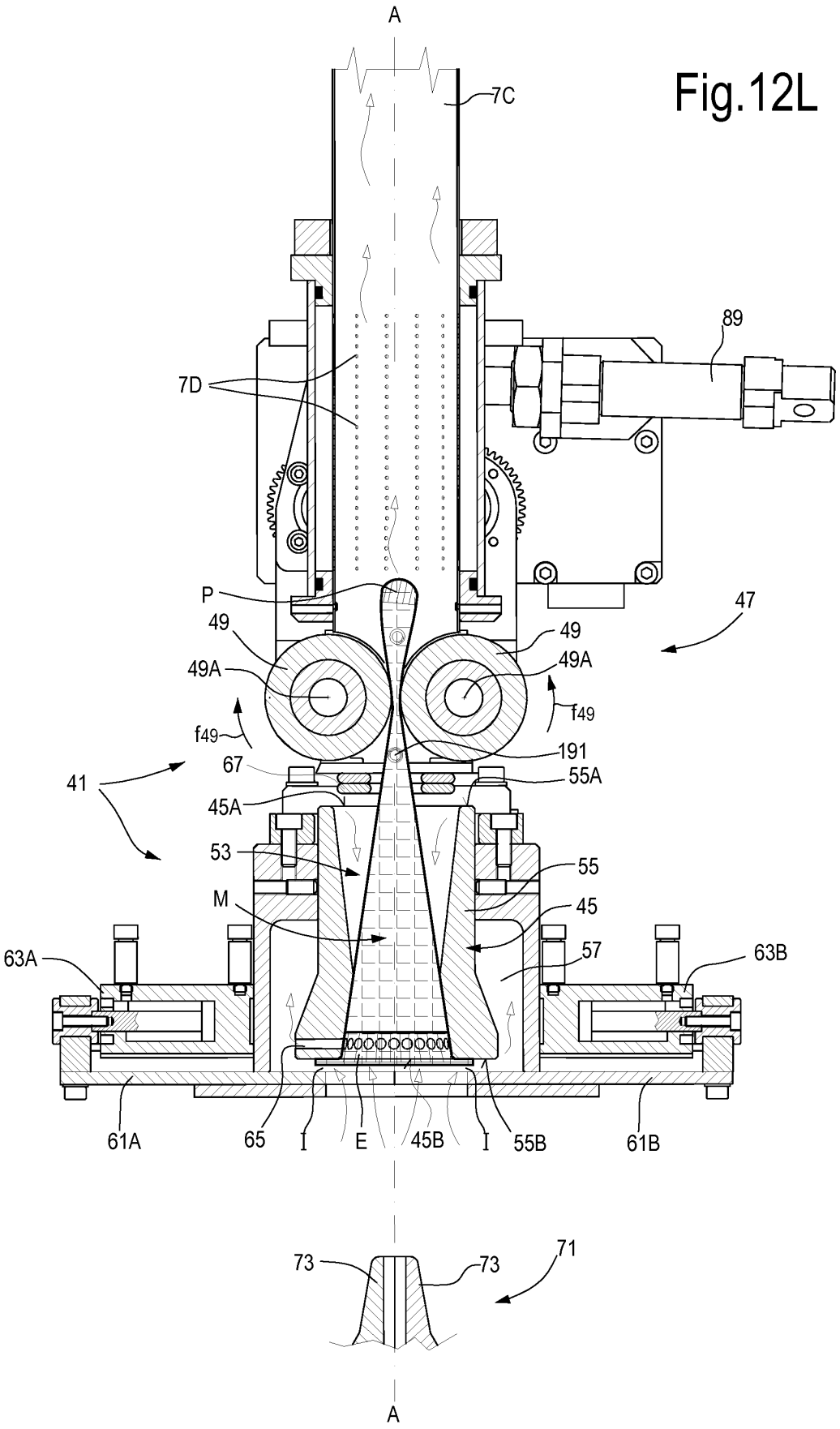
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Fig.12M

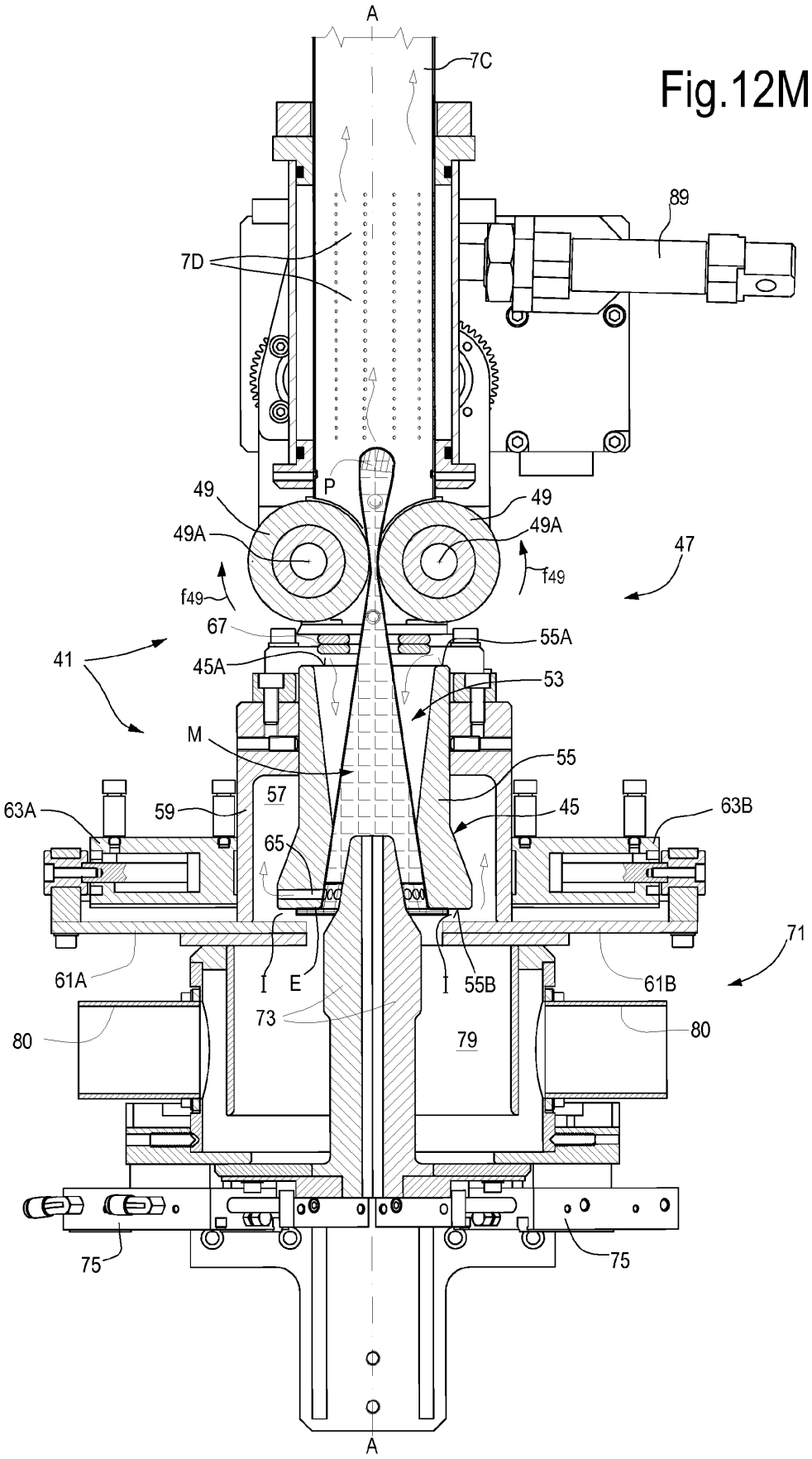
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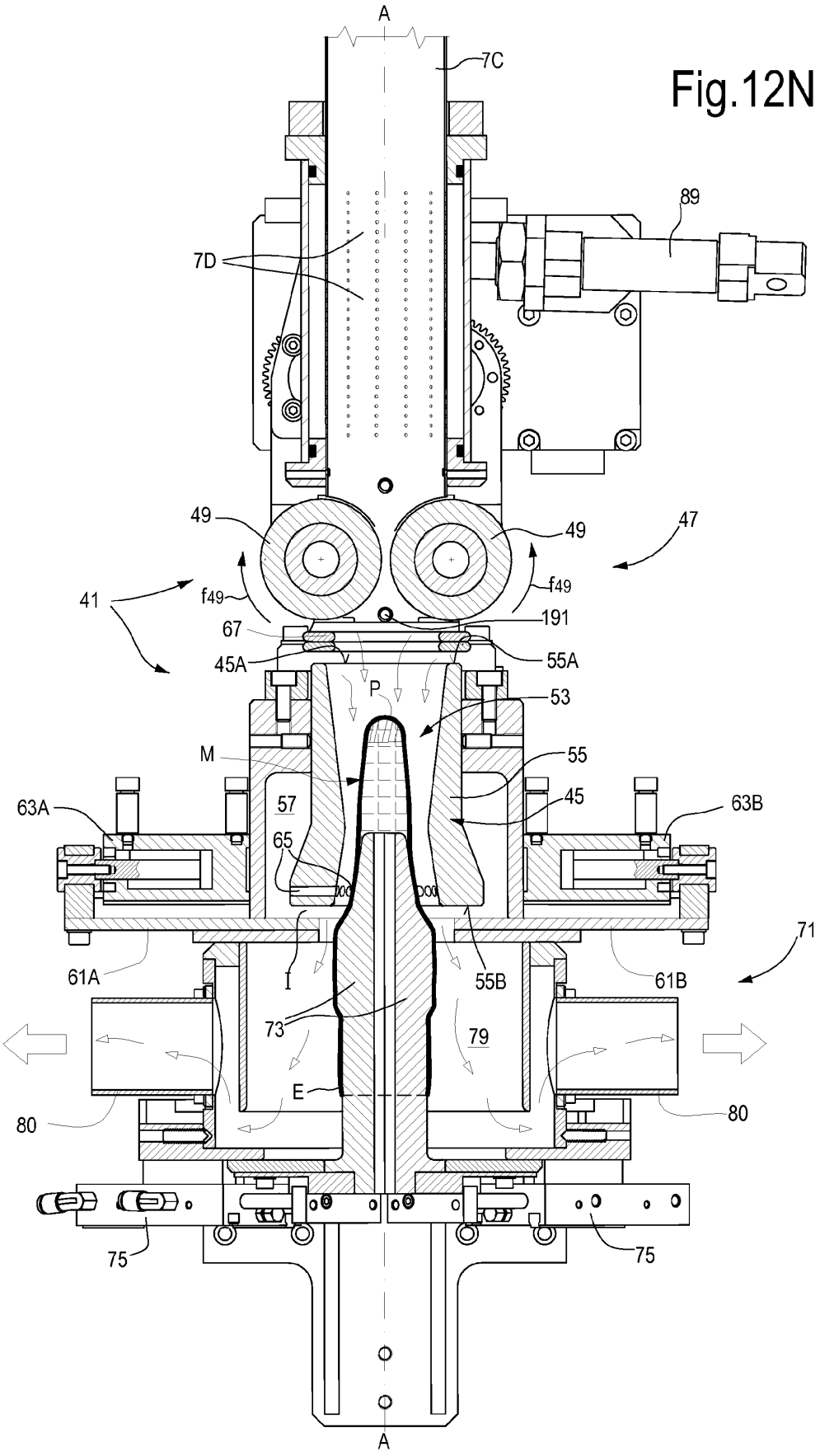
Fig.12N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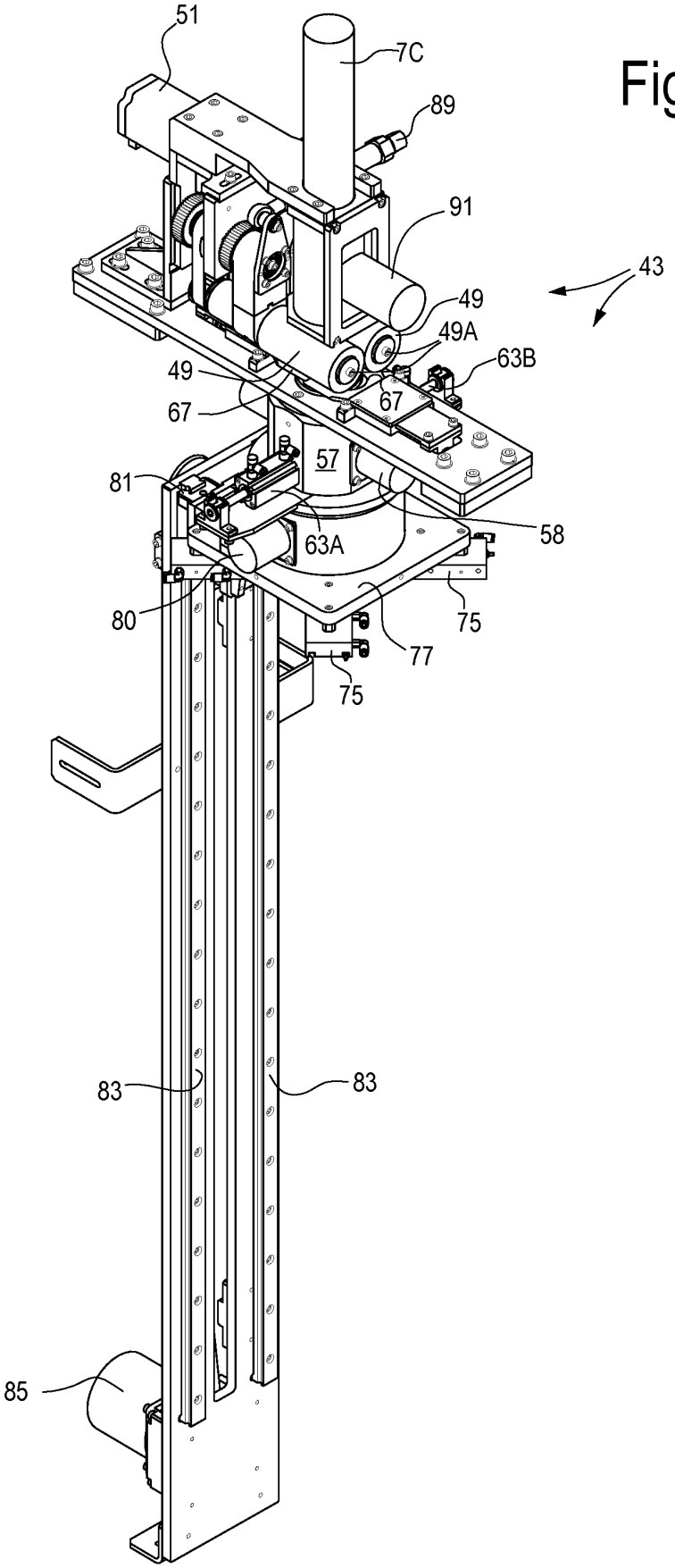

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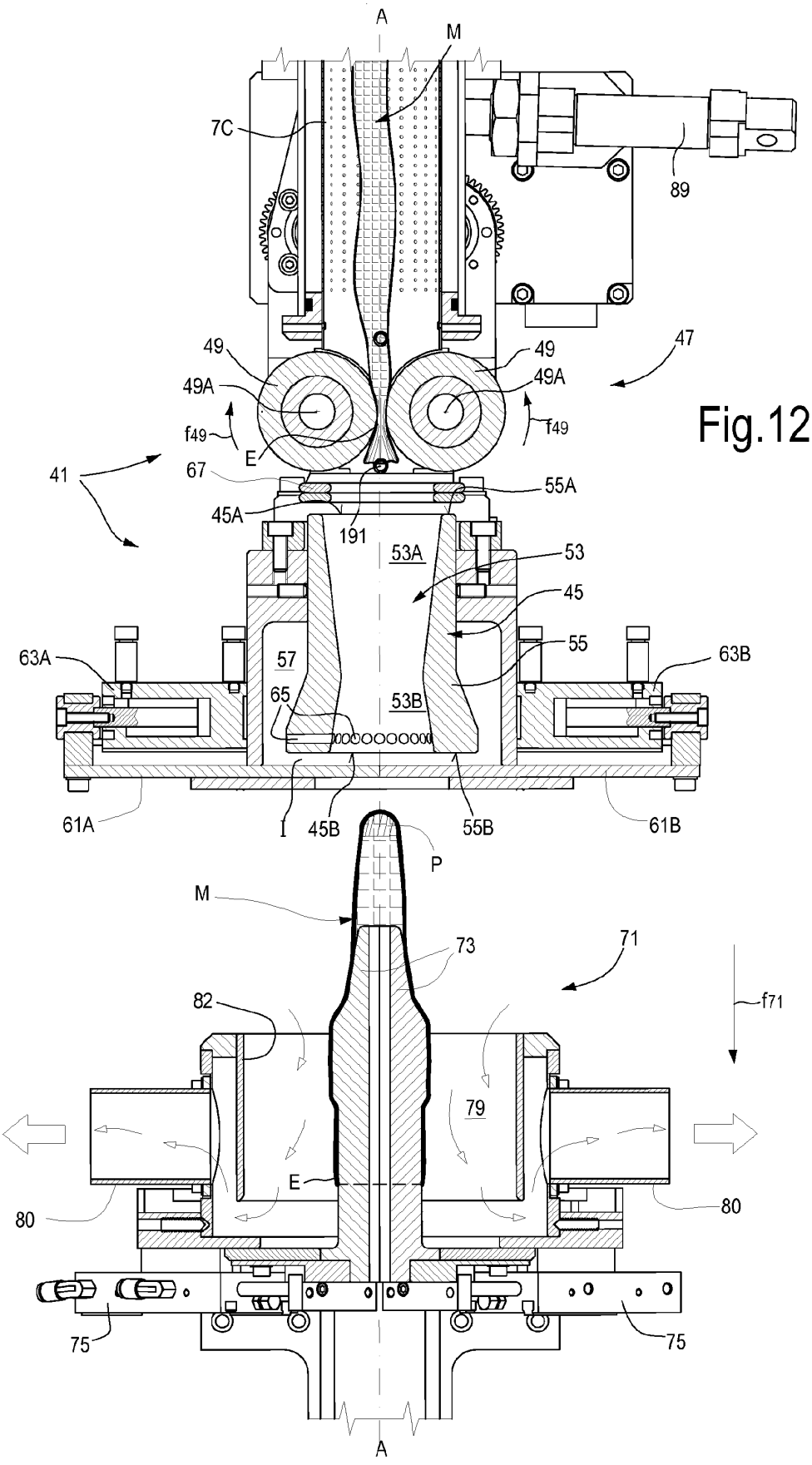
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Fig.12P

Fig.12Q

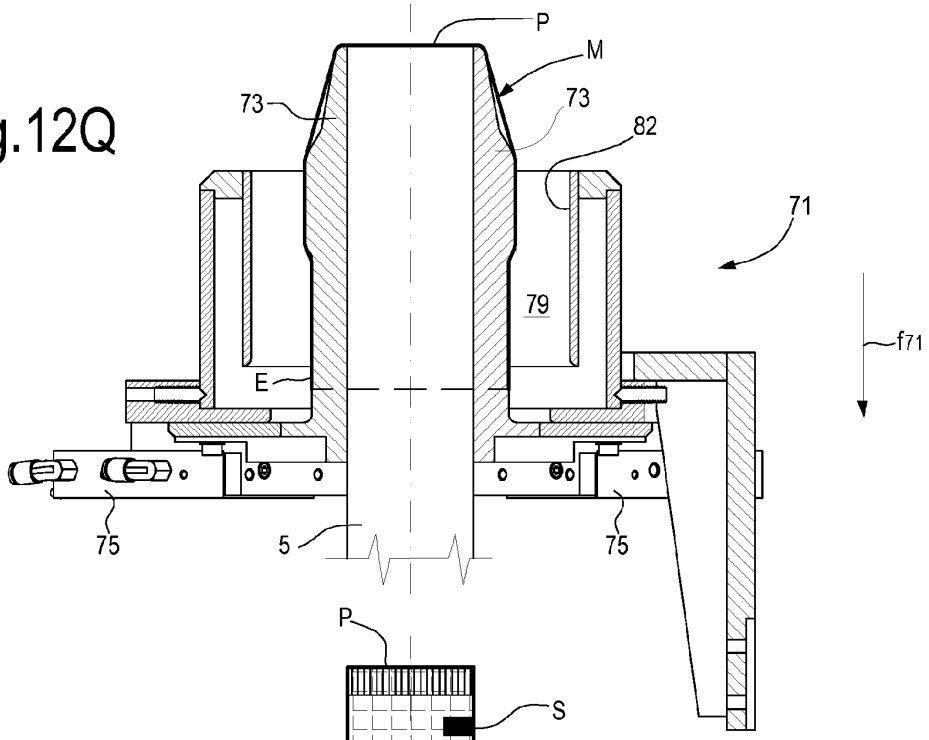
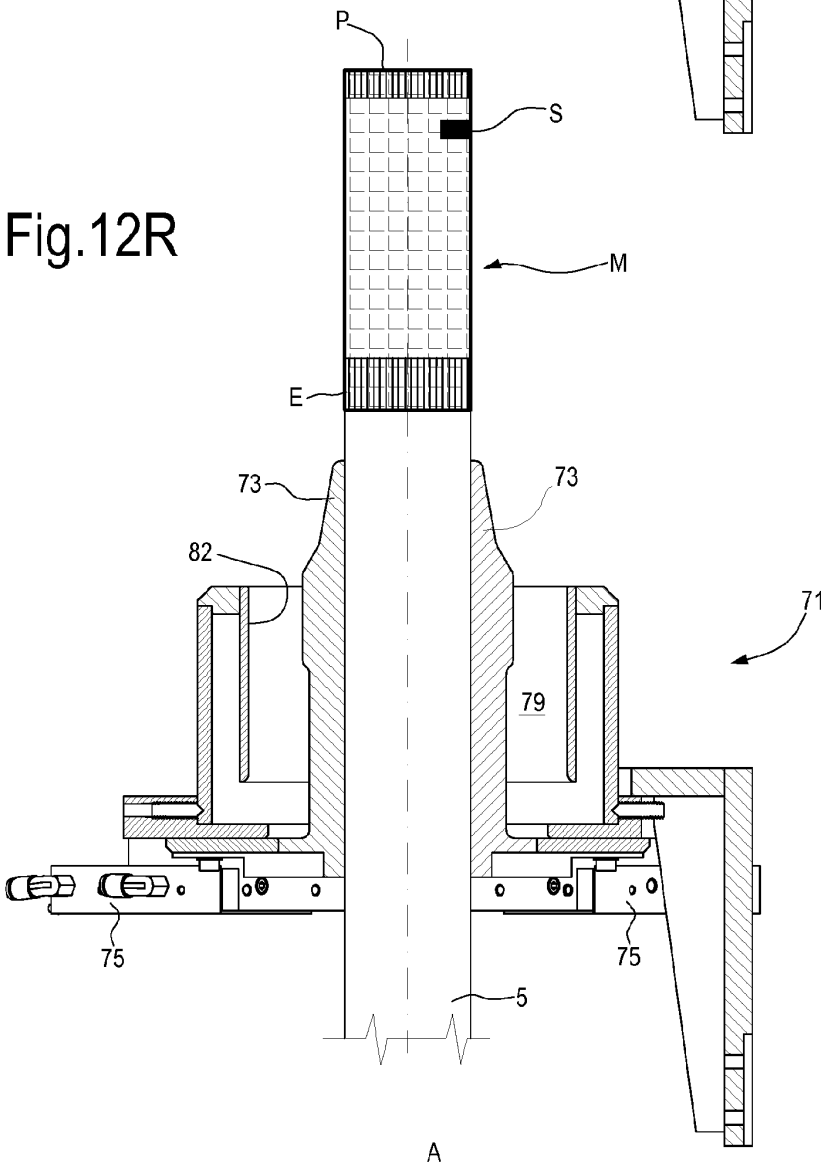


Fig.12R



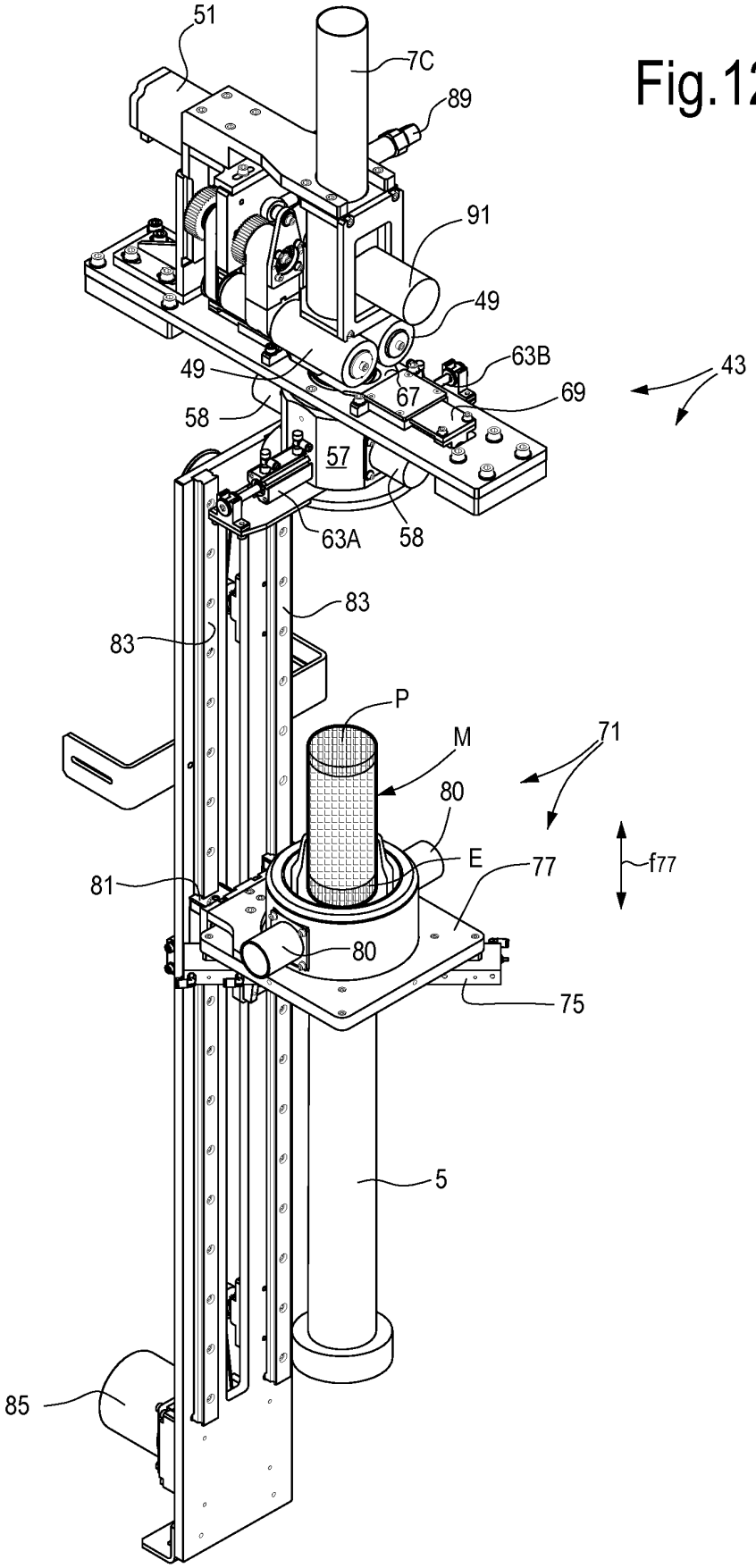

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Fig.12S

Fig.13A

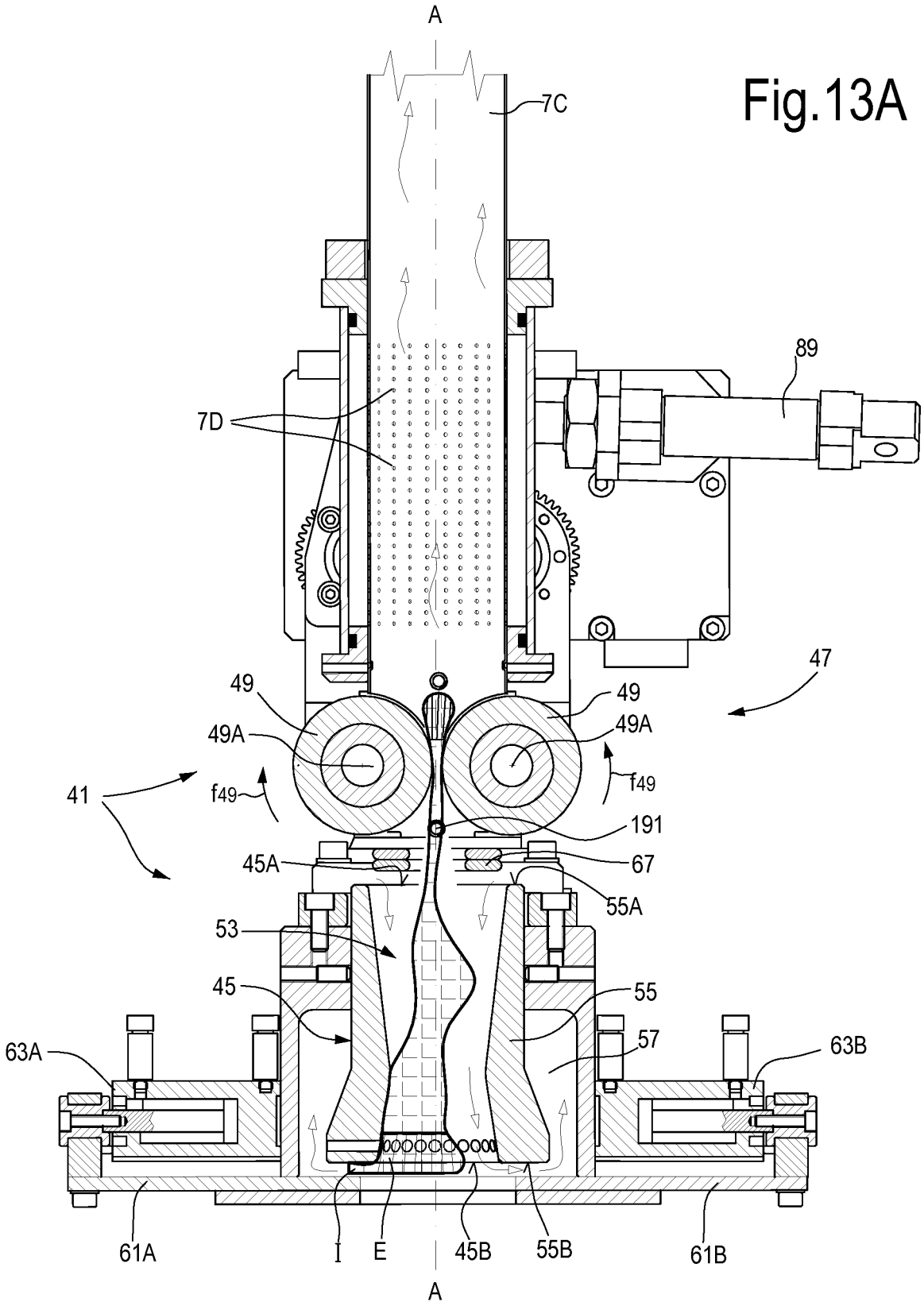
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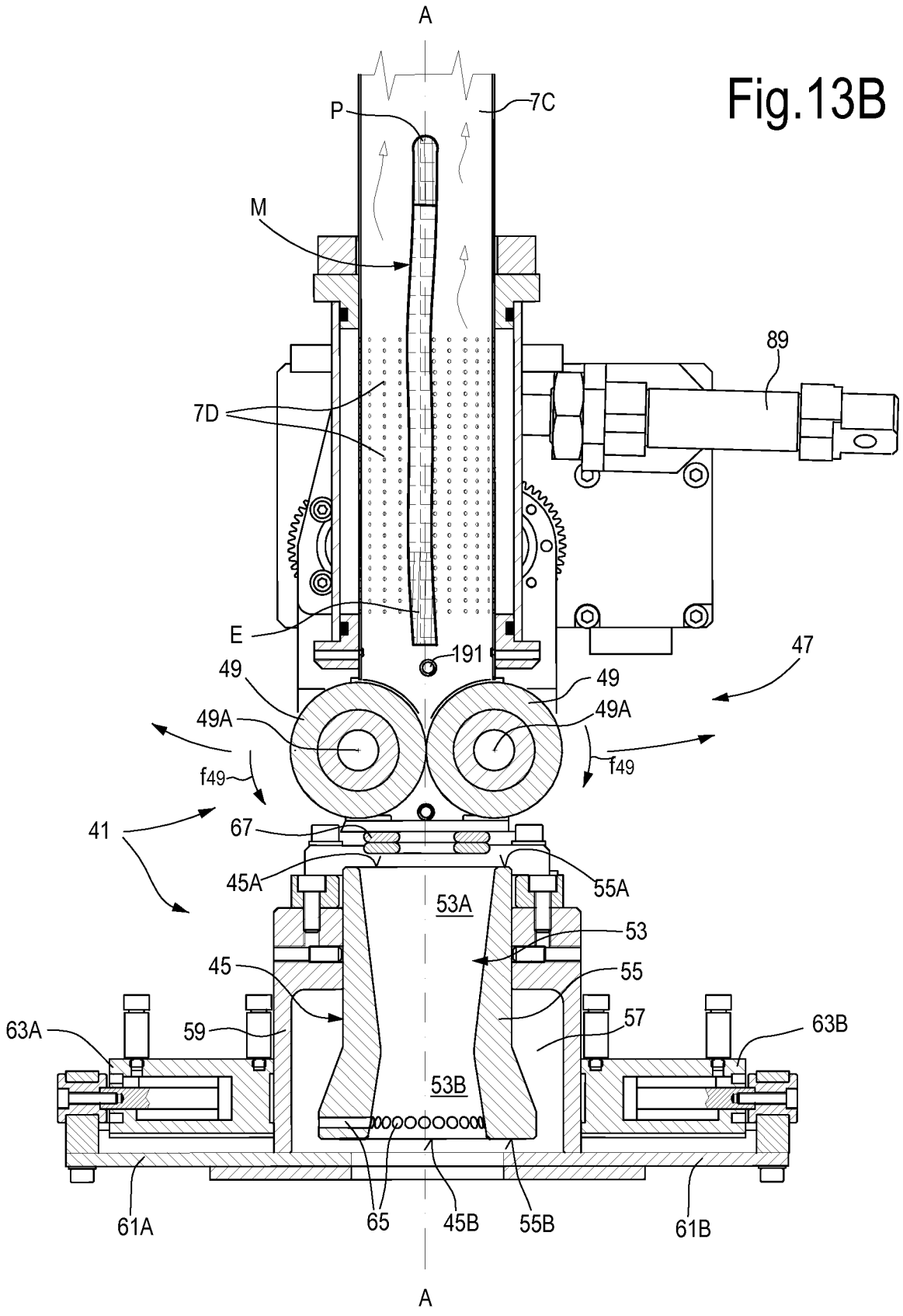
Fig.13B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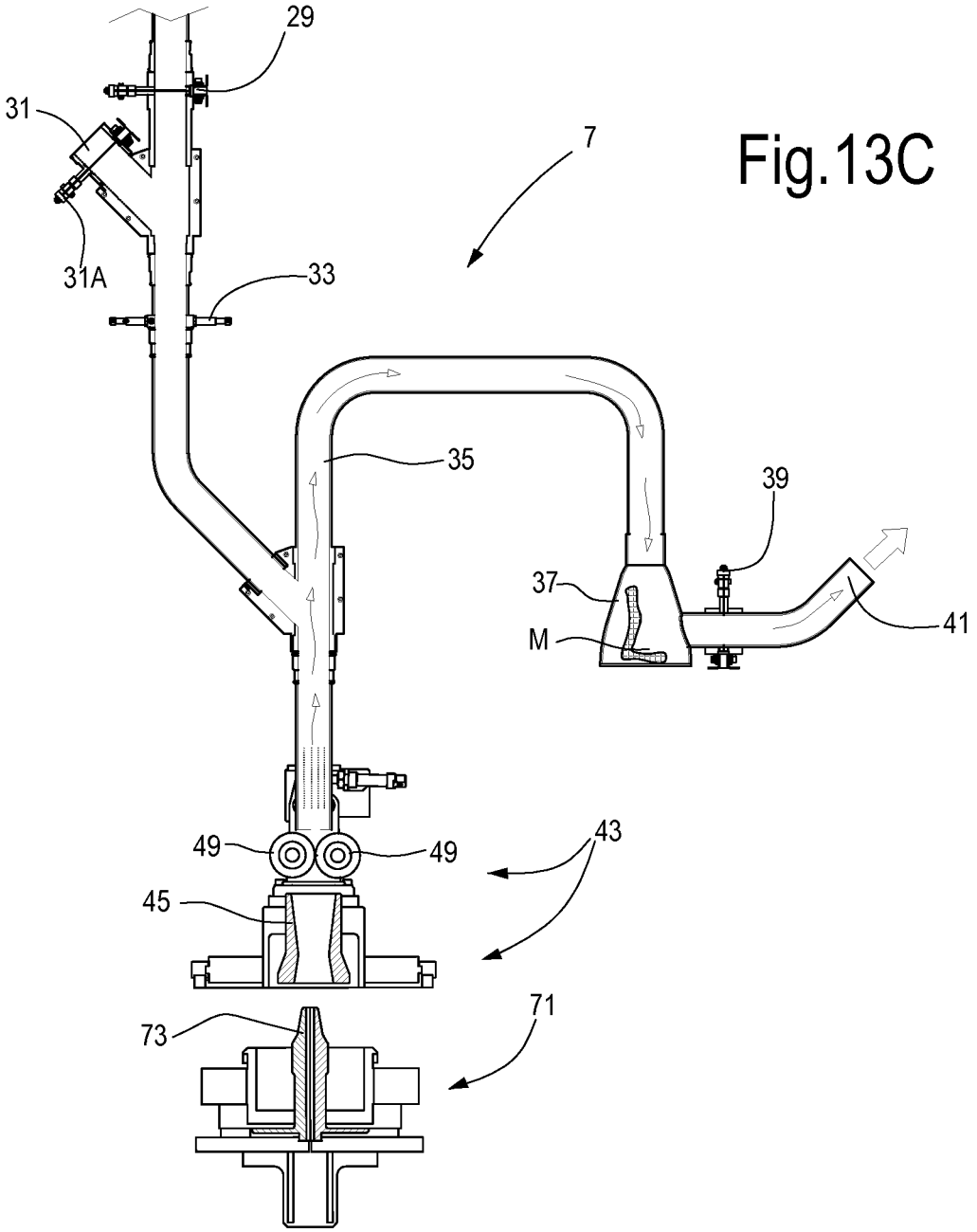

Fig.13C

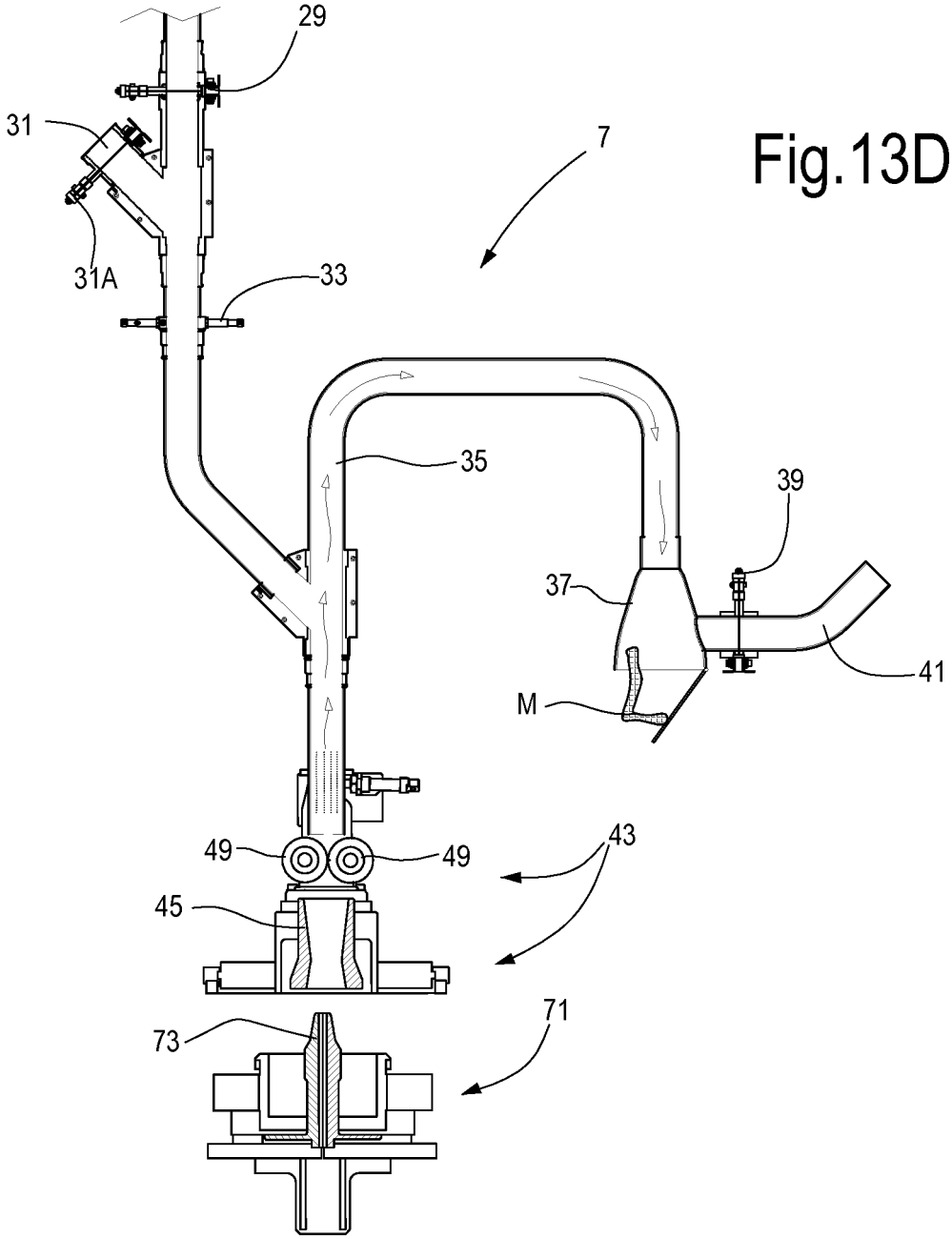

Fig.13D

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 0218696 A **[0007]**
- GB 2181465 A **[0008]**
- EP 0677608 A **[0009]**
- WO 0177432 A **[0010]**
- US 20050173476 A **[0011]**
- GB 2374090 A **[0012]**
- EP 1460165 A **[0013]**