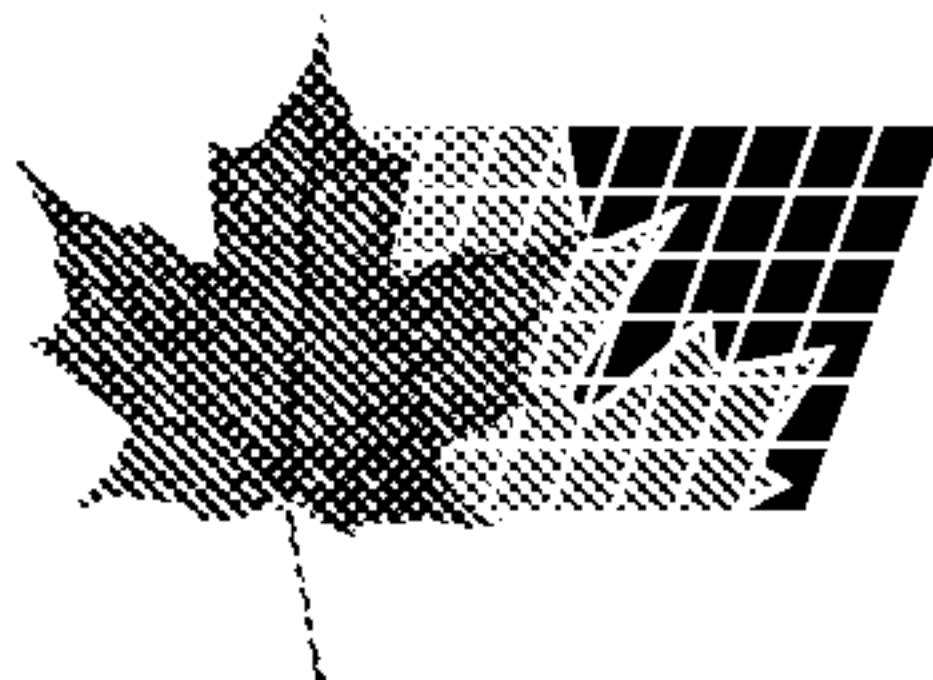




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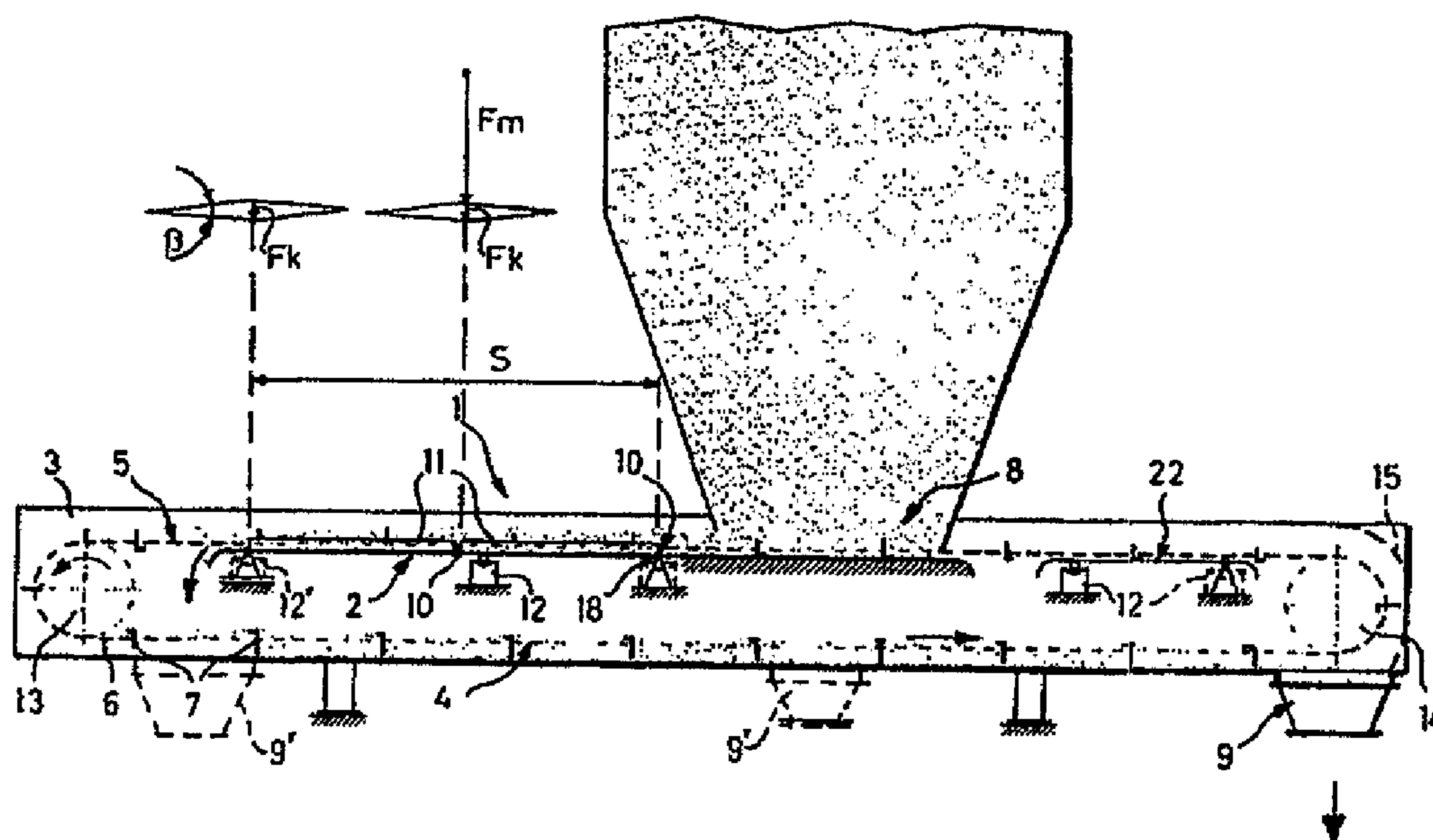
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(54) TRANSPORTEUR A CHAÎNE

(54) CHAIN CONVEYOR



(57) Afin d'améliorer la précision de mesure/dosage d'un transporteur à chaîne (1) tout en gardant une construction simple, au moins une section de mesure (S), notamment un pont de mesure (2), est placée entre l'ouverture d'entrée et l'ouverture de sortie (8, 9) et s'appuie sur au moins un dispositif de mesure de force (12). Le transporteur à chaîne (6) est guidé le long du pont de mesure (2) par des éléments de guidage (11) fixés sur les côtés du pont, notamment des rails de section cruciforme. Une partie du pont de mesure (2) peut être placée découplée à l'aide d'éléments intermédiaires (10) flexibles afin d'agir sur le dispositif de mesure de force (12) distant avec compensation des forces de chaîne (Fk).

(57) The aim of the invention is to provide a chain conveyor (1) with a more precise measuring/metering capacity and a simple construction. To this end, at least one measuring section (S), preferably a measuring bridge (2), is located between an inlet opening and an outlet opening (8, 9) and is supported on at least one force-measuring device (12). The conveyor chain (6) is guided along the measuring bridge on guiding elements (11) which are fixed at the sides, especially rails with a cross-shaped section. Part of the measuring bridge (2) can be arranged with flexible intermediate elements (10) in such a way that it is decoupled, so that the chain forces (Fk) are compensated as the force-measuring device (12), which is set apart, is impinged upon.



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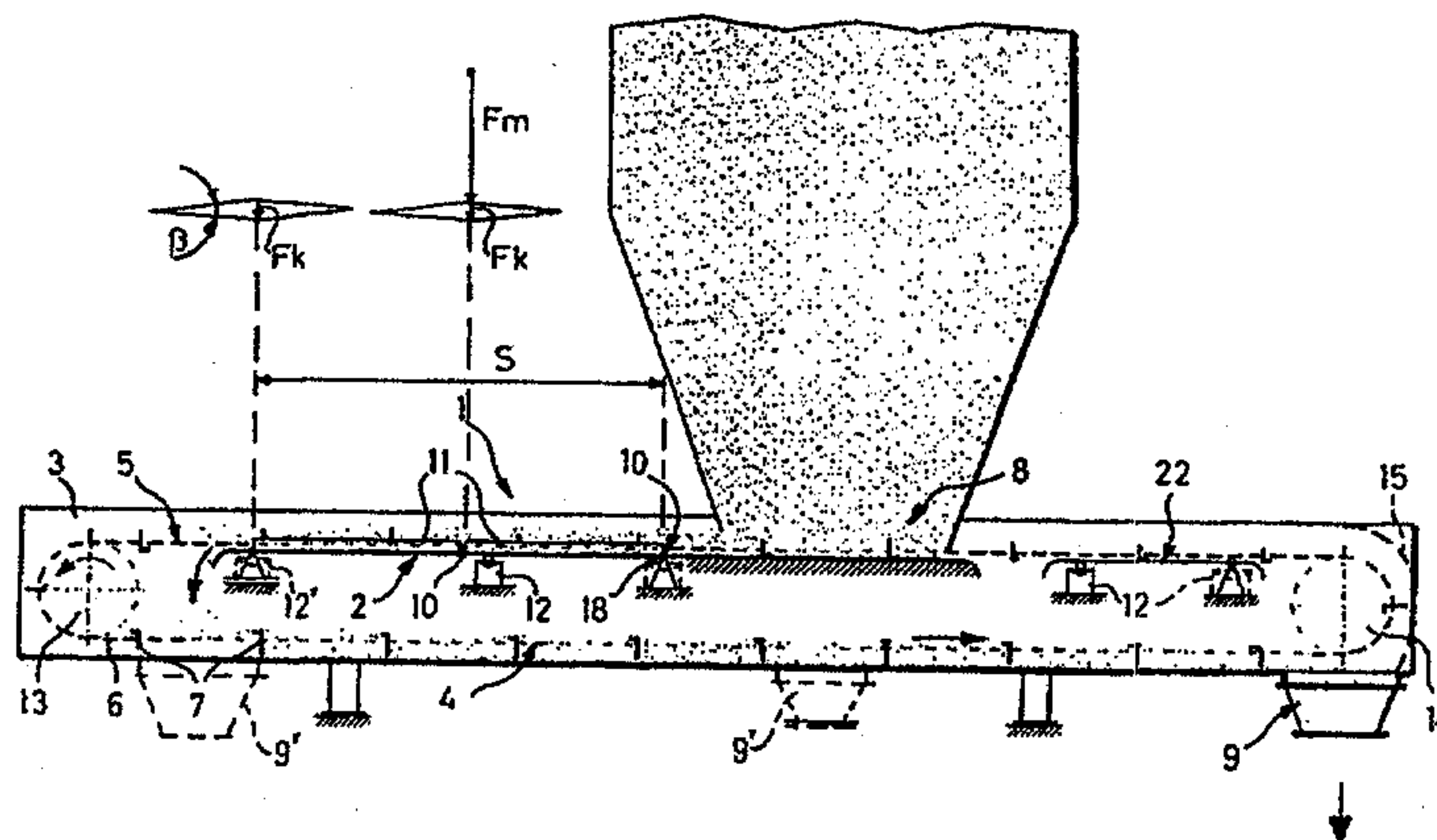
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(54) Title: CHAIN CONVEYOR

(54) Bezeichnung: KETTENFÖRDERER

**(57) Abstract**

The aim of the invention is to provide a chain conveyor (1) with a more precise measuring/metering capacity and a simple construction. To this end, at least one measuring section (S), preferably a measuring bridge (2), is located between an inlet opening and an outlet opening (8, 9) and is supported on at least one force-measuring device (12). The conveyor chain (6) is guided along the measuring bridge on guiding elements (11) which are fixed at the sides, especially rails with a cross-shaped section. Part of the measuring bridge (2) can be arranged with flexible intermediate elements (10) in such a way that it is decoupled, so that the chain forces (Fk) are compensated as the force-measuring device (12), which is set apart, is impinged upon.

Description

Chain Conveyor

This invention relates to a chain conveyor with the pre-characterizing features of claim 1.

Such chain conveyors are used in particular to convey bulk materials. In years past such chain conveyors have been used increasingly in basis materials industries (e.g. in coal mining or cement manufacture) to meter or determine the feed rate of bulk materials, since they facilitate a construction which resists wear with high throughput on account of their large abstraction power. In addition a chain conveyor is relatively inexpensive to make and service and can be set up without problem, so that - because of its robust construction - it is suitable as a hopper abstraction unit even for abrasive, coarse grained or sticky bulk materials, as is described in ZKG (Zement-Kalk-Gips [= Cement-Chalk-Gypsum]) No. 7/1993, p. 380.

A disadvantage with the usual structure of a chain conveyor is however that the metering accuracy is relatively poor, since the volumetric filling can be very non-uniform on account of differing densities and also conveyed material can adhere to the conveyor chain connecting the entraining bars during the emptying. Appreciable deviations in respect of the metering accuracy can result from this, which is particularly serious for aggregate mixtures.

Scales combined with belt conveyors or plate conveyors are already known, e.g. according to DE 19 536 871 or DE 4 230 368, wherein the conveyor belt or the plate belt runs over a positionally fixed weighbridge. However, these conveyors have disadvantages in relation to their wear characteristics or the required energy demand, since on the one hand conveyor belts of rubber materials suffer from a lot of wear, even when reinforced, and on the other hand plate belts have a lot of friction, on account of the relative movement between the individual articulated members, especially when heavily loaded.

The invention is accordingly based on the object of improving the metering accuracy of chain conveyors, with a simple construction.

This object is met by a chain conveyor according to the features of claim 1.

The support of at least a partial region of a measuring segment, especially of a measuring bridge, on at least one force measuring device, results in precise gravimetric control over the amount of material transported by the chain conveyor. In this way, irregularities such as are unavoidable from differing filling levels in volumetric metering, are reliably avoided and material adhering to conveyor chains and the like can be detected, while the set-point metering amount can accordingly be maintained precisely in the manner of a metering scale with regulated drive. Because of the definite guiding of the conveyor chain in the region of the measuring segment, disturbing forces, e.g. from jamming of granular material between the entraining members and the measuring bridge, can largely be eliminated, so that the measuring segment itself is largely free from external forces, in the manner known from technical mechanics as "isolated", even in the case of very high chain tractive forces. A closed system unit results from guiding the conveyor chain in the region of the measuring segment, where the conveyor chain is securely held down. This can be assisted in a simple way by a slightly peaked form of the measuring bridge, so that a predetermined pre-load on the measuring segment arranged in the tight run results, which reliably avoids lifting of the conveyor chain even with slackening or varying chain tension. Thus problems with unequal feed, such as can occur in the arrangement in the slack run free from tractive force, are likewise reliably avoided.

A particularly simple design of the proposed chain conveyor results in that the measuring bridge of the chain conveyor is pivotally arranged at a defined axis arranged preferably centrally in the plane of circulation of the chain and the weight or force measuring device is spaced from this axis. This arrangement is particularly suitable for retro-fitting of existing chain conveyors in the tight run with guiding of the conveyor chain on the measuring segment, since retro-fitting of the chain conveyor with the gravimetric force measuring device is possible by simple fixing of bolts or other bearings forming the axis, e.g. also of drag-link conveyor apparatuses.

The same applies to movable mounting of only a part of the measuring bridge, which is decoupled by flexible intermediate elements. By interposing flexible intermediate elements, especially composite rubber-and-steel bars or weakening of the material in the manner of a

film hinge and support on the measuring device, a simple retro-fitting of existing chain conveyors can be achieved.

A particularly advantageous design has two measuring bridges, where a second tare measuring bridge is arranged before the inlet or hopper feed opening and after the outlet opening, so that the actual discharge amount at the outlet opening can be determined and a tare measurement can thus be effected. The arrangement of two bridge parts, which are connected to one another by a link and act on only a single force measuring device in the manner of a weigh beam, is possible for detecting the chain and entraining member weight in a simple way.

Further advantageous arrangements will appear from the following description of embodiments shown in the drawings, in which:

Fig. 1 shows a chain conveyor scale in side view;

Fig. 2 shows a portion of the chain conveyor according to Fig. 1 in an enlarged side view in the region of the measuring segment;

Fig. 3 is cross-sectional view of the side region of the chain conveyor in the region of the measuring segment along the section line III in Fig. 2; and

Fig. 4 shows a portion of the measuring segment region of the chain conveyor in plan view.

A chain conveyor 1 is shown in Figs. 1 and 2 in side view and an associated enlargement in the measuring region respectively, located in a housing or trough 3 and comprising a measuring segment S running in a straight line, which is located in the upper run 5 and is also called the measuring bridge 2 below. A conveyor chain 6 circulates along the measuring bridge 2 in the housing/trough 3 and has entraining bars 7 at regular intervals. Bulk material, which enters the housing 3 from an opening 8 (here from a hopper or silo), is transported by the entraining bars 7 along the measuring bridge 2 in the upper run 5 and then along the lower run 4 to an outlet opening 9, in the counter-clockwise sense, as is shown here by arrows. In between the inlet/filling opening 8 and the outlet opening 9 the plate-like measuring bridge 2 is mounted by means of flexible intermediate elements 10 so as to be movable or slightly yielding or decoupled in the vertical direction, being supported on at least one force measuring device 12 arranged below the measuring bridge 2, especially an approximately centrally arranged load cell. Near to the left end of the measuring bridge 2 a drive 13 is

provided in the form of a sprocket wheel which engages in the conveyor chain 6.

After being conveyed along the measuring segment S or measuring bridge 2, the conveyed material (indicated by dots) drops down, overshoot in front of the drive 13 on to a wear-resistant bottom plate in the region of the lower run 4 and finally passes through horizontal feed by the conveyor chain 6 and the bar-formed entraining members 7 to the outlet opening 9, where it can fall out under gravity or be blown out. It should be noted that such a blow-out device, not shown, can be arranged in the housing 3, especially with a pressure-tight or dust-tight design of the chain conveyor, so that no disturbing moments can be exerted on the force measuring device 12. In addition cleaning of the chain elements and/or the entraining members 7 can be effected by this, which can be assisted by a reciprocating brush or the like.

The guiding along the housing bend 15 here at the right is also important, since bulk material which has not been ejected can be fed back to a second measuring bridge 22 (likewise with a force measuring device 12) for tare weighing. Any force measuring devices such as shear force transducers or load cells working on an inductive, capacitive or piezoelectric basis can be used as the force measuring device 12 for the measuring bridges 2, 22. A force measuring device 12 is preferred which measures with practically no deflection, especially a strain gauge load cell, since the angle of deflection of the measuring bridge 2 can be restricted to a few minutes of arc by this, so that the circulating movement of the conveyor chain 6 is hardly impeded at all.

A pivotal axis 18 is thus formed by the flexible intermediate elements 10 (see also Fig. 2), about which the measuring bridge parts can deflect slightly like a rocking beam or hinge with straight bridge leaves. These bridge leaves of the measuring segment S are preferably designed slightly peaked or polygonally raised or "cambered", as is shown in exaggerated fashion for clarity by the angle β . The conveyor chain 6 is thus "tensionally" restrained securely from lifting from the measuring segment S and a downwardly directed pre-load or chain force F_k results, which acts on the load cell 12 together with the gravitational force F_m of the bulk material (compare the parallelogram of forces). The chain force F_k acts to same extent on the discharge end of the measuring segment S here at the left and can be measured there by a second load cell 12', so that the effective weight of the conveyed material ($= F_m$)

transported over the measuring segment can be determined by subtraction of this value F_k from the value of the force measuring device 12 ($=F_m + F_k$). The force measuring device 12, 12' passes the measured value to a computer which computes the instantaneous throughput amount by formation of the product from this together with speed values, such as are obtained from a tachometer on the drive 13 for example. This actual value is preferably compared with a preset set-point value for metering purposes and the controlled drive 13 is regulated in a manner known per se when there are deviations.

The side region of the chain conveyor is shown in Fig. 3, wherein the design of the guide elements 11 shown also in Figs. 1 and 2 for the "positive" retention of the conveyor chain 6 on the measuring segment S can be seen in cross-section. It is essential that the bar-form, slotted guide elements 11 are arranged on the measuring bridge 2, so that excessive chain forces which may occur do not pass into the measuring results or are eliminated. The conveyor chain 6 is thus guided precisely on both sides in the cross-shaped, slotted guide elements 11, while the entraining bar 7 is inserted by means of a forked plug-in entraining element 27 (cf. Fig. 4) known per se inserted in the chain elements standing on edge.

It is possible to dispense with the lateral guide function of the guide elements 11, so that the conveyor chain 6 can for example be prevented from lifting up from the measuring segment S by a smooth bar, while the underside of the conveyor chain 6 can run on a PTFE strip on the measuring bridge 2. Rollers or wheels could also be provided to guide and support the conveyor chain 6 on the measuring segment S, as is shown in Fig. 3 in chain-dotted lines.

The measuring bridge 2 can also be made in one piece, while it can then be supported following short run-in and run-out zones at its end regions (referred to the conveying direction) on four load cells 12', as is indicated in Fig. 1 in broken lines, and the part of the measuring bridge 2 lying towards the hopper is movably mounted by at least one flexible intermediate element 10. In this design also, with four force measuring devices 12 the measuring bridge 2 can move down slightly under the load of the conveyed material during feed of the bulk material and thus act on the two force measuring devices 12 in the manner of weighbridge. After passing the measuring bridge 2 forming the measuring

segment S the conveyed material finally reaches the outlet opening 9 and there falls out, down between the entraining bars 7.

As indicated in Fig. 1 in broken lines, the outlet opening 9' can also be arranged below the filling opening 8 or in the vicinity of the drive 13. The second measuring bridge 22 following the outlet opening 9 can also be supported on two force measuring devices 12 or be mounted decoupled on intermediate elements 10. The dead weight of the conveyor chain 6 with the entraining members 7 can accordingly be detected, so that the actual amount of conveyed material arriving at the outlet opening 9 can be determined by forming a difference, by comparing the two measured values of the measuring bridges 2 and 22. If particles of conveyed material should adhere to the entraining bars 7 or the conveyor chain 6, only the amount of bulk material actually leaving the chain conveyor 1 is thus determined. An appreciable increase in the measuring and metering accuracy is possible through this tare measurement. It should be noted that the second measuring bridge 22 can also be arranged in the lower run 4, depending on the position of the outlet opening 9, so that the sag of the conveyor chain 6 and thus the loading of the force measuring devices 12 is the same in each case and thus can be eliminated from the results of measurement.

As shown above, a deflection of the measuring bridge 2 of only an angle of deflection (β) of a few minutes of arc or seconds of arc is involved, so that the circulating movement of the conveyor chain 6 is not impeded. A pivotal bearing with side link plates 11' can also be provided as a flexible intermediate element 10 between the guide elements 11, as is indicated in Fig. 2 in broken lines. The axis 18 thus formed to facilitate the ability of the measuring bridge 2 to pivot (cf. Fig. 2) preferably lies in the plane of circulation of the chain, above the measuring bridge 2. The force measuring device 12 is arranged offset below this, so that a defined lever arm from the axis 18 is obtained. Instead of the link plates/pins other lower friction bearings can be provided to form the axis 18, while the conveyor chain 6 itself can also form a hinge link in its plane of circulation, since the distance between the guide elements 11 preferably amounts to about two or three chain members.

It should be noted that the measured values of the force measuring device(s) 12 are passed to evaluation electronics with a computer in a manner known per se, for calculating the instantaneous feed rate from

the measuring bridge loading and the conveyor speed, and they are there compared with adjusted set-point values. By accelerating or braking the drive 13 of the chain conveyor 1, for example by electronic speed regulation, the desired feed or metering amount (feed rate or feed strength) can thus be maintained precisely, even with materials which are relatively difficult to convey, such as clinker or even sludge.

CLAIMS

1. A chain conveyor for gravimetric measuring/metering, especially of bulk materials, with a housing/trough, in which there circulates at least one conveyor chain with entraining members fixed thereon, as well as an inlet/filling opening and an outlet opening in the housing/trough, wherein at least one measuring segment is arranged between the inlet/filling opening and the outlet opening and is supported on at least one force measuring device, characterized in that along the measuring segment (S) the conveyor chain (6) is guided positively and/or tensionally on the measuring segment (S), especially of a measuring bridge (2) on guide elements (11) fixed thereto.
2. A chain conveyor according to claim 1, characterized in that the measuring bridge (2) is pivotally mounted about an axis (18) and the force measuring device (12) is spaced from the axis.
3. A chain conveyor according to claim 2, characterized in that the axis (8) runs approximately centrally between two measuring bridge parts (2) in the plane of circulation of the chain.
4. A chain conveyor according to claim 2 or 3, characterized in that the force measuring device (12) is arranged at the point of the measuring bridge part (2) furthest from the axis (18).
5. A chain conveyor according to any of claims 2 to 4, characterized in that the force measuring device (12) is arranged approximately centrally below the measuring bridge (2).
6. A chain conveyor according to claim 1, characterized in that a measuring bridge part (2) is decoupled relative to the remaining part of the measuring segment (S) by at least one flexible intermediate element (10).
7. A chain conveyor according to any of claims 1 to 6, characterized in that the measuring bridge (2) is arranged on the upper run (5).

8. A chain conveyor according to any of claims 1 to 6, characterized in that the measuring bridge (2) is arranged on the lower run (4), especially for tare weighing.
9. A chain conveyor according to any of claims 1 to 8, characterized in that the whole measuring bridge (2) is supported on at least three force measuring devices (12).
10. A chain conveyor according to any of claims 1 to 9, characterized in that a second measuring bridge (22) is supported on at least one further force measuring device (12) following the outlet opening (9) or a return housing curve (15) and the force measuring devices (12) of the two measuring bridges (2; 22) are connected or coupled to one another for forming the difference of the measured values.
11. A chain conveyor according to any of claims 6 to 10, characterized in that the first and second measuring bridge parts (2, 22) are supported on a single, common force measuring device (12).
12. A chain conveyor according to any of claims 1 to 11, characterized in that the lateral guide elements (11) are cross-shaped in cross-section.
13. A chain conveyor according to any of claims 1 to 12, characterized in that the guide elements (11) are formed by rollers or wheels (11'') for supporting the conveyor chain (6).
14. A chain conveyor according to any of claims 2 to 13, characterized in that the guide elements (11) are pivotally connected in the vertical direction in the region of the axis (18) by means of link plates (11').
15. A chain conveyor according to any of claims 1 to 14, characterized in that the force measuring device (12) is coupled to a computer, in which, in order to determine the instantaneous conveyed material throughput, the product is formed from the weight values of the force measuring device (12) and the conveyor speed, which

is detected by a speed measuring device, especially at the drive (13), and especially for metering, the computer comprises a comparator for comparing the instantaneous conveyed material throughput with a set-point value and a controller for controlling the drive (13).

16. A chain conveyor according to any of claims 1 to 15, characterized in that the entraining members (7) have an arrow formation between the conveyor chains (6), and are guided especially on the guide elements a minimum distance above the measuring bridge (2), in order to reduce wear.
17. A chain conveyor according to any of claims 1 to 16, characterized in that a cleaning device circulating in the feed direction is provided for the entraining bars (7) and/or the conveyor chains (6).
18. A chain conveyor according to any of claims 1 to 17, characterized in that the measuring bridge (2) is slightly cambered or peaked and the force measuring device(s) (12) is/are arranged to detect the chain forces (F_k) of the conveyor chains (6).
19. A chain conveyor according to any of claims 1 to 18, characterized in that the measuring bridge (2) is arranged directly adjoining the inlet opening (8), in particular as a hopper abstraction device.
20. A chain conveyor according to any of claims 16 to 19, characterized in that the middles of the entraining members (7) trail in the feed direction and centre the conveyed material towards the middle, especially in conjunction with a return diverting region (15).

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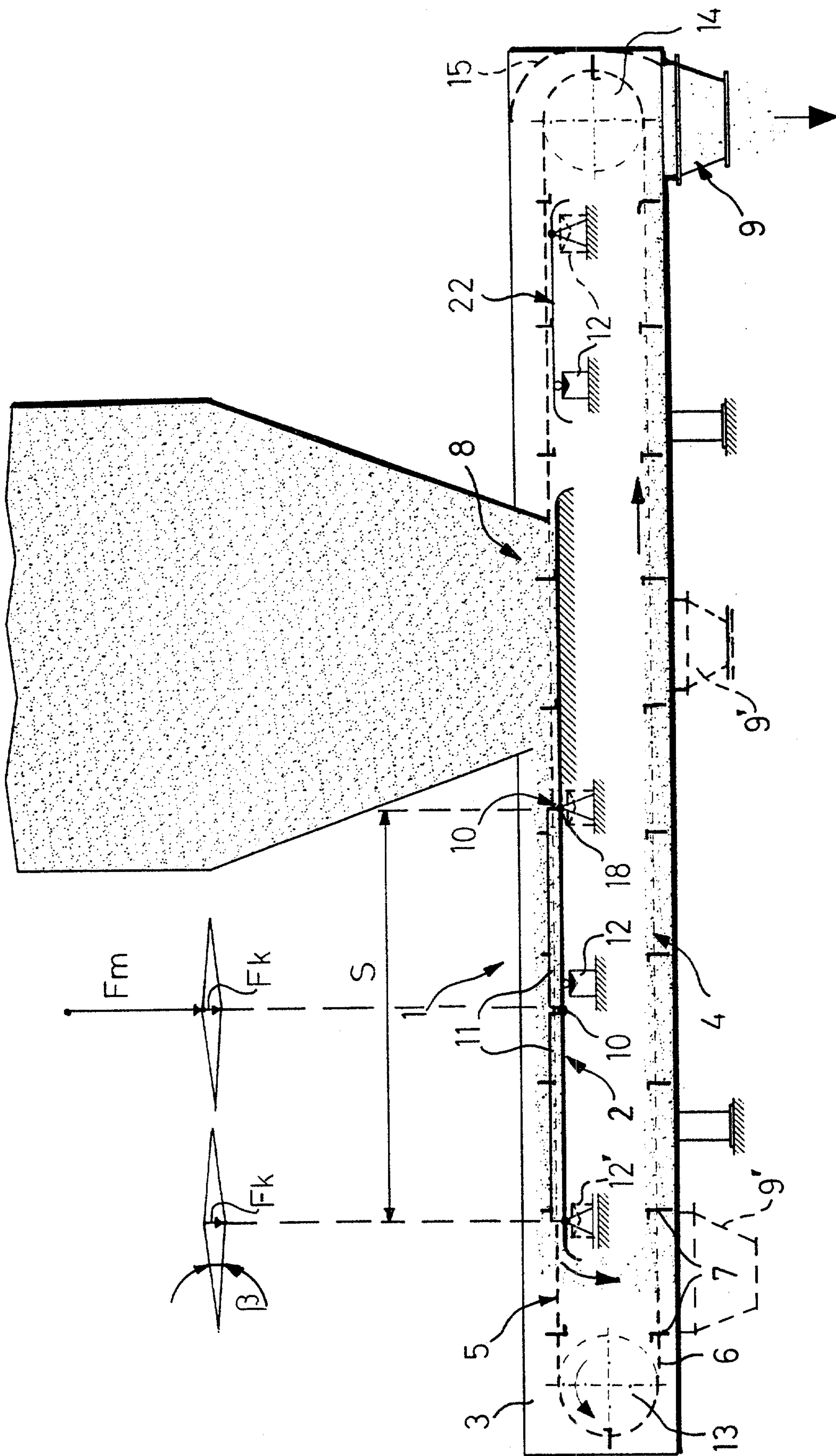


FIG.1

2/2

