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(54) A CRANE FOR LIFTING A LOAD

LASTHEBEKRAN

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Description

Technical Field

[0001] This invention relates to a crane for lifting a load.

[0002] More specifically, the crane of the invention is a mobile crane, that is to say, a crane which can be mounted on a vehicle, in particular on a motor vehicle or truck.

Background Art

[0003] Cranes for mounting on trucks are known which comprise a base structure, a pivoting arm for pivotal mounting to the base structure and a telescopically extensible arm having a respective base section or member which is articulated to the pivoting arm and from the inside of which extend respective sliding members or sections.

[0004] In cranes known up to date, each sliding member corresponds to a respective motor means or actuator which drives the sliding member between a retracted position and an extended position relative to the member preceding it or coaxially on the outside of it. Thus, in prior art cranes where the extensible arm has a high number of sliding members, many actuators are used. The actuators are housed outside the arm sliding members, preferably above them. Otherwise, a single, complex actuator is used which has a plurality of stages for respective sliding members and which is thus excessively complicated to make and drive.

[0005] To avoid excessive height in the overall dimensions of the assembly consisting of the arms and telescopic drive actuators, the tendency is to make tubular sliding members whose section is not of the optimum height, that is, excessively reduced in height.

[0006] Such a configuration, with telescopic arm members whose section is reduced in height, is necessary to enable the actuators to be placed above the respective member without creating an excessive overall height or perpendicular dimension for the arm.

[0007] As a result, however, to obtain the adequate flexural strength, it is conversely necessary to make the tubular members very thick, with the disadvantage of massive crane weight and excessive deformation or sagging of the lifting arm under loaded conditions.

[0008] In practice, that way, it is not possible to use state-of-the-art types of steel offered by the iron and steel industry, which, even in the presence of resistant sections of reduced height, would enable resistant sections with a relatively small thickness to be made without the risk of reaching the breaking point. In effect, in the presence of reduced thicknesses, these high-strength state-of-the-art steels have corresponding excessive flexural elasticity which, in practice, makes them unusable for such applications.

[0009] In addition, it should be noted that current actuators have the drawback of heavy weight, constructional complexity and high crane costs. Thus, a large number of actuators constitutes a further undesirable drawback of current cranes.

[0010] Moreover, the possibility of extending and retracting the telescopic arm while lifting a load is another strongly felt need in the trade. This is a particularly onerous condition which places the load-bearing structure under heavy stress.

[0011] EP1321426 discloses a crane for lifting a load comprising an extensible arm having a base member and a plurality of sliding members and first and second actuators for driving the extension and retraction of the sliding members of the extensible arm that are fixed on the base more heavy member of the same arm.

[0012] A crane according to the preamble of claim 1 is known from JPH11301976A.

Disclosure of the Invention

[0013] This invention proposes a novel solution, alternative to the solutions known up to now, and, more specifically, aims to overcome one or more of the above mentioned drawbacks or problems, and/or to meet one or more of the needs mentioned or inferable from the above.

[0014] Therefore, there is provided a crane for lifting a load, the crane comprising an extensible arm that can be lifted and lowered; the extensible arm comprising a base member and a plurality of sliding members terminating with an end sliding member; the sliding members of the extensible arm being coaxially inserted one inside the other and being telescopically movable relative to each other between a respective retracted position and a respective extended position under the action of corresponding telescopic drive means, wherein the telescopic drive means comprise a first and a second actuator.

[0015] That way, using a limited number of drive actuators, it is possible to make sliding members which are greater in height, thus maximizing the strength and deformation properties of the material they are made of.

[0016] That also allows the telescopic arm to be extended and retracted sufficiently rapidly.

[0017] Furthermore, according to the invention, the telescopic drive means are mounted on the end sliding member.

[0018] That means the telescopic arm can be slid out or extended relatively easily even when the crane is lifting a heavy load.

[0019] In effect, the sliding members can be extended, or made to slide out starting from the ones with the largest, and hence more resistant, sections, that is to say, the ones closest to the base followed by the adjacent ones progressively further away from the base.

[0020] Thus, even if the arm is extended while carrying a suspended load, the structural strength of the crane is not placed at risk.

[0021] According to the invention, each actuator has a movable end which is equipped with means for engaging and disengaging respective members of the extensible arm.

Brief Description of the Drawings

[0022] These and other innovative aspects of the invention are set out in the appended claims and its technical features and advantages are apparent from the detailed description which follows of preferred, advantageous embodiments of it, to be considered purely as non limiting examples, with reference to the accompanying drawings, in which:

- Figure 1A is a longitudinal cross section of a first preferred embodiment of a telescopically extensible arm applicable to the crane according to this invention;
- Figure 1B shows a front view of the first preferred embodiment of an extensible arm;
- Figure 1C is an enlarged detail view of an upstream end of the first preferred embodiment of the extensible arm
- Figure 1D shows an enlarged view of a detail of the front view of the first preferred embodiment of the extensible arm;
- Figures 2 to 5 are longitudinal cross sections showing different operating positions of the first preferred embodiment of the extensible arm;
- Figure 6A is a longitudinal cross section of a second preferred embodiment of a telescopically extensible arm applicable to the crane according to this invention, with the extensible arm in a retracted condition;
- Figure 6B shows a front view of the second preferred embodiment of the extensible arm in the retracted condition;
- Figure 6C shows an enlarged detail of the upstream end of the second preferred embodiment of the extensible arm;
- Figure 6D shows an enlarged view of a detail of the front view of the second preferred embodiment of the extensible arm;
- Figures 7 to 10 are longitudinal cross sections showing different operating positions of the second preferred embodiment of the extensible arm;
- Figure 11A is a longitudinal cross section of a third preferred embodiment of a telescopically extensible arm applicable to the crane according to this invention;
- Figure 11B shows a front view of the third preferred embodiment of the extensible arm;
- Figure 11C is an enlarged detail view of an upstream end of the third preferred embodiment of the extensible arm;
- Figure 11D shows an enlarged detail of the means for locking the tubular members of the third preferred embodiment of the extensible arm;
- Figure 11E shows a perspective view of the third preferred embodiment of the extensible arm in the retracted condition;
- Figure 11F shows a detail from the preceding perspective view of the third preferred embodiment of the telescopically extensible arm;
- Figures 12 to 14 are longitudinal cross sections showing different operating positions of the third preferred embodiment of the extensible arm;
- Figures 15A to 15H illustrate the means for locking the tubular members of the third preferred embodiment of the arm in different operating conditions;
- Figure 16A is a longitudinal cross section of a fourth preferred embodiment of a telescopically extensible arm applicable to the crane, not covered by the claimed invention;
- Figure 16B is a top plan view of the fourth preferred embodiment of a telescopically extensible arm applicable to the crane, not covered by the claimed invention;
- Figure 16C shows a front view, without the disengagement nibs, of the fourth preferred embodiment of the extensible arm;
- Figure 16D is an enlarged detail view of a downstream end of the fourth preferred embodiment of the extensible arm;
- Figure 16E shows an enlarged detail of the means for locking the tubular members of the fourth preferred embodiment of the extensible arm;
- Figures 17 and 18 are longitudinal cross sections showing different operating positions of the fourth preferred embodiment of the extensible arm during extension;
- Figures 19 and 20 are longitudinal cross sections showing different operating positions of the fourth preferred embodiment of the extensible arm during retraction;
- Figure 21 shows a transversal cross section of an engagement zone between tubular members of the fourth preferred embodiment of the arm in the extended condition;
- Figure 22 shows a side view of an engagement zone between tubular members of the fourth preferred embodiment of the arm in the extended condition;
- Figures 23A to 23F show different operating positions of the means for locking the tubular members of the fourth preferred embodiment;
- Figure 24A is a longitudinal cross section of a fifth preferred embodiment of a telescopically extensible arm applicable to the crane, not covered by the claimed invention;
- Figure 24B shows a front view of the fifth preferred embodiment of the extensible arm;
- Figure 24C shows an enlarged detail of an upstream end of the fifth preferred embodiment of the extensible arm;
- Figure 24D shows an enlarged view of a detail of the front view of the fifth preferred embodiment of the extensible arm;
- Figures 25 and 26 are longitudinal cross sections showing different operating positions of the fifth preferred embodiment of the extensible arm.

Description of the Preferred Embodiments of the Invention

[0023] Figures 1A to 1D illustrate preferred embodiment 3 of a part of a crane for lifting a load, the crane being, more specifically, in the form of a mobile crane, especially a crane applicable to a vehicle, in particular a motor vehicle or truck. It will be understood, however, that the crane of this application might also be used in a fixed installation, that is to say, it might be in the form of a fixed crane.

[0024] In its general configuration, the crane comprises a base structure, or base, more specifically composed of a base for mounting to the vehicle and from which there extends upwardly a respective upright, or a pivoting arm, articulated at a respective end to the upright and able to be lifted or lowered relative to the latter under the driving action of a corresponding actuator or hydraulic cylinder

[0025] The crane also comprises a telescopically extensible arm 3, illustrated in Figure 1A, which extends from the pivoting arm for pivotal mounting to the base structure, the extensible arm being in turn articulated at a respective upstream end of it to the pivoting arm and being able to be lifted and lowered relative to the pivoting arm under the driving action of a corresponding actuator or hydraulic cylinder.

[0026] As is evident, the accompanying drawings illustrate only the extensible arm 3 of the crane. The rest of the crane may be made in any suitable manner and is in any case well within the knowledge of an expert in the trade and does not therefore need to be described in detail.

[0027] As illustrated, the telescopically extensible arm 3 comprises a plurality of tubular members or sections, comprising, more specifically, a base tubular member or section 31 connected directly and in articulated manner to the pivoting arm of the crane, and a plurality of tubular sliding members or sections which are located coaxially inside the base member 31 and inside each other.

[0028] The extensible arm also comprises a series of intermediate tubular sliding members, labelled 33, 34, 35, 36, 37, 38, 39, and an end sliding member labelled 40.

[0029] The members 31, 33, 34, 35, 36, 37, 38, 39, 40 of the extensible arm are in the form of tubular sections, and more specifically polygonal sections, which are progressively smaller in size from the base connecting member 31 to the end member 40, so that each member is housed inside the other members and, in particular, inside the member adjacently outside it, and able to slide longitudinally relative to it, in particular by engaging its outer surface with the inside surface of the member adjacently outside it.

[0030] As illustrated, the members of the extensible arm are coaxially inserted one inside the other and are telescopically movable relative to each other between a respective retracted position and a respective extended position, as will become clearer as this description continues.

[0031] In practice, the movable members of the extensible arm 3 are coaxially guided to move relative to the base member and relative to each other and can be optionally extended or retracted one after the other, or in succession.

[0032] More specifically, the members of the extensible arm are extended and retracted by the action of corresponding telescopic drive means 4 which operate in such a way as to move the sliding members 33, 34, 35, 36, 37, 38, 39, 40 from the respective retracted position to the respective extended position and vice versa.

[0033] As illustrated, in the rest or retracted position, shown in Figure 1A, the tubular members of the extensible arm 3 have a respective upstream end 31a, 33a, 34a, 35a, 36a, 37a, 38a, 39a, which protrudes relative to the end or edge of the tubular member 33, 34, 35, 36, 37, 38, 39, 40 adjacently inside it.

[0034] In practice, as illustrated, in the rest condition, at the mounting or upstream end 3', the respective end 31a, 33a, 34a, 35a, 36a, 37a, 38a, 39a of each larger or coaxially external sliding member protrudes beyond the end or end edge of the respective adjacent tubular member smaller than it.

[0035] Also, in the rest condition, at the downstream end 3" of the extensible arm, the respective end 33b, 34b, 35b, 36b, 37b, 38b, 39b, 40b of each narrower or coaxially internal sliding member protrudes beyond the end of the tubular member adjacently outside it.

[0036] The extensible arm has telescopic drive means 4, which are provided, or located, inside the respective members 31, 33, 34, 35, 36, 37, 38, 39, 40 of the extensible arm 3.

[0037] That way, it is possible to make sliding members which are large in height, thus maximizing the strength properties of the material they are made of.

[0038] In effect, under equal conditions of dimensions in height, with this extensible arm, which houses the drive means 4 inside the section of the arm members, it is possible to make tubular members with a resistant section that is taller and hence particularly reduced in thickness.

[0039] Advantageously, as illustrated, the telescopic drive means 4 of the extensible arm 3 comprise only a first actuator 41 and a second actuator 42, which are both housed inside the tubular members of the extensible arm 3 and which are reciprocatingly driven to extend respective and successive members of the extensible arm or to retract respective and successive members of the extensible arm, as will become clearer as this description continues.

[0040] Also, the first and second actuators 41, 42 are driven simultaneously, respectively, to move a respective sliding member and to engage, or hook onto, a further sliding member, after releasing a corresponding sliding member, to go towards the position for engaging or hooking onto a further sliding member to be moved after it.

[0041] In practice, the first and second actuators 41,

42 can advantageously be driven simultaneously in opposite directions for moving a respective sliding member and to perform a backward return movement to hook onto a further sliding member.

[0042] In practice, the first and second actuators 41, 42 can advantageously be driven in such a way that one moves a respective sliding member and the other returns to the respective retracted position for catching a further sliding member during extension of the arm, or protrudes to the extended position for catching or hooking onto a sliding member to be retracted next during retraction of the telescopic arm.

[0043] More in detail, the telescopic drive actuators 41, 42 have a respective rod 41a, 42a which is extensible and retractable relative to a respective cylinder 41b, 42b, forming a respective drive chamber 41c, 42c for the respective rod 41a, 42a.

[0044] In practice, the telescopic drive actuators 41, 42 extend and are driven to move along a direction longitudinal to the tubular members or to the extensible arm 3.

[0045] According to the invention, the telescopic drive means 4 are mounted on the end sliding member 40.

[0046] In practice, the telescopic drive means 4 are fixed to, or integral with, the end sliding member 40.

[0047] That means the telescopic arm can be extended and retracted relatively easily even when the crane is lifting a load.

[0048] The sliding members can be extended, or made to slide out, by first extending the ones with the largest, and hence more resistant, sections, that is to say, starting from the one closest to the base followed by the adjacent ones progressively further away from the base.

[0049] That also means the telescopic arm can be retracted relatively easily even when the crane is lifting a load.

[0050] Similarly, the sliding members can be retracted, by first withdrawing the ones with the smallest, and hence less resistant, sections, that is to say, starting the one furthest from the pivoting arm followed by the adjacent ones progressively closer to the base.

[0051] Thus, even if the arm is extended or retracted while carrying a suspended load the structural strength of the crane and of the drive means is not placed at risk. In effect, that way, the drive means are closer to the suspended load and are thus subjected to relatively low stresses and can thus be configured with smaller dimensions.

[0052] More specifically, as illustrated, each actuator 41, 42 has a respective end 41', 42', which is connected to, and in this particular embodiment, is integral with, the end sliding member 40 of the extensible arm 3, at the downstream end of the latter.

[0053] Each actuator 41, 42 also has a respective rod 41a, 42a which extends rearwards, that is, towards the upstream end 3' of the extensible arm.

[0054] More specifically, each actuator 41, 42 also has another end 41", 42" which is provided with means 51, 52 for connecting to, or hooking onto, a respective member 31, 33, 34, 35, 36, 37, 38, 39 of the extensible arm 3 in order to extend or retract it relative to the adjacent tubular member, as will become clearer as this description continues.

[0055] More specifically, each actuator 41, 42 also has another end 41", 42" which is provided with means 51, 52 for engaging and disengaging, a respective member 31, 33, 34, 35, 36, 37, 38, 39 of the extensible arm 3 in order to extend or retract or move it relative to the adjacent tubular member.

[0056] These means 51, 52 for engagement and disengagement at the movable end 41", 42" of the telescopic drive actuators 41, 42 comprise respective and opposite connecting pins, labelled 51a, 51b e 52a, 52b, which can be inserted into matching openings 53, 54 provided in the sidewalls of the respective tubular members of the extensible arm 3.

[0057] The engagement and disengagement means also comprise respective engagement pin means 51a, 51b e 52a, 52b which can be inserted into matching hole means made in the corresponding members of the extensible arm 3.

[0058] The engagement pin means which are, more specifically, in the form of two opposite pins 51a, 51b, 52a, 52b movable transversally between a plurality of positions of engaging and connecting respective tubular members of the extensible arm and a plurality of positions of disengaging the same tubular members.

[0059] In practice, for each tubular member, the respective engagement pin means 51a, 51b or 52a, 52b are movable transversally between an extended position where it engages and connects the respective tubular member of the extensible arm and a retracted position where it disengages the same tubular member.

[0060] The engagement pin means 51a, 51b or 52a, 52b are driven by a corresponding hydraulic cylinder 51e, 52e, which is provided at the movable or free end of the respective telescopic drive actuator 41, 42.

[0061] The engagement and disengagement actuators 51e, 52e which drive the pins 51a, 51b, 52a, 52b extend transversally to the longitudinal direction of the arm with respective and transversally opposite rods, labelled 51c, 51d, 52c, 52d in Figure 1D.

[0062] In practice, the engagement and disengagement means comprise engagement means 51, 52 which act in conjunction with respective engagement surfaces 53, 54 of respective members 31, 33, 34, 35, 36, 37, 38, 39 of the extensible arm 3.

[0063] The hole means or openings 53, 54 are, as illustrated, in the form of corresponding annularly profiled openings made in respective, opposite sidewalls of the members 31, 33, 34, 35, 36, 37, 38, 39 of the arm 3.

[0064] There are also advantageously provided means for mutually locking adjacent members 31, 33, 34, 35, 36, 37, 38, 39, 40 in the mutually extended position and means for mutually locking adjacent members 31, 33, 34, 35, 36, 37, 38, 39, 40 in the mutually retracted posi-

tion.

[0065] More specifically, there are provided means, labelled 61, 62, 63, 64, 65, 66, 67, 68 for mutually locking adjacent members, 31, 33, 34, 35, 36, 37, 38, 39, 40 both in the mutually extended and retracted positions.

[0066] The mutual locking means 61, 62, 63, 64, 65, 66, 67, 68 act in conjunction with matching annular openings or sockets, 60a, 60b provided in the top wall respectively at the upstream and downstream ends of each adjacently outside tubular member 31, 33, 34, 35, 36, 37, 38, 39.

[0067] In other words, there are provided means 61, 62, 63, 64, 65, 66, 67, 68 for mutually locking adjacent members, 31, 33, 34, 35, 36, 37, 38, 39, 40 of the extensible arm in the mutually extended position and/or in the mutually retracted position of the arm members.

[0068] In practice, as illustrated, each tubular member has at the upstream end of it a respective socket or hole 60a and at the downstream end of it a respective socket or hole 60b for corresponding locking means 61, 62, 63, 64, 65, 66, 67, 68.

[0069] Advantageously, the means for mutually locking the arm sliding members comprise a respective engagement pin 60.

[0070] More specifically, each engagement pin 60 is integral with the respective sliding member.

[0071] In practice, the first preferred embodiment of the crane has mutual locking means 61, 62, 63, 64, 65, 66, 67, 68 which comprise a plurality of engagement pins 60

[0072] As illustrated, each pin 60 is mounted at the respective end of the respective sliding member 33, 34, 35, 36, 37, 38, 39, 40.

[0073] In practice, the mutual locking means 61, 62, 63, 64, 65, 66, 67, 68 are each in the form of a respective pin or piston 60 which is mounted at the respective upstream end of the respective sliding member 33, 34, 35, 36, 37, 38, 39, 40 and which is movable between a position where it engages corresponding sockets or cavities 60a, 60b at opposite ends of the respective member 31, 33, 34, 35, 36, 37, 38, 39 of the extensible arm 3 and a position where it disengages the sockets 60a, 60b.

[0074] In practice, the pin or piston 60 is movable vertically between an extended or drawn out position where it is inserted in corresponding vertical-axis through sockets or openings, 60a, 60b, and a retracted or drawn in position where it is disengaged from the sockets 60a, 60b.

[0075] More specifically, during its longitudinal extension, the pin or piston 60 is movable between a drawn out position where it engages the respective upstream socket 60a of the tubular member adjacently outside the tubular member that mounts that locking pin, and a drawn in position where it disengages and allows free sliding of that tubular member towards an extended position of that outside tubular member, and where the movable pin or piston 60 is again movable between the drawn in disengagement position and a drawn out position of engagement with the respective downstream socket 60b of the same tubular member adjacently outside the tubular member, and vice versa during retraction of the extensible arm.

[0076] The locking pin 60 is slidable in a corresponding tubular housing 60', and in particular, as illustrated, extends vertically and is integral with the respective sliding member 33, 34, 35, 36, 37, 38, 39, 40, the tubular housing 60' being open at the top and forming a respective hole 60" made in the top wall of the same sliding member.

[0077] The tubular housing 60' for the locking pin is therefore inside the respective tubular member.

[0078] Further, the housings 60' of the respective locking pins are longitudinally aligned with each other.

[0079] As illustrated, the mutual locking means 60 also comprise a respective longitudinal plate forming two-way engagement means for respective means for moving, or activating and deactivating, the locking pin.

[0080] As illustrated, in the drawn out or extended position and in the drawn in or retracted position, the plates 60"a for gripping the mutual locking means or pistons 60 are aligned with each other.

[0081] As may be well inferred from Figure 1D, the means for activating and deactivating the mutual locking means 60 comprise a forked end 601 for gripping the respective plate portion 60" a.

[0082] Thus, advantageous means 7 are provided for activating and deactivating the mutual locking means 61, 62, 63, 64, 65, 66, 67, 68.

[0083] The means 7 for activating and deactivating the mutual locking means 61, 62, 63, 64, 65, 66, 67, 68 are movable longitudinally to be positioned at respective mutual locking means 61, 62, 63, 64, 65, 66, 67, 68.

[0084] The activation and deactivation means 7 move the mutual locking means 60 between an extended locked position and a retracted disengaged position.

[0085] More specifically, the means 7 for activating and deactivating the mutual locking means 61, 62, 63, 64, 65, 66, 67, 68 are mounted on a corresponding end sliding member 40 forming part of the plurality of members of the telescopic arm 3.

[0086] The means for activating and deactivating the mutual locking means are in the form of a corresponding actuator 7 having one end equipped with means for bilaterally engaging a corresponding plate 60"a of the locking pin 60.

[0087] In practice, at its insertion end, each locking pin 60 has a corresponding extension 60'a terminating with a plate 60"a, which is engaged by a corresponding forked portion which is integral with the bilaterally movable rod of the activating and deactivating actuator 7.

[0088] Means are provided for longitudinally moving the means 7 for activating and deactivating the mutual locking means 61, 62, 63, 64, 65, 66, 67, 68.

[0089] More specifically, for the longitudinally movable support of the means 7 for activating and deactivating the mutual locking means, there is provided an actuator 8 having a respective rod 81 which mounts the vertical

actuator 7 at a respective free end of it, and a cylinder 82 which is integral with the cylinder 41b of the first telescopic drive actuator 41.

[0090] That way, the actuator 8 which mounts the means 7 for activating and deactivating the mutual locking means 60 is integral with and mounted on a corresponding longitudinal end sliding member 40 forming part of the plurality of members of the telescopic arm 3.

[0091] Also, the means for moving, or shifting, the means for activating the locking pin move the activation means 7 to the means for locking corresponding sliding members, in particular, adjacent and consecutive sliding members.

[0092] In practice, the movable rods of the longitudinal telescopic drive cylinders 41 and 42 and of the cylinder 8 for longitudinally moving the means for activating and deactivating the mutual locking means extend in a rearward direction, that is to say, towards the upstream mounting end, in particular towards the end where the extensible arm 3 is mounted to the pivoting arm.

[0093] In practice, with reference also to Figures 2 to 5, the operation of the system for extending and retracting the extensible arm 3 is briefly as described below.

[0094] Starting from a condition where the arm 3 is fully retracted, illustrated in Figure 1A, where all the members 33, 34, 35, 36, 37, 38, 39 and 40 are withdrawn and the locking means 60 are in the condition where the respective adjacent tubular members engage each other, the locking actuator 61 at the end of the rod of the first extending actuator 41 slots into the seats or openings in the sidewalls of the member 31, which connects to the pivoting arm of the crane, in such a way as to engage that member At the same time, the activation and deactivation actuator 8 disengages the locking pin 60 of the corresponding locking means 61, which connects the base member 31, mounted to the pivoting arm of the crane, to the adjacently inside member 33 causing it to come out of the respective upstream socket 60a of the base member 31.

[0095] At this point, the rod 41a of the extending actuator 41 is drawn out, thereby causing the members downstream of the base member 31 to move longitudinally relative to the base member 31 until reaching the end position where the member 33 is fully extended relative to the member 31 adjacent to it, as illustrated in Figure 2.

[0096] At this point, the activation and deactivation actuator carries the corresponding locking pin 60 of the locking means 61 until it slots into the socket 60b downstream, that is, at the other end of the tubular member 31, thereby securely locking the tubular member 31 to the tubular member 33 adjacent to it in the extended condition.

[0097] As shown in Figure 3, at this point, the positioning actuator 8, retracts a little or causes the respective rod to withdraw a little, and positions the actuator 7 for activating and deactivating the mutual locking means at the locking means 62 between the sliding member 33 and the adjacently inside sliding member 34, thereby releasing them, that is to say, drawing the pin 60 out of the upstream socket 60a of the tubular member 33.

[0098] At this point, the transversal engagement actuator 51 of the first drive actuator 41 is disengaged from the corresponding tubular member 31 and the corresponding rod 41b withdraws into the respective cylinder 41d, thereby positioning the respective engagement element 51 at the openings of the remaining sliding members, as illustrated in Figure 4.

[0099] In turn, and simultaneously, while the respective transversal engagement actuator 52 remains engaged with the tubular member 33, the second telescopic extension actuator 42 draws out the corresponding rod 42a, thereby causing the members downstream of the member 33 to move longitudinally until reaching the end position where the member 33 is fully extended relative to the base member 31, as illustrated in Figure 4.

[0100] In this position, the activation and deactivation means engage the pin 60 of the respective locking means 62 with the socket 60b at the downstream end of the tubular or sliding member 33.

[0101] At this point, the positioning actuator 8 positions the actuator 7 for activating and deactivating the mutual locking means at the locking means 63 between the sliding member 34 and the sliding member 35 adjacently inside it, thereby releasing them, that is to say, drawing the pin 60 out of the upstream socket 60a of the tubular member 34.

[0102] After that, as illustrated in Figure 5, the operations continue, as already described in connection with extension relative to the tubular connecting element 31, with the drawing out of the corresponding telescopic drive rod 41a and the extension of the plurality of profiles relative to the tubular member 34.

[0103] In this situation, the engagement actuator 52 of the second drive actuator 42 was previously disengaged from the sliding tubular member 33 and the rod 42a of the second drive actuator 42 withdraws to a position for engaging a further tubular member 35.

[0104] The extension procedures can continue as described until the telescopically extensible arm is fully extended.

[0105] For retracting the extensible arm, the procedure is obviously the reverse of the one described above for extending the arm.

[0106] In practice, retraction involves first withdrawing the end sliding member 40 and then, progressively, the sliding members 39, 38, 37, 36, 35, 34 and 33

[0107] During retraction of the telescopic arm, the locking pistons 60 are disengaged from the downstream socket 60b and once again engaged with the upstream socket 60a of the adjacent tubular member.

[0108] Figures 6A to 6D illustrate a second preferred embodiment 103 of the extensible arm applicable to a crane, for example of the type described above with reference to the first preferred embodiment.

[0109] The second preferred embodiment of the extensible arm has components which are similar to those

of the first preferred embodiment and which, to avoid making this description too lengthy, are denoted by the same reference characters and will not be commented upon again in detail.

[0110] In the second embodiment, the means for activating and deactivating the locking means are mounted directly on both the telescopic drive means 41, 42.

[0111] More specifically, the means for activating and deactivating the locking means 61, 62, 63, 64, 65, 66, 67, 68 comprise a first actuator 107a for activating and deactivating the locking means and which is mounted on the first telescopic drive actuator 41, and a second actuator 107b for activating and deactivating the locking means and which is mounted on the second telescopic drive actuator 42.

[0112] The first and second actuators 107a, 107b for activating and deactivating the locking means and which are mounted on the first and second telescopic drive actuators 41, 42 are driven alternately by operating on the respective means for locking the consecutive sliding members.

[0113] As illustrated in Figure 6A, each actuator 107a, 107b for activating and deactivating the locking means and mounted on a respective actuator 41, 42, is located at one end of the respective cylinder 41b, 42b, and more specifically, at the end from which the telescopic drive rod 41a, 42a come out.

[0114] Advantageously, to be able to conveniently move the respective activation and deactivation actuators 107a, 107b to the corresponding locking means, the respective telescopic drive actuator 41, 42 is provided with a second positioning rod 141, 142 which extends from the end opposite the one from which the telescopic extension rod 41a, 42a extends.

[0115] More specifically, the positioning rods 141, 142 are driven by a corresponding control chamber provided inside each cylindrical body 41b, 42b.

[0116] That way, it is possible to move the mounting end of the activation and deactivation means 107a, 107b to the respective locking means 61, 62, 63, 64, 65, 66, 67, 68.

[0117] The operation of the second embodiment is described briefly below.

[0118] Starting from a condition where the arm 3 is fully retracted, illustrated in Figure 6A, the locking actuator 51 at the end of the cylinder of the first extending actuator 41 slots into the seats or openings 53 in the sidewalls of the member 31, which connects to the pivoting arm of the crane, in such a way as to engage that member.

[0119] At the same time, the first activation and deactivation actuator 107a disengages the corresponding locking pin 60 of the corresponding locking means 61, which connects the base member 31 to the adjacently inside member 33 causing it to come out of the respective upstream socket 60a

[0120] At this point, the rod 41a of the extending actuator 41 is drawn out, thereby causing the members downstream of the member 31 to move longitudinally relative to the member 31 until reaching the end position where the member 33 is fully extended relative to the member 31 adjacent to it, as illustrated in Figure 7.

[0121] At this point, the activation and deactivation actuator 107a carries the corresponding locking pin 60 of the locking means 61 until it slots into the socket 60b downstream, that is, at the other end of the tubular member 31, thereby securely locking the tubular member 31 to the tubular member 33 adjacent to it in the extended condition.

[0122] At this point, the activation and deactivation means or actuator 107b mounted on the cylinder 42b of the second telescopic drive actuator 42, release the corresponding pin 60 of the locking means 62 which connects immediately adjacent tubular members 33 and 34 to each other, causing the pin 60 to come out of the respective socket 60a at the upstream end of the tubular member 33, as illustrated in Figure 8.

[0123] At this point, the transversal engagement actuator 51 is disengaged from the corresponding tubular member 31 and the corresponding rod 41a withdraws into the respective cylinder 41b, thereby positioning the respective engagement element 51 at the openings 53 of the tubular member 34 , as illustrated in Figure 9 After the means 107 have released the pin of the locking means 62 from the socket 60a of the sliding member 33, the second telescopic extension drive actuator 42 in turn, and simultaneously, while the respective transversal engagement actuator 52 remains engaged with the tubular member 33, that is to say, with the openings 54 in that member, draws out the corresponding rod 42a, thereby causing the members downstream of the member 33 to move longitudinally relative to the member 33 until reaching the end position where the member 34 is fully extended relative to the adjacent member 33, as illustrated in Figure 9.

[0124] In this position, the activation and deactivation means 107b engage the pin 60 of the respective locking means 62 with the socket 60b at the downstream end of the tubular or sliding member 33.

[0125] At the same time, as shown in Figure 9, the means 141 for moving the activation means 107a provided on the first telescopic extension means 41 withdraw. In practice, the rod 141 withdraws into the respective control chamber inside the cylinder 41b, moving the respective end of the cylinder 41b, which mounts the first activation and deactivation means 107a, to the next locking means 63, thereby proceeding to the next releasing operation between the sliding member 34 and the sliding member 35.

[0126] After that, the procedure continues, as already described in connection with extension relative to the tubular connecting element 31, with the drawing out of the corresponding telescopic drive rod 41a and the extension of the plurality of profiles relative to the tubular member 34, as illustrated in Figure 10.

[0127] In this situation, the engagement actuator 52 of the second drive actuator 42 was previously disengaged

from the sliding tubular member 33 and the rod 42a of the second drive actuator 42 is conveniently withdrawn.

[0128] At the same time, each of the means 142 for moving the respective activation and deactivation means 107b position the latter at the next locking means 64, as illustrated in Figure 10.

[0129] The extension procedures can then continue as described until the telescopically extensible arm is fully extended.

[0130] For retracting the extensible arm, the procedure is obviously the reverse of the one described above for extending the arm.

[0131] In practice, retraction involves first withdrawing the end sliding member 40 and then, progressively, the sliding members 39, 38, 37, 36, 35, 34 and 33.

[0132] During retraction of the telescopic arm, the locking pistons 60 are disengaged from the downstream socket 60b and once again engaged with the upstream socket 60a of the adjacent tubular member.

[0133] Figures 11A to 11F illustrate a third preferred embodiment of a telescopically extensible arm applicable to a crane as described in connection with the first preferred embodiment.

[0134] The components of the third preferred embodiment of the extensible arm which are similar to those of the preceding embodiments, in particular, of the first preferred embodiment, are not commented up again in detail so as to avoid making this description too lengthy and maintain the same reference characters

[0135] More specifically, like the first and second preferred embodiments, the extensible arm 203 of the third preferred embodiment comprises a plurality of tubular members, in particular comprising a tubular member 31 for connection to the pivoting arm of the crane, an end sliding member 40, and between these, a plurality of sliding tubular members 33, 34, 35, 36, 37, 38, 39.

[0136] The third preferred embodiment, too, comprises telescopic drive means comprising a first and a second actuator 41, 42, exactly the same as those of the first preferred embodiment and therefore not commented upon in detail and which, in this case, too, have a respective cylinder 41b, 42b that is connected to the end sliding member 40 at a respective upstream end of the latter. From each of the cylinders 41b, 42b there extends a corresponding rod 41a, 42a at the end of which there are transversal actuators 51, 52 for engaging and disengaging the respective members of the telescopic arm 203 and which operate with corresponding openings that are exactly the same as those of the preceding embodiments.

[0137] The third preferred embodiment also comprises advantageous means 290 for mutually and releasably locking the members of the telescopic arm and which are adapted to release the tubular members in sequence.

[0138] More specifically, means 290 are provided for mutually and releasably locking the members of the telescopic arm and which are adapted to release the members of the telescopic arm sequentially from the outermost one to the innermost one.

[0139] The third preferred embodiment also comprises means 290 for mutually and releasably locking the members of the telescopic arm and which are adapted to release the members of the arm in sequence.

[0140] More specifically, the means 290 for mutually and releasably locking the members of the telescopic arm are adapted to lock the members of the arm sequentially from the innermost one to the outermost one.

[0141] Advantageously, the third preferred embodiment also comprises means 290 for mutually and releasably locking the members of the telescopic arm and which are adapted to release the tubular members in sequence and to lock the tubular members in sequence.

[0142] Advantageously, the means 290 for mutually and releasably locking the members of the telescopic arm are adapted to engage and retain the respective members of the arm in the mutually retracted position.

[0143] Further, the means 290 for mutually and releasably locking the members of the telescopic arm comprise a pin which is movable into one or more positions for locking and releasing corresponding members of the telescopic arm.

[0144] Advantageously, the means for mutually and releasably locking the members of the telescopic arm are driven by a corresponding actuator 290, more specifically one in the form of an actuator that can be activated and deactivated by control, in particular, of electrical or hydraulic type.

[0145] The third preferred embodiment also comprises, at the end of the cylinder 41 opposite the end from which there extends the longitudinal drive rod 41a of the corresponding means 290 for engagement with and connection to the end sliding member, 40, and for locking the members 31, 33, 34, 35, 36, 37, 38, 39, 40 of the telescopic in the retracted condition. The means for engaging or locking the members of the extensible arm in the retracted condition are formed by at least one corresponding pin which slots into a corresponding opening made in the tubular members, in particular in the sidewalls of the latter and which is mounted on a corresponding transversal actuator 290 housed inside the tubular members of the arm.

[0146] More specifically, the actuator 290 for locking the members of the extensible arm in the retracted position is inside the tubular members.

[0147] Further, the actuator 290 for locking the members of the extensible arm in the retracted position is at the end of a corresponding telescopic drive actuator.

[0148] As illustrated, the actuator 290 for locking the members of the extensible arm in the retracted position is, more specifically, at the end of the telescopic drive actuator 41.

[0149] More specifically, the transversal actuator comprises a first and a second locking pin 291, 292 extending transversally, movable simultaneously in opposite directions and adapted to act in conjunction with respective surfaces or holes 293, provided, as illustrated in Figures

11E and 11F, in the sidewalls of the sliding members. That way, it is possible to lock the tubular members to each other in the retracted position, releasing them progressively in sequence, or one by one, to allow each to slide longitudinally to the corresponding extended position. Obviously, the locking means 290 are also adapted to engage the tubular members 31, 33, 34, 35, 36, 37, 38, 39, not only before the tubular members are extended but also after they return to the respective retracted position.

[0150] Also provided in the third preferred embodiment are advantageous means for mutually locking adjacent members 31, 33, 34, 35, 36, 37, 38, 39, 40 and which can be activated automatically.

[0151] Further provided in the third preferred embodiment are advantageous means for mutually locking adjacent members 31, 33, 34, 35, 36, 37, 38, 39, 40 and which can be deactivated automatically.

[0152] More specifically, the means for mutually locking adjacent members 31, 33, 34, 35, 36, 37, 38, 39, 40 can be activated automatically when the selfsame arm members 31, 33, 34, 35, 36, 37, 38, 39, 40 are in the respective mutually extended position.

[0153] The means for mutually locking adjacent members 31, 33, 34, 35, 36, 37, 38, 39, 40 comprise a corresponding locking pin 260 which is subjected to the action of respective elastic activation means 261.

[0154] Further, the means for mutually locking the members of the extensible arm are mounted on a respective tubular member of the telescopic arm and lock that tubular member to the tubular member adjacent to it and, more specifically, on the outer side of it.

[0155] The activation means are in the form of a spring 261 which normally pushes the pin 260 into a condition suitable for locking corresponding members of the extensible arm to each other.

[0156] As illustrated, advantageously, the locking pin 260 mounted on a respective member of the arm, engages a corresponding socket 60b of an adjacent tubular member.

[0157] More specifically, the locking pin 260 is movable between a position where it is engaged with, and a position where it is disengaged from, the socket 60b for retaining the selfsame locking pin.

[0158] More specifically, and advantageously, the locking pin 260 is housed and slidable in a corresponding bush 260'.

[0159] More specifically, the locking pin 260 is housed in a matching bush 260' which also houses the elastic activation means 261.

[0160] The elastic means 261 push the locking pin 260 out of the bush to protrude through a hole F in the tubular member which the locking means are associated with.

[0161] As illustrated, the bush is integral with a respective member of the telescopic arm.

[0162] Advantageously, the locking means 260, in particular in the form of a respective locking pin and mounted on a respective member of the telescopic arm, slide against the inside surface of the member of the telescopic arm adjacent to the one that mounts the locking means, until they reach a matching socket 60b provided in that adjacent member, engaging the socket 60b in such a way as to mutually lock those members of the telescopic arm.

[0163] As may be well inferred from Figure 15C, the locking means 260 slide easily against a corner portion of the corresponding tubular member, this corner portion being formed by adjacent walls which are at angle to each other and which, more specifically, make an obtuse angle.

[0164] These means for mutually locking adjacent members 31, 33, 34, 35, 36, 37, 38, 39, 40 comprise advantageous deactivation means 262.

[0165] Further advantageously, the deactivation means 262 oppose the elastic pushing means 261 in the activated condition, in particular in such a way as to disengage the locking pin 260 from the respective retaining socket 60b.

[0166] In the third preferred embodiment means are advantageously provided for mutually locking adjacent members 31, 33, 34, 35, 36, 37, 38, 39, 40 and which can be activated and deactivated automatically.

[0167] More specifically, in this preferred embodiment means are advantageously provided for mutually locking adjacent members 31, 33, 34, 35, 36, 37, 38, 39, 40 in the mutually extended position and which can be activated and deactivated automatically. In this case, less actuators and related hoses are required.

[0168] These means for mutually locking the members of the extensible arm are labelled 161, 162, 163, 164, 165, 166, 167 and are fixed at the upstream end of the respective tubular member in such a way as to lock each of the tubular members 33, 34, 35, 36, 37, 38, 39 to the tubular member 31, 33, 34, 35, 36, 37, 38 adjacently outside it, in the extended position.

[0169] Each of the locking means 161, 162, 163, 164, 165, 166, 167 comprises, as illustrated in Figure 11D, a respective locking pin 260 which is operated upon by corresponding elastic activation means 261 and corresponding deactivation means 262, opposing the action of the spring 261 and whose deactivating action is accomplished by engaging a corresponding inside surface S of the tubular member adjacently inside the one that mounts the locking means.

[0170] As illustrated, the locking pin 260 is housed inside a corresponding cylindrical chamber or bushing 260', with the spring 261 located at the bottom of it to normally push the pin 260 out of the bush to protrude through the corresponding socket or hole F in the tubular member these locking means are associated with, that is to say which the hollow cylindrical body 260' is fixed to.

[0171] As illustrated, the means 262 for deactivating or withdrawing the pin 260 are activated by engaging a corresponding inside surface S at the end of the adjacently inside surface.

[0172] As illustrated, the deactivation means comprise

a wheel 262 which is mounted on a respective bar 263 integral with an element 265 which is longitudinally or vertically movable inside the bush 260' and which is provided with respective means 266 for releasably hooking onto the piston or pin 260.

[0173] As illustrated, the wheel mounting bar 263 passes through and is vertically movable in a corresponding slot 264 made in the sidewall of the vertical cylindrical housing 260'. The slot 264 is vertically elongate to allow the means 262 to move in it as one with the hooking and drive element 265 and the corresponding piston 260.

[0174] As illustrated, the vertical housing 260' has a respective bottom wall 260'a and a sidewall 260'b and is open at the top to allow the locking pin or piston 260 to come out of it.

[0175] In practice, in the third preferred embodiment, releasable hooking means are provided between the locking pin 260 and the deactivation means 262, that is to say, hooking means which can be engaged with and disengaged from the pin 260 and which comprise an annular element 266 having corresponding opposite portions 266a, 266b which can be inserted into and taken out of a suitable radial housing or groove 267 made in the bottom part of the body of the locking pin 260, that is top say, at a collar or reduced diameter portion 260".

[0176] As stated, moving vertically inside the outer housing 260' is the hooking element 265 which mounts the hooking ring 266 and which slides vertically relative to the housing 260'.

[0177] The hooking element 265 is in turn internally hollow, or has a cylindrical cavity and coaxially houses the locking pin 260 or a bottom part of it 260". The locking pin 260 can move vertically relative to the cylindrical element 265, as will become clearer as this description continues.

[0178] More specifically, the hooking element 265 is adapted to slide vertically relative to the fixed outer housing 260' under the action of corresponding spring means 268 located between the bottom of the bush 260' and an opposite annular shoulder of the movable element 265 (not illustrated in detail in the drawings), the element 265 moving between a lowered position and a raised position where it hooks onto the locking pin 260 through the ring 266.

[0179] Under the action of the wheel 262, the hooking element 265, with the piston 260 connected to it, is then moved between the raised position of engagement with and hooking to the piston 260, illustrated in Figure 15E, and a lowered position, illustrated in Figure 15G, where the locking pin 260 comes out of and is released from the respective housing in the outer tubular member and which is reached thanks to the movable element 265 driving the locking pin 260.

[0180] More specifically, means are provided for engaging the hooking ring or element 266 to the locking pin 260 when the same are in the raised condition. These engagement means comprise an inside surface 269 of a circumferential protrusion 269a fixed to the upper part of the bush 260' and extending towards the inside of the bush 260' itself. The protrusion 269 acts in conjunction, or interferes, with an outside surface 266c of the hooking ring in order to force corresponding portions 266a, 266b of the ring into the hooking pin engagement groove 267.

[0181] The annular hooking element 266 is movable radially or transversally relative to the element 265 between an inside position where it hooks onto the locking pin 260, corresponding to the raised position of the element 265 and piston 260, and an outside position where the piston 260 is released, corresponding to a position where the piston 260 is lowered further down relative to the drive element 265.

[0182] Disengagement means are also provided between the locking pin 260 and the hooking and drive means 265, these disengagement means comprising opposing means 263' acting on the locking pin 260 in such a way as to move it downwards against the action of the spring 261, while the annular element 266 is vertically withheld and thus protrudes from the groove 267 in the piston 260.

[0183] More in detail, the opposing means comprise a corresponding downwardly or inwardly protruding portion 263' provided on the inside face of the tubular member (more specifically, the tubular members 31, 33, 34, 35, 36, 37, 38) adjacently outside the one that mounts the locking means 260, in particular at the upstream end of that tubular member (namely, the tubular members 31, 33, 34, 35, 36, 37, 38).

[0184] In practice, the operation of the third preferred embodiment of the extensible arm is briefly as described below.

[0185] Starting from the fully retracted condition shown in Figure 11A, the transversal piston 290 for locking the arm in the retracted condition is disengaged from the base tubular member or outermost member 31 connecting to the pivoting arm of the crane, and the first actuator 41 extends the corresponding rod 41a in such a way as to move the remaining tubular members relative to the member 31 towards the respective extended condition illustrated in Figure 12.

[0186] In this situation, the locking means 260 pass from the position shown in Figure 15A, corresponding to that of Figure 11D, where the piston 260 is in the lowered position, under the pushing action of the protuberance 263', to the position of Figures 15B and 15C, where the piston 260 has risen freely relative to the hooking element 265 under the action of the respective spring 261, and slides against the inside surface S' of the outer tubular member.

[0187] When the locking pin or piston 260 reaches a socket 60b at the downstream end of the outermost tubular member 31 under the action of the spring 261, it is pushed inside the socket 60b, thus locking the inner tubular member 33 at the downstream end of the outermost tubular member 31, as illustrated in Figure 12.

[0188] At this point, the cylinder or actuator 41 disengages the respective transversal hooking actuator 51 and

withdraws towards the retracted position, whilst the other cylinder or actuator 42 starts pushing outwards relative the tubular member 33 the tubular member 34 and the other tubular members connected to it, as illustrated in Figure 13.

[0189] This occurs, obviously, after the transversal locking piston 290 has released the tubular member 33 from the tubular member 34 and from the other tubular members.

[0190] At this point, as illustrated in Figure 15E, when the inner tubular member 34 moves away from, or is extended relative to, the tubular member 33, releasing the wheel 262, the hooking element 265 is pushed to the raised position where it hooks onto the locking pin 260.

[0191] In practice, as stated, the hooking element 265 is pushed by the spring means 268 towards the extended or raised position of the locking pin 260, causing the insertion ring 266 to interfere with the circumferential surface 269, in such a way as to slot into the peripheral groove 267 of the locking pin 260.

[0192] The extension procedure then continues in a similar manner, as illustrated in Figure 14, to extend the member 35 on the inside of the member 34 that has been extended, and so on until the entire arm is completely extended, if necessary.

[0193] Retraction of the sliding members occurs in the same way as that described above for extension but in reverse.

[0194] In practice, retraction involves first withdrawing the end sliding member 40 and then, progressively, the sliding members 39, 38, 37, 36, 35, 34 and 33

[0195] During retraction of the telescopic arm, the locking means 161, 162, 163, 164, 165, 166, 167 are disengaged automatically.

[0196] More specifically, as may be inferred from Figures 15F and 15G, withdrawal of the inside tubular member causes the wheel 262 to engage the inside surface of that member, thereby pulling downwards the locking pin 260, whose ring 266 is in the inserted condition, and thus causing the locking pin 260 to come out of the socket 60b of the respective outside tubular member.

[0197] With the aid of a respective telescopic drive cylinder, the tubular member which mounts the respective locking pin is made to withdraw in such a way that its top face slides against the inside surface of the outside tubular member, in a similar way to that illustrated in Figure 15C, until reaching the respective retracted position where a protrusion 263 causes the pin 260 to be lowered and released, as described above, from the hooking element 265, that is to say, causing the corresponding portions of the ring 266 to come out of the groove 267 of the locking pin 260 itself, as illustrated in Figure 15H.

[0198] A fourth preferred embodiment of the crane, not covered by the claimed invention, is illustrated in Figures 16A to 23F.

[0199] The fourth preferred embodiment 303 of the telescopic arm has components which are similar to those of the preceding preferred embodiments and which, to avoid making this description too lengthy, are denoted by the same reference characters and will not be commented upon again in detail.

[0200] Unlike the preceding embodiments, the fourth preferred embodiment has telescopic drive means 4 which are mounted on the base member 31.

[0201] In practice, the telescopic drive means 4 of the fourth preferred embodiment 303 have an end which is fixed to, or integral with, the base member 31 of the telescopic arm.

[0202] The fourth preferred embodiment, like the third preferred embodiment, also comprises advantageous means 390a, 390b for mutually and releasably locking the members of the telescopic arm and which are adapted to release the tubular members in sequence.

[0203] More specifically, means 390a, 390b are provided for mutually and releasably locking the members of the telescopic arm and which are adapted to release the members of the telescopic arm sequentially from the innermost one progressively to the outermost one.

[0204] The fourth preferred embodiment also comprises means 390a, 390b for mutually and releasably locking the members of the telescopic arm and which are adapted to release the members of the arm in sequence.

[0205] More specifically, the means 390a, 390b for mutually and releasably locking the members of the telescopic arm are adapted to lock the members of the arm sequentially from the outermost one progressively to the innermost one.

[0206] Advantageously, the fourth preferred embodiment also comprises means 390a, 390b for mutually and releasably locking the members of the telescopic arm and which are adapted to release the tubular members in sequence and to lock the tubular members in sequence.

[0207] Advantageously, the means 390a, 390b for mutually and releasably locking the members of the telescopic arm are adapted to engage and retain the respective members in the mutually retracted position.

[0208] Further, in the fourth preferred embodiment the means for mutually and releasably locking the members of the telescopic arm comprise a first and a second pin 390a, 390b which are movable into one or more positions for locking and releasing corresponding members of the telescopic arm.

[0209] Advantageously, the means for mutually and releasably locking the members of the telescopic arm are driven by corresponding first and second actuators 390a, 390b, more specifically in the form of actuators that can be activated and deactivated by control, in particular, of electrical or hydraulic type.

[0210] In practice, like the third preferred embodiment, the fourth preferred embodiment has means for mutually locking adjacent members 31, 33, 34, 35, 36, 37, 38, 39, 40 in the retracted position, these locking means comprising at least one actuator and, more specifically, a first and a second actuator 390a, 390b which drive a respective locking pin and which are adapted to disengage the

members 31, 33, 34, 35, 36, 37, 38, 39 in sequence to allow said members to slide towards the extended position and to re-engage said members after they have returned to the retracted position.

[0211] Advantageously, in the fourth preferred embodiment, each actuator 390a, 390b for locking the members of the extensible arm in the retracted position is located, or extends, outside the tubular members and is fixed to the base member 31 in such a way as to be situated close to the end of a corresponding telescopic drive actuator.

[0212] In practice, as stated, in the fourth preferred embodiment, the means for mutually locking adjacent members 31, 33, 34, 35, 36, 37, 38, 39, 40 in the retracted position, comprise a first and a second actuator 390a, 390b for corresponding pins for locking the members of the extensible arm, these pins extending transversally and horizontally and slotting into corresponding openings made in the opposite sidewalls of the tubular members.

[0213] In practice, as illustrated, each locking actuator has a respective pin 391a, 391b which slots into a corresponding opening made in the tubular members of the arm.

[0214] As illustrated, the first and second actuators 390a, 390b extend transversally and horizontally on opposite sides of the base member 31.

[0215] Advantageously, as illustrated in Figures 21 and 22, to facilitate extension and retraction operations with the drive means 4 remaining far from the load being lifted, sliding means P are provided which are interposed between the sliding members or tubular members. These sliding means are in the form of corresponding runner means P. More specifically, the sliding means P comprise rotatable means which are adapted to create rolling friction and which are positioned, as illustrated in Figures 21 and 22, between opposite faces of adjacent tubular members.

[0216] The rolling friction means forming the runner comprise corresponding revolving rollers which are not illustrated in detail in the accompanying drawings.

[0217] Like the third preferred embodiment, the fourth preferred embodiment also comprises means for mutually locking adjacent members 31, 33, 34, 35, 36, 37, 38, 39, 40 and which can be activated and deactivated automatically.

[0218] More specifically, in the fourth preferred embodiment means are advantageously provided for mutually locking adjacent members 31, 33, 34, 35, 36, 37, 38, 39, 40 in the mutually extended position and which can be activated and deactivated automatically. In this case, less actuators and related hoses are required.

[0219] These means for mutually locking the members of the extensible arm are labelled 361, 362, 363, 364, 365, 366, 367 and are fixed at the upstream end of the respective tubular member in such a way as to lock each of the tubular members 33, 34, 35, 36, 37, 38, 39, 40 to the tubular member, 33, 34, 35, 36, 37, 38, 39 adjacently outside it, in the extended position.

[0220] Each of the locking means 361, 362, 363, 364, 365, 366, 367 comprises, as illustrated in Figure 23A, a respective locking pin 260 which is operated upon by corresponding elastic activation means 261 and corresponding deactivation means 262, opposing the action of the spring 261 and whose deactivating action is accomplished by engaging a corresponding protrusion or nib N1, N2, as may be better inferred from Figure 23E, and as will become clearer as this description continues.

[0221] As illustrated, the locking pin 260 is housed inside a corresponding cylindrical chamber or bushing 260', with the spring 261 located at the bottom of it to normally push the pin 260 out of the bush to protrude through the corresponding socket or hole F in the tubular member which the locking means are associated with, that is to say which the hollow cylindrical body 260' is fixed to.

[0222] As illustrated, the deactivation means comprise a wheel 262 which is mounted on a respective bar 263 integral with an element 265 which is longitudinally or vertically movable inside the bush 260' and which is provided with respective means 265' for releasably hooking onto the piston or pin 260.

[0223] As illustrated, the wheel mounting bar 263 passes through and is vertically movable in a corresponding slot 264 made in the sidewall of the vertical cylindrical housing 260'. The slot 264 is vertically elongate to allow the means 262 to move in it as one with the corresponding piston 260.

[0224] As illustrated, the vertical housing 260' has a respective bottom wall 260'a and a sidewall 260"a and is open at the top to allow the locking pin or piston 260 to come out of it.

[0225] In practice, in the fourth preferred embodiment, releasable hooking means are provided between the locking pin 260 and the deactivation means 262, that is to say, hooking means which can be engaged with and disengaged from the pin 260 and which comprise respective detents 265' inserted in a suitable radial housing or groove 267 made in the bottom part of the body of the locking pin 260, that is to say, at a collar or reduced diameter portion 260".

[0226] As illustrated, the hooking element 265 is coaxially mounted and moves in the vertical housing 260', sliding vertically relative to the latter.

[0227] The hooking element 265 is in turn internally hollow and cylindrical and coaxially houses the locking pin 260.

[0228] More specifically, the hooking element 265 is adapted to slide vertically relative to the fixed outer housing 260' under the action of corresponding spring means 268 located between the bottom of the bush 260' and an opposite annular shoulder of the movable element 265 (not specifically indicated in the drawing), between a raised position where the locking pin 260 is hooked and a lowered position where the locking pin 260 is in a disengaged condition, reached under the driving action of the element 265.

[0229] In the fourth preferred embodiment the deacti-

vation means 262 are activated by engagement with a corresponding inside or underside surface S of a protruding element or nib N1, N2 located at the end of a corresponding telescopic drive actuator 41, 42.

[0230] Each protruding element or nib N1, N2 is movable between a position where it engages the wheel 262 and a position of free passage beyond the locking block and, more specifically, for the purpose, it is rotatable or angularly movable, as indicated by the arrows FR between a first vertical position for engaging the wheels 262 and a second position of free passage, illustrated in Figure 16E.

[0231] Also imaginable is the case where the protruding element or disengagement nib N1, N2 is moved longitudinally, as indicated by the arrows FL in Figure 16E, to be positioned at a locking pin or element to be operated on.

[0232] In practice, the operation of the fourth preferred embodiment of the extensible arm is briefly as described below.

[0233] Starting from the fully retracted condition shown in Figure 16A, the transversal locking pistons 390a and 390b of the arm in the retracted condition release the tubular end member or innermost member 40 and the first actuator 41 extends the corresponding rod 41a in such a way as to move the end member, which carries the load, towards the respective extended position, illustrated in Figure 17.

[0234] In this situation, the locking means 260, as illustrated in Figures 23A and 23B, slide against the inside surface of the outside tubular member and when the locking piston or pin 260 reaches a socket 60b at the downstream end of the inside tubular member 40, the action of the spring 261 pushes it into the socket 60b, thus locking the inside tubular member 40 to the downstream end of the outside tubular member 39, as shown in Figure 17.

[0235] At this point, the cylinder or actuator 41 disengages the respective transversal hooking actuator and withdraws towards the retracted position, whilst the other cylinder or actuator 42 starts pushing outwards relative the tubular member 38 the tubular member 39, as illustrated in Figure 18.

[0236] Obviously, the above occurs after the transversal locking piston 390a, 390b has released the tubular member 39 itself from the tubular member 38 and the arm extension procedure can proceed in a manner similar to that just described for the tubular member 40, if necessary until the arm is fully extended.

[0237] Retraction of the sliding members occurs in the same way as that described above for extension but in reverse.

[0238] In practice, retraction involves first withdrawing the tubular members which are closest to the base member 31, that is to say, the sliding members 33, 34, 35, 36, 37, 38, 39 and lastly the end sliding member 40.

[0239] During retraction of the telescopic arm, the locking means 361, 362, 363, 364, 365, 366, 367 are disengaged automatically thanks to the respective protrusions or nibs N1, N2.

[0240] More specifically, as may be inferred from Figures 19, 23D and 23E, showing a situation where the arm is being retracted, withdrawal causes the nib N1 to engage the wheel 262 with the inside surface S of the nib N1, thereby causing the locking pin 260 to move downwards and to protrude from the socket in the outside tubular member.

[0241] With the aid of a respective drive cylinder, the tubular member with the locking pin disengaged from the socket 60b of the outermost tubular member is withdrawn and the piston 260 slides with its top surface against the inside surface of the outside tubular member, as illustrated in Figure 23F, until reaching the respective retracted position.

[0242] In practice, as illustrated in Figure 20, withdrawal of the nib N1 causes the wheel 262 to engage the inside surface S of the nib, thereby causing the locking pin 260 to move downwards and to protrude from the socket 60b in the outside tubular member. After that, with the aid of a respective drive cylinder the inside tubular member is made to withdraw.

[0243] A fifth preferred embodiment of the crane, not covered by the claimed invention, is illustrated in Figures 24A to 26.

[0244] The fifth preferred embodiment of the extensible arm has components which are similar to those of the preceding preferred embodiments and which, to avoid making this description too lengthy, are denoted by the same reference characters and will not be commented upon again in detail.

[0245] The fifth preferred embodiment of the extensible arm is substantially similar to the second preferred embodiment from which it differs in that it comprises telescopic drive means 4 which are mounted on the base member 31.

[0246] In practice, the telescopic drive means 4 of the fifth preferred embodiment have an end which is fixed to, or integral with, the base member 31 of the telescopic arm.

[0247] In this case, when the arm is extended, the end member 40 is extended first and then the progressively adjacent ones.

[0248] In practice, when the arm is extended, the inside members whose resistant sections are less tall, are extended first.

[0249] Conversely, when the arm members are retracted, the outside members with the tallest resistant sections are retracted first.

[0250] Advantageously, to facilitate extension and retraction operations with the drive means 4 remaining far from the load being lifted, the fifth preferred embodiment, too, comprises sliding means which are interposed between the sliding members and which are exactly the same as those of the fourth preferred embodiment and therefore not illustrated in detail. These sliding means are in the form of corresponding runner means and, more specifically, comprise rotatable means designed to cre-

ate rolling friction.

[0251] The operation of the fifth embodiment is described briefly below.

[0252] Starting from a condition where the arm 403 is fully retracted, illustrated in Figure 24A, the locking actuator 51 at the end of the cylinder of the first extending actuator 41 slots into the seats or openings in the sidewalls of the member 40, which connects to the pivoting arm of the crane, in such a way as to engage that member.

[0253] At the same time, the first activation and deactivation actuator 107a disengages the corresponding locking pin 60 of the corresponding locking means 68, which connects the end member 40 of the crane to the adjacently inside member 39 causing it to come out of the respective upstream socket 60a.

[0254] At this point, the rod 41a of the extending actuator 41 is drawn out, thereby causing the member 40 to move longitudinally relative to the outside member 39 until reaching the end position where the member 40 is fully extended relative to the member 39.

[0255] At this point, the activation and deactivation actuator 107a carries the corresponding locking pin 60 of the locking means 68 until it slots into the socket 60b downstream, that is, at the other end of the tubular member 39, thereby securely locking to it the tubular member 40 in the extended condition.

[0256] At this point, the activation and deactivation means or actuator 107b mounted on the cylinder 42b of the second telescopic drive actuator 42, release the corresponding pin 60 of the locking means 67 which connects immediately adjacent tubular members 39 and 38 to each other, causing the pin 60 to come out of the respective socket 60a at the upstream end of the tubular member 38.

[0257] At this point, the transversal engagement actuator 51 is disengaged from the corresponding tubular member 40 and the corresponding rod 41a withdraws into the respective cylinder 41b, thereby positioning the respective engagement element 51 at the lateral opening the inside member 38.

[0258] In turn, while the respective transversal engagement actuator 52 remains engaged with the tubular member 39, the second telescopic extension actuator 42 draws out the corresponding rod 42a, thereby causing the member 39 to move longitudinally or be drawn out relative to the outside member 38 until reaching the end position where the member 39 is in the extended condition relative to the adjacent member 38.

[0259] In this position, the activation and deactivation means 107b engage the pin 60 of the respective locking means 67 with the socket 60b at the downstream end of the tubular or sliding member 38.

[0260] At the same time, means which are similar to the means 141 described in connection with the second preferred embodiment, move the activation means 107a located on the first telescopic extension means 41. In practice, the rod 141 is withdrawn. In practice, a rod not illustrated in detail, and similar to the rod 141 of the second referred embodiment, withdraws into the respective control chamber inside the cylinder 41b, moving the respective end of the cylinder 41b, which mounts the first activation and deactivation means 107a, to the next locking means 66, thereby proceeding to the next releasing operation between the sliding member 38 and the sliding member 37

[0261] After that, the procedure continues, as already described in connection with extension of the tubular connecting element 40, with the drawing out of the corresponding telescopic drive rod 41a and the extension of the tubular member 38 relative to the tubular member 37.

[0262] In this situation, the engagement actuator 52 of the second drive actuator 42 was previously disengaged from the sliding tubular member 38 and the rod 42a of the second drive actuator 42 is thus conveniently withdrawn.

[0263] At the same time, means similar to the means of the second preferred embodiment move the respective activation and deactivation means 107b and position the latter at the next locking means 65.

[0264] The extension procedure can then continue as described until the telescopically extensible arm is fully extended.

[0265] For retracting the extensible arm, the procedure is obviously the reverse of position the latter at the next locking means 65.

[0266] The extension procedure can then continue as described until the telescopically extensible arm is fully extended.

[0267] For retracting the extensible arm, the procedure is obviously the reverse of the one described above for extending the arm.

[0268] In practice, retraction involves first withdrawing the sliding member 33 and then, progressively, the sliding members 34, 35, 36, 37, 38, 39 and 40

[0269] During retraction of the telescopic arm, the locking pistons 60 are disengaged from the downstream socket 60b and once again engaged with the upstream socket 60a of the respective adjacent tubular member.

[0270] The invention described above is susceptible of industrial application. It would be obvious to one skilled in the art that several changes and modifications can be made to the invention which is defined solely by the appended claims.

Claims

1. A crane for lifting a load, the crane comprising an extensible arm that can be lifted and lowered; the extensible arm (3) comprising a base member (31) and a plurality of sliding members (33, 34, 35, 36, 37, 38, 39, 40) terminating with an end sliding member (40); the sliding members (31, 33, 34, 35, 36, 37, 38, 39, 40) of the extensible arm (3) being coaxially inserted one inside the other and being telescopically

movable relative to each other between a respective retracted position and a respective extended position under the action of corresponding telescopic drive means (4), the telescopic drive means (4) being mounted on the end sliding member (40);
the crane being **characterized in that** the telescopic drive means (4) comprise a first and a second actuator (41, 42),
and further **in that** each actuator has a movable end (41", 42") which is equipped with means (51, 52) for engaging and disengaging respective members of the extensible arm (3).

2. The crane according to claim 1, **characterized in that** the telescopic drive means (4) are provided inside respective members (31, 33, 34, 35, 36, 37, 38, 39, 40) of the extensible arm (3).

3. The crane according to either of the foregoing claims, **characterized in that** the first and the second actuator (41, 42) can be driven alternately to move respective each sliding member relative to the adjacent member.

4. The crane according to any of the foregoing claims from 1 to 3, **characterized in that** the first and the second actuator (41, 42) can be driven simultaneously.

5. The crane according to claim 4, **characterized in that** the first and the second actuator (41, 42) can be driven simultaneously to move a respective sliding member and to perform a backward return movement, respectively.

6. The crane according to claim 1, **characterized in that** each actuator (41, 42) has a rod (41a, 42a) that can be extended and retracted relative to a respective cylinder (41b, 42b) forming a respective drive chamber (41c, 42c).

7. The crane according to claim 6, **characterized in that** each actuator (41, 42) has a respective end which is connected to the end sliding member (40).

8. The crane according to any of the foregoing claims, **characterized in that** the engagement and disengagement means comprise respective engagement pin means (51a, 51b, 52a, 52b) which act in conjunction with respective engagement surfaces of respective members of the extensible arm (3).

9. The crane according to claim 8, **characterized in that** the engagement and disengagement means comprise respective engagement pin means (51a, 51b, 52a, 52b) which can be inserted into matching openings in the corresponding members of the extensible arm (3).

10. The crane according to any of the foregoing claims 8 and 9, **characterized in that** the engagement pin means (51a, 51b, 52a, 52b) are on a respective movable rod (51c, 51d, 52c, 52d) of a respective cylinder (51e, 52e) mounted at the movable end of the respective telescopic actuator (41, 42).

11. The crane according to any of the foregoing claims, **characterized in that** means (61, 62, 63, 64, 65, 66, 67, 68) are provided for locking adjacent members (31, 33, 34, 35, 36, 37, 38, 39, 40) to each other in the mutually extended position.

12. The crane according to any of the foregoing claims, **characterized in that** means (61, 62, 63, 64, 65, 66, 67, 68) are provided for locking adjacent members (31, 33, 34, 35, 36, 37, 38, 39, 40) to each other in the mutually retracted position.

13. The crane according to any of the claims 11 and 12, **characterized in that** the means for mutually locking adjacent members (31, 33, 34, 35, 36, 37, 38, 39, 40) comprise a corresponding locking pin (260) which is subjected to the action of respective elastic activation means (261).

Patentansprüche

1. Lasthebekran, wobei der Kran einen ausziehbaren Arm umfasst, der angehoben und abgesenkt werden kann; wobei der ausziehbare Arm (3) ein Basiselement (31) und eine Vielzahl an Gleitelementen (33, 34, 35, 36, 37, 38, 39, 40) umfasst, die mit einem Endgleitelement (40) enden; wobei die Gleitelemente (31, 33, 34, 35, 36, 37, 38, 39, 40) des ausziehbaren Arms (3) koaxial ineinander eingesetzt sind und zwischen einer jeweiligen zurückgezogenen Position und einer jeweiligen ausgezogenen Position unter der Wirkung von entsprechenden Teleskopantriebsmitteln (4) teleskopisch relativ zueinander beweglich sind, wobei die Teleskopantriebsmittel (4) an dem Endgleitelement (40) angebracht ist;
wobei der Kran **dadurch gekennzeichnet ist, dass** die Teleskopantriebsmittel (4) einen ersten und einen zweiten Steller (41, 42) umfassen
und ferner dadurch, dass ein jeder Steller ein bewegliches Ende (41", 42") aufweist, das mit Mitteln (51, 52) zum Ein- und Ausrücken der jeweiligen Elemente des ausziehbaren Arms (3) ausgestattet ist.

2. Kran nach Anspruch 1, **dadurch gekennzeichnet, dass** die Teleskopantriebsmittel (4) innerhalb der jeweiligen Elemente (31, 33, 34, 35, 36, 37, 38, 39, 40) des ausziehbaren Arms (3) vorgesehen sind.

3. Kran nach einem der beiden vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der erste

und der zweite Steller (41, 42) abwechselnd angetrieben werden können, um jeweils ein jedes Gleitelement relativ zu dem benachbarten Element zu bewegen.

4. Kran nach einem der vorhergehenden Ansprüche von 1 bis 3 **dadurch gekennzeichnet, dass** der erste und der zweite Steller (41, 42) gleichzeitig angetrieben werden können.

5. Kran nach Anspruch 4, **dadurch gekennzeichnet, dass** der erste und der zweite Steller (41, 42) gleichzeitig angetrieben werden können, um jeweils ein jeweiliges Gleitelement zu bewegen bzw. eine Rückwärtsrücklaufbewegung auszuführen.

6. Kran nach Anspruch 1, **dadurch gekennzeichnet, dass** ein jeder Steller (41, 42) eine Stange (41a, 42a) aufweist, die relativ zu einem jeweiligen Zylinder (41b, 42b), der eine jeweilige Antriebskammer (41c, 42c) ausbildet, aus- und eingezogen werden kann.

7. Kran nach Anspruch 6, **dadurch gekennzeichnet, dass** ein jeder Steller (41, 42) ein jeweiliges Ende aufweist, das mit dem Endgleitelement (40) verbunden ist.

8. Kran nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Einrück- und Ausrückmittel jeweilige Einrückstiftmittel (51a, 51b, 52a, 52b) umfassen, die in Verbindung mit jeweiligen Einrückflächen der jeweiligen Elemente des ausziehbaren Arms (3) wirken.

9. Kran nach Anspruch 8, **dadurch gekennzeichnet, dass** die Einrück- und Ausrückmittel jeweilige Einrückstiftmittel (51a, 51b, 52a, 52b) umfassen, die in passende Öffnungen in den entsprechenden Elementen des ausziehbaren Arms (3) eingesetzt werden können.

10. Kran nach einem der vorhergehenden Ansprüche 8 und 9, **dadurch gekennzeichnet, dass** sich die Einrückstiftmittel (51a, 51b, 52a, 52b) auf einer jeweiligen beweglichen Stange (51c, 51d, 52c, 52d) eines jeweiligen Zylinders (51e, 52e) am beweglichen Ende des jeweiligen Teleskopstellers (41, 42) angebracht sind.

11. Kran nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Mittel (61, 62, 63, 64, 65, 66, 67, 68), zum Verriegeln zueinander benachbarter Elemente (31, 33, 34, 35, 36, 37, 38, 39, 40) in der gegenseitig ausgezogenen Position vorgesehen sind.

12. Kran nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Mittel (61, 62, 63, 64, 65, 66, 67, 68), zum Verriegeln zueinander benachbarter Elemente (31, 33, 34, 35, 36, 37, 38, 39, 40) in der gegenseitig eingezogenen Position vorgesehen sind.

13. Kran nach einem der Ansprüche 11 und 12, **dadurch gekennzeichnet, dass** die Mittel zum gegenseitigen Verriegeln benachbarter Elemente (31, 33, 34, 35, 36, 37, 38, 39, 40) einen entsprechenden Verriegelungsstift (260) umfassen, der der Wirkung der jeweiligen elastischen Aktivierungsmittel (261) unterzogen ist.

Revendications

1. Grue pour soulever une charge, la grue comprenant un bras extensible qui peut être soulevé et abaissé ; le bras extensible (3) comprenant un élément de base (31) et une pluralité d'éléments coulissants (33, 34, 35, 36, 37, 38, 39, 40) se terminant par un élément coulissant d'extrémité (40) ; les éléments coulissants (31, 33, 34, 35, 36, 37, 38, 39, 40) du bras extensible (3) étant insérés coaxialement les uns dans les autres et étant mobiles télescopiquement les uns par rapport aux autres entre une position rétractée respective et une position étendue respective sous l'action des moyens d'entraînement télescopiques correspondants (4), les moyens d'entraînement télescopiques (4) étant montés sur l'élément coulissant d'extrémité (40) ;
la grue étant **caractérisée en ce que** les moyens d'entraînement télescopiques (4) comprennent un premier et un second actionneur (41, 42),
et en outre **en ce que** chaque actionneur a une extrémité mobile (41", 42") qui est équipée de moyens (51, 52) pour engager et désengager des éléments respectifs du bras extensible (3).

2. Grue selon la revendication 1, **caractérisée en ce que** les moyens d'entraînement télescopiques (4) sont prévus à l'intérieur des éléments respectifs (31, 33, 34, 35, 36, 37, 38, 39, 40) du bras extensible (3).

3. Grue selon l'une des deux revendications précédentes, **caractérisée en ce que** le premier et le second actionneur (41, 42) peuvent être entraînés alternativement pour déplacer chaque élément coulissant respectif par rapport à l'élément adjacent.

4. Grue selon l'une quelconque des revendications précédentes 1 à 3, **caractérisée en ce que** le premier et le second actionneur (41, 42) peuvent être entraînés simultanément.

5. Grue selon la revendication 4, **caractérisée en ce que** le premier et le second actionneur (41, 42) peuvent être entraînés simultanément pour déplacer un

élément coulissant respectif et pour effectuer un mouvement de retour en arrière, respectivement.

6. Grue selon la revendication 1, **caractérisée en ce que** chaque actionneur (41, 42) possède une tige (41a, 42a) qui peut être étendue et rétractée par rapport à un cylindre respectif (41b, 42b) formant une chambre d'entraînement respective (41c, 42c).

7. Grue selon la revendication 6, **caractérisée en ce que** chaque actionneur (41, 42) a une extrémité respective qui est reliée à l'élément coulissant d'extrémité (40).

8. Grue selon l'une quelconque des revendications précédentes, **caractérisée en ce que** les moyens d'engagement et de désengagement comprennent des moyens de broche d'engagement respectifs (51a, 51b, 52a, 52b) qui agissent en conjonction avec les surfaces d'engagement respectives des éléments respectifs du bras extensible (3).

9. Grue selon la revendication 8, **caractérisée en ce que** les moyens d'engagement et de désengagement comprennent des moyens de broche d'engagement respectifs (51a, 51b, 52a, 52b) qui peuvent être insérés dans des ouvertures correspondantes dans les éléments correspondants du bras extensible (3).

10. Grue selon l'une quelconque des revendications précédentes 8 et 9, **caractérisée en ce que** les moyens de broche d'engagement (51a, 51b, 52a, 52b) sont sur une tige mobile respective (51c, 51d, 52c, 52d) d'un cylindre respectif (51e, 52e) monté à l'extrémité mobile de l'actionneur télescopique respectif (41, 42).

11. Grue selon l'une quelconque des revendications précédentes, **caractérisée en ce que** des moyens (61, 62, 63, 64, 65, 66, 67, 68) sont prévus pour verrouiller les éléments adjacents (31, 33, 34, 35, 36, 37, 38, 39, 40) les uns aux autres dans la position mutuellement étendue.

12. Grue selon l'une quelconque des revendications précédentes, **caractérisée en ce que** des moyens (61, 62, 63, 64, 65, 66, 67, 68) sont prévus pour verrouiller les éléments adjacents (31, 33, 34, 35, 36, 37, 38, 39, 40) les uns aux autres dans la position mutuellement rétractée.

13. Grue selon l'une quelconque des revendications 11 et 12, **caractérisée en ce que** les moyens de verrouillage mutuel d'éléments adjacents (31, 33, 34, 35, 36, 37, 38, 39, 40) comprennent une broche de verrouillage correspondante (260) qui est soumise à l'action d'un moyen d'activation élastique respectif (261).

FIG.1A

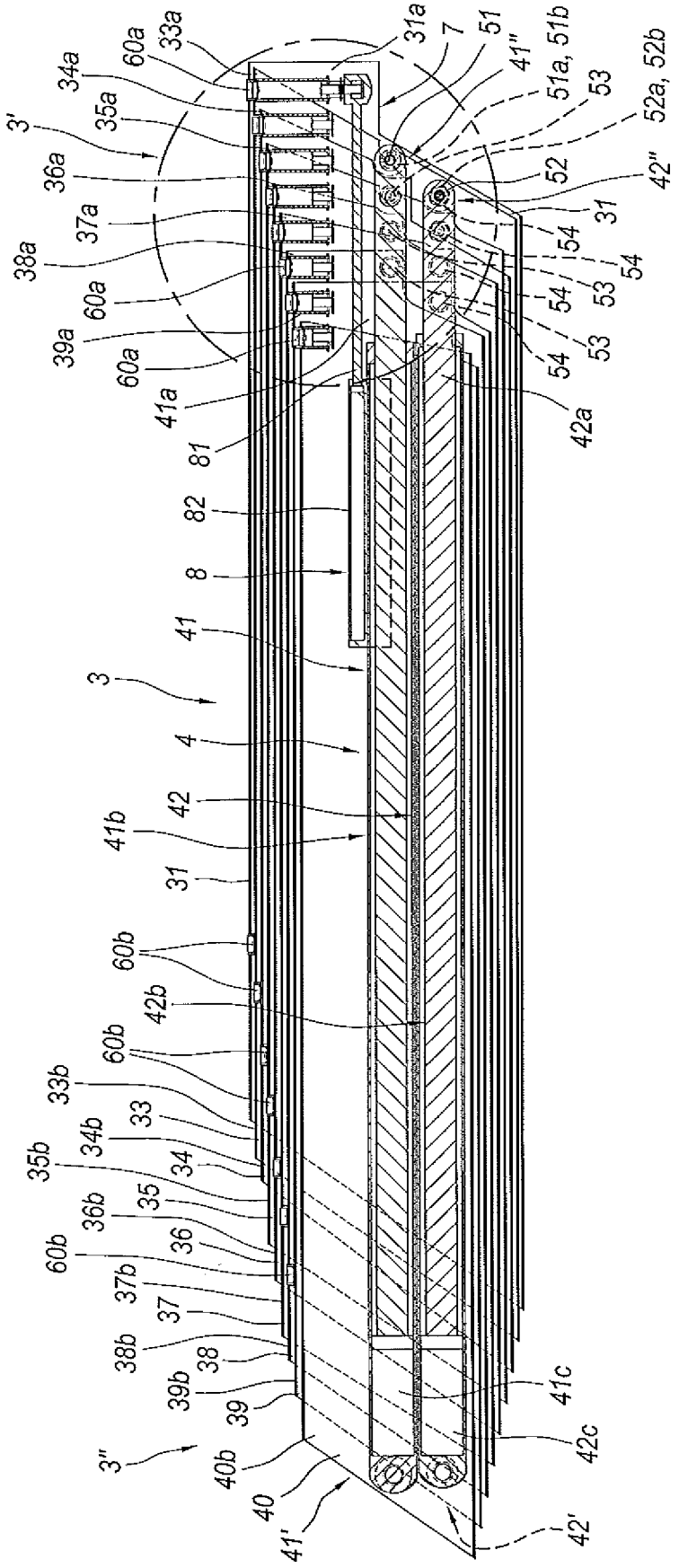

3'
3"
3
4
7
8
31
31a
33a
33b
34a
34b
35a
35b
36a
36b
37a
37b
38a
38b
39a
39b
40
40b
41
41'
41a
41b
41c
41"
42
42'
42a
42b
42c
42"
51
51a, 51b
52
52a, 52b
53
54
60a
60b
81
82

FIG.1C

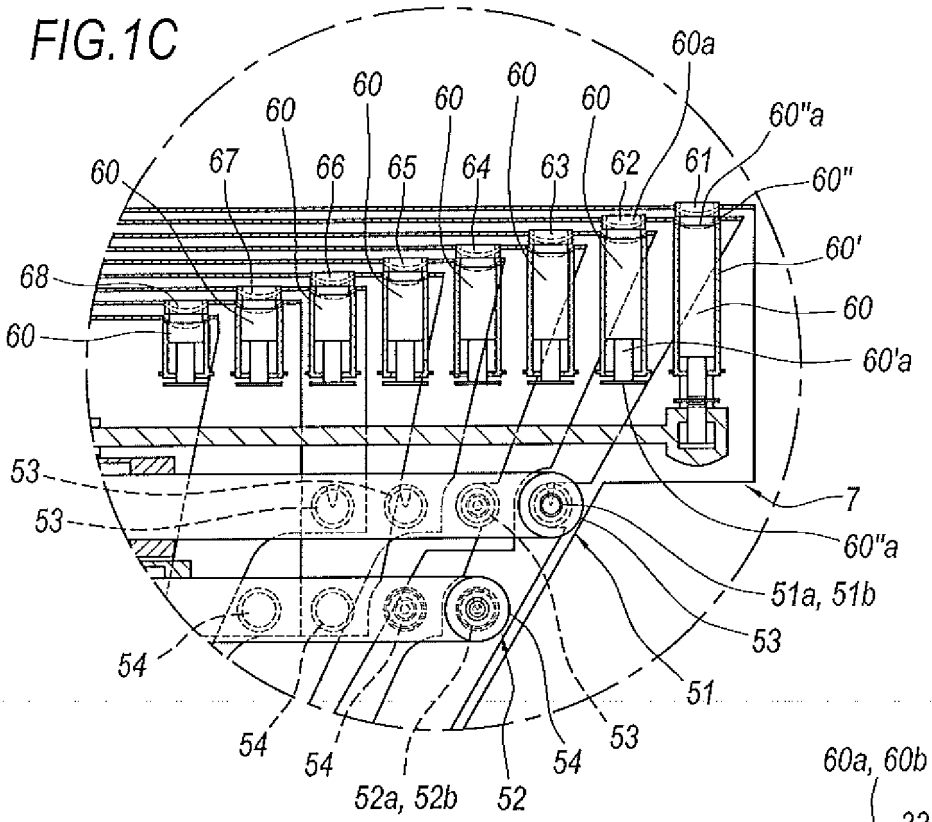
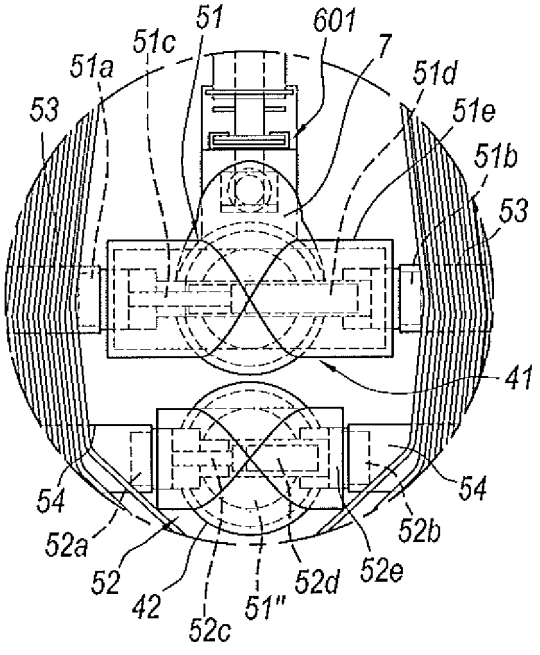


FIG.1D



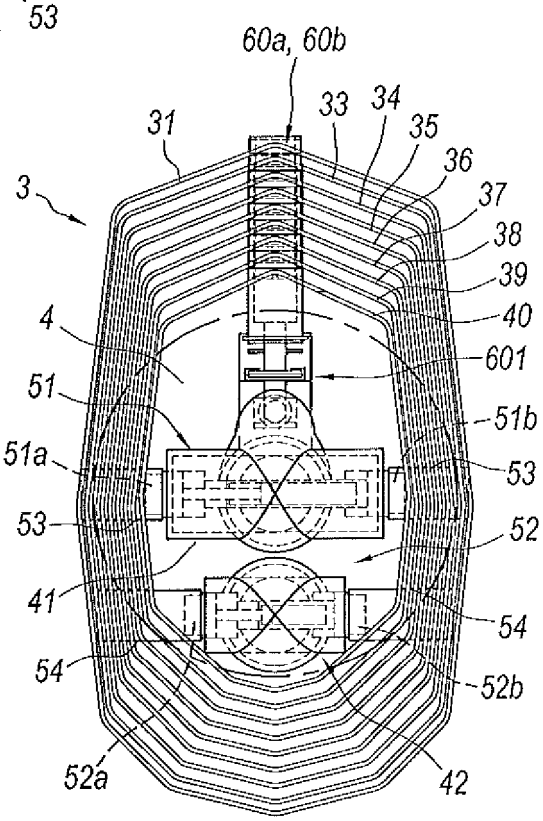


FIG.1B

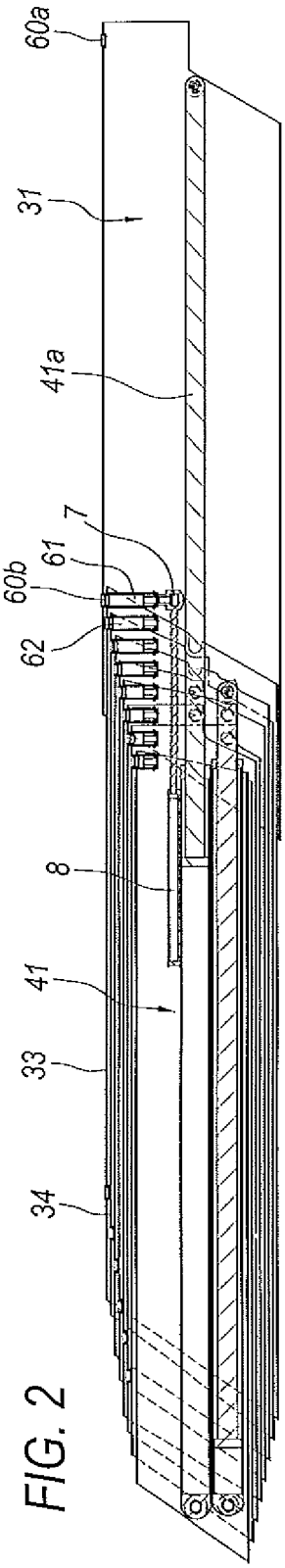


FIG. 2

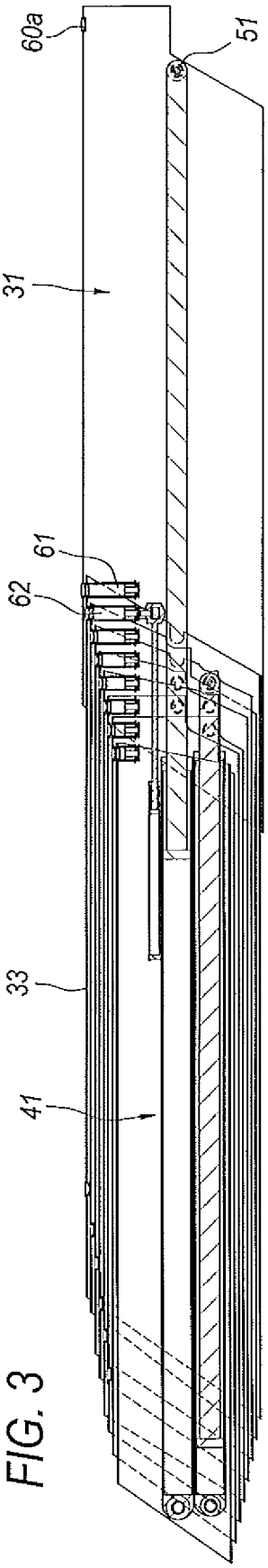


FIG. 3

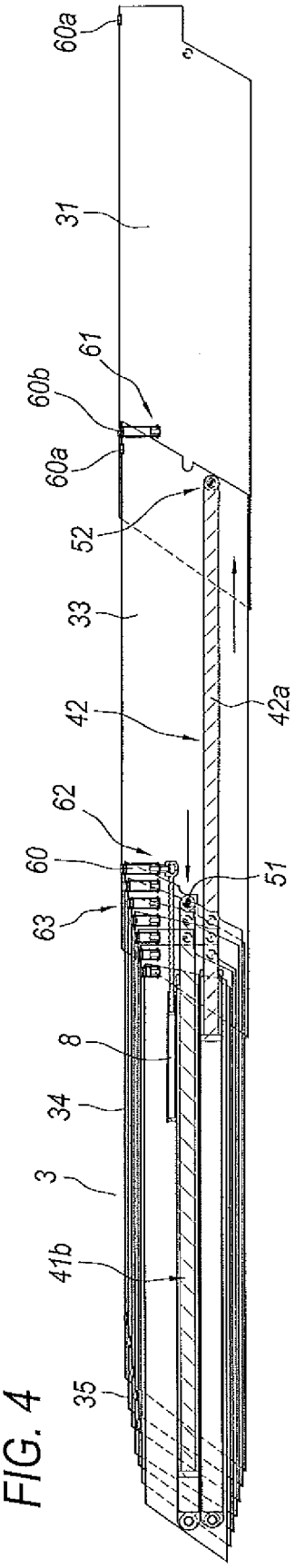


FIG. 4

FIG. 5

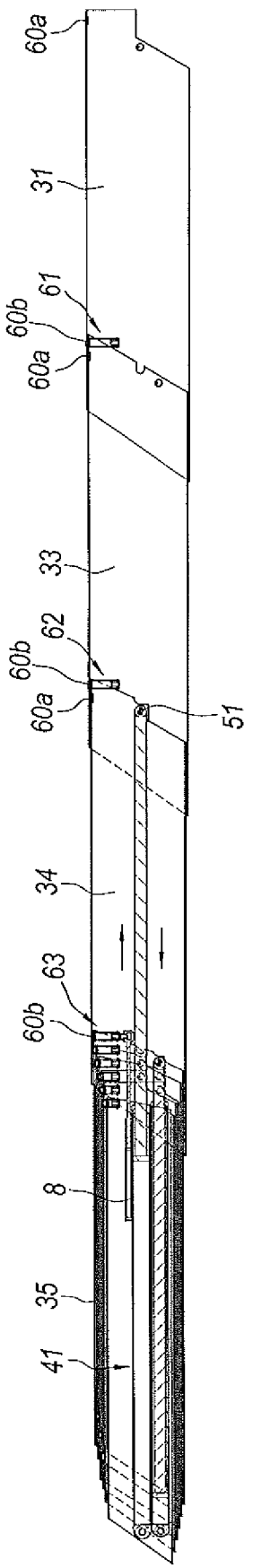

60a
31
61
60b
60a
33
62
60b
60a
51
34
63
60b
8
35
41

FIG. 6A

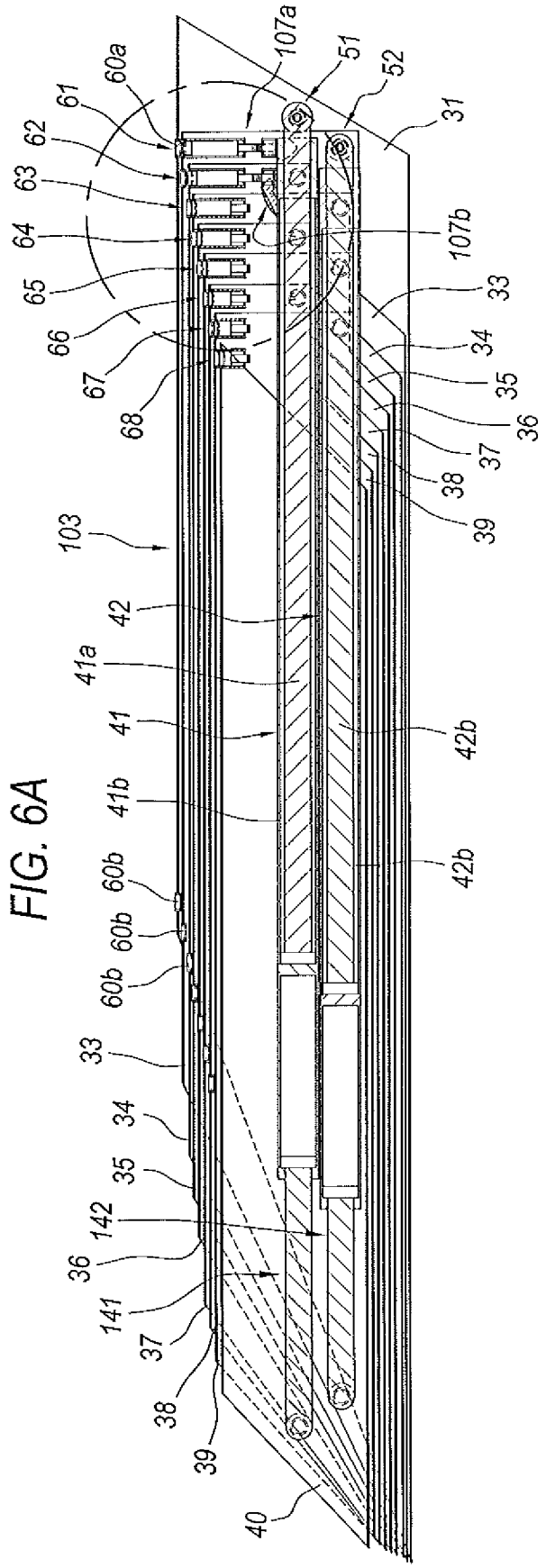

107a
51
52
60a
61
62
63
64
65
66
67
68
31
107b
33
34
35
36
37
38
39
103
42
41a
41
41b
42b
60b
60b
60b
33
34
35
142
36
141
37
38
39
40

FIG. 6C

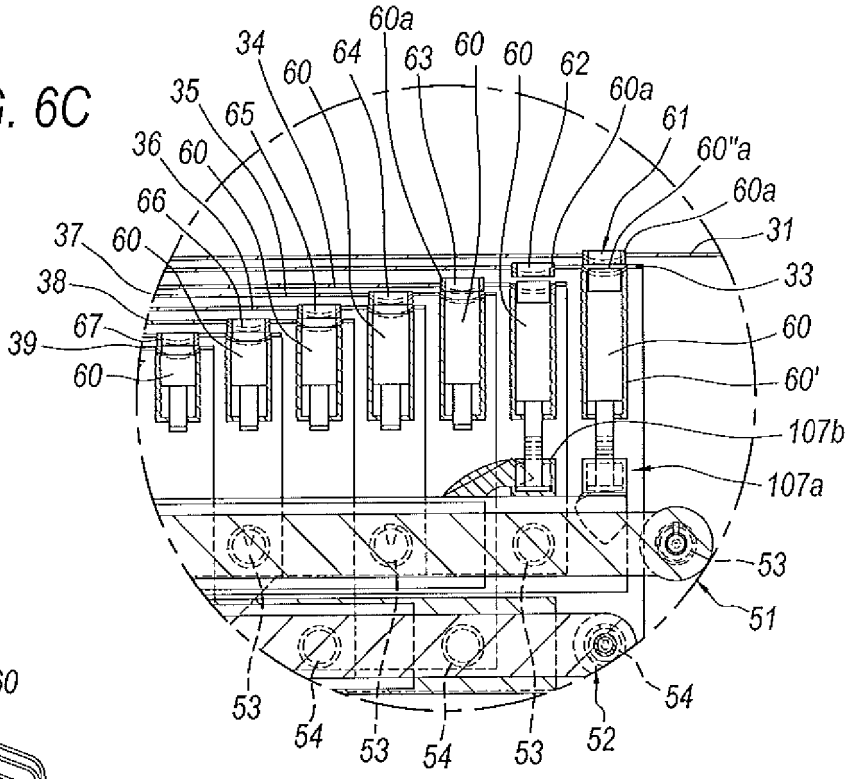


FIG. 6B

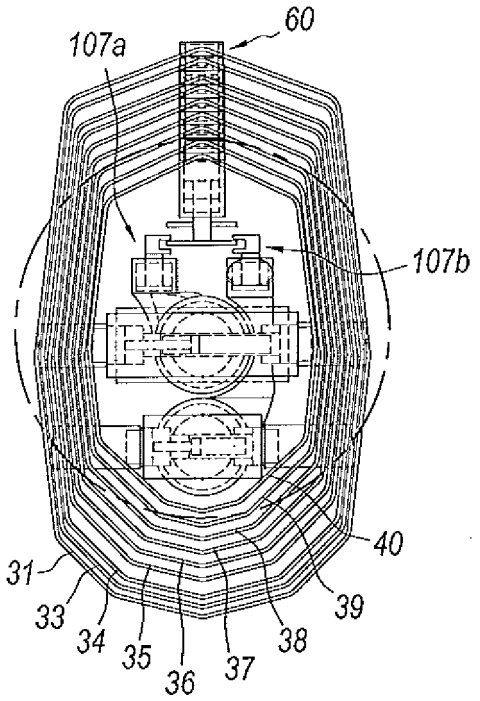
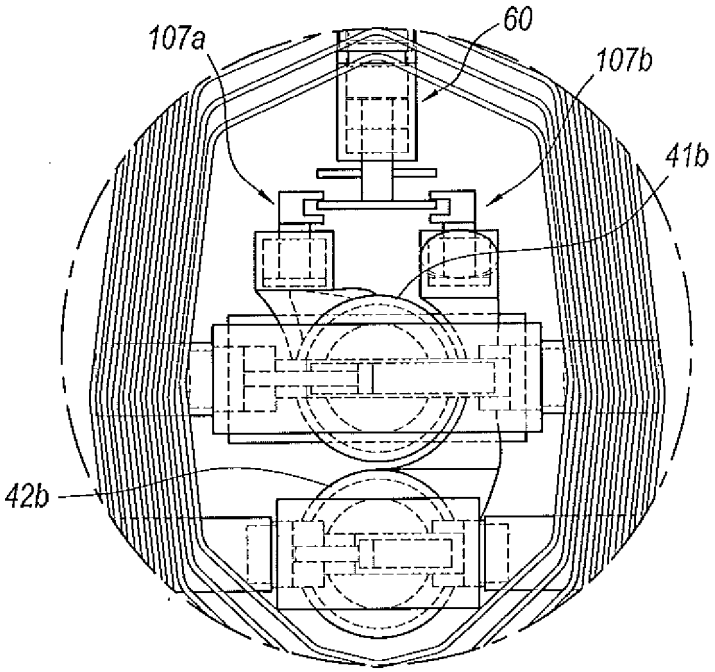


FIG. 6D



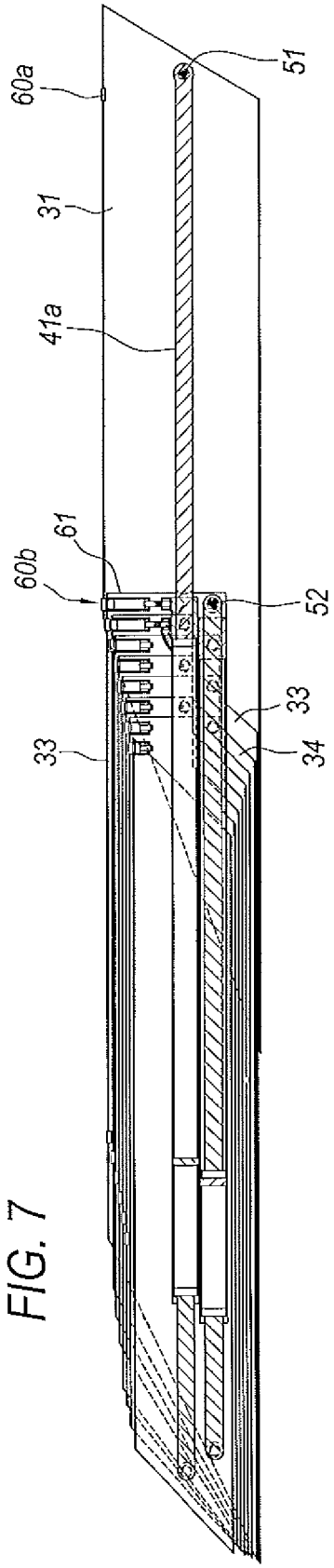


FIG. 7

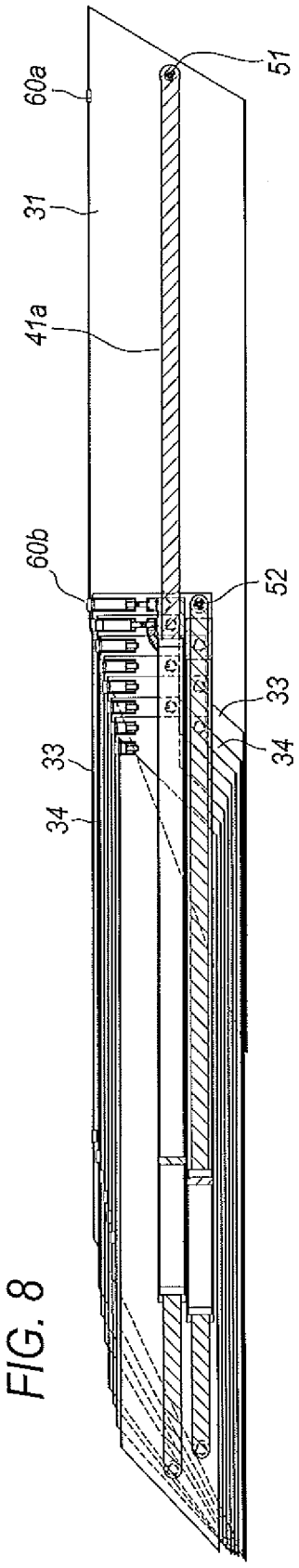


FIG. 8

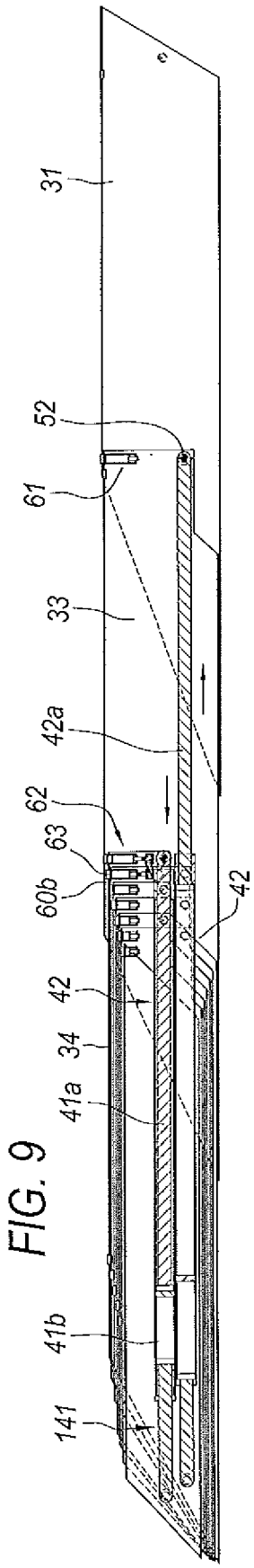


FIG. 9

FIG. 10

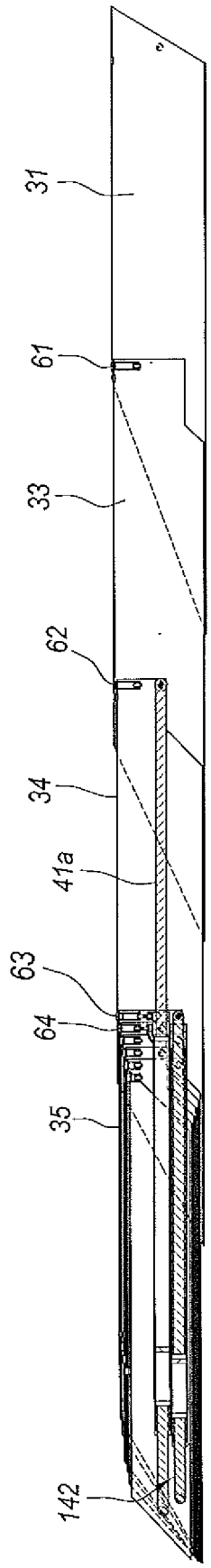


FIG. 11A

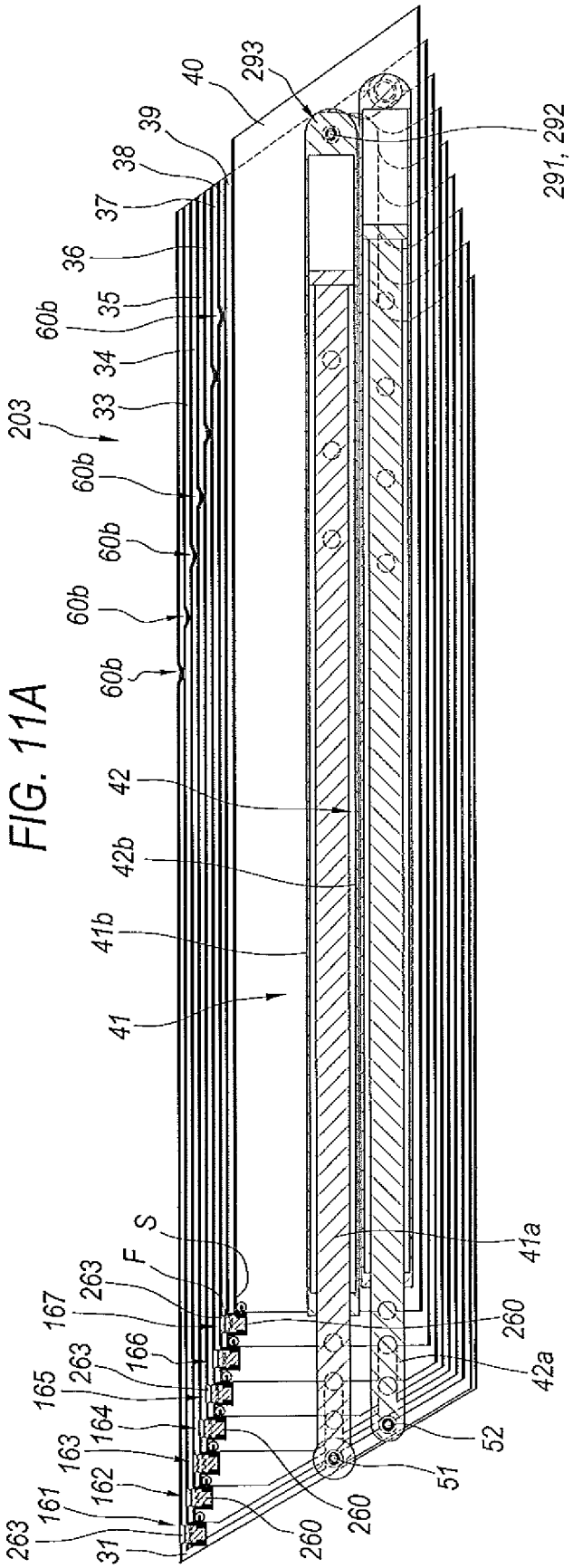


FIG. 11C

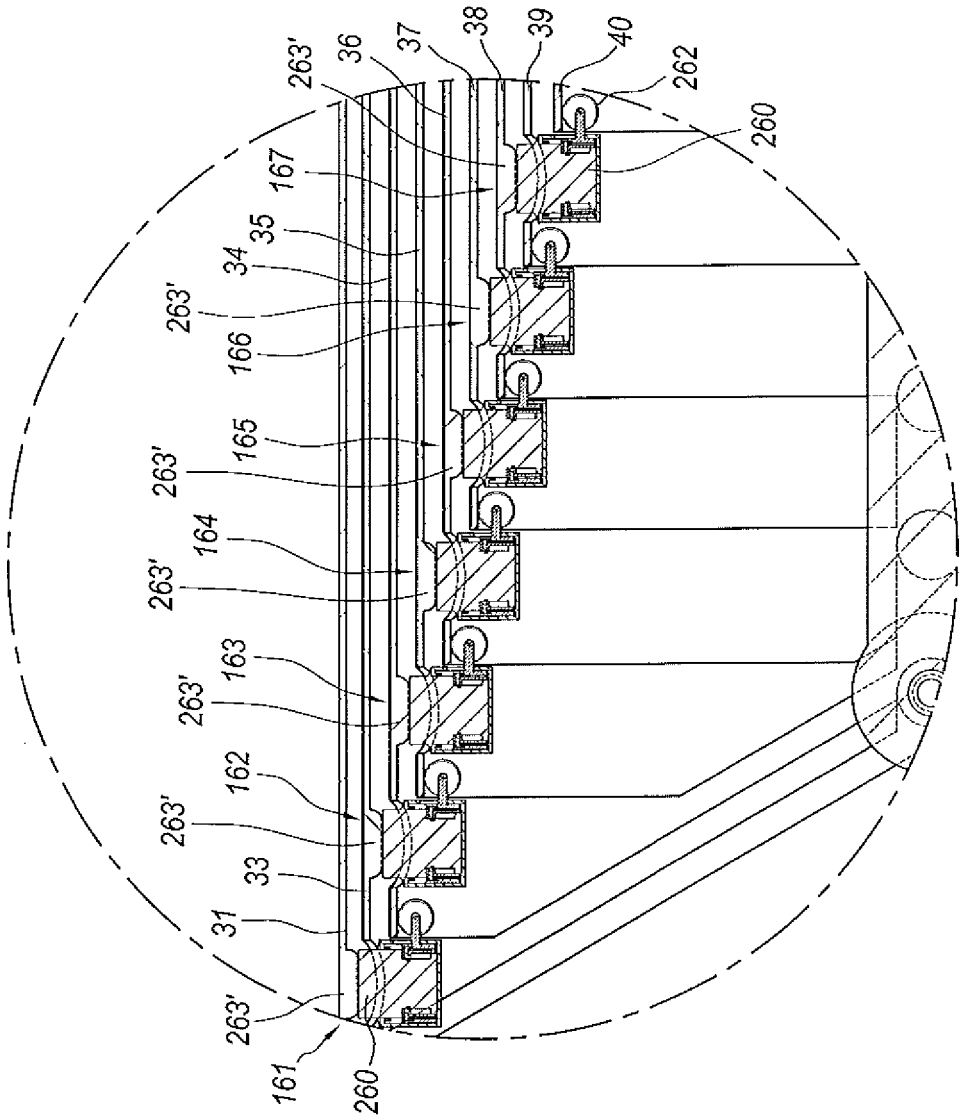
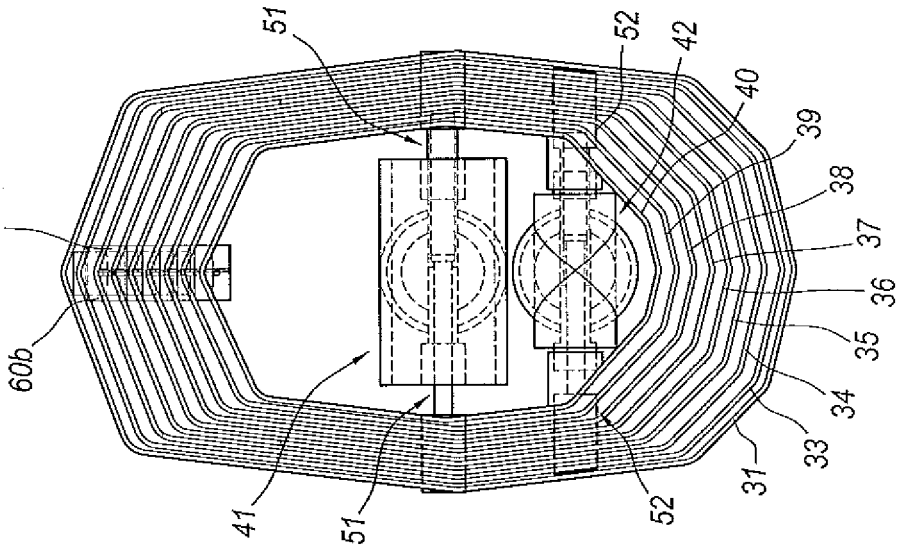


FIG. 11B



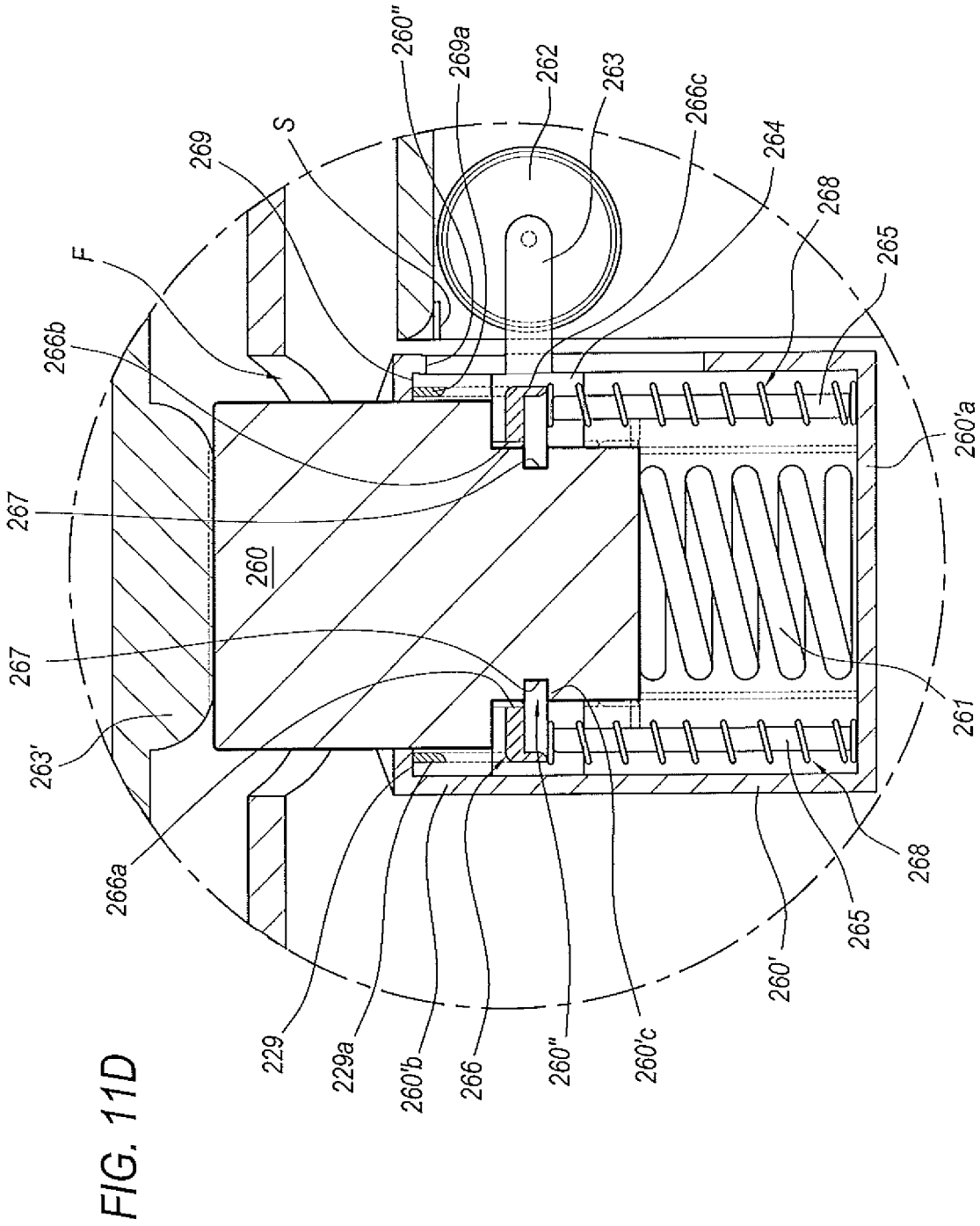
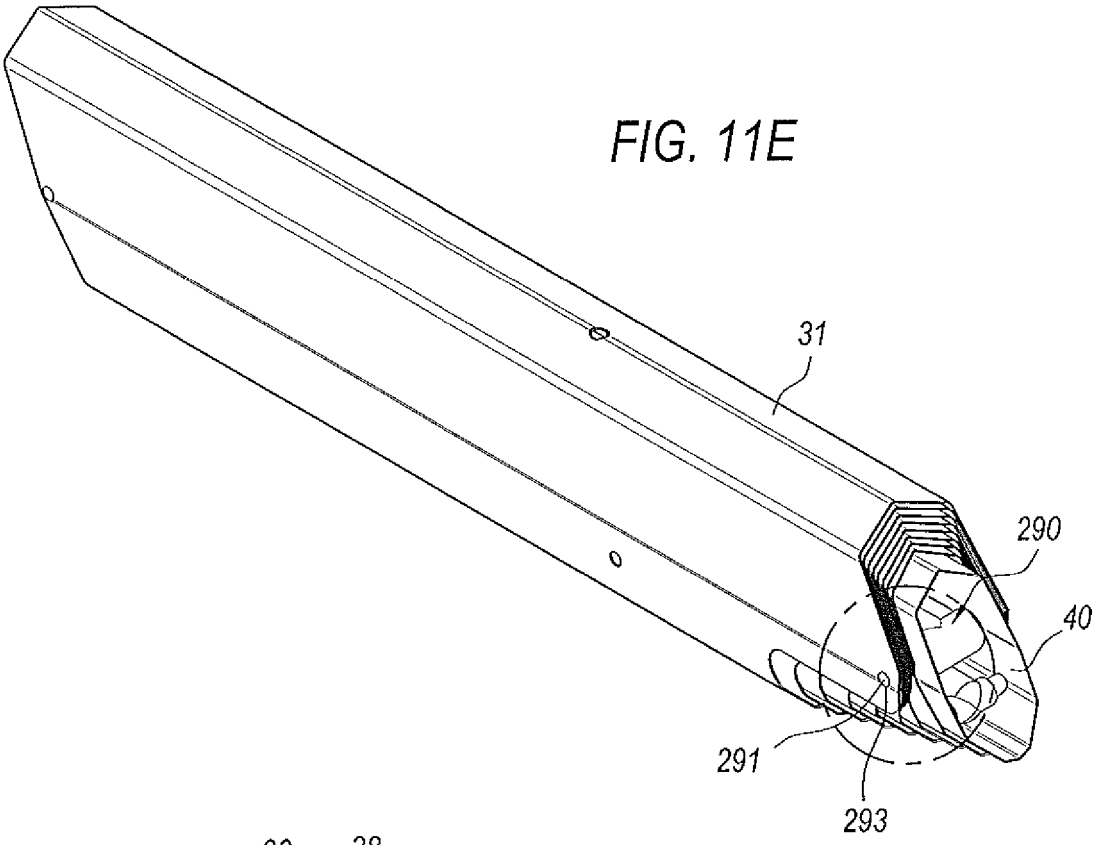

260''
269a
262
263
266c
264
268
265
269
S
F
266b
260'a
267
260
267
261
263'
266a
268
265
260'
229
229a
260'b
266
260''
260'c

FIG. 11D

FIG. 11E



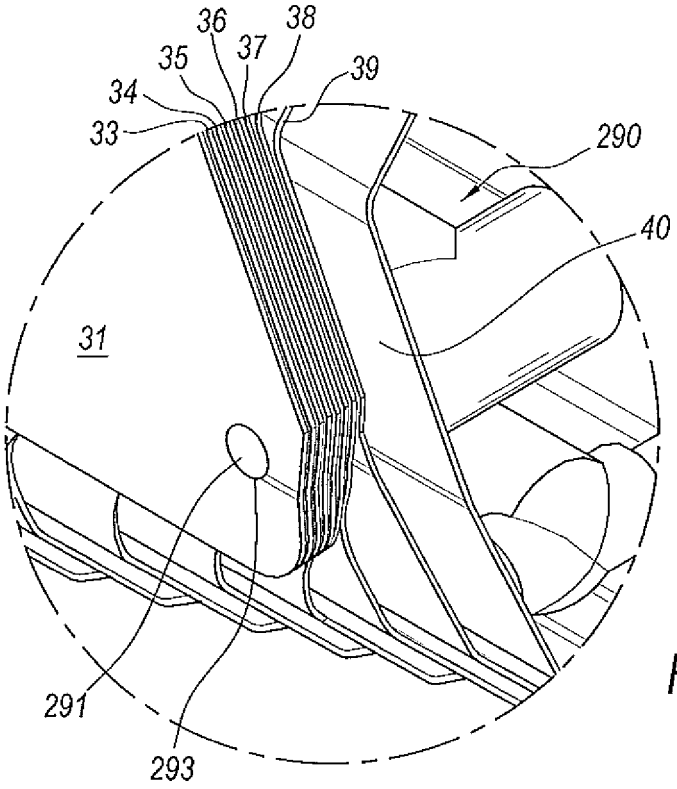


FIG. 11F

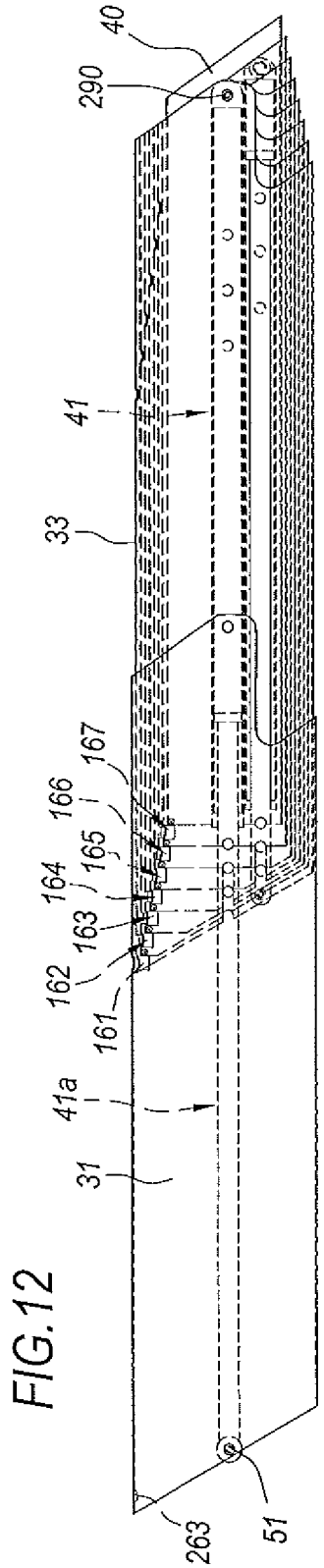


FIG.12

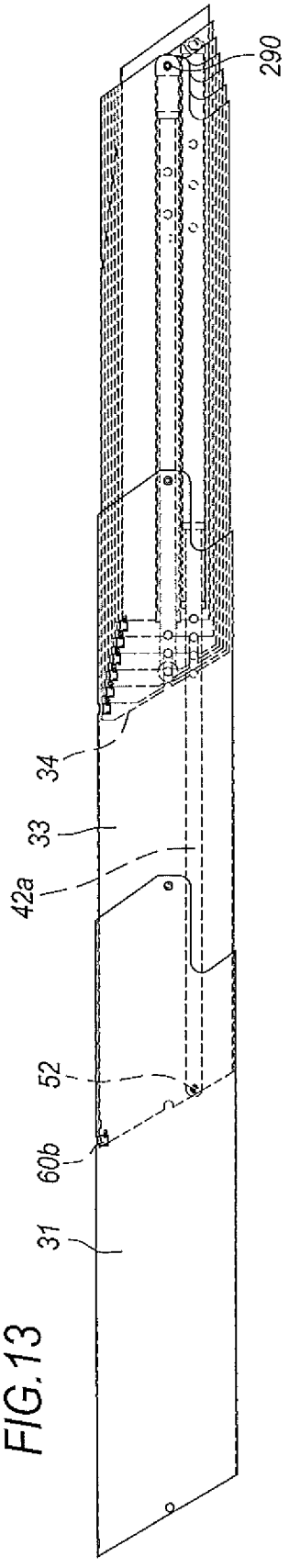


FIG.13

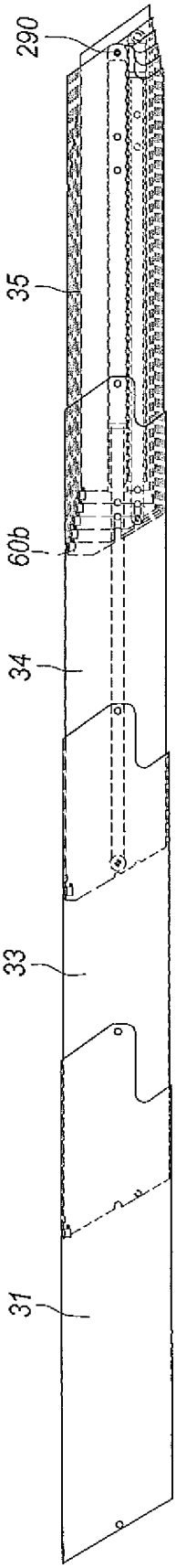


FIG.14

FIG.15A

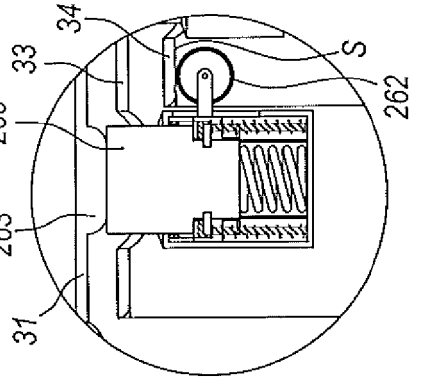


FIG.15B

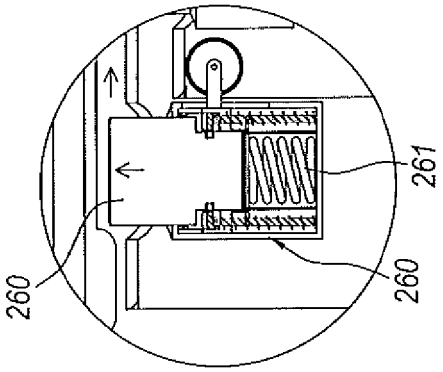


FIG.15C

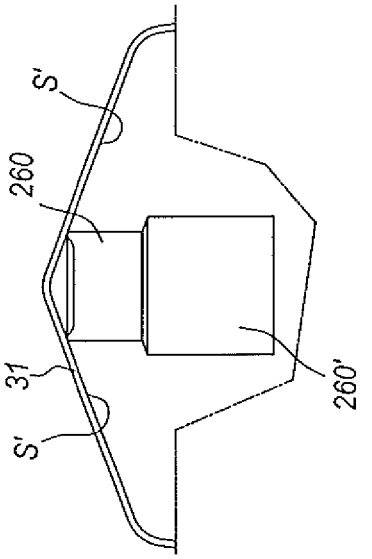


FIG.15D

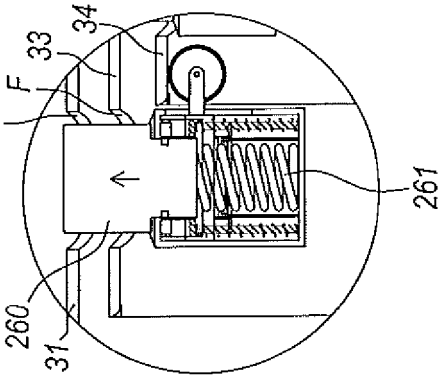


FIG.15E

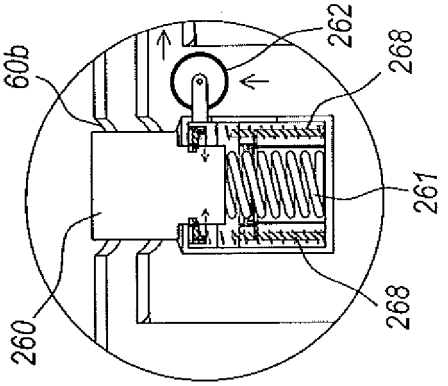


FIG.15F

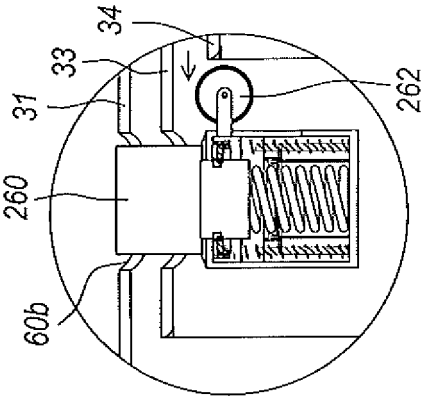


FIG.15G

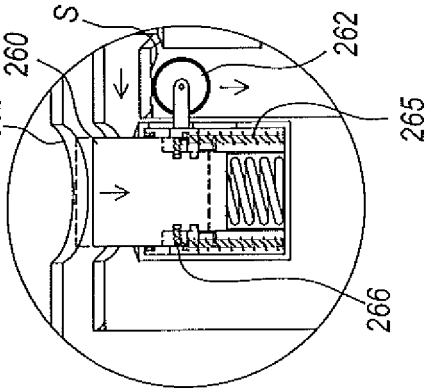
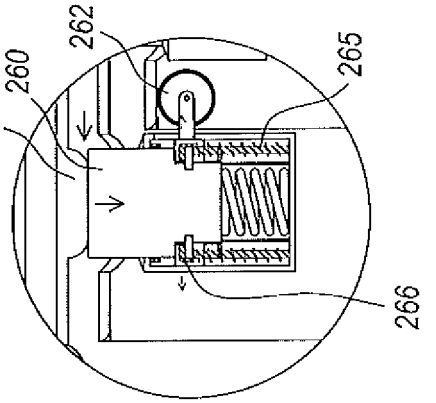


FIG.15H



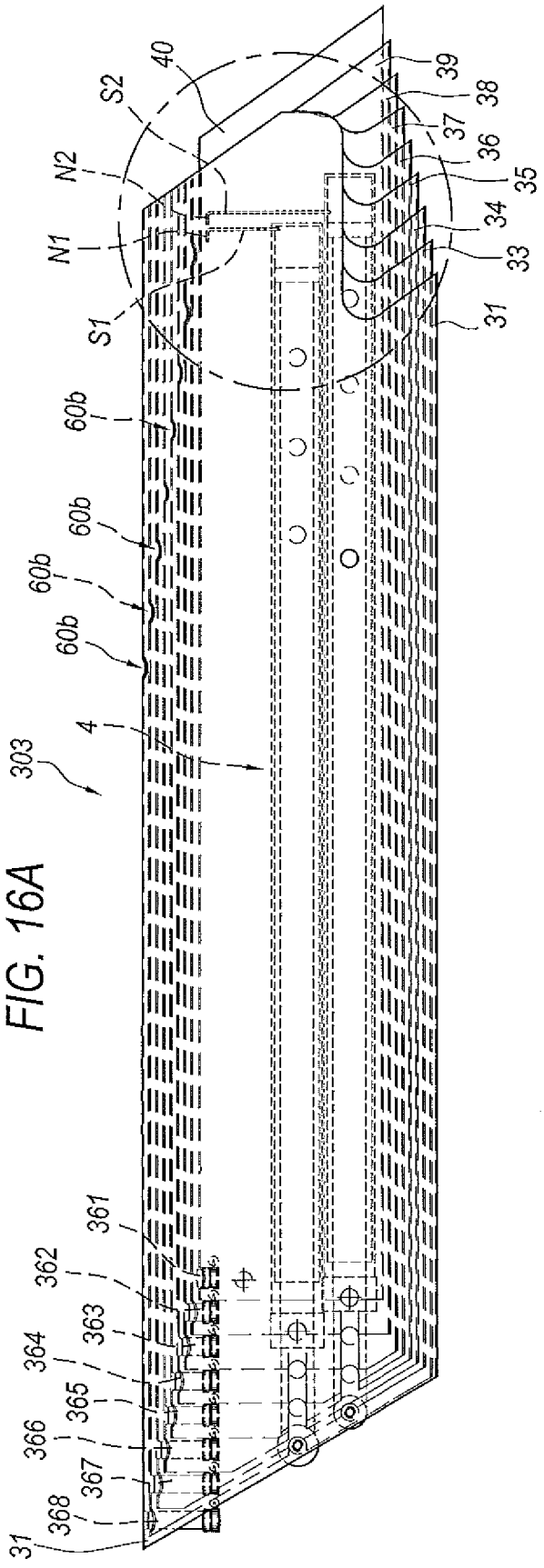


FIG. 16A

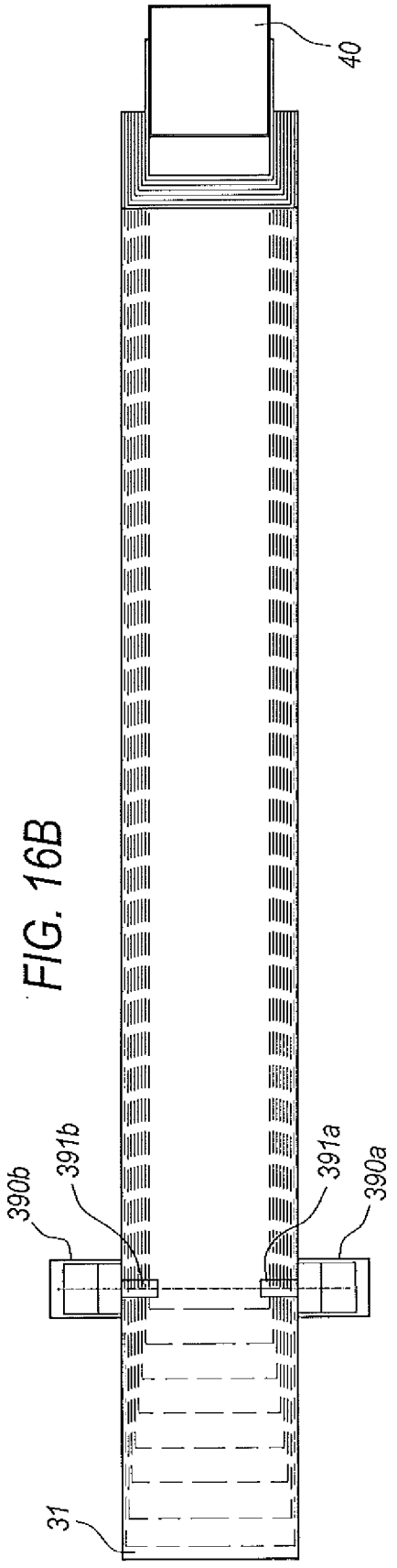


FIG. 16B

FIG. 16C

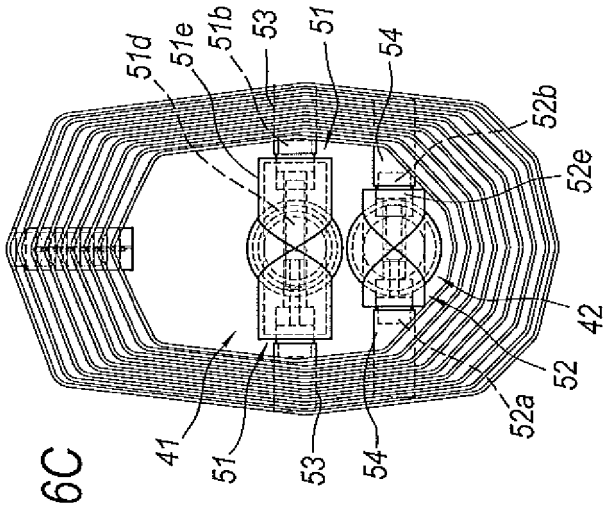


FIG. 16D

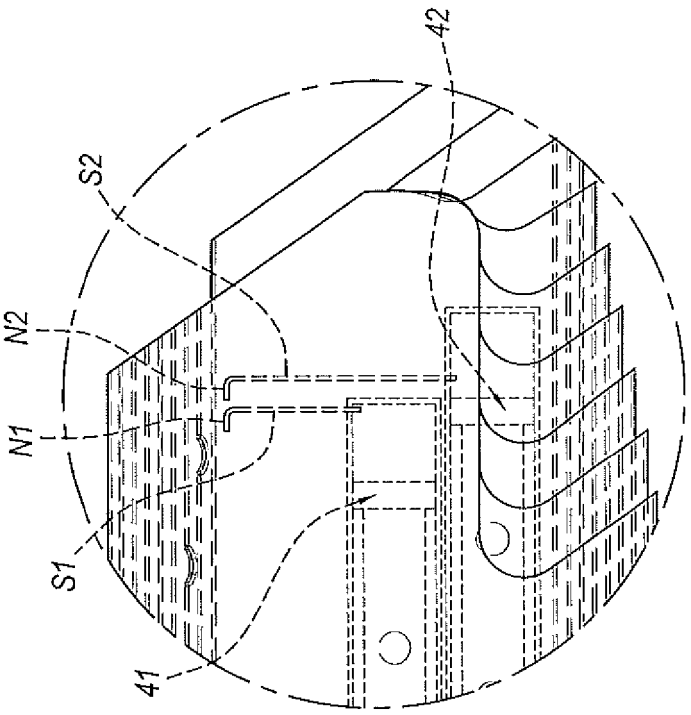
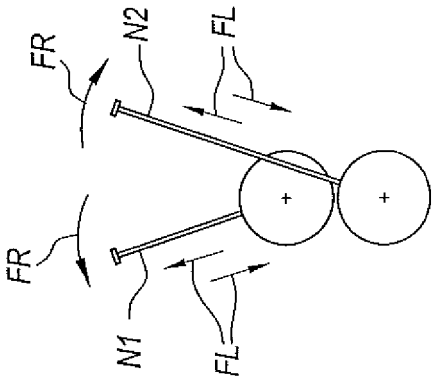


FIG. 16E



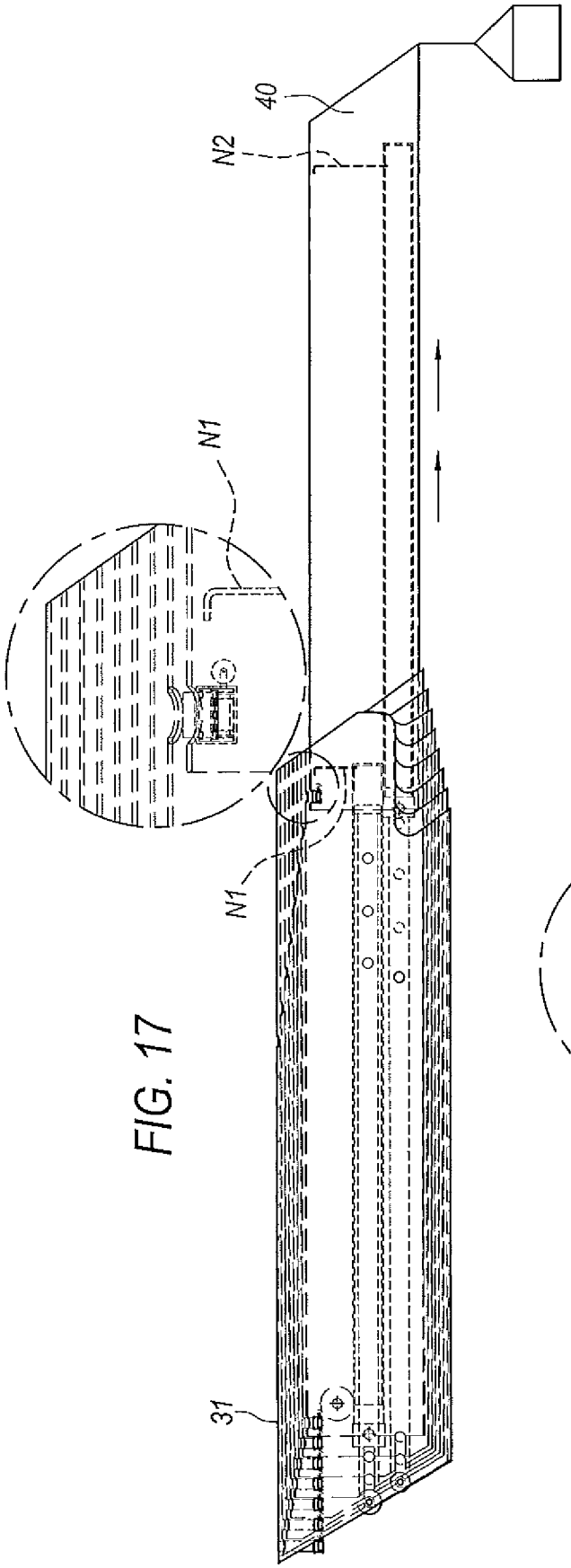


FIG. 17

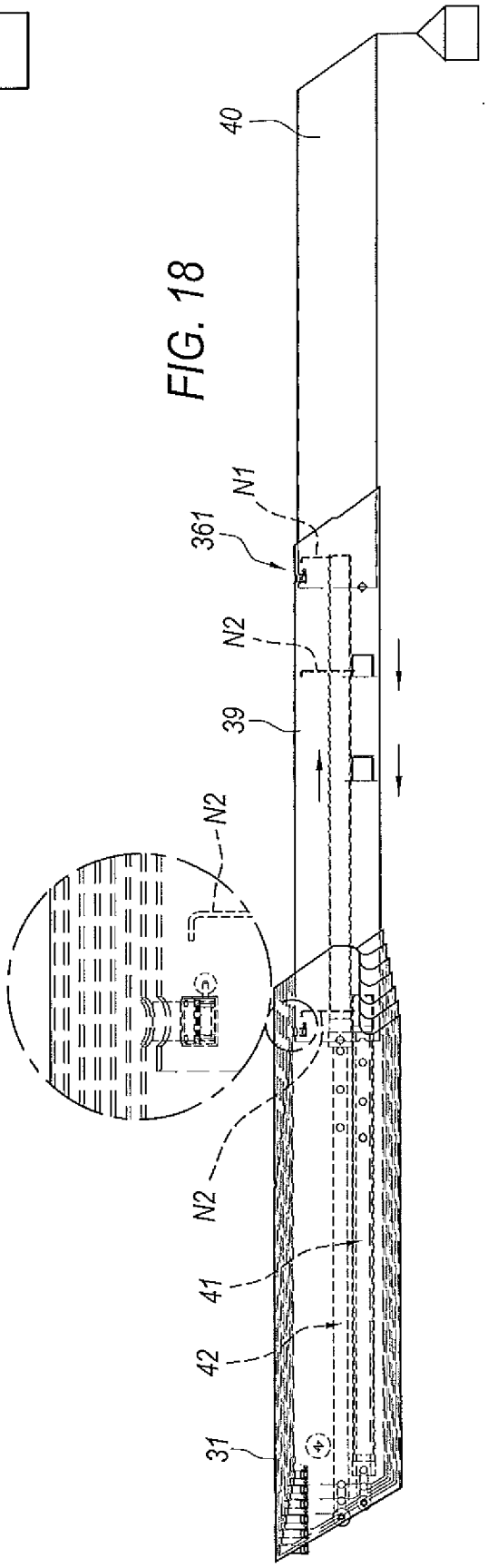


FIG. 18

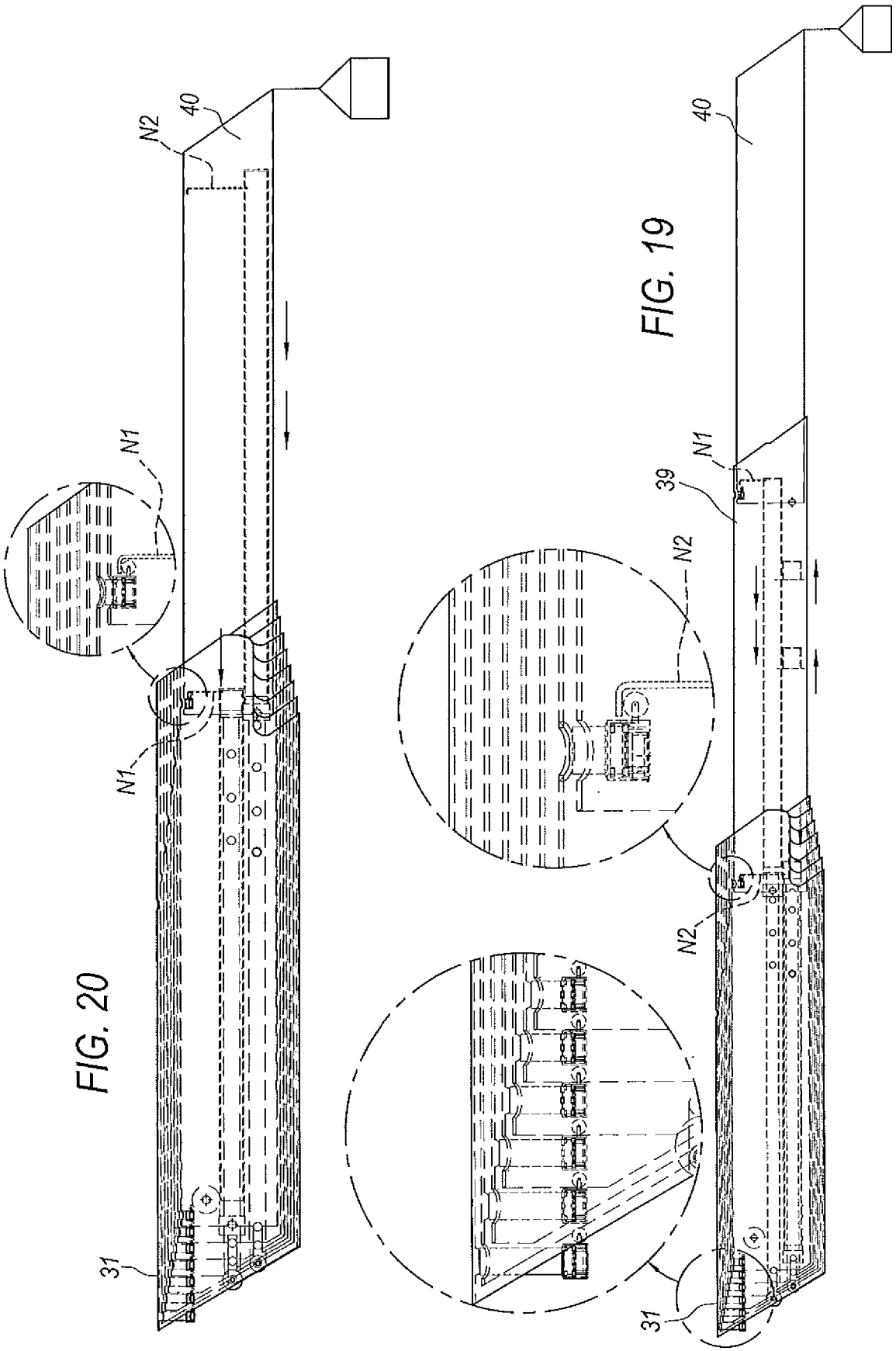


FIG. 20

FIG. 19

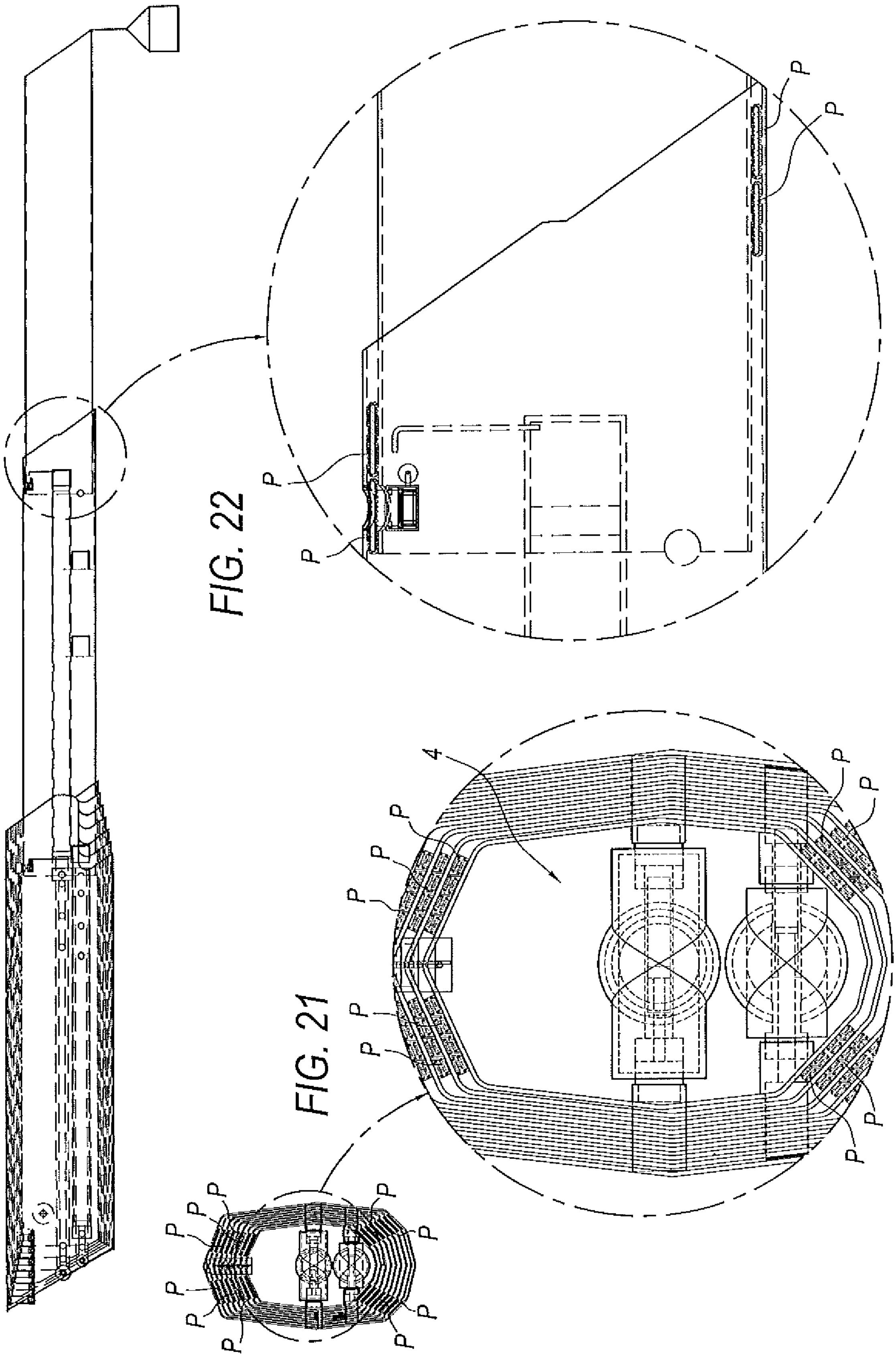


FIG. 22

FIG. 21

FIG. 23A

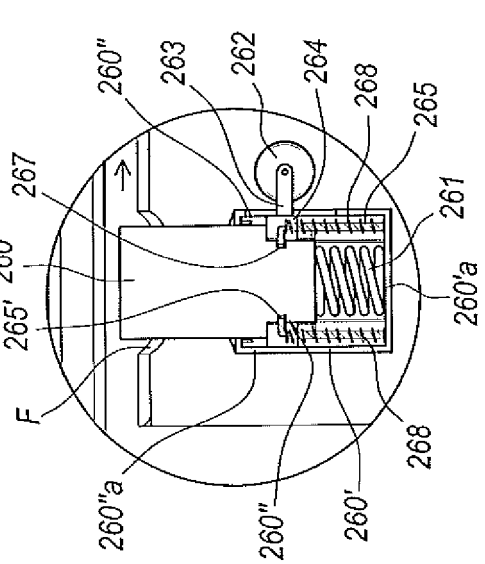


FIG. 23B

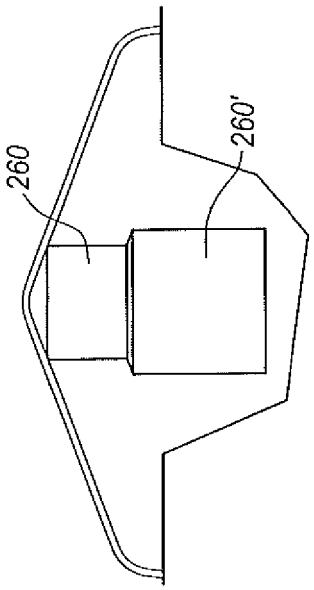


FIG. 23C

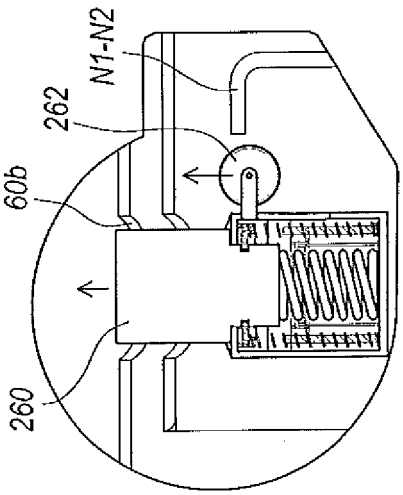


FIG. 23D

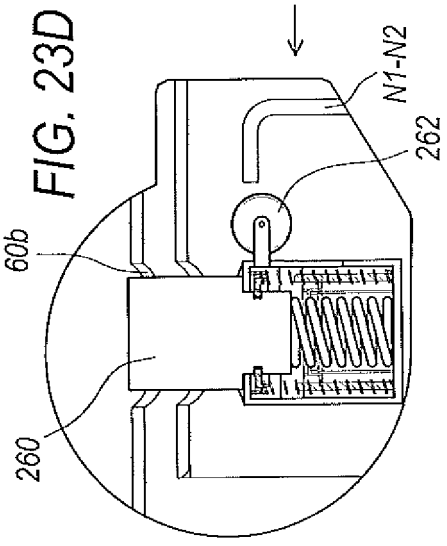


FIG. 23E

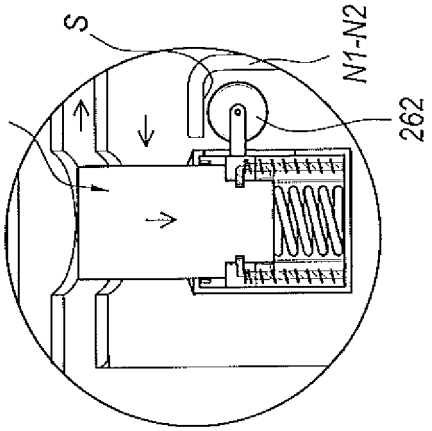
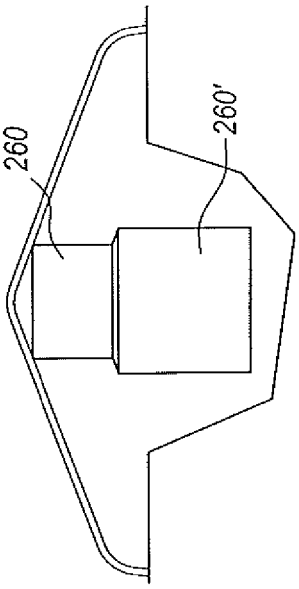


FIG. 23F



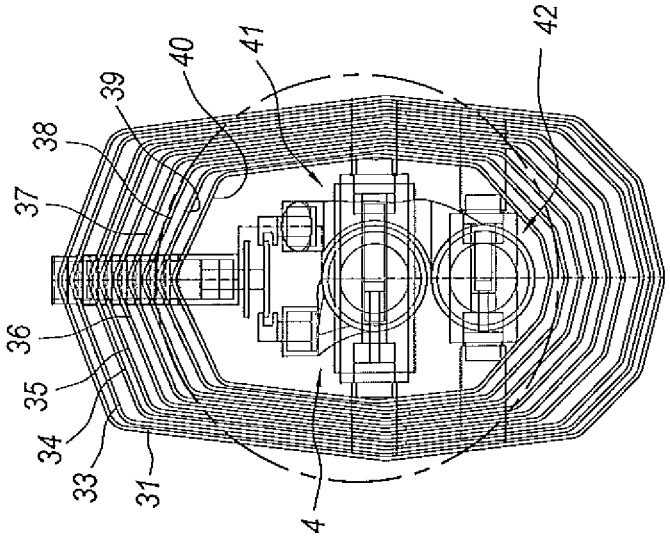


FIG. 24B

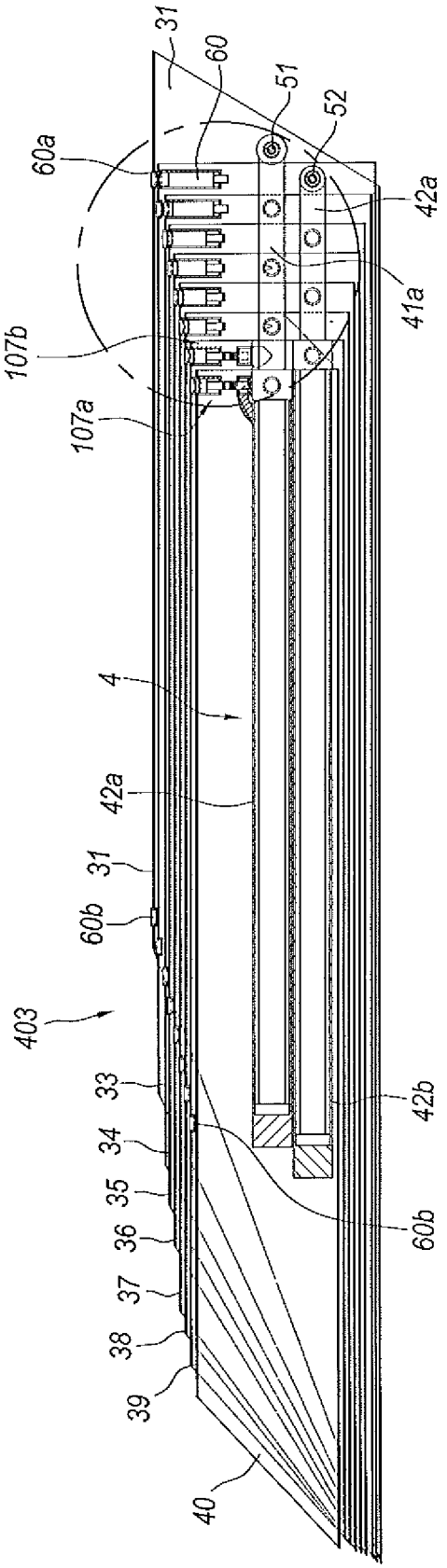


FIG. 24A

FIG. 24C

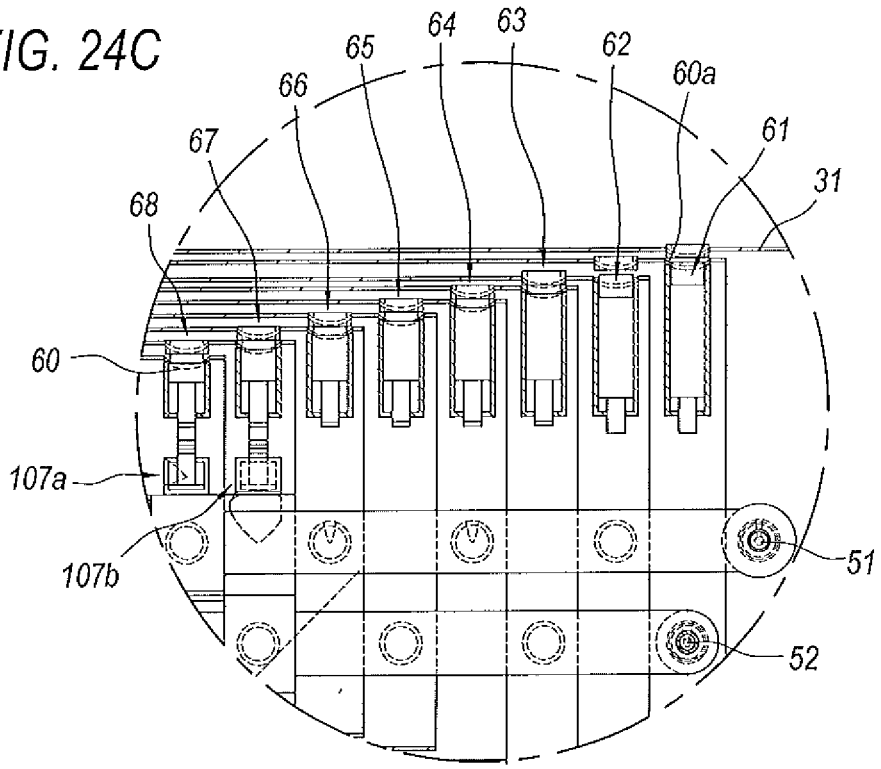
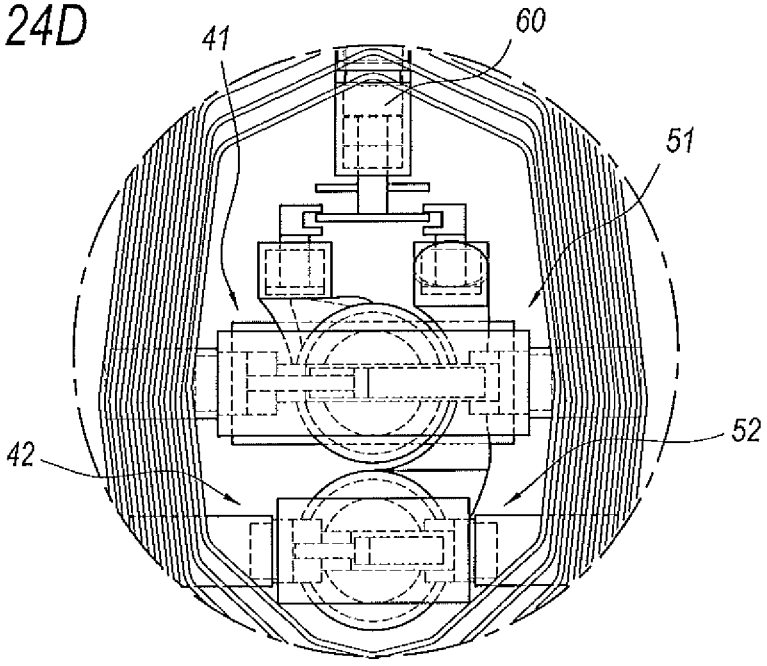


FIG. 24D



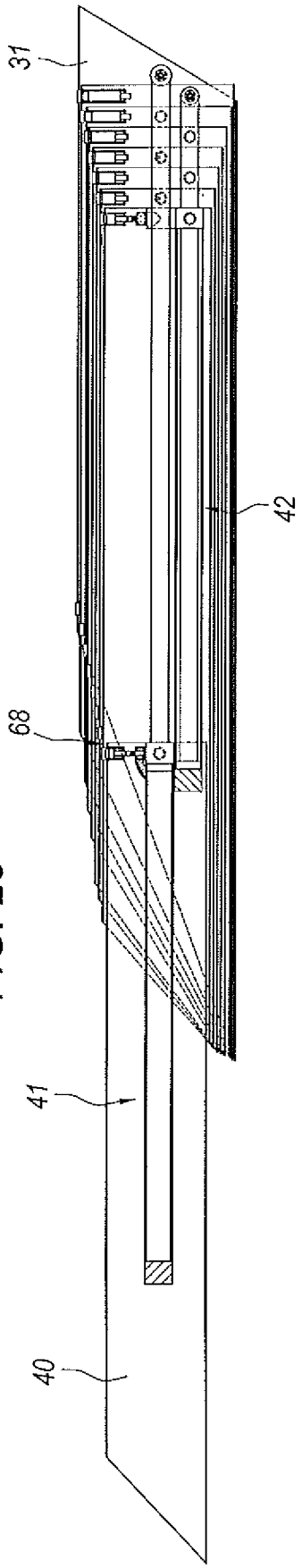


FIG. 25

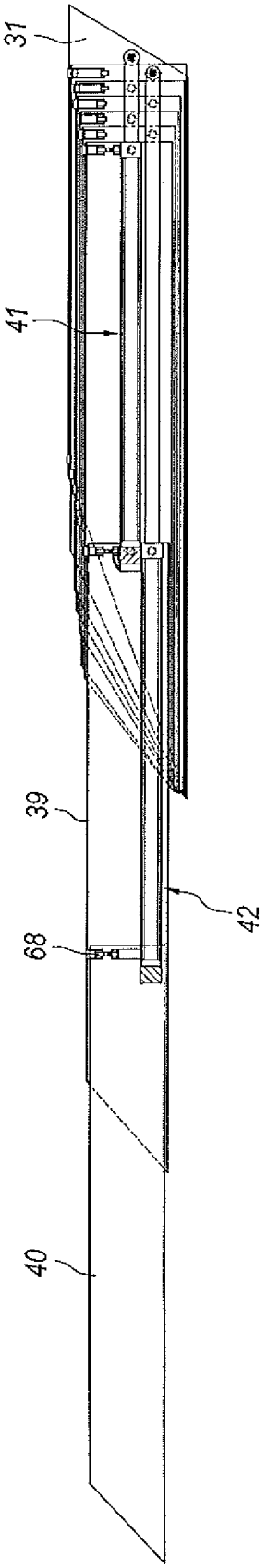


FIG. 26

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1321426 A **[0011]**