(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
9 January 2014 (09.01.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/006477 A2

(51) **International Patent Classification**:
F16F 7/10 (2006.01)

(21) **International Application Number**:
PCT/IB2013/001415

(22) **International Filing Date**:
2 July 2013 (02.07.2013)

(25) **Filing Language**: Polish

(26) **Publication Language**: English

(30) **Priority Data**:
P.399782 3 July 2012 (03.07.2012) PL

(71) **Applicant**: **EPAR SP. Z O. O.** [PL/PL]; ul. Laczna 1, PL-58-540 Karpacz (PL).

(72) **Inventors**: **GUMUŁA, Stanisław**; ul. Kijowska 48/40, PL-30-079 Kraków (PL). **RAMUT, Jacek**; ul. Karpacka 102, PL-58-533 Kostrzyca (PL). **ŁĄGIEWKA, Przemysław**; ul. Wiejska 29/5, PL-58-530 Kowary (PL).

(74) **Agent**: **ŁUKASZYK, Szymon**; Kancelaria Patentowa Łukaszyk, ul. Głowackiego 8/6, 41-062 Katowice (PL).

(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

WO 2014/006477 A2

(54) **Title**: SHOCK ABSORBING PLATFORM FOR UNLOADING CONTAINERS AT PORTS

(57) **Abstract**: A shock absorbing platform for unloading containers at ports, comprising the top plate (1) guided vertically by means of guides (3) and disposed substantially on the same level as the surrounding stage (13) and a shock-absorbing means connected with the plate and comprising kinetic energy absorption rotor arrangements (10), characterized in that it comprises an angular drive train arrangement (7) having an input rod (6) and at least one output rod (8) perpendicular to said input rod (6), wherein the input rod (6) is coupled with the top plate (1) and the output rod (8) is connected to the kinetic energy absorption rotor arrangement (10), comprising at least two serially coupled racks (12, 13, 14) driving the toothed wheel (16, 17, 18), wherein between at least two serially connected racks (12, 13, 14) shock-absorbing means (20) are arranged enabling for relative displacement of the racks (12, 13, 14) in relation to each other.

SHOCK ABSORBING PLATFORM FOR UNLOADING CONTAINERS AT PORTS

The present invention relates to a shock absorbing platform for unloading containers at ports, designed to protecting containers or vehicles during loading operation against effects of an excessively rapid drop of the unloaded commodity during unloading operation.

Bringing containers down onto sea-platform constitutes a significant problem. Unloading process depends on atmospheric conditions existing on the sea. Strong winds blowing frequently, lateral oscillation caused by a movement of sea-waves or sea-currents result in great losses related with damages of containers hitting sea-platforms. The force of impact of a container against a platform is dependent on an instantaneous weather conditions existing on the sea, and therefore an unloading operation may be impossible during a very short period of time.

For providing shock absorption for containers being brought down, the plates of platforms are supported by means of resilient shock-absorbing arrangements. In different solutions containers in an unload operation are protected by employment of shield elements that are made of elastomeric materials and absorb impacts.

Another system designed for absorbing kinetic energy is disclosed in international patent application WO2004028864 describing a rotor device in which kinetic energy is converted into kinetic energy of rotating masses. In this known solution an element absorbing energy is connected with two toothed bars which by medium of toothed wheels drive kinetic energy rotor accumulators in forms of rods with moveable weights slidably mounted on the rods. An appropriate progressiveness of energy absorption is obtained in this known solution by employment of the moveable weights located as close to the rotation axis of the rotor with the rods as possible in order that a moment of inertia of the rotor in the initial phase of energy absorption be as small as possible. In further movement phase while the rotor starts to rotate, the weights start to translocate under influence of centrifugal force and move away from the rotation axis along the rod axis, until they reach the rod end limiters and in such weight positions the biggest moment of inertia of rotor is achieved that enables for absorption of the increased kinetic energy.

International patent application WO2005121593 discloses a device for absorbing and dissipating kinetic energy comprising a beater element cooperating with a rack inducing by means of a toothed wheel a rotational movement of a kinetic energy rotor accumulator, in order to transform impact energy into kinetic energy of rotor accumulator rotational movement.

Such known solutions do not provide high efficiency of a shock absorption for impacts of containers during bringing down operations at different bringing down velocities and different masses. Therefore the object of the present invention is to provide increased efficiency of absorbing and dissipating different and random energy amounts.

A shock-absorbing platform according to the present invention comprises the top plate guided vertically by means of guides and disposed substantially on the same level as the surrounding stage and a shock-absorbing means connected with the plate and comprising kinetic energy absorption rotor arrangements. The solution is characterized in that it comprises an angular drive train arrangement having an input rod and at least one output rod perpendicular to said input rod, wherein the input rod is coupled with the top plate and the output rod is connected to the kinetic energy absorption rotor arrangement, comprising at least two serially coupled racks driving the toothed wheel, wherein between at least two serially connected racks shock-absorbing means are arranged enabling for relative displacement of the racks in relation to each other.

The kinetic energy rotor accumulators preferably have differentiated capability of energy accumulation.

The kinetic energy rotor accumulators preferably have differentiated moments of inertia.

The angular drive train arrangement preferably has a form of a hydraulic T-piece having one input cylinder and at least two output cylinders.

Thanks to embedding shock absorbing elements between at least two serially connected racks, appropriate gaps are formed therebetween, that provides gradual inducing rotational movements of alternate kinetic energy rotor accumulators, and

thus in turn it enables for obtaining an abrupt stepped increase of capability of energy absorption. Such a construction enables for adjustment of shock absorbing capability of the platform in dependence of requirements related with differentiated height from which containers drop down onto the platform and with differentiated mass of containers.

Arrangement of shock absorbing elements in front of the alternate racks results in a decrease of impact load acting on cooperating elements during an actuation of alternate kinetic energy rotor accumulators.

Owing to a gradation of moment of inertia of alternate kinetic energy rotor accumulator, in particular when kinetic energy rotor accumulator driving by means of the first rack has smaller moment of inertia than the moment of inertia of kinetic energy rotor accumulator driven by means of the second rack, especially advantageous, smooth and gradual increase of capability of absorbing kinetic energy related with a collision of the container with a platform is achieved.

The device arrangement according to the present invention provides high efficiency of kinetic energy absorption during impacts of low kinetic energy as well as during impacts of higher kinetic energy. In the first instance the device according to the present invention provides efficient and very smooth impact energy absorption, as an absorption of kinetic energy of progressive movement takes place with using kinetic energy rotor accumulators of the smallest moment of inertia. In the second instance, the device according to the present invention also provides appropriately efficient and uniform shock-absorption of impact energy, as kinetic energy absorption takes place with using several rotor accumulators of increasing energy absorption capabilities.

In case of impacts of greater energy an additional effect occurs in the device according to the present invention consisting in that impact kinetic energy is in a great part accumulated in the rotor accumulators featuring lower energy absorption capability before the rotor accumulators featuring higher energy absorption capability are actuated. Such a sequence of energy absorption provides smoother operation of the device according to the present invention during actuation of next rotor

accumulators, even those of the greatest capability of energy absorption featuring the bigger moment of inertia.

The exemplary embodiments of the present invention are schematically presented below in connection with the attached drawings on which:

Fig. 1 presents a side view of a shock absorbing platform according to the present invention during operation of bringing down a container;

Fig. 2 presents the same platform during operation of loading a container onto a transport vehicle, and

Fig. 3 depicts a kinetic energy absorption arrangement.

As presented in the embodiment of Fig. 1 and Fig. 2, the top plate 1 of the platform according to the present invention is connected to a concrete cavity of the stage 2 by means of vertical guides 3 disposed in guiding sleeves 4 in which helical springs 5 are embedded pushing the guides 3 out. Under the central area of the top plate 1 is disposed an output rod 6 of an angular drive train arrangement 7, and each of two output rod 8, oriented perpendicularly relative to the input rod 6, contacts a bumper 9 of kinetic energy absorption rotor arrangement 10. In this embodiment the angular drive train arrangement 7 has a form of a hydraulic T-piece 11, in which the input rod 6 constitutes the rod of the input piston, and the output rod 8 constitutes the rods of the output pistons.

As shown in Fig. 3, the bumper 9 of the kinetic energy absorption rotor arrangement 10 is coupled to three serially connected racks 12, 13, 14. Between the racks 12, 13, 14 and between the bumper 9 and the first rack 12 appropriate gaps are defined enabling appropriate operation of shock absorbing elements 20 and providing a relative displacement of racks 12, 13, 14 relative to each other and between the bumper 9. Each of the racks 12, 13, 14 interengages with a toothed wheel 15 driving a kinetic energy rotor accumulator 16, 17, 18, wherein for achieving greater efficiency of absorbing and dissipating impact energy, the first kinetic energy rotor accumulator 16 driven by the first rack 12 has the smallest moment of inertia, the second kinetic energy rotor accumulator 17 driven by the second rack 13 has the medium moment of inertia, whereas the third kinetic energy rotor accumulator 18 driven by the third rack 4 has the greatest moment of inertia.

The bumper 9 is slidably coupled to the side walls of the body plate 19 to which the guide of racks 12, 13, 14 is also attached.

The progressiveness of a characteristic of impact energy absorption may be adjusted by appropriate selection of effective diameters of the driving toothed wheels 15 and by appropriate selection of moments of inertia of alternate kinetic energy rotor accumulators 16, 17, 18.

In the described embodiments unidirectional couplings are also employed, though not presented on the drawing, and arranged between the toothed wheels 15 and kinetic energy accumulators 16, 17, 18. The function of these unidirectional couplings is transferring a torque onto kinetic energy rotor accumulators. After absorption of energy, when angular velocity of the appropriate toothed wheel 15 shall be smaller than angular velocity of corresponding kinetic energy rotor accumulator 16, 17, 18, the unidirectional coupling becomes disconnected thus enabling for unrestricted rotation of the kinetic energy rotor accumulator 16, 17, 18.

Energy acting upon the bumper 9 during a drop of a container on the top plate 1 is transferred by medium of the rods 6, 8 of the hydraulic T-piece 11 to the racks 12, 13, 14, and subsequently to kinetic energy rotor accumulators 16, 17, 18. In a result of serial arrangement of the racks 12, 13, 14, a consecutive actuation of kinetic energy rotor accumulators 16, 17, 18 is realized starting from the kinetic energy rotor accumulator 16 of the smallest moment of inertia, and ending with the kinetic energy rotor accumulator 18 of the greatest moment of inertia. In the solution according to the present invention, the maximal idle stroke of the bumper 9 relative to the endmost rack 14 driving the kinetic energy rotor accumulator 18 of the greatest moment of inertia equals the sum of the gaps between the bumper 9 and the first rack 1 and between the racks 12, 13, 14.

Patent Claims:

1. A shock absorbing platform for unloading containers at ports, comprising the top plate (1) guided vertically by means of guides (3) and disposed substantially on the same level as the surrounding stage (13) and a shock-absorbing means connected with the plate and comprising kinetic energy absorption rotor arrangements (10), characterized in that it comprises an angular drive train arrangement (7) having an input rod (6) and at least one output rod (8) perpendicular to said input rod (6), wherein the input rod (6) is coupled with the top plate (1) and the output rod (8) is connected to the kinetic energy absorption rotor arrangement (10), comprising at least two serially coupled racks (12, 13, 14) driving the toothed wheel (16, 17, 18), wherein between at least two serially connected racks (12, 13, 14) shock-absorbing means (20) are arranged enabling for relative displacement of the racks (12, 13, 14) in relation to each other.

2. The shock absorbing platform according to Claim 1, characterized in that the kinetic energy rotor accumulators (16, 17, 18) have differentiated capability of energy accumulation.

3. The shock absorbing platform according to Claim 1 or 2, characterized in that the kinetic energy rotor accumulators (16, 17, 18) have differentiated moments of inertia.

4. The shock absorbing platform according to Claim 1 or 2 or 3, characterized in that the angular drive train arrangement (7) has a form of a hydraulic T-piece having one input cylinder and at least two output cylinders.

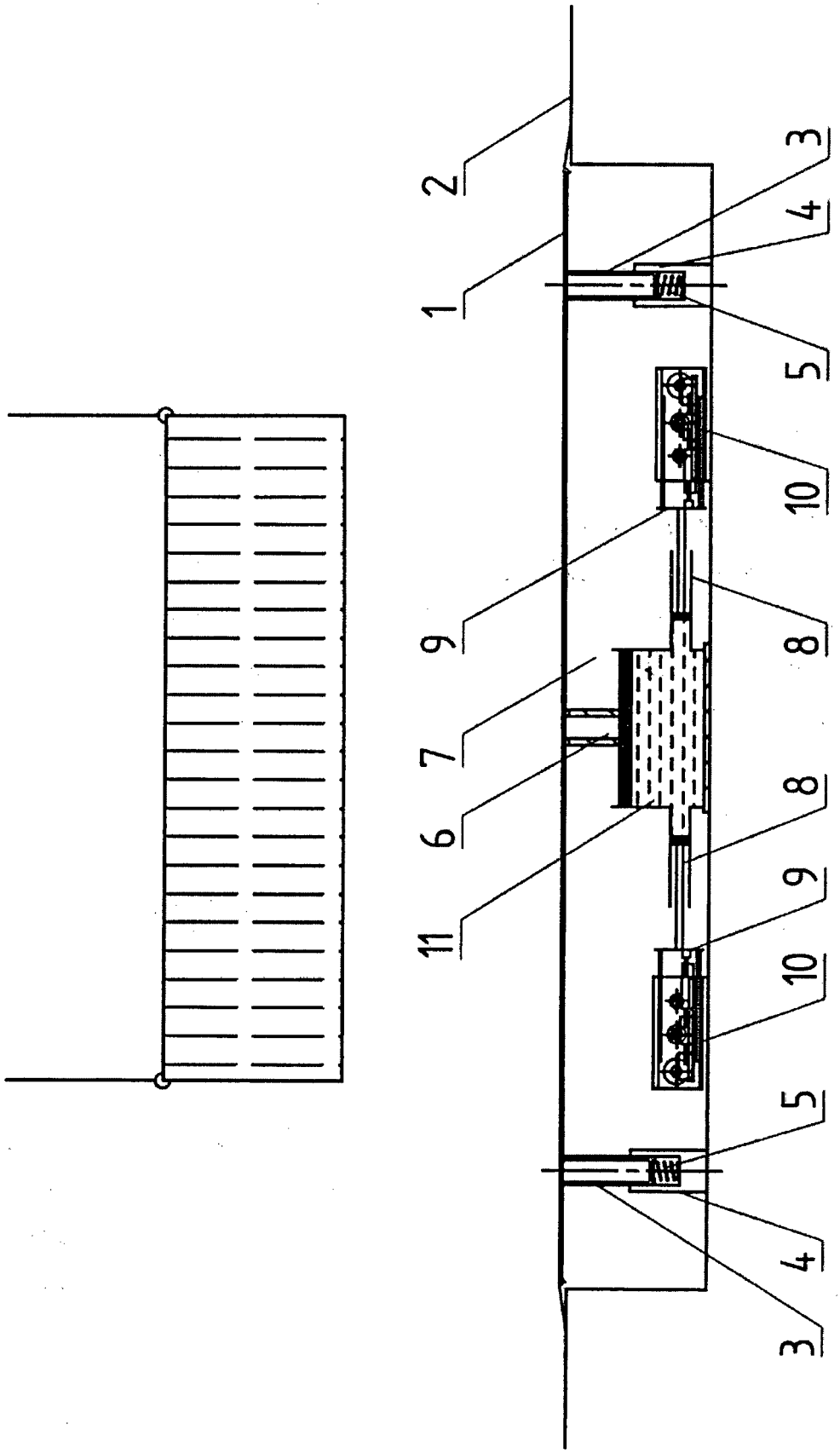

Fig. 1

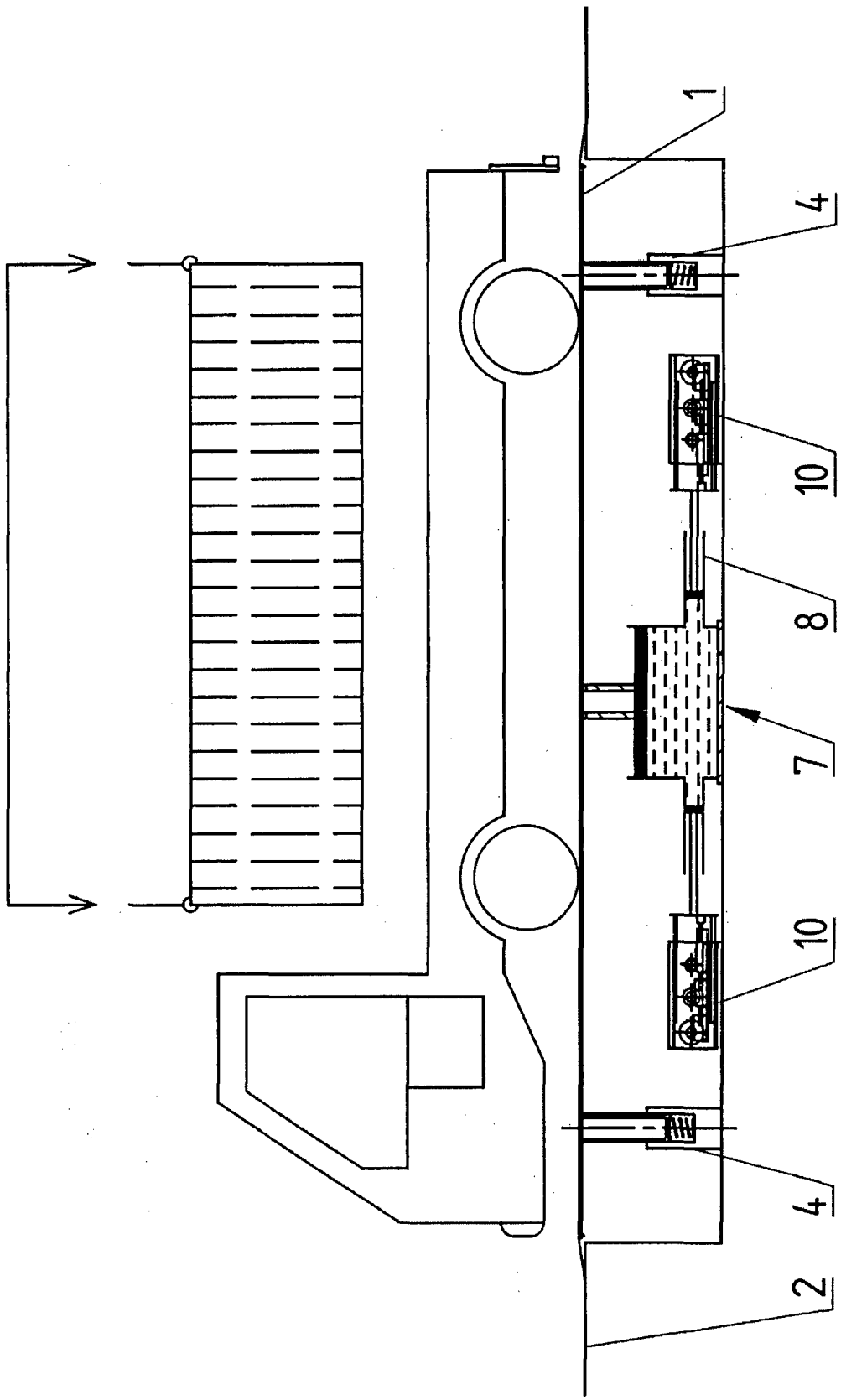

Fig. 2

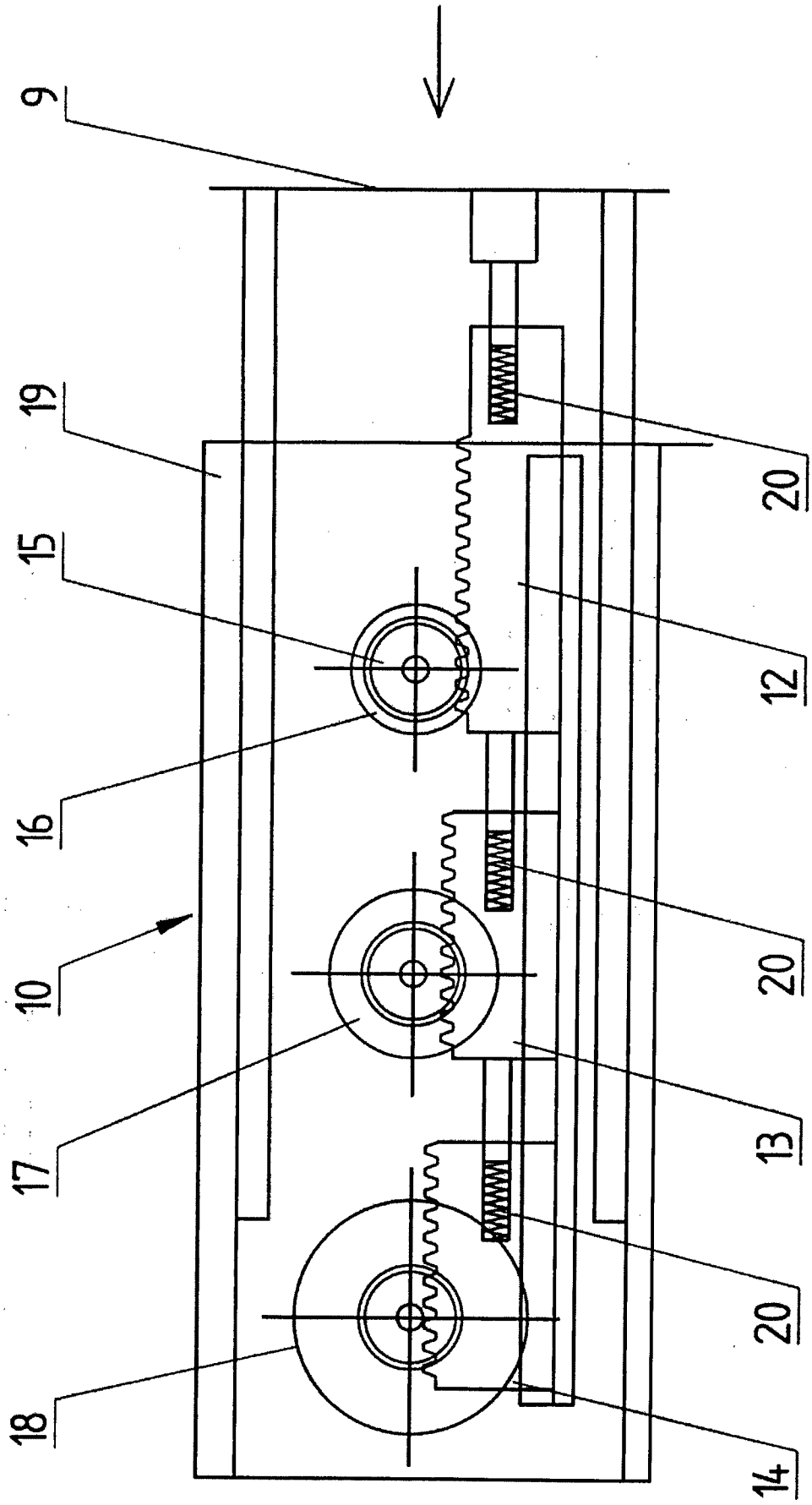

Fig. 3