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(54) **Device for capturing the skein-end during the preparation of the spools to be fed to the automatic winding**

(57) Device for the preparation of the spools fed to an automatic winder comprising means for capturing and holding the thread skein-end by means of suction inside a mouth served from an individual suction system which alternately supplies both high and low depression suc-

tion, consisting of an individual sucking device which individually equips the preparation device with driving means at variable speed-rates for alternately generating a depression value that is high for capturing the skein-end or that is low for the release of the thread, respectively.

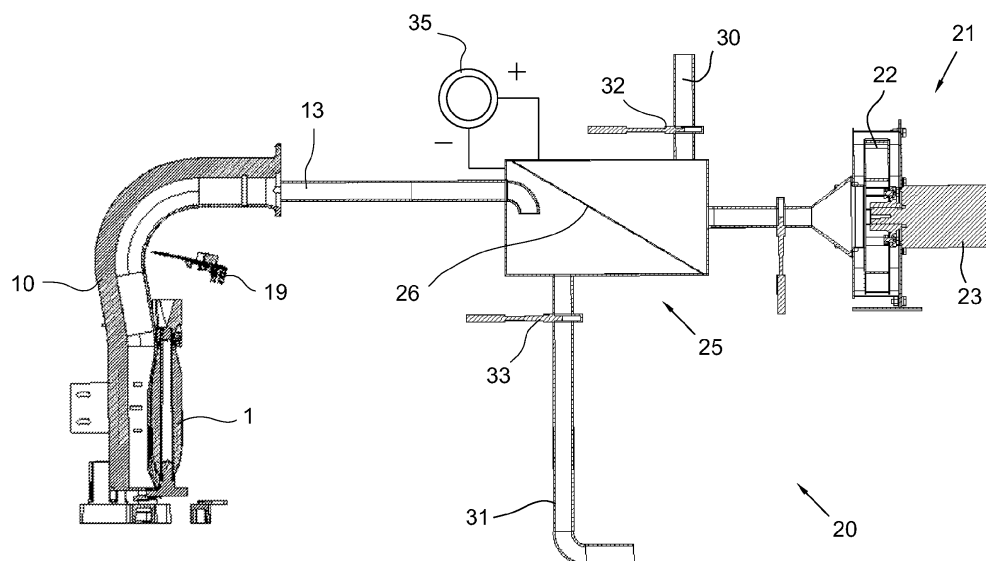


Fig. 2

Description

[0001] The present invention refers to a device for the preparation of the spools to be fed to the automatic winding.

[0002] In the industry there is widespread use of the technique of producing yarns in a first stage of spinning - typically ring-spinning that produces spools of yarn - followed by a second winding stage in which the yarn is unwound from its spool, purified of its defects and re-wound onto a reel, which contains a much greater amount of yarn and that corresponds to a substantial number of processed spools. The winding process is much faster than the spinning and therefore a small number of winding units or stations, of the order of tens units, is capable of processing the production of a great number of spinning units, of the order of thousands units.

[0003] The transfer between the two processes, of the spools full of yarn to the winder and of their empty quills to the spinning frame, can occur "in bulk" i.e. through trolley boxes, or - in so called "thread spin-winders" - by directly and individually transferring the spools to the winding. Generally, the spools from the spinning frame have the end part of their thread wound by a set number of rotations around the package of the spool or at the base of its quill.

[0004] Before being fed to one of the winding stations that form the automatic winder, the spool to be unwound must be prepared, with a process that is carried out in many phases. The end part of the yarn on the spool must be freed from the base of the quill, or from the body of the spool, and unwound from the outer surface of the spool by a certain length. The yarn is then cut to measure and fitted into the upper end of its quill, from which - at the beginning of the unwinding of the new fed spool - the winding station can withdraw it, connect it with the available skein-end on the bobbin and start the winding again. Such a preparation is required both for the new spools coming from the spinning frame and for the spools that have not completely be unwound, that - in the automatic winder - are generally recovered and recycled so as to use up the residual yarn still wound on them.

[0005] As a general rule, the preparation device of the spools is arranged on board of the automatic winder and the carrying out of the preparation cycle is controlled by one of its dedicated control units, that receives the signals from the sensors present in the various parts that form the device and sends the commands for carrying out the various operations of the cycle in succession.

[0006] Such an operation of preparing the spool before feeding it to the winding stations is generally carried out by keeping the spool in an upright position during transportation and its preparation, like for example in patents EP 463.695 and EP 1.932.793 A1 to the same applicant.

[0007] The provision of keeping the spool in an upright position both during transport and in the preparation and unwinding operations, thus transferring and processing the spools without practically touching them, makes it

possible to avoid that the spools are exposed and become soiled or deteriorate through contact with the machine organs. In more recently conceived automatic winders, it is commonly used the technique of moving the full spools and the empty quills, by using peg tray supports to be arranged on conveyor belts or similar machine service movement organs to individually bring said spools and quills in the movements between spinning frame and winder.

[0008] As already illustrated in the previous patent application EP 1.932.793 A1 to the same applicant, the first phase of the preparation operation of the spool consists of the capturing of the thread skein-end wound on it, which in its broadest terms is described in the following description with reference to figure 1.

[0009] In the working position, the spool 1 to be prepared, is kept upright on its peg tray 2 and is centred in a vertical position with a tailstock 3 brought up to the top of the spool itself.

[0010] A motorised roller 5, which is used for setting the spool to be prepared in rotation, is brought up to the base of the peg tray 2 that holds the spool 1, keeping it held and centred with centring organs, like for example a counter-roller 6.

[0011] In the work station, next to the spool 1 being prepared there is a fixed suction mouth 10 that, in its generatrix closest to the spool 1, is equipped with a slit 11 which projects from its base to its curved top 12 that joins it to the duct 13 for connecting to the centralised suction; at the beginning of said duct 13, a valve 14 is inserted for partialising the flow. According to a preferred embodiment of the mouth 10, its vertical portion, which the spool 1 to be prepared is brought up to, is made with a concave-shaped cross-section, like in the enlarged detail of figure 1A in which the part of mouth presented to the spool and containing the slit 11 can be seen, having a winding portion with respect to the spool and that invites the skein-end of the spool to enter into the mouth 10.

[0012] For capturing the skein-end, the mouth 10 is fed with the maximum suction depression from the duct 13, with the valve 14 open to the maximum suction flow rate. In general, the depression values required for holding the skein-end are of between 3500 and 5000 Pascal. The motorised roller 5 is activated by making the spool 1 rotate by a certain number of times in the unwinding direction of the remaining thread arranged around the spool or at its base. Through the effect of the strong suction exerted inside the mouth 10, the slit 11 has a substantial suction effect towards the thread skein-end of the spool being processed and draws it back from the spool itself inside the mouth 10.

[0013] As a general rule, in order to successfully capture the skein-end, the efficiency of the suction is decisive; however, the operation of finding and capturing the skein-end through suction is often assisted by tools that facilitate its detachment from the spool, like brush elements or nail elements, that can be brought up to the generatrix of the spool and made to slide vertically to

intercept the loops of thread and to detach them, whereas the spool 1 is made to rotate in one or the other direction movement. During such a processing phase, the strong suction inside the mouth 10 does not allow the sucked thread to come out from the slit 11 of the curved portion 12 of the mouth 10. Inside the end part of the mouth 10, there is a sensor that indicates the presence of the sucked thread inside it and the successful capturing of the skein-end. Once the thread has been captured and detected, the opening in the valve 14 is made smaller maintaining a "partialised" flow with a low flow rate and low depression and the rotation of the spool 1 is stopped.

[0014] Due to such a low depression suction, the thread 18 is still under tension and can come out from the slit 11 of the curved portion 12 of the mouth 10 - as shown in figure 1 - and enter into the opening of a holding organ 19, from which the subsequent preparation phase through means for fixing the skein-end prepared on the quill, will begin. Generally, the values of low depression sufficient for making the thread come outside from the slit 11 and for obtaining its controlled release - that is to say, the delivery of the thread 18 still tense to the holding organ 19 - are in the range of 200-500 Pascal.

[0015] Inside the holding organ 19, there is a sensor of the thread, that indicates to the control unit of the preparation device of the spool that the delivery of the thread 18 has occurred. The subsequent phase of the process of preparing the spool can, for example, be carried out as illustrated in the mentioned patent application EP 1.932.793 A1 to the same applicant.

[0016] On the other hand, in the case in which the sensor of the skein-end arranged inside the end part of the mouth 10 does not indicate the presence of the thread at the end of the first capturing phase, such a capturing phase can be reiterated - on command of the control unit of the preparation device - for a predetermined number of times, preferably by progressively modulating the procedure of holding the skein-end. If such a reiteration is unsuccessful, the spool is discarded and/or prepared manually by the workers.

[0017] In any case, the reiteration of the capturing phase of the skein-end is a substantial loss of time and of productivity of the unit for preparing the skein-end, so that it requires to install in winders consisting of a high number of winding units a plurality of preparation units of the spools arranged in parallel, thus ensuring the feeding of the winding units with the required spools.

[0018] In general, the processing rate of the spools in the preparing device corresponds to an overall processing time not longer than 3-5 seconds for each spool.

[0019] There is thus the need to ensure maximum efficiency of the initial operations of finding, detaching and capturing the skein-end, so as to obtain the holding of the skein-end at the first attempt. Generally, the greatest difficulties in detaching and capturing the thread, come from the very hairy or twisted yarns, and the modulation of the procedure concerns both the ways in which the spool 1 is rotated, and the ways in which the tools helping

to detach the thread are brought up, as well as the suction method.

[0020] In the prior art, according to the diagram illustrated with reference to figure 1, the suction derives from a collective suction manifold that equips the winder to which the duct 13 is connected, modulating its depression induced in the mouth 10 with the valve 14. The derivation of the suction from a common service does not allow a high capturing efficiency, since the suction depression value available when the valve 14 is open cannot be increased; on the contrary, it is negatively influenced when other organs of the winder simultaneously require the suction service, leading to a reduction of such a depression value. There is also the drawback of the common collective suction manifold having an own substantial volume and so having a substantial inertia with respect to the depression variations required by the single units to which it is connected.

[0021] The present invention is aimed at the preparation of the spool, in which the procedure of capturing and withdrawing the skein-end from the spool is carried out with an autonomous modulation of the suction exerted on the spool being processed.

[0022] The invention shall be described hereafter with reference to an its typical embodiment on board of an automatic winder.

[0023] The present invention, in its most general embodiment of a preparation device of the spool, is defined in the first claim. Variants or preferred embodiments are defined in claims from 2 to 9.

[0024] The characteristics and the advantages of the device and of the preparation process of the spools according to the present invention shall become clearer from the description of a typical embodiment thereof, given as an example and not for limiting purposes, illustrated in figure 2. Figure 1, however, refers to the prior art and explains the technical problem.

[0025] In the example embodiment shown in figure 2 there are again the same components as in figure 1 with the relative reference numerals, except for the suction device in which the suction comes from a collective suction manifold that equips the winder. The suction device now consists of an individual sucking means 20 which individually equips the preparation device of the spools according to the present invention. In order to clarify the drawing, the components of the suction device 20 according to the invention are shown enlarged with respect to the preparation device.

[0026] As already outlined, the operation of the preparation device is driven by a dedicated control unit - not indicated in the figure for the sake of simplicity - that receives the signals from the sensors present in the various parts that form the preparation device of spools, processes and sends the commands for successively carrying out the various operations of the cycle.

[0027] In the technical solution shown in figure 2, an individual suction unit 20 is foreseen serving the preparation device of the spool. Such a suction unit consists

of a rotary suction device 21 with a rotor, or propeller, 22 actuated with an electric motor 23 driven to operate with a rate varying each time in relation to the suction requirements. According to the embodiment of the invention illustrated as an example in figures 2 and 3, such a rotary suction device is a centrifugal suction device. According to a preferred embodiment of the invention, the motor 23 is a brushless electric motor driven in frequency from the control unit of the winding unit. Such a technical solution makes it possible to vary the high depression value, that is necessary for detaching the thread 18 from the spool 1 and holding it.

[0028] Finally, the device is provided with driving means at variable rates from the control unit of the preparation device for alternately generating - with the suction device 20 - first a high depression value for capturing the thread skein-end 18 inside the holding organ of the skein-end and, and in this case as an example and not for limiting purposes with reference to the device illustrated in the mentioned patent EP 1.932.793 A1, inside the fixed mouth 10 and then a low depression value for causing its release from the slit 11 for its subsequent manipulation, in this case as an example and not for limiting purposes with reference to the device illustrated in the mentioned patent application EP 1.932.793 A1, starting from the holding organ 19. The control unit is connected with the thread presence sensors and operates based upon the signals received by said sensors. In particular - for each new spool that arrives at the station - the control unit drives a suction period with high depression until the sensor inside the mouth 10 indicates the presence of the thread; after such a signal, the control unit commutates the control to the motor 23 to operate at low speed with a low depression suction, until the sensor inside the holding organ 19 indicates the presence of the thread. After a brief time period, the operation is repeated when a further spool arrives at the station.

[0029] On the duct 13, connecting to the rotary suction device 21, there is a mesh filter 25 that has the essential function of holding the portions of thread in excess, conveyed by suction to enter into the duct 13 and released by the holding organ 19, at the start of the subsequent preparation phase of the spool.

[0030] The filter 25 consists of a container interposed along the duct 13, in which a mesh 26, for holding the sucked material and in particular the portions of thread in excess sucked by the mouth 10, is arranged. The material accumulated in the filter 25 is periodically discharged by pneumatic transportation, by opening the ducts 30, 31 that connect to the outside, for actuating the respective gate valves 32, 33. Alternatively, the filter 25 can be emptied out by injecting compressed air from the duct 30, or by exerting suction from the duct 31.

[0031] According to an improved embodiment of the present invention, across the filter 25, a pressure drop measuring device 35 is installed, currently indicated as "ΔP meter", as shown in figure 2. The measuring and the knowledge of the degree of saturation or obstruction of

the mesh 26 of the filter 25, makes it possible to carry out the cleaning of the filter, no longer at a predetermined time, but only when the filter reaches a predetermined value of pressure drop. Such knowledge also makes it possible to possibly compensate such a pressure drop by graduating the suction for holding the thread.

[0032] The operation of the individual suction unit 20 dedicated to the preparation device of the spools for the winding according to the present invention is illustrated with reference to the figures 3A-C. These are examples of the trend of the suction depressions, of the flow rates and of the powers required by an individual centrifugal suction device at the service of the preparation device of the spools for the levels of high and low depression. Figure 3A, for a centrifugal suction device like the suction device 21, shows the characteristic trend of the suction depression ΔP in Pascal as a function of the flow rate in mc/h, parameterised on different rotation rate values. Figure 3B, for said centrifugal suction device, shows the characteristic trend of the absorbed power, again as a function of the flow rate in mc/h, parameterised on different rotation rate values. Figure 3Bbis shows an enlarged view of such a trend for the low depression values. Figures 3C and 3Cbis, on the other hand, - as an example - show the characteristic trend of the depression ΔP required by the preparation unit when it is alternately required for there to be the suction of the skein-end inside the mouth 10 and the coming out of the thread 18 from the slit 11 with rectilinear development to enter the holding organ 19. Figure 3Cbis shows the enlarged detail of the trend for the low depression values.

[0033] The characteristic trend of the figures 3C is a function of the geometry of the system and it is combined with the characteristic curves of the suction device 20 according to figures 3A and 3B. Based upon the characteristic curve in broken line of the holding system of the thread skein-end made up of the mouth 10 shown in figures 3C and 3Cbis, during the capturing of the thread inside the slit 11, from the figure 3C it can be gathered that the rotation rate can vary between 7000 and 10000 revs/min to give the high depression values of 3000-5000 Pascal. From figure 3B it can be gathered that during the time of operation at high speed to take the skein-end from the spool - with said intervals of high depression and high rotation speed ranges - the motor 23 absorbs from 0.7 to 2kW. For the subsequent release of the thread, from figure 3Cbis it can be gathered that the values of low depression, sufficient to make the thread come out from the slit 11 and to deliver it still tense to the holding organ 19, are in the range of 200-500 Pascal and correspond to 1500-2500 revs/min. From the figure 3Bbis it can be gathered that during the time of operation at low speed - with said low depression and low rotational speed ranges - the motor 23 absorbs negligible power.

[0034] Finally, the motor 23 is required to have a speed with pulsations with period of a few seconds, in which the motor alternately rotates to give high and low rotation speed to the rotor, or propeller, 22, which in turn gener-

ates the high and low depression that cause first the capturing of the thread skein-end 18 from the spool 1 inside the mouth 10 and then the release of the thread 18 from its slit 11 for its manipulation starting from the holding organ 19. Considering the fact that the preparation device of the spools substantially operates continuously and with a pulsating rhythm, a preferred embodiment of the present invention foresees the use of a brushless motor equipped with cooling to have a control of its operation temperature.

[0035] Based upon the signals obtained by the thread presence sensors inside the mouth 10 and the holding organ 19, the control unit of the preparation device of the spools is capable of adjusting the suction duration and depression to what is strictly necessary to ensure the capturing of the skein-end from the spool.

[0036] Compared to the preparation systems of the spools available in the prior art, the skein-end holding device for the preparation of the spool according to the present invention offers substantial advantages and amongst these at least the following deserve to be briefly mentioned.

[0037] With respect to the technical solutions currently in use that, for the preparation of the spools, use a centralised suction service on board of the winder, the exerted suction values of the individual sucking device 20 can be modulated according to the contingent requirement of the single spool, according to the signals obtained by the sensors. For example, the detachment and the holding of the skein-end can be obtained by exerting an increasing suction depression, according to a predetermined rotation rate "ramp" of the suction device 21, starting from a certain initial rotation rate value of the motor 23 and increasing it according to a predetermined acceleration up to the maximum allowed value, until the sensor inside the mouth indicates the presence of the thread. Such a strategy practically eliminates the reiteration needs of the capturing of the skein-end.

[0038] Again for example, the initial value of the rate "ramp" can be periodically set based upon the statistics of the rate values at which the holding of the skein-end have occurred over a previous discrete period of time.

[0039] With the device according to the present invention, the values of suction depression available can be adjusted according to the requirements and there is no influence of other organs of the winder. The direct connection of the suction device 20 to the preparation device without common manifolds eliminates the inertia of the system itself and reduces energy consumption for the suction services.

Claims

1. A device for the preparation of the spools fed to an automatic winder comprising means for capturing and holding the thread skein-end (18) wound onto the spool (1) supported by a peg tray (2), by means

of its suction inside a holding organ (10), means for the subsequent release and delivery of the thread to a thread holding organ (19) and means for fixing the skein-end prepared on the spool quill, **characterized in that** the device is provided with an individual suction system (20) which individually equips the preparation device, said individual suction system (20) being provided with driving means at variable rates, from the control unit of the preparation device for alternately generating the depression values required first for capturing and holding the thread skein-end (18) from the spool (1) and subsequently for causing the controlled release of the thread (18) for its manipulation, starting from the holding organ (19).

2. A device for the preparation of the spools fed to an automatic winder which comprises means for capturing and holding the thread skein-end (18) wound onto the spool (1) supported by a peg tray (2) by means of its suction inside a fixed mouth (10), through an its slit (11) situated in the generatrix of said mouth (10) closest to the spool (1), and means for its subsequent controlled release outside the slit (11) for the delivery of the thread to a thread holding organ (19), wherefrom the subsequent phase of the spool preparation is initiated, essentially consisting in cutting the thread to measure and inserting it into the upper end of the spool quill, said preparation device being served by a suction system which alternately supplies both high and low depression suction, **characterized in that** said suction system consists of an individual sucking means (20) which individually equips the preparation device, said individual sucking means (20) being provided with driving means at a variable rate from the control device of the preparation device, for alternately generating first a high depression value for capturing the skein-end of the thread (18) from the spool (1) inside the fixed mouth (10) and subsequently a low depression value for causing the controlled release of the thread (18) from the slit (11) for its manipulation starting from the holding organ (19).

3. The device for the preparation of spools according to claim 2, **characterized in that** the individual sucking means (20) consists of a centrifugal suction device (21) with a rotor, or propeller, (22) activated with an electric motor (23) driven to operate from the control unit of the device with a rate varying each time in relation to the suction requirements.

4. The device for the preparation of spools according to claim 3, **characterized in that** the motor (23) is a brushless electric motor driven in frequency by the control unit of the device.

5. The device for the preparation of spools according

to claim 4, **characterized in that** the motor (23) is a brushless electric motor equipped with cooling.

6. The device for the preparation of spools according to claim 2, **characterized in that**, for the commutation of the depression values first for capturing the skein-end from the spool (1) and then for causing the release of the thread (18) from the slit (11) to the holding organ (19), there are thread presence sensors situated inside the fixed mouth (10) and organ (19) connected to the control unit of the device. 5 10
7. The device for the preparation of spools according to claim 4, **characterized in that** the motor (23) is a brushless electric motor driven frequency from the control unit of the device alternately at a rate of 7,000-10,000 revs/min for generating high depression and at a rate of 1,500-2,500 revs/min for generating low depression. 15 20
8. The device for the preparation of spools according to claim 3, **characterized in that** the individual suction device (20) is equipped with a filter (25) provided with periodic discharge means. 25
9. The device for the preparation of spools according to claim 8, **characterized in that** the filter (25) is provided with pressure drop measurement means (35). 30

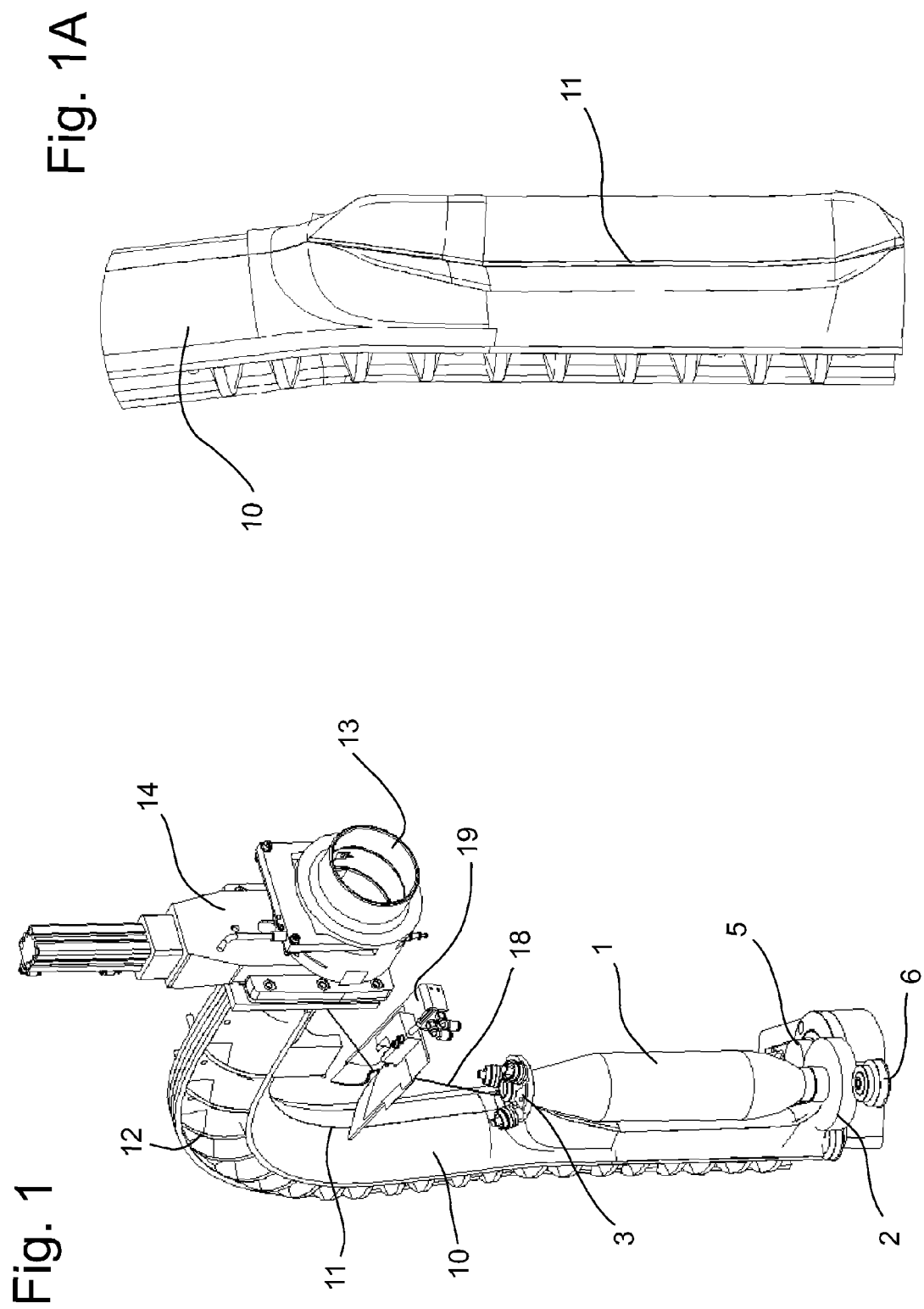
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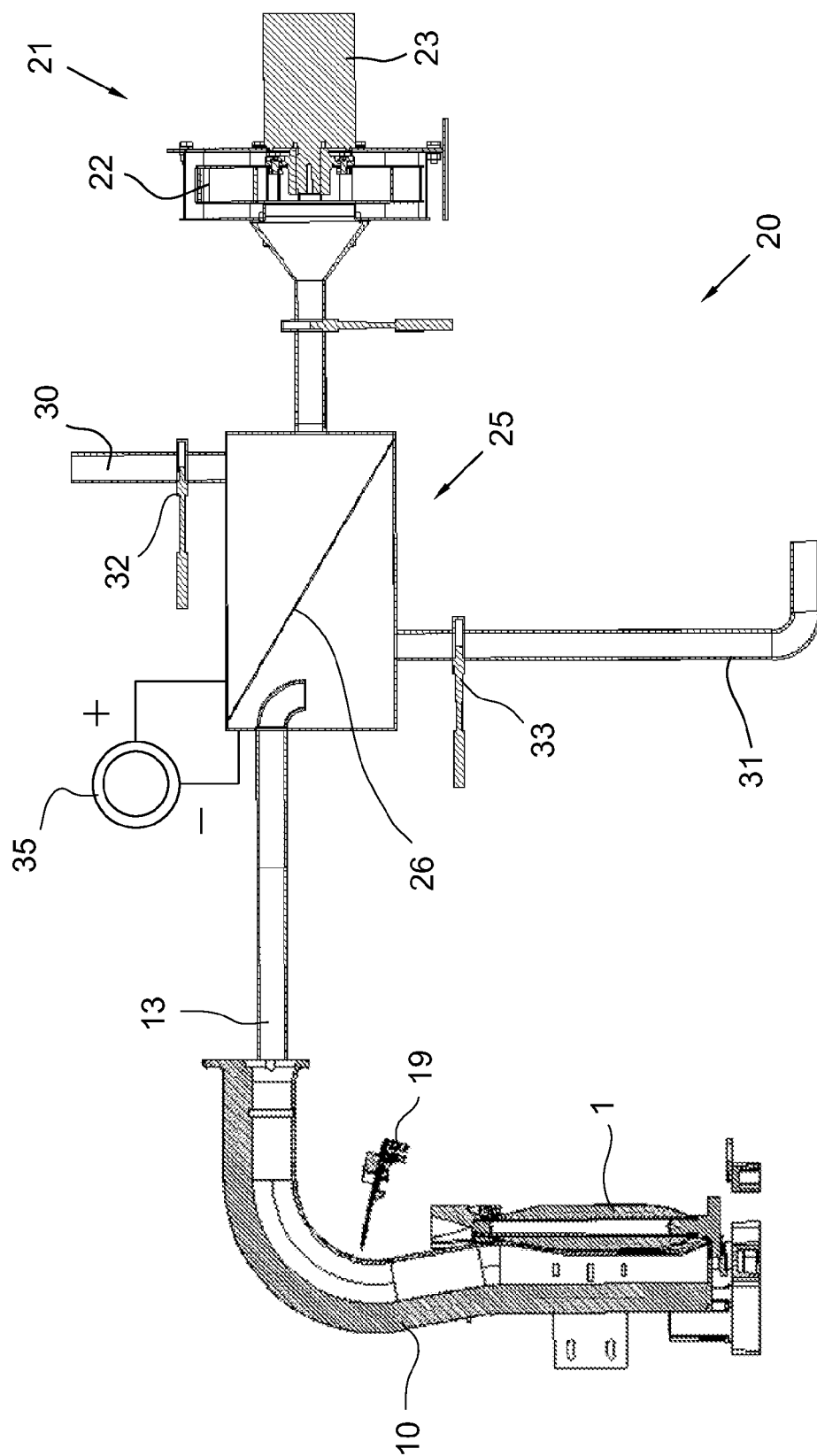


Fig. 2

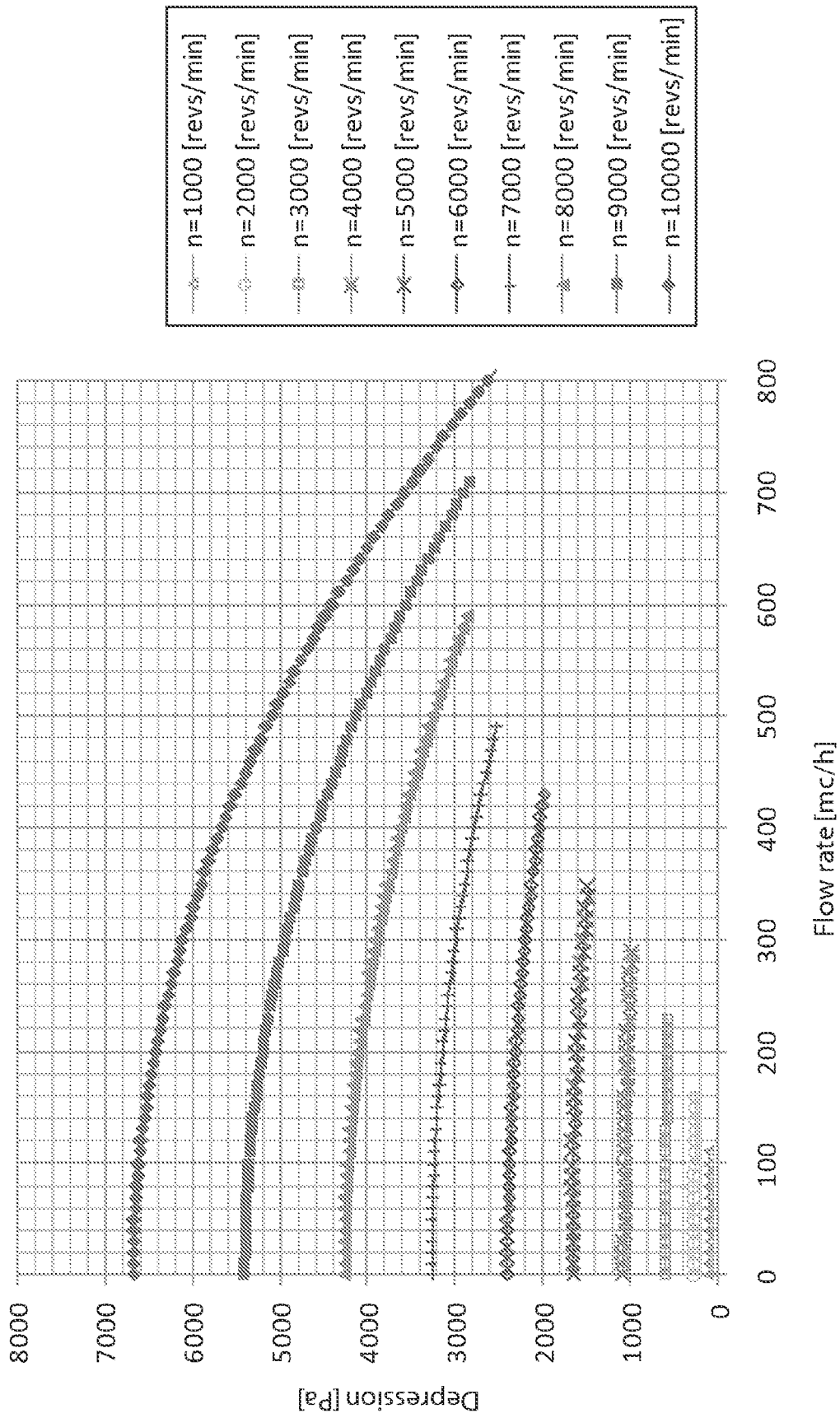


Fig. 3A

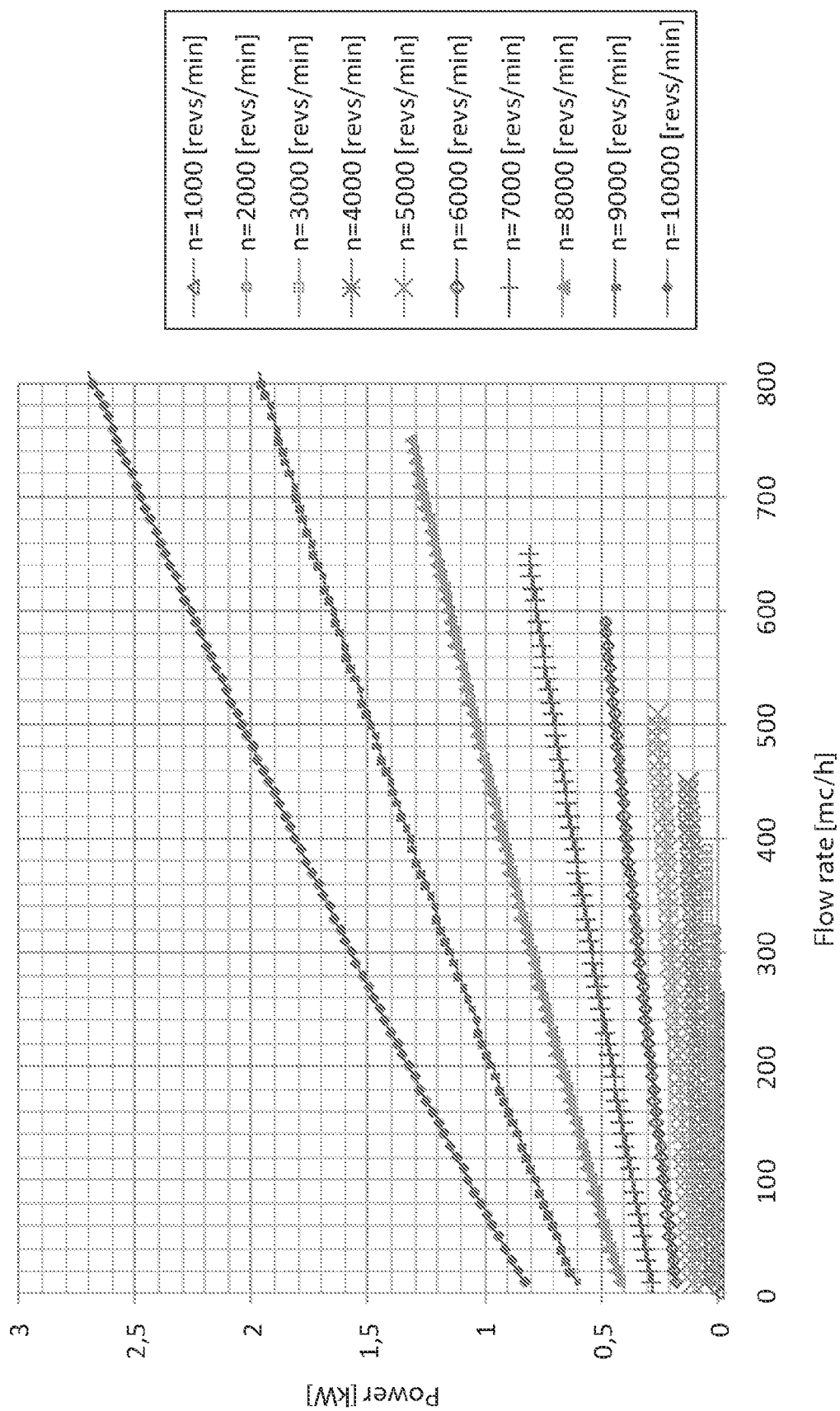


Fig. 3B

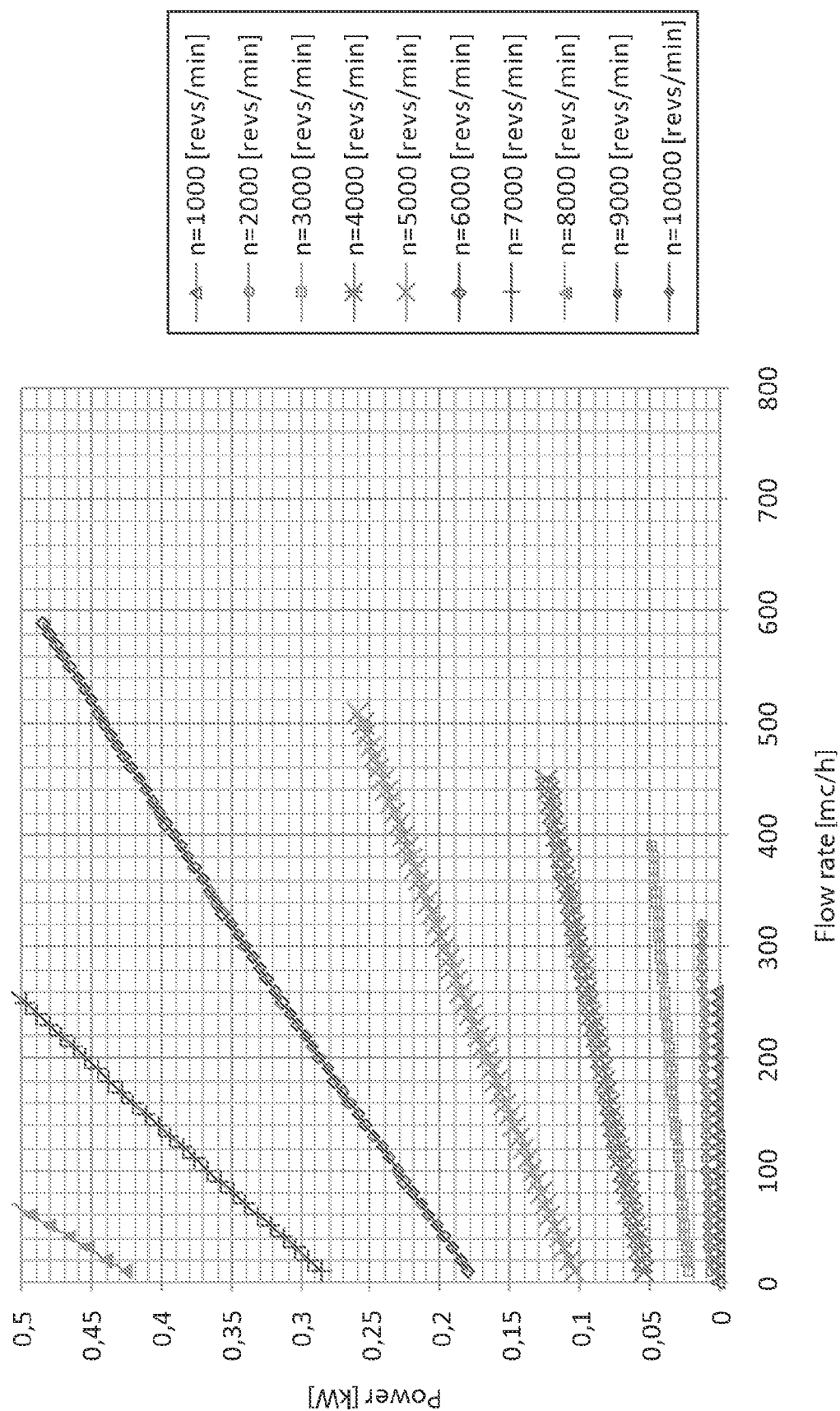


Fig. 3B bis

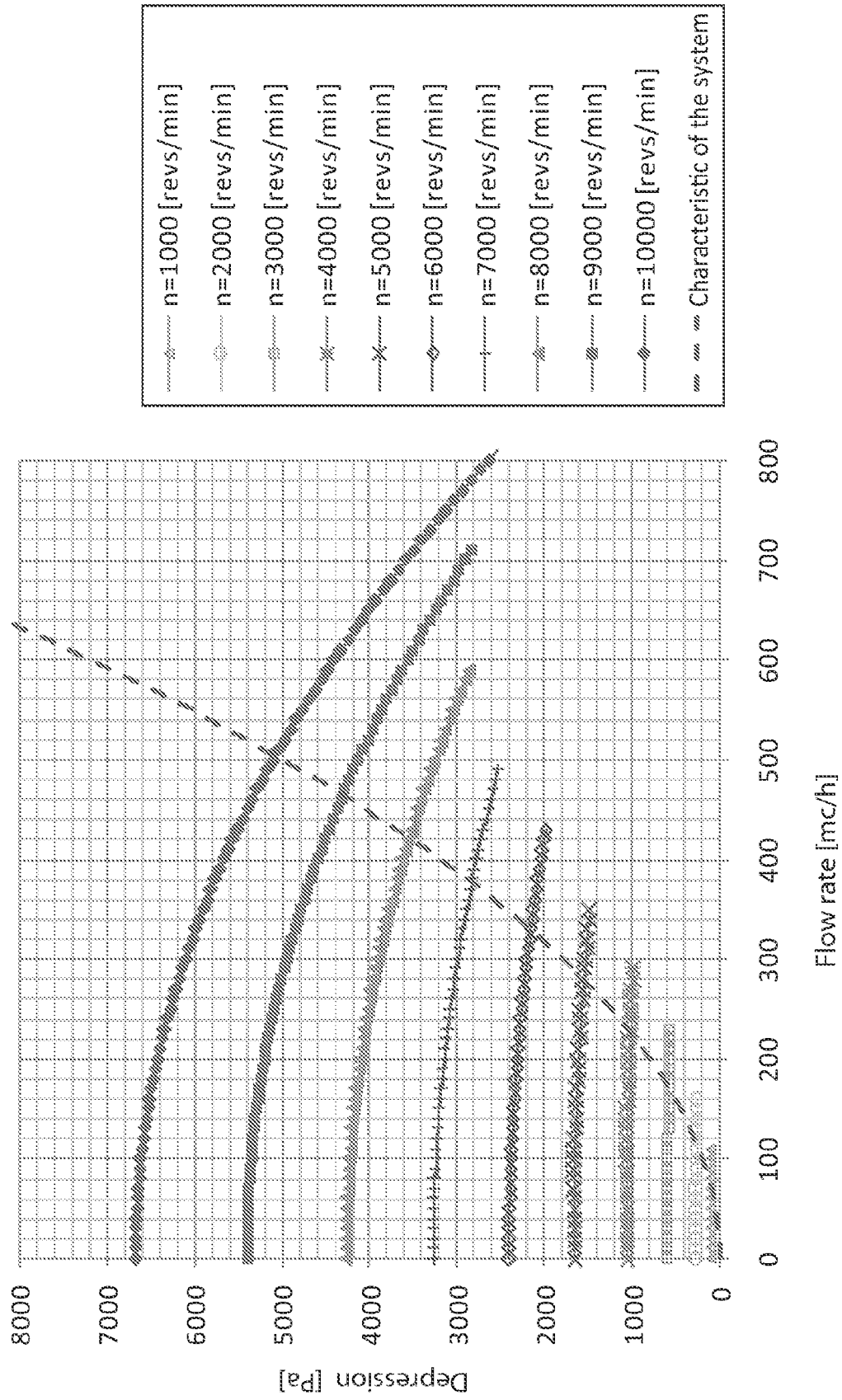


Fig. 3C

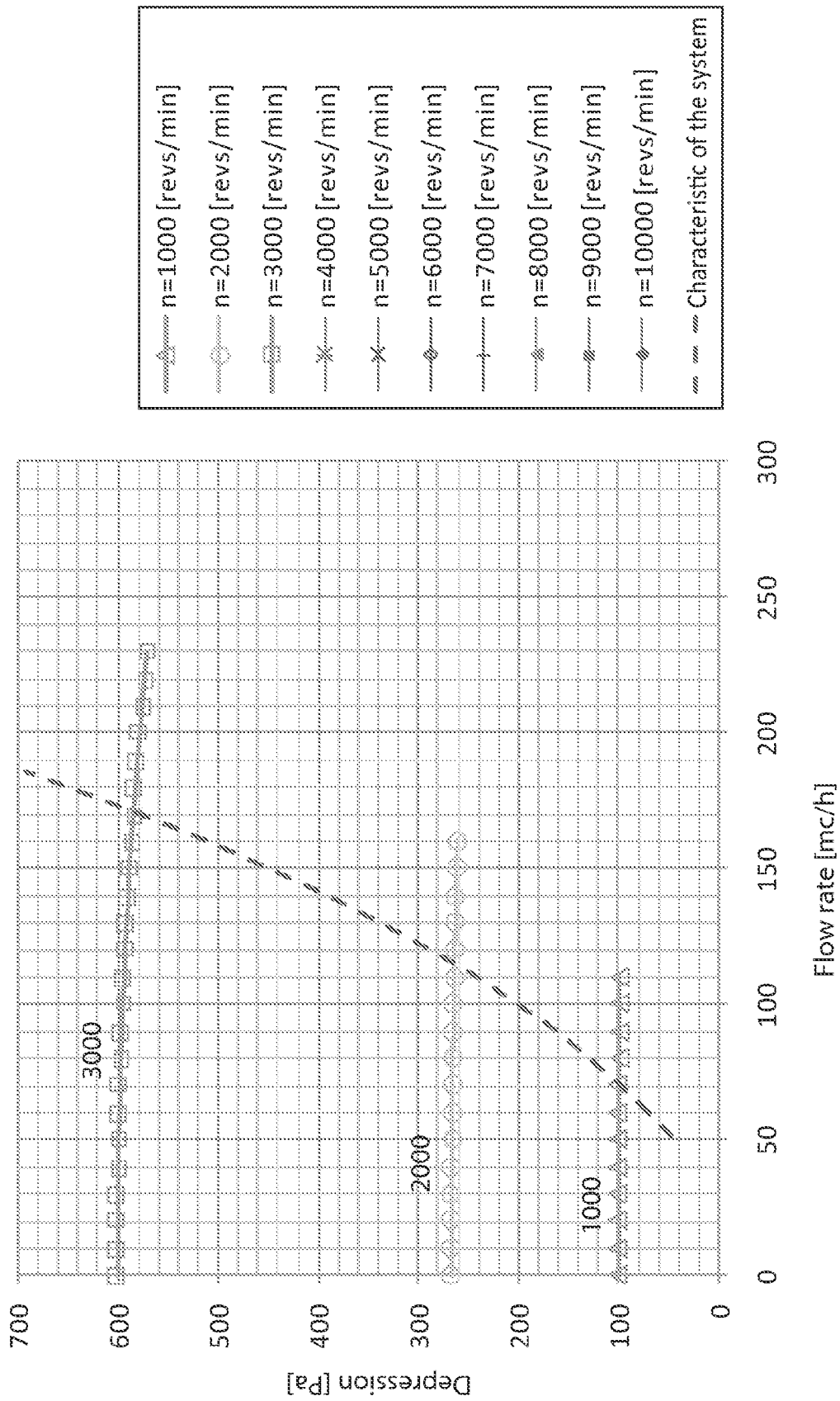


Fig. 3C bis



EUROPEAN SEARCH REPORT

Application Number
EP 10 18 9706

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	EP 0 962 417 A1 (SCHLAFHORST & CO W [DE]) 8 December 1999 (1999-12-08) * figure 2 *	1,2	
			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		9 February 2011	Pussemier, Bart
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			

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

EP 10 18 9706

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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