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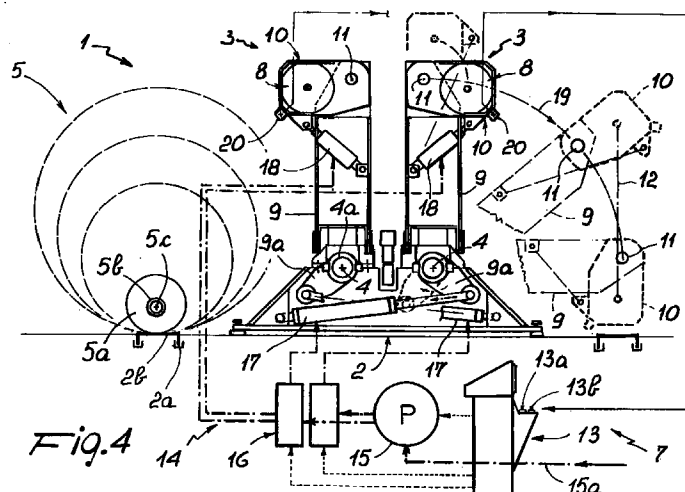
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(54) **A machine for reel handling, in particular for paper material production lines**

(57) A reel handling machine is provided, in particular for paper material production lines, comprising: a base structure (2), at least one pair of movable arms (3) connected to the base structure (2), a driving apparatus (7) adapted to move the arms (3) between a loading or unloading position and a work position, and grasping means (8) for the reels supported by the arms (3), each of said arms (3) comprising at least two portions (9, 10) which are movable and consecutive with respect to

each other, and connections (10a, 11) between the portions (9, 10) adapted to enable each of the arms (3) to take positions included between a contracted setting and an extended setting defining the minimum and maximum lengths of the arm (3) respectively, the driving apparatus (7) selecting the arm length adapted to the sizes of each reel.



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Description

[0001] The present invention relates to a machine for reel handling, in particular for paper material production lines, of the type comprising at least one pair of handling arms to be positioned at the opposite end faces of a reel and movable between a lowered loading or unloading position and a raised work position, as described in the preamble of Claim 1.

[0002] It is known that in plants for producing sheet materials, paper or corrugated board materials for example, paper or paperboard reels are required to be moved from lowered positions corresponding to the positions of the carriages usually sliding on rails on which said reels are disposed, to raised work positions, and vice versa from the last-mentioned positions to the former.

[0003] For these reel-handling operations apparatuses of various kinds can be used, which are for example either of general use and of the moving type such as elevators, or in the form of specific and dedicated apparatuses such as handler arms oscillatably connected to a base structure.

[0004] Practically, in the last-mentioned solution the handler arms generally consist of levers emerging from a base structure and spaced apart from each other by a distance proportional to the longitudinal sizes of the reels to be lifted or lowered.

[0005] These handler arms have free ends provided with grasping means capable of engaging the hollow cores of the reels on opposite sides and therefore these arms are such movable that they get closed clamp-wise on the end faces of the reels or they open for release.

[0006] Obviously, the hollow cores of the reels to be gripped are required to be exactly in alignment with the grasping means supported by the handler arms, to enable said arms to close clamp-wise.

[0007] For reel lifting and lowering, the handler arms are provided with a rotatory motion about a horizontal axis and therefore the grasping means describes a trajectory in the form of an arc of a circle capable of intercepting the hollow core of a reel placed on a carriage only if this core is at a predetermined fixed height, corresponding to a reel of standard and constant diameter.

[0008] If the reel diameter is different from the usual one, manual adjustments of the position of the carriage on which the reel is disposed or manual displacements of the reel position on the carriage are necessary, at all events in such a manner that the reel centre is brought to intersect the trajectory of the grasping means.

[0009] Therefore additional adjustment operations for the reel loading or unloading steps take place, if the reel does not correspond to the expected diameter, which operations give rise to slowdowns in the production rates and, as a result, to increases in costs.

[0010] These production slowdowns and cost increases are of great amount when a repeated loading and unloading of small-sized reels having varying diam-

eters is concerned.

[0011] It is to point out that the frequency of the loading and unloading operations is due, among other things, to the necessity of quickly making production comply with the diversified and fragmentary requirements of the market.

[0012] Since manual-adjustment interventions are required in the known art, an automatic running of the machine during the reel loading/unloading operations is not allowed and therefore there is a serious limit in the paper material production lines.

[0013] It is also to point out that when the handler arms lift a reel and reach a work position, at which the reel is being unwound, they keep said reel at a predetermined fixed position, its central axis being exactly horizontal and perpendicular to the unrolling direction. This predetermined position is the optimal one only in the case of well shaped reels having paper or the like of perfectly uniform basis weight.

[0014] In case of unevennesses in winding or irregularities in the paper basis weight, it very easily happens that during the reel unwinding a reel side and a side of the paper ribbon or the like is tauter (more tensioned) than the other side.

[0015] As a result, malfunctions in the whole chain of workings carried out downstream of the reels take place.

[0016] No remedies substantially exist for the above drawbacks when presently known handler arms are used, since it is surely impossible to provide the latter with wide plays or tolerances in order to remedy the reel irregularities: in any case an imprecise and not very stable positioning of the reels themselves would be obtained.

[0017] Under this situation, the technical task of the present invention is to devise a reel handling machine capable of substantially obviating the above drawbacks.

[0018] Within the scope of this technical task, it is an important aim of the present invention to devise a machine enabling the loading/unloading times of the reels to be reduced, even when the reels have greatly differentiated diameters, while avoiding any intervention of the manual type.

[0019] Another important aim of the invention is to devise a flexible and adjustable machine capable of enabling the most appropriate positioning of a reel to be achieved, when said reel has been raised and is being unwound, so that possible imprecisions of the same are compensated for, without however introducing uncertainty or imprecision elements in the reel positioning.

[0020] The aims specified are achieved by a reel handling machine, in particular for paper material production lines, as claimed in the appended claim 1.

[0021] The features and advantages of the invention will become more apparent from the following detailed description of a reel handling machine in accordance with the invention, illustrated in the accompanying drawings, in which:

Fig. 1 is an elevation front view of a machine in accordance with the invention, provided with two pairs of arms for handling two reels;

Fig. 2 shows a detail of one end of a handler arm;

Fig. 3 shows a reel in a partial perspective view, and the ends of two arms of a pair of handler arms intended for moving the reel;

Fig. 4 is an elevation view similar to the one in Fig. 1 showing an overall functional diagram of the machine, at some of its operating positions;

Fig. 5 is a diagrammatic sectional view of a telescopic handler arm of the machine;

Fig. 6 is similar to Fig. 5 and shows an alternative embodiment of said arm;

Fig. 7 is an elevation view showing the structure of the grasping means of a reel placed at the ends of the handler arms; and

Fig. 8 is a perspective view showing how the handler arms modify the work position of a reel.

[0022] With reference to the drawings, the machine in accordance with the invention has been generally identified by reference numeral 1. It comprises, as shown in Figs. 2 and 4, a base structure 2 alongside which there are rails 2a on which preferably power-driven carriages 2b run.

[0023] The base structure 2 defines at least a pivot axis 4 which is substantially horizontal or parallel to the rest surface of the machine 1, along which a shaft 4a of great length or two shafts 4a coaxial with each other are disposed.

[0024] Linked to the base structure 2 is at least one pair of handler arms 3, merely referred to as arms 3 in the following. Two pairs of arms 3 are shown in the figures and each pair is independent of the other pair.

[0025] Arms 3 of each pair are disposed in side by side relationship and spaced apart from each other and they are simultaneously movable with at least two movements: a rotatory movement around the shaft 4a coaxial with the horizontal pivot axis 4, and a translational movement along shaft 4a and the pivot axis 4.

[0026] Said translational movement, identified by arrows 6a in Fig. 3, is provided to enable the arms 3 of each arm pair to move close to or away from each other, in order to conform the distance between said arms to the axial sizes of a reel 5 to be submitted to movement.

[0027] Said reel 5 (Fig. 3) externally has a cylindrical surface and two end faces 5a which are substantially flat and parallel to each other, and internally has a cylindrical and hollow core 5b, coaxial with a central axis 6. Intersection between the central axis 6 and the two end faces 5a defines two centres identified by 5c.

[0028] It is pointed out that each reel 5 is loaded or unloaded always in an extended position, that is with its central axis 6 substantially horizontal, onto and from a respective carriage 2b guided by rails 2a. Therefore in the loading or unloading positions the central axis 6, seen in plan view, always lies centrally over rails 2a and

a respective carriage 2b, independently of the diameter of reel 5.

[0029] The rotatory movement enables displacement of each arm 3 between lowered loading/unloading positions of a reel 5 and one or more raised work positions, to be used for the intended operations to which reel 5 is to be submitted.

[0030] Movements of arms 3 are controlled by a driving apparatus 7, described in the following.

[0031] Arms 3 are integral with grasping means consisting of heads 8 projecting from arms 3 and adapted to be fitted into the core 5b when arms 3 are close to each other.

[0032] As shown in Figs. 3 and 6, heads 8 are provided with a spindle assembly 8a to be fitted in core 5b, a flange assembly 8b supporting the spindle assembly 8a, and a control unit 8c.

[0033] The control unit 8c controls rotation of the two above mentioned assemblies and therefore of the whole reel 5, by means of a clutch device preventing accidental rotations of reel 5.

[0034] The spindle and flange assemblies 8a and 8b are integral with each other and oscillatable along a short stroke towards arm 3, when the flange assembly 8b is submitted to the pressure of an edge of core 5b. This oscillation movement actuates a contrivance inside the spindle assembly 8a causing expansion of keys 8d placed on the spindle assembly itself, so as to lock core 5b from the inside. Practically the spindle and flange assemblies 8a and 8b embody an expanding spindle, known per se.

[0035] Arms 3 are defined by a plurality of mutually movable rigid portions, which portions are in particular mutually movable in order to be able to continuously vary the position of each arm 3 between a contracted setting, defining the minimum length of arm 3, and an extended setting defining the maximum length of arm 3.

[0036] In detail, each arm 3 comprises a rigid first portion 9 hinged on the pivot axis 4, and a rigid second portion 10 connected to the first portion 9 and terminating at a head 8.

[0037] The first and second portions, 9 and 10, of each arm are in engagement with each other (Figs. 5, 6) in a telescopic manner or in the form of an open kinematic chain (Figs. 1, 2, 4) through connections adapted to enable said contracted and extended settings and the intermediate settings.

[0038] When portions 9 and 10 telescopically engaged with each other are concerned, the second portion 10 is provided to have (Figs. 5, 6) a connection defined by a stem 10a of the second portion 10 itself, which is axially slidable relative to the first portion 9.

[0039] When portions 9 and 10 engaged with each other like an open kinematic chain are concerned, connection between portions 9, 10 is provided to be made (Figs. 1, 2, 4) by a pivot pin or hinging axis 11 parallel to the pivot axis 4.

[0040] Sizes of portions 9 and 10 and the maximum

and minimum distances between heads 8 and the pivot axis 4 are such selected that each head 8 is allowed to be positioned at any point of a substantially rectilinear and vertical grasping stretch 12 (Fig. 4), which is coincident with the positions of the centres 5c of reels 5 of differentiated diameter disposed on carriage 2b.

[0041] In particular each arm 3 in said contracted setting has such a length that its head 8 can be disposed at a distance from its pivot axis 4 equal to or lower than the distance between a median line of a carriage 2b and the pivot axis 4 itself.

[0042] In said extended setting, each arm 3 has such a length that its head 8 is disposed at a distance from its pivot axis 4 which is greater or much greater than the distance between a median line of a carriage 2b and the pivot axis 4 itself.

[0043] The above stated different movements of arms 3, i.e. the translational movement for mutual approach or separation and the rotatory movement about the pivot axis 4, and the movements between portions 9 and 10 to cause expansion or contraction in length of arms 3, are controlled by the driving apparatus 7.

[0044] In particular, for the translational movement involving mutual approach or separation of arms 3, parallelly to the pivot axis 4, the driving apparatus 7 comprises elements known per se, not shown, such as operating screws for example, that make arms 3 slide along shaft 4a.

[0045] For the rotatory movement of arms 3 around the pivot axis 4 and said other movements of said arms in the case of an open kinematic chain, as shown in particular in Fig. 4, the driving apparatus 7 comprises a control centre 13, to be made in a manner known per se and suitably computerized, to which a fluid-operated circuit 14 is interlocked.

[0046] The fluid-operated circuit 14 comprises several members: at least one pump 15 connected to a feeding source 15a, a plurality of sets of distributors 16, and a plurality of fluid-operated actuators.

[0047] Provision is made for the same number of sets of distributors 16 as that of arms 3 and in each arm 3 actuators are made of a first fluid-operated cylinder 17 for operating the first portion 9 rotating about the pivot axis 4, and a second fluid-operated cylinder 18 for operating the second portion 10 rotating about the hinging axis 11.

[0048] The rod of the first cylinder 17 is in engagement with a bent tailpiece 9a of the first portion 9 so as to create an arm conveniently spaced away from the pivot axis 4 in order to reduce the force to be exerted by cylinder 17, the obtained torque being the same.

[0049] The control centre 13 is programmed for coordinating the angular position of each first portion 9, rotating about the pivot axis 4 and therefore shifting the hinging axis 11 along a trajectory in the form of an arc of a circle 19, with the position of each second portion 10 rotating about the hinging axis 11.

[0050] This coordination is adapted to position heads

8 close to the grasping stretch 12, along which at different heights the centres 5c of reels 5 on carriage 2b arrange themselves.

[0051] If the two portions 9 and 10 of each arm 3 are connected to each other in a telescopic manner, as diagrammatically shown in Fig. 5, the driving apparatus 7 remains substantially the same and the second fluid-operated cylinder 18 intervenes making the second portion 10 project to a greater or less extent so as to place head 8 on the grasping stretch 12.

[0052] With reference to Fig. 6, it is also to point out that the telescopic engagement between the first and second portions 9 and 10 makes it easy to replace the second fluid-operated cylinder 18 with an electric-control operating unit 26, in which a reduction motor 27 operates a toothed wheel 28, through a worm screw 27a.

[0053] The toothed wheel is prevented from translation by means of brackets 29 and is screwed down and engaged with an axially movable operating screw 30 which is integral at the end with the second portion 10 of arm 3.

[0054] Obviously, when a fluid-operated cylinder is replaced by the operating unit 26, only electric connections are provided between the operating unit and the control centre 13.

[0055] Advantageously, sensor means 20 is provided which is for example defined by photoelectric elements capable of detecting the geometric features of a reel 5 placed on carriage 2b and adapted to supply the control centre 13 with a corresponding signal.

[0056] Based on this signal, the control centre 13 operates setting of arms 3 and disposes heads 8 along the grasping stretch 12 and in line with the central axis 6.

[0057] Shown in Figs. 2 and 4 by way of example is a photoelectric cell placed on the second rigid portion 10 of arm 3, alongside the respective head 8, on the side thereof which is the first to come close to a reel 5 placed on a carriage 2b.

[0058] When arm 3 rotates downwardly, the photoelectric cell signals where the outer cylindrical edge of reel 3 is placed. This placement is univocally correlated with the reel diameter and therefore the control centre 13 is capable of positioning heads 8. The sensor means 20 can be disposed axially relative to heads 8 or at another position.

[0059] Referring now to Figs. 4 and 8, it is pointed out that the control centre 13 may advantageously be adapted to intervene separately on each of the arms 3 of each arm pair, since each arm 3 is associated with its own set of distributors 16, and since the driving apparatus 7, and in particular the control centre 13, includes offsetting commands denoted by numbers 13a and 13b.

[0060] By these offsetting commands, each of the two arms or only one of them can be offset as regards its position, in particular angularly, relative to the other arm, so as to lose parallelism therewith.

[0061] Preferably, displacement takes place with reference to the raised work position and in the direction shown in Fig. 8, that is in the direction bringing the central axis 6 of a raised reel 5 in a work position to oscillate angularly in a plane 21 which is substantially horizontal, or substantially parallel to the unrolling plane of the paper material or the like.

[0062] By a machine structured as shown in the drawings, practically a small rotation of a single arm 3 about the pivot axis 4 is operated, which rotation is carried out optionally in opposite ways.

[0063] For instance, each time the offsetting command 13a is operated, it imposes a one-degree displacement to a given arm 3 in the paper unrolling direction, whereas command 13b acts in the opposite way, on the same arm 3.

[0064] Alternatively or in addition to the offsetting commands 13a, 13b, the driving apparatus 7 also comprises a sensor apparatus 22 placed on arms 3 or immediately downstream of reel 5 at a work position and adapted to detect the tractive efforts exerted on the paper or similar material at the reel 5 edges.

[0065] The sensor apparatus 22 comprises an auxiliary roller 23 at which paper carries out a deviation, so as to exert pressure thereon, and sensors or load cells 24 capable of detecting pressures at the ends of this auxiliary roller 23.

[0066] It is pointed out that in Fig. 8 there are shown and denoted by 25 normal conveyor and guide rollers for the paper material or the like unrolled from reel 5.

[0067] Operation of the machine is as follows.

[0068] All arms are first oriented upwardly and, in each arm pair, arms are at the maximum mutual distance so that a power-driven carriage 2b, on which a reel 5 rests, can be freely inserted between them.

[0069] Only after a signal indicating that carriage 2b is correctly inserted between a pair of arms 3, at the base thereof, reaches the control centre 13, descent of arms 3 is operated.

[0070] In addition, first the first and second portions 9 and 10 are maintained in a contracted setting, as shown in solid line in Figs. 4 and 5, i.e. a setting in which the second portions 10 are bent or placed over the first ones.

[0071] The contracted setting is abandoned as arms 3 begin rotating to bring heads 8 at once close to the vertical grasping stretch 12 and then run along it; preferably the contracted setting which is less bulky, may be also abandoned only when, due to rotation of arms 3, the sensor means 20 detects the presence of reel 5.

[0072] At all events, when the sensor means 20 detects the presence of reel 5, a signal is issued and, based on the angular position of the first portion 9, the control centre 13 determines the diameter and placement of the central axis 6 of the reel and, as a result, makes portions 9 and 10 take their final settings so as to dispose heads 8 in alignment with the central axis 6 of the reel.

[0073] When this final position has been reached, arms 3 move close to each other closing the reel clamp-wise, while inserting the spindle assemblies 8a into cores 5b. The flange assemblies 8b are squashed towards arms 3 causing a consequent expansion of keys 8d and locking of reel 5.

[0074] When the reel has been grasped, arms 3 move upwardly and dispose said reel at a raised work position, where the control units 8c adjust and control rotation thereof.

[0075] If the reel 5 or the wound paper show any defect bringing to a greater tensioning of one side of reel 5 during unwinding thereof, an adjustment remedying this drawback can be carried out.

[0076] In fact an angular displacement of a single arm 3 and therefore of the central axis 6 can be operated through the offsetting commands 13a or 13b.

[0077] This displacement is carried out based on empiric controls, by watching how the reel unwinding takes place for example, or on the basis of tensioning data detected by the sensor apparatus 22.

[0078] The sensor apparatus 22 can also directly operate an angular adjustment of one arm 3 and the central axis 6 to obtain displacement of the latter, so that the reel edges have the same tensioning.

[0079] For the unloading cycle, descent of arms 3 is operated until they lay down reel 5 on carriage 2b, if part of the reel 3 is to be returned, or until the end of their stroke if the core 5b alone is to be unloaded. Then arms 3 are moved away and lifted until they reach said starting position.

[0080] Carriage 2b can be started while the machine is waiting for the beginning of a new loading cycle.

[0081] The invention achieves important advantages.

[0082] In fact, the machine lends itself to handle reels of any diameter without requiring manual interventions.

[0083] Therefore, times for placing new or partly used reels to their work position and for returning said reels once they have been partly or fully used are reduced, which will bring about a reduction in the production costs, above all when frequent reel changes are required by the working processes.

[0084] It is in particular pointed out that adaptability of the arms to differentiated reel diameters is obtained through employment of particularly simple mechanical structures for said arms, which results in reduced installation and management costs.

[0085] In addition, the machine is also particularly flexible and adapted to compensate, also in an automatic manner, for reel winding irregularities or irregularities in the base weight of the paper or similar material wound on the reels.

Claims

1. A machine for reel handling, in particular for paper material production lines, comprising: a base structure (2), at least one pair of movable arms (3) con-

nected to said base structure (2), a driving apparatus (7) for moving said arms (3) between a reel loading or unloading position and a work position, and grasping means (8) for said reels supported by said arms (3) at a position spaced apart from said base structure (2),

- characterized in that each of said arms comprises at least two portions (9, 10) which are movable and consecutive with respect to each other, and in that connections (10a, 11) exist between said portions (9, 10) for enabling each of said arms (3) to take a contracted setting and an extended setting defining the minimum and maximum lengths of said arms (3) respectively, and intermediate settings, said driving apparatus (7) selecting the length of said arms (3) appropriate to the sizes of each reel.

2. A machine as claimed in Claim 1, in which said reels have end faces (5a), a central axis (6) and centres (5c) defined by the intersection of said central axis (6) with said end faces (5a), and in which said grasping means (8) engages said reels at said central axis (6), said driving apparatus (7) selecting the length of said arms (3) for disposing said grasping means (8) along grasping stretches (12) defined by said centres (5c) of reels of different diameter in a loading or unloading position.
3. A machine as claimed in Claim 1, in which said base Structure (2) has at least one pivot axis (4), and in which each of said arms (3) has a first portion (9) rotatably in engagement with said pivot axis (4) and a second portion (10) movable relative to said first portion (9) and supporting said grasping means (8).
4. A machine as claimed in Claim 3, in which said second portion (10) is telescopically movable relative to said first portion (9).
5. A machine as claimed in Claim 3, in which said second portion (10) forms an open kinematic chain with said first portion (9).
6. A machine as claimed in Claim 3, in which said connections (10a, 11) are selectively formed by a stem (10a) of said second portion (10) slidable on said first portion (9) and by a hinging axis (11) parallel to said pivot axis (4) and inserted between said first and second portions (9, 10).
7. A machine as claimed in Claim 3, in which said driving apparatus (7), for each of said arms (3) comprises a first fluid-operated cylinder (17) interposed between said base structure (2) and said first portion (9), and at least one second fluid-operated cyl-

inder (18) and, selectively, an electric-control operating unit (26) interposed between said first and second portions (9, 10).

8. A machine as claimed in Claim 1, in which there is sensor means (20) adapted to detect the geometric features of a reel in a loading position.
9. A machine as claimed in Claim 8, in which said sensor means (20) comprises photoelectric elements positioned at said arm (3) and in which said driving apparatus (7) comprises a control centre (13) connected to said sensor means (20).
10. A machine as claimed in Claim 1, in which said driving apparatus (7) comprises a control centre (13) having offsetting commands (13a, 13b) for diversifying the work position of one of said arms (3) relative to the other arm of said arm pair (3).
11. A machine as claimed in Claim 10, in which a sensor apparatus (22) is provided which is connected to said control centre (13) for detecting tensioning of the paper material or the like during unwinding thereof from said reel.
12. A machine as claimed in Claim 11, in which said sensor apparatus (22) comprises an auxiliary roller (23) close to said reel in its work position, and load cells (24) in contact with said auxiliary roller (23).

Fig. 3

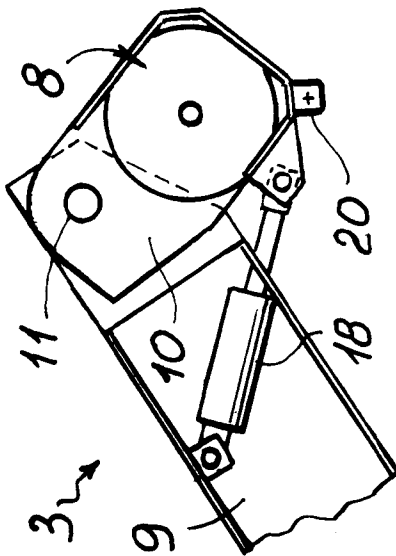
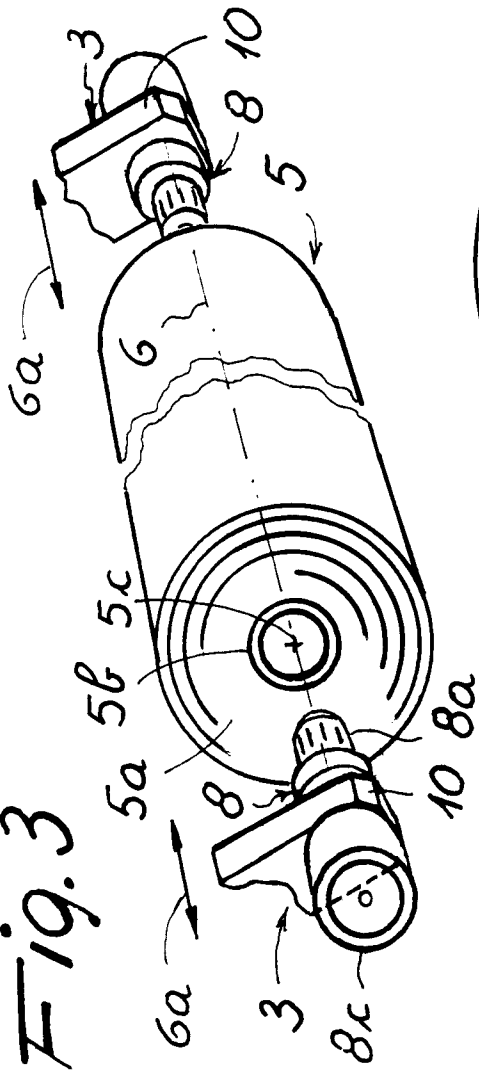


Fig. 2

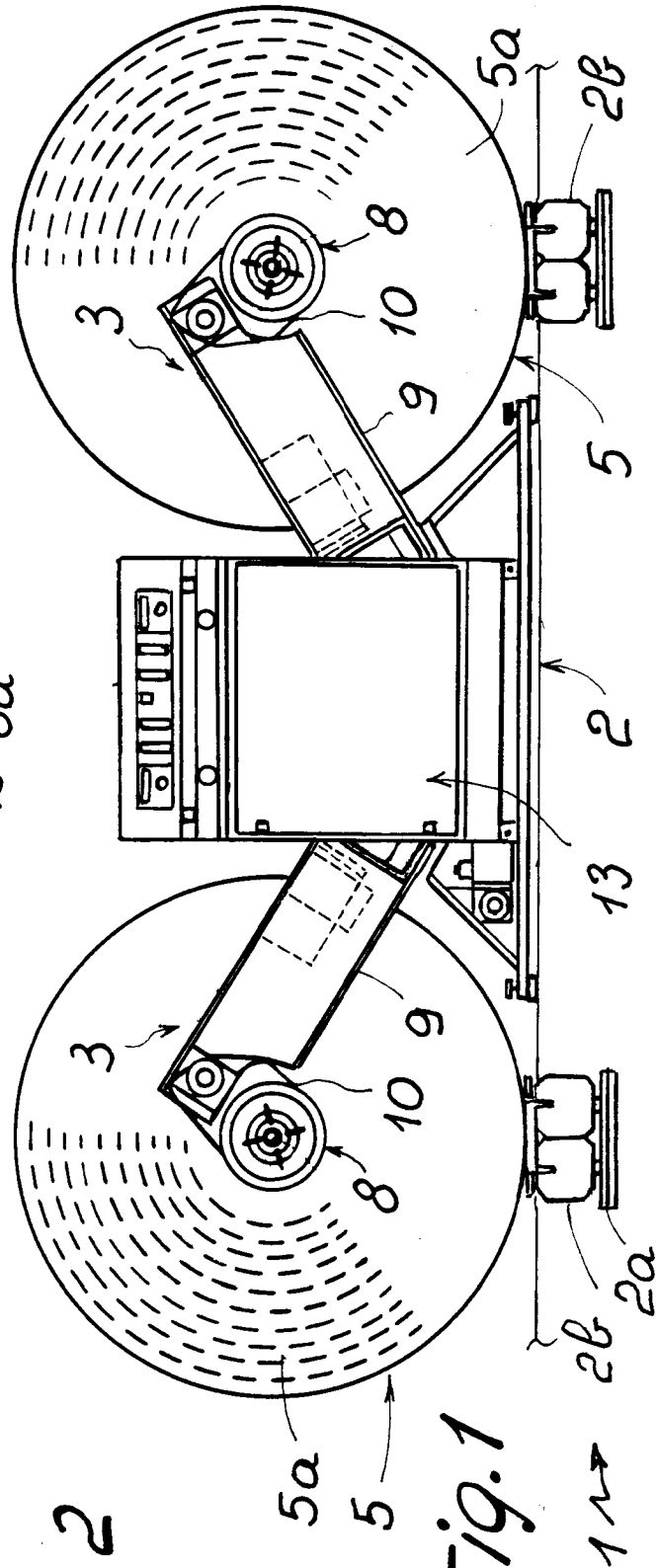
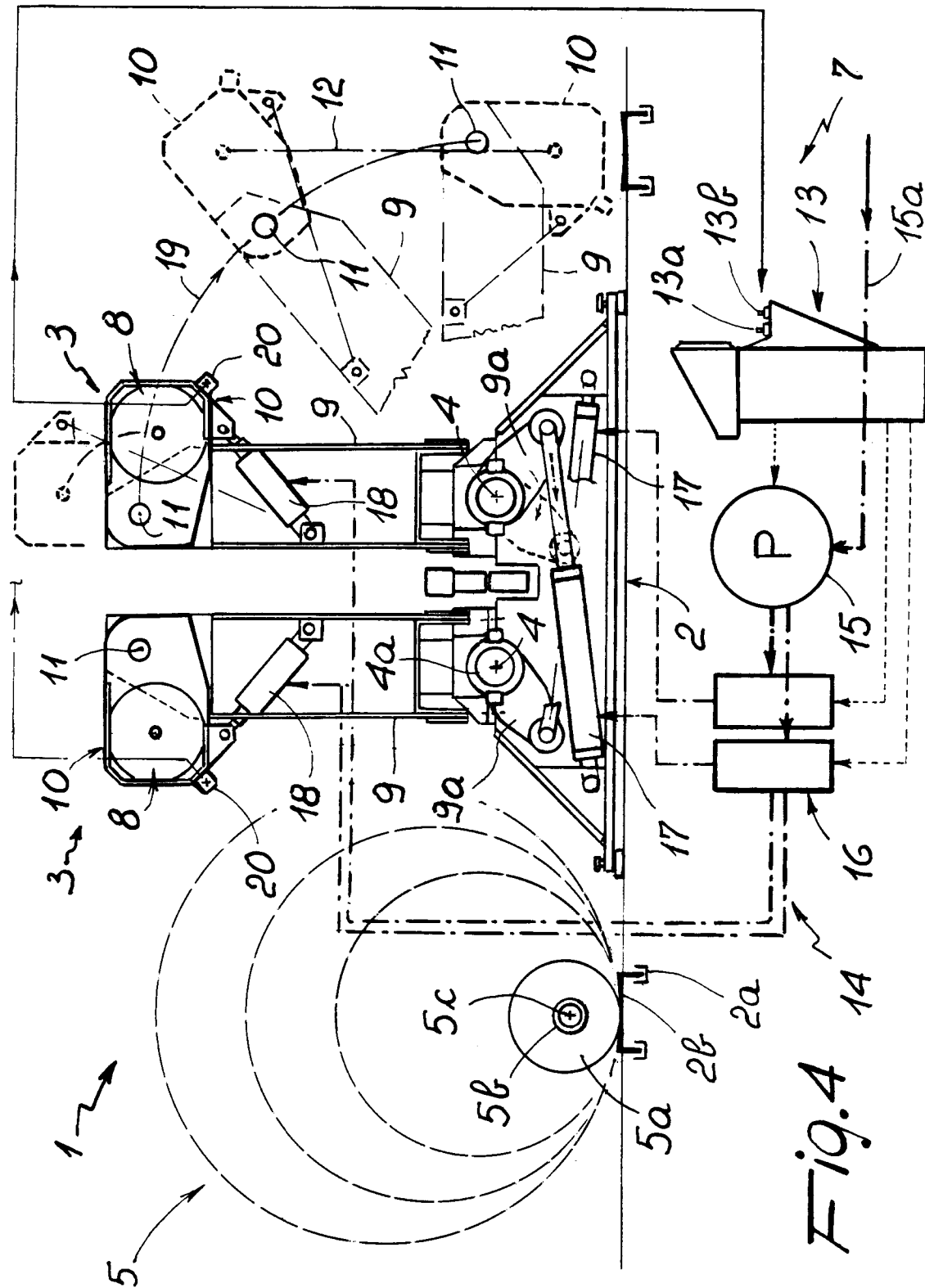
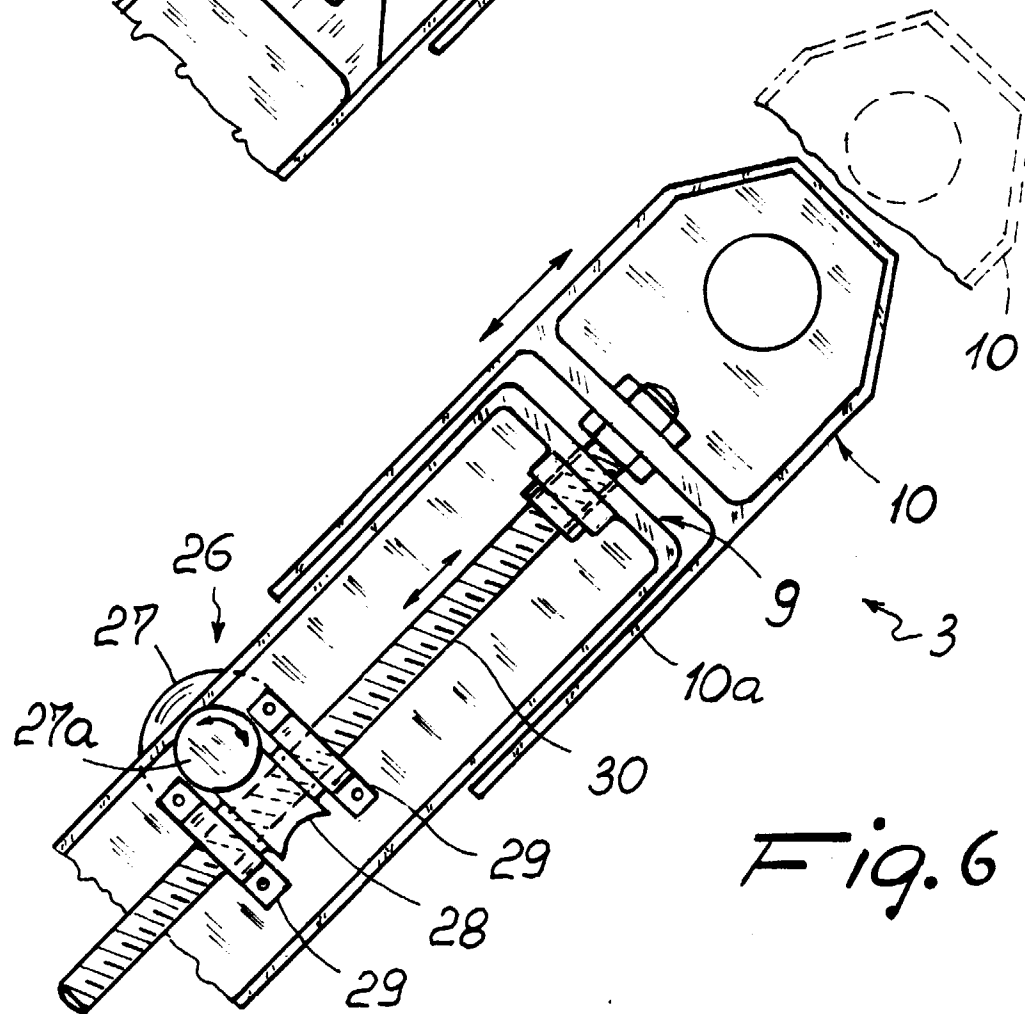
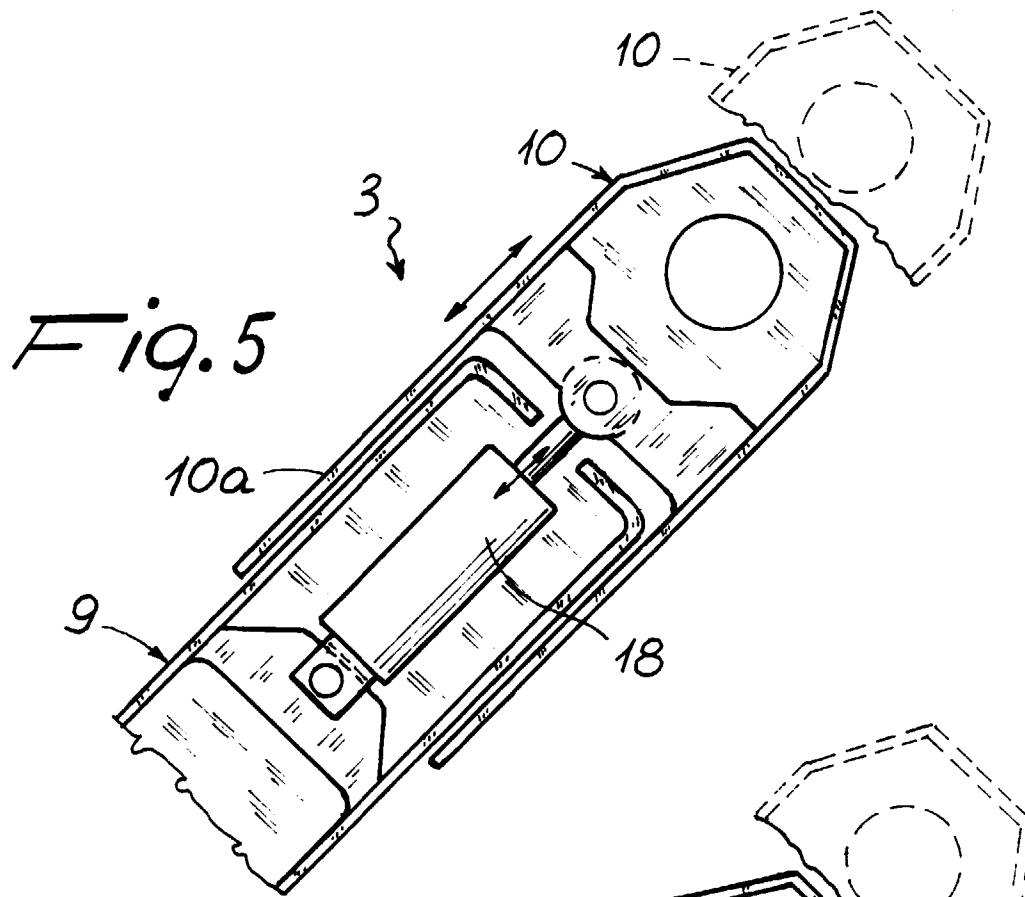
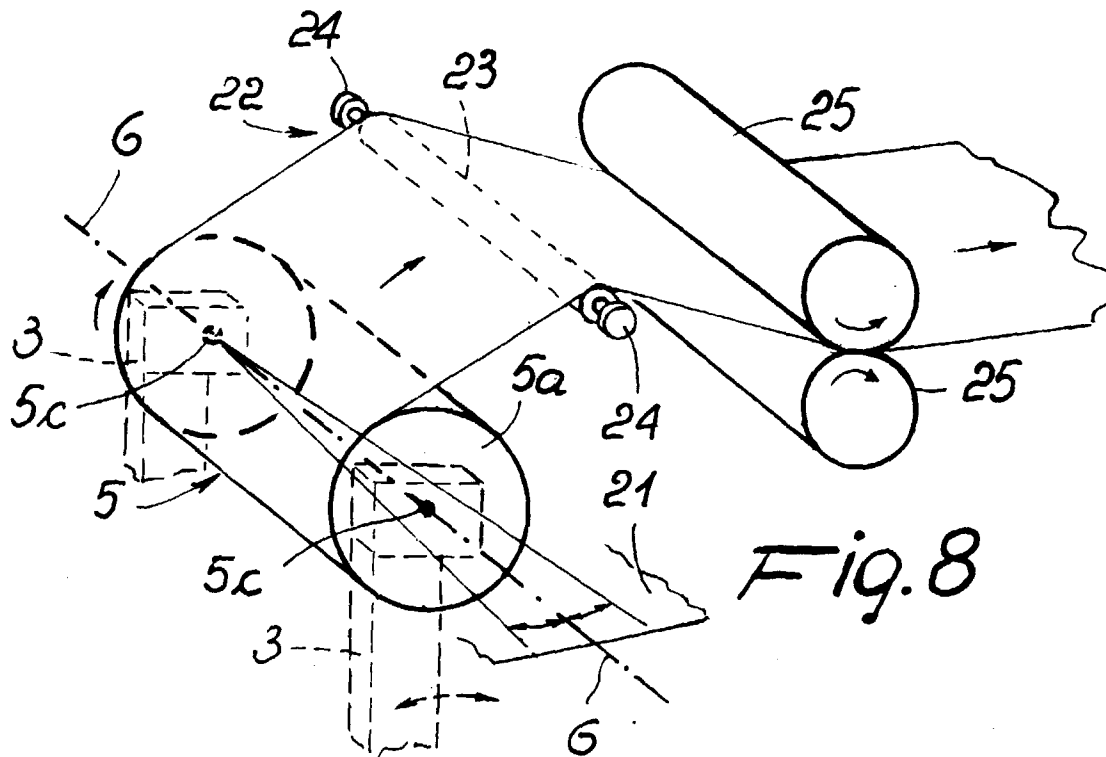
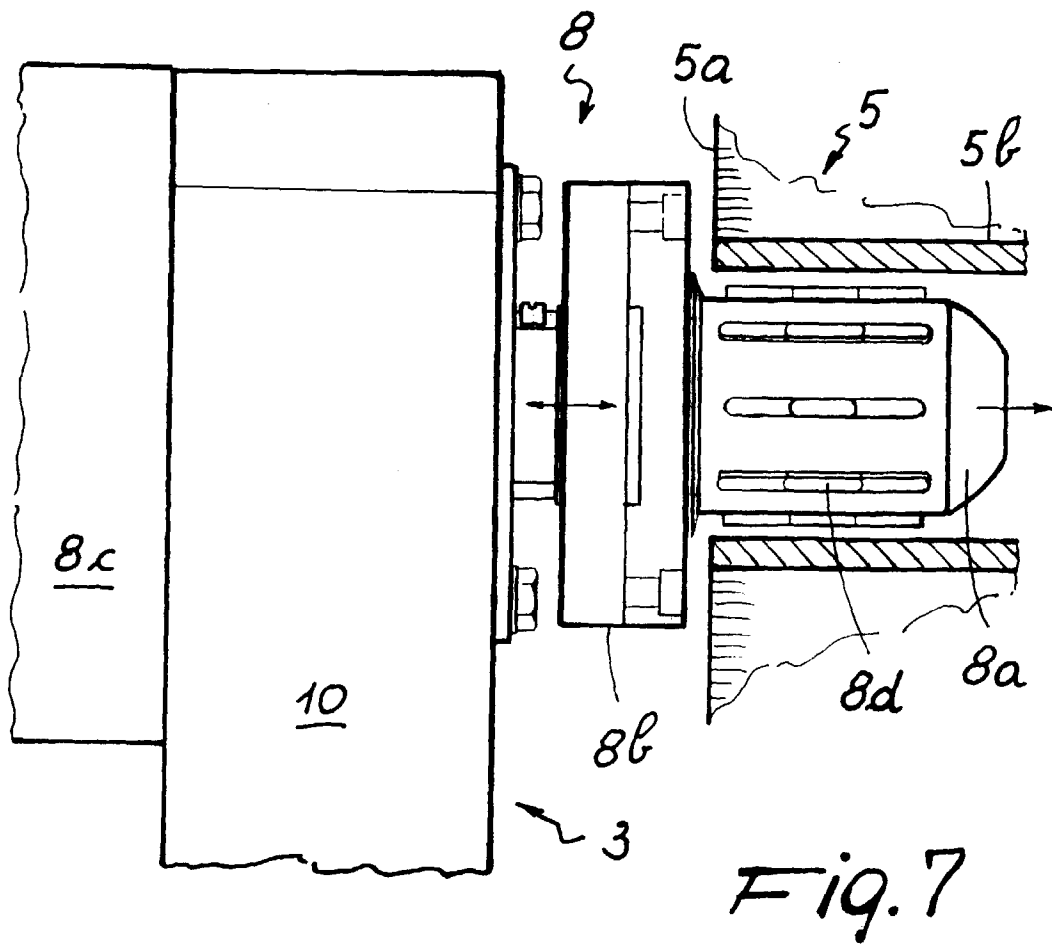


Fig. 1









European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 98 11 1964

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 8 March 1999	Examiner Haaken, W
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 98 11 1964

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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