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(54) IMPROVEMENTS IN OR RELATING TO A MOVABLE ACCESS RAMP FOR VEHICLES

(71) We, MACGREGOR-COMARAIN S.A. a body corporate organized under the laws of France, of 219—221 Rue de Versailles, 92410 Ville D'Avray, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates generally and is essentially directed to a movable device forming an access ramp or like gangway or bridge means adapted to provide a means of communication passage, conveyance, transshipment or the like between a vehicle, in particular a marine vessel such as a ship, boat or like floating vessel and an outside loading or unloading area or platform such as a quay, pier, wharf, bank, shore or beach or another vessel as well as the various applications and uses resulting from implementing the same.

There are already known in particular in naval or marine applications, transport or cargo ships of the roll on-roll off type for conveying for instance wheeled vehicles and in particular automotive or motor vehicles or various goods and products. In the case of automotive vehicles, the shipping and unshipping thereof are effected by their own self-contained or independent propulsion or drive means by rolling individually or separately and directly on a movable access ramp interconnecting the ship (and more specifically the loading deck thereof) and the quay or the like. In the case of general cargo, such a ramp is also used directly by automotive handling carriages, trucks or like carts or wheeled cargo-handling gears running on said ramp in a shuttle like manner enabling them to have direct access to the ship and to come back to the quay for loading or shipping and unloading or unshipping cargoes. For this purpose, the ship is provided either aft or astern, or afore

at the bow, or yet sidewise, with at least one large ramp of the kind pivotally connected at its inboard end to the ship for swinging vertically so as to be liftable or raisable upwards to a substantially inoperative upstanding position in a stowed or lashed condition on the ship during its sea trip and lowerable in operative working position to bear onto the quay with its opposite, i.e. outboard end. As the ship is generally moored or secured along the quay berth in parallel relation thereto, said ramp, when it is located astern i.e. at the rear end of the ship, is generally positioned slantwise in its lowered working condition with respect to the longitudinal central vertical plane of the ship so that the longitudinal direction of the ramp is at an angle of about 45° with respect to the longitudinal direction of the ship. Such a ramp thus enables various kinds of wheeled vehicles to be taken aboard the ship for instance from quays which are not fitted up or suited for such a use.

The ramp must be long enough to enable the ship to use various kinds of quays while retaining an acceptable slope with respect to the horizontal direction for the passage of wheeled vehicles, but at the same time, when the ramp is folded vertically back against the planking or structure of the ship it must not offer too high a hold to the wind when the ship is at sea nor have an excessive height likely to affect the stability of the ship.

A ramp is known, for example, from the French patent publication No. 2,071,787, consisting of three successive sections pivotally interconnected to each other, respectively, in the longitudinal direction, the innermost end or inboard section being pivoted to the ship in particular at the level of any opening thereof for example at a cargo port provided at one of its ends or laterally in the side of the ship whereas the outer end or outboard section serves as a bearing or supporting flap member onto the

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quay and is pivotally connected to the corresponding outer end portion of the intermediate section. In this known arrangement, the intermediate and outermost sections may be folded back together by being laid downwards against the bottom portion of the innermost or inboard section alongside thereof in a substantially upward raised or vertical position and both opposite side frame members or like girders or spars of the inboard section are extended outwards through a pair of booms or arm-like beams extending beyond the vehicle runway carried therebetween and on either side and along the intermediate section so as to bear in the lowered and extended working condition onto a pair of sidewise outwards projecting supports provided on the intermediate section on either side thereof, through the medium of a pair of longitudinal lower levers pivotally connected to the side frame members so that said levers may be swung in a vertical plane to an adjustable relative angular position by pressure fluid operated ram-type actuators or like power means. This arrangement enables the angle between the outboard and intermediate sections in the lowered and extended working state to be adjusted. The innermost or inboard section is secured by an intermediate point of one or each side frame member thereof and adjacent to its pivotal connection with the intermediate section to at least one handling cable or rope or to a pair of handling cables or ropes each one of which is wound up on an associated operating winch located on the ship whereby the ramp may be raised through a powered action or lowered through gravity. The innermost section is partially suspended from each handling rope because the latter is kept taut with a determined constant tension corresponding for instance to the total weight of the loading ramp and each rope may be automatically wound up or paid out according to the variation in the load. At least one winch and possibly both powered winches for extending the intermediate section are mounted on one or both side frame members, respectively, of the innermost section and the rope of each winch is successively received onto a first guide sheave or pulley carried by the free end of said extension boom and onto a second guide pulley or sheave carried by the intermediate section to be made fast at a stationary point of said boom. The outermost section, forming a supporting pad or flap member to enable the ramp to bear onto the quay, is pivotally connected substantially at its centre of gravity to said intermediate section.

65 This known appliance exhibits various

disadvantages since on the one hand it requires a relatively complex special mechanism to achieve a temporary engagement or like bearing connection between each boom end in extension of one side frame member of the innermost section with a corresponding sidewise projecting supporting pad of the intermediate section and on the other hand it requires the provision of at least one and possibly of a pair of operating winches for extending the intermediate section of the ramp into the lowered working condition.

The present invention seeks to overcome the aforementioned disadvantages by providing a device which, with suitable arrangement, may be of a simpler hence more economical construction performing a more effective and reliable operation.

According to the invention, there is provided an access ramp for a vehicle, which comprises a first ramp section adapted to be pivotally connected at one end to the body of a vehicle, a second ramp section pivotally connected at one end to the other end of the first ramp section, at least one first handling cable for connecting the first ramp section to the vehicle body whereby to enable the ramp sections to be moved between an extended position in which they provide access to the vehicle and a stowed position in which the ramp sections are substantially vertical and the second ramp section is folded downwardly against the first ramp section on the side remote from the vehicle, and at least one second handling cable for connecting the second ramp section to the body of the vehicle in a manner to act as a restraint controlling the attitude of the second ramp section during movement of the ramp sections between the said two positions thereof, wherein the or each said second handling cable is connected to means for automatically tensioning the cable through the action of potential energy, said means being adapted to form a stationary fastening means for generating, by limiting the effective useful length of the cable, a tractive reaction force tending to raise the second ramp section into its extended position during lowering of the first ramp section into the extended position.

The arrangement according to the invention enables the second ramp section to be extended without the use of any powered winch but by exclusively making use of the potential energy stored in the innermost first ramp section in its raised position whereby said innermost section tends by itself to rock or tilt naturally downwards through gravity under the action of its own weight while causing at the same time the adjacent ramp section to be extended accordingly. At the beginning or

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5 during the initial period of downward motion of the innermost section from its substantially vertically or upright raised and stowed position, the component of the total ramp weight which is likely to act upon each handling cable for extending said adjacent section is inadequate for exerting any significant rotary effect thereon, so that according to a preferred feature of the invention, said means for automatically tensioning the or each second handling cable are arranged so as to be operative only from a given angle of slope, for instance of about 20°, of the innermost section with respect to the vertical direction during the starting period of downward motion thereof.

10 According to another preferred feature of the invention, as said innermost ramp section is suspended from the end of each aforementioned handling cable, there are provided selectively adjustable load transfer means for varying at will the bearing reaction of the ramp onto a platform in the extended position of the ramp thereby transferring at least one selectively variable part of the weight and instant load of said second ramp section either onto said innermost ramp section or onto independent auxiliary supporting means provided on said vehicle. Such an arrangement offers the advantage of possibly achieving an automatic control of the bearing pressure force of the ramp onto said platform in accordance with the true load carried by said second ramp section.

35 The or each second handling cable may be reeved over at least one elevated or overhead loose guide pulley or idle sheave mounted on said vehicle and terminate in a movable counterweight and means for stopping and unidirectionally holding said cables against motion may consist of a stationary stop means provided on said vehicle for limiting the upward motion of said counter-weight. The weight or the or each counterweight is preferably selectively adjustable.

40 According to an alternative embodiment, the or each second handling cable is connected to a stationary fastening point provided on said vehicle through the medium of an adjusting member having a selectively variable length, such as a turn buckle or like tension shackle, rope tightener or stretcher, forming an aforesaid tensioning and load transfer means.

45 According to a modification, the or each second handling cable is connected to a linear-displacement type pressure fluid operated actuator, for example of the ram type, generating a selectively adjustable force and forming one aforesaid tensioning and load transfer means.

50 According to still another alternative

embodiment, the or each second handling cable is connected to a stationary fastening point provided on said vehicle through the medium of at least one resiliently deformable spring-like member constituting said automatic tensioning means and the or each said handling cable is stopped and unidirectionally held against motion by a stationary stop means limiting the strain or deformation of said spring-like member under maximum stress. The automatic tensioning means preferably comprise a self-acting winding-up appliance. The winding-up appliance may be provided with braking means for braking said appliance for braking said cable at the end of useful paying-out motion of said of said second handling cable(s).

According to still a further modification of the invention, the or each aforesaid second handling cable is connected to a power-operated winch providing for constant cable tensioning and located on said vehicle to form an aforesaid load transfer means.

According to still another alternative embodiment, said load transfer means consist of at least one counterweight or like counterbalancing or weighting body having a selectively adjustable weight and located on one lever arm integral with said second ramp section so as to urge the latter towards its extended position.

The access ramp according to the invention may further be provided with a third or outermost ramp section forming a supporting pad to bear on an outside platform and pivotally connected preferably by an intermediate point thereof to the corresponding outer end of said second ramp section forming an intermediate section, self-acting or operated means being provided for raising said outermost section. For this purpose and according to one embodiment of the invention, each handling cable for controlling the extension of said intermediate section is reeved over at least one associated main loose guide pulley carried by said intermediate ramp section and this cable is secured with its outer end to said outermost ramp section at a point located outwards beyond the pivotal connection of said outermost section with said intermediate ramp section. Such an arrangement offers the advantage that the outermost section can be automatically raised so as to assume a proper laid flat position when engaging the quay thereby preventing any possibility of buttressing or abutting against some projection of the quay.

According to an alternative embodiment, an operated means for controlling the raising of said outermost element may

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5 consist of at least one ram-like, pressure fluid operated actuator provided between the intermediate and outermost ramp sections and remote-controlled either automatically or by an operator from a remote-control station or desk.

10 Moreover, in the device according to the invention, the ramp, in its lowered and extended working condition, may remain at least partially suspended from its handling cables or ropes reeved on the associated king-posts, respectively, of the ship and made fast adjacent to the outer end of the inboard ramp section (i.e. that section which is pivoted to the ship) so as to relieve the quay from the load sustained by decreasing the bearing pressure of the free end of the ramp thereon by transferring or carrying over at least one part of the total ramp weight and of its possible instant load to the ship. The bearing pressure exerted onto the quay by the outermost ramp section may also or in addition be decreased by applying a suitable adequate tension to the handling cables or ropes for controlling the extension of said intermediate section, so that their reeved portions between pulley or tackle blocks, interconnecting the innermost ramp section and the adjacent outer or intermediate ramp section pivotally connected thereto thereby exerts a relative lifting force on the combination of said intermediate ramp section and outermost ramp section for thereby transferring at least one part of the weight of such an assembly and of the instant load possibly carried thereby to said innermost ramp section while unidirectionally blocking the pivotal direction between both innermost and intermediate ramp sections in the relative swinging direction for folding same together.

45 According to yet another preferred embodiment of the invention, the first ramp section is provided with a pair of side frame members at least one of which carries a buttressing ram the line of action of which is spaced from the geometrical axis of pivotal connection between said adjacent innermost and second ramp sections, said buttressing ram being adapted to bear removably against an abutment means integral with the corresponding side of said adjacent ramp section in the lowered and extended working position of said ramp for blocking said pivotal connection in the direction of rotation of increasing extension of the ramp, in a relative angular position which is selectively variable through the adjustable operative length of stroke of said ram, whereas selectively variable connecting means are provided between said side frame member and said corresponding side, respectively, of both

ramp sections for blocking said pivotal connection in the direction of rotation of folding back said ramp, in the same relative angular position, and wherein on the one hand said ram is of the double-acting kind and pivotally connected with its body onto said side frame member of said innermost ramp section while extending in substantially parallel relation to the longitudinal relative vertical plane of said side frame member, said ram being located higher than the geometrical axis of said pivotal connection between both ramp sections in their working position and said adjacent second ramp section also comprising a pair of side frame members on its opposite sides, respectively, whereas on the other hand said ram is provided with a movable push head adapted to freely and directly engage at least one substantially concave abutment pad forming said abutment means and secured to the adjacent end of said corresponding side frame member of said second ramp section; operated locking means being provided on said corresponding side frame member of said adjacent second ramp section to rigidly connect said movable push head with said abutment pad thereby to form said selectively variable connecting means.

The buttressing ram also serves as a bracing member connecting together both interconnected ramp sections in the locking position of the ram thereby positively and effectively preventing any relative folding or rotary motion about the pivotal connection between both ramp sections involved.

The movable push or thrust head of said ram preferably comprises at least one sidewise projecting portion, such as for instance a transverse projecting stud-pin, adapted to bearingly engage said buffer member or abutment pad which is preferably substantially square-shaped and said locking means preferably comprise at least one movable retaining member actuated by an associated actuator and mounted on said adjacent second ramp section, said retaining member being adapted to bear against said sidewise projecting portion to keep it in abutting engagement with said abutment pad.

According to a further preferred embodiment of the invention, each aforesaid retaining member is automatically urged constantly towards its operative locking position by a resilient biasing means or through gravity so that its associated actuator is only used for unlocking purposes.

This retaining member thus provides a temporary rigid working assembly secured against any separation, disengagement or like disconnection and against any slipping

or sliding motion through mutual displacement.

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which like parts are denoted by like reference numerals and in which:—

Figure 1 shows a perspective view of the ramp of the invention according to a first embodiment thereof, with a second ramp section provided with cantilever booms or outriggers or like projecting arms, the ramp being mounted astern i.e. at the rear portion of a ship moored longitudinally along a quay berth and shown in its lowered extended working configuration wherein its longitudinal direction makes an acute angle with the general backwards pointing longitudinal direction of the ship;

Figure 2 is a fragmentary top view of the arrangement shown in Figure 1;

Figure 3 is a fragmentary side view to a larger scale showing the ramp in a raised and folded stowing position, in an intermediate handling position in a partially lowered and extended state and in two lowered and extended working positions, respectively, in both cases where the access area of the ship is located higher or lower than the quay surface, respectively;

Figure 4 is a partial side view of the upper right-hand portion of Figure 3 showing the use of a counterweight for each handling cable controlling the extension of said second ramp section;

Figure 5 is a view similar to Figure 4, showing an alternative embodiment illustrating the use of a hydraulic actuator for each handling cable controlling the relative extension of said second ramp section;

Figure 6 is a view similar to Figures 4 and 5, showing another modification illustrating the use of a spring for each handling cable controlling said relative extension of the second ramp section;

Figure 7 is a view similar to Figures 4 to 6, showing a still further alternative embodiment illustrating the use of a constant-tension winch for each handling cable controlling the relative extension of said second ramp section;

Figure 8 is a partial side view of the ramp portion adjacent to the quay in its working condition, illustrating by way of another alternative embodiment, the use of a counterweight for each projecting boom or cantilever outrigger of the second ramp section;

Figure 9 is a perspective view, similar to Figure 1 but to a slightly smaller scale, showing a second embodiment of the invention wherein said cantilever booms or projecting outriggers are carried by the

innermost ramp section instead of being carried by the intermediate ramp section;

Figure 10 is a fragmentary side view of the embodiment shown in Figure 9 showing the device in its raised and folded stowing position;

Figure 11 is a view similar to Figure 10 but corresponding to the configuration shown in Figure 9 when assuming the level of the access area of the ship to be approximatively the same as or slightly higher than that of the quay;

Figure 12 is a fragmentary side view at a larger scale of the encircled detail XII of Figure 11;

Figure 13 is a view similar to Figure 11 but wherein the access area of the ship is assumed to be located higher than the quay surface;

Figure 14 is an enlarged fragmentary side view of the encircled detail XIV of Figure 13;

Figure 15 is a view similar to Figures 11 and 13 but wherein the level of the access area of the ship is assumed to be located below the quay surface level;

Figure 16 is an enlarged fragmentary side view of the encircled detail XVI of Figure 15;

Figure 17 is a fragmentary side view at a larger scale, similar to Figures 10, 11, 13 and 15 and showing the ramp in different successive end and intermediate positions, respectively, to show the various steps of its operation in both cases where the access area of the ship is located lower and higher, respectively, than the quay surface;

Figure 18 is a side view, with parts broken away, of the ramp portion located adjacent to the pivotal connection between the innermost and central or intermediate ramp sections in a partially folded position with an upward projecting angle, said portion being provided with a device according to the invention, placed in its retracted inoperative position, i.e. without producing any buttressing effect;

Figure 19 is a fragmentary side view to a larger scale of a ramp portion about its pivotal connection in a relative lowered and extended working position with the innermost and intermediate ramp sections substantially aligned in mutually registering relationship in extension of each other, said buttressing appliance being in its operative extended position; and

Figure 20 is a fragmentary top view of the adjacent end portions of both corresponding side frame members of both ramp sections involved, respectively, shown in Figure 19.

According to the exemplary form of embodiment shown in Figures 1 to 8, a ship, generally denoted by the reference numeral 1 and the stern or rear end portion of which

only is shown, is moored adjacent a quay 2 for instance alongside thereof, so that the longitudinal direction 3 of the ship is substantially parallel or co-extensive with the direction of the quay edge. The rear portion of the ship is fitted with a movable access ramp 4 consisting of three successive innermost or foremost, central or intermediate and rearmost or outermost sections 4a, 4b and 4c, respectively, pivotally connected to each other at adjoining ends in substantially aligned mutually registering relationship in the lowered extended working position by pivot hinges or the like 5, 5', respectively. The outermost section 4c is desirably in the shape of a bearing pad or like engaging plate serving to support the ramp on the quay 2, so that this section automatically provides a gentle rise from the quay surface to the access ramp irrespective of the relative slope of the intermediate section 4b. In order to facilitate the passage of vehicles on the ramp, the outermost section 4c is as known per se wider on at least one side and at least towards its free end than the adjacent intermediate section 4b. The innermost or inboard section 4a is made desirably wider at least towards one side as known per se at its forward or inner end through which it is pivoted at 6 to the ship 1.

At least the innermost section 4a is provided on either side thereof with two side frame members 7. To the innermost section 4a, preferably at its outer end or adjacent to its pivotal connection 5 with the intermediate section 4b, is secured at least one handling cable or rope wound up on an associated power-operated handling winch located on the ship. There are preferably provided at least two handling cables 8, 8' made fast at 9, 9', respectively, onto the side frame members 7 of the ramp section 4a and winding up on two corresponding handling winches 10, 10', respectively, desirably located at an overhead or elevated level, for instance on the upper deck 11 of the ship. Each handling cable 8, 8', extending from its associated power-operated winch 10, 10' passes at first over at least one preferably elevated auxiliary guide pulley or sheave 12, 12' mounted for instance on a deck erection or like superstructure such as a suitable derrick or king-post 13, 13' (at the bottom portions of which the winches 10, 10' are located) and then over at least one main guide-pulley 9, 9' mounted on the side frame members 7 of the ramp section 4a. In order to reduce the tractive force to be exerted on the handling cables 8, 8', it is advantageous that each handling cable 8, 8' forms a suitable reeved portion interconnecting the ramp section 4a with the corresponding derrick or king-

post 13, 13' while thus passing successively on several auxiliary guide-pulleys 12, 12' mounted in the same pulley or tackle block carried by the corresponding derrick or king-post 13, 13' and then on several main guide-pulleys 9, 9' also fitted together in the same tackle block secured to the corresponding side frame member 7, 7'. Each cable 8, 8' thus exhibits multiple runs extending between the ship and the ramp. To balance the tensions in the various runs of the cables 8, 8', one single cable only is used which, extends from the winch 10 and after having passed over the pulley-blocks 12 and 9 is reeved at 8'' successively over the guide-pulleys 9a, 9'a located beneath the ramp section 4a at the outlet of pulley block 9 and the inlet of pulley-block 9', respectively, for passing them over the latter and afterwards over the tackle-block 12' to be finally taken up by the other winch 10'.

The intermediate section 4b is foldable downwards against the innermost section 4a and extends beyond its pivotal connection 5 with the innermost section 4a with at least one longitudinal projecting arm-like boom or integral outrigger carrying towards its free end at least one auxiliary guide-sheave for respective handling cables 15, 15' controlling the extension of said intermediate section. For this purpose there are desirably provided two such cantilever arm-like booms or projecting outriggers 23, 23' consisting of outwards offset extensions of the corresponding longitudinal edges of the intermediate section 4b beyond the pivotal connection 5 forming the outer end of the vehicle runway supported by the side frame members 7 of the innermost section 4a, these booms being preferably arranged so as to be located higher than the innermost section 4a in the extended position of the ramp and to embrace the latter. Each projecting boom 23, 23' carries at least one auxiliary guide-pulley 19, 19' for the handling cable 15, 15' controlling the extension of said intermediate section, which thus is reeved successively over this pulley 19, 19' and then on a main loose associated guide-pulley 14, 14' carried by the innermost section 4a respectively at the corresponding auxiliary sheave 19, 19' to be made fast at a stationary point 14a, 14b on the associated side frame member of the innermost section 4a. There are desirably provided, on each boom 23, 23', several auxiliary loose guide-pulleys 19, 19' mounted in a same tackle-block and, on the innermost section 4a on either side thereof, several loose main guide-pulleys 14, 14' also mounted in a same tackle-block so as to form a force-reducing reeving between each boom 23, 23' and the innermost

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section. The handling cables 15, 15' are passed over at least one and preferably two loose guide sheaves 16, 16' which are preferably at an elevated position and carried for instance by a derrick or king-post 13, 13', respectively, to be made fast through the medium of a turn-buckle, rope, stretcher or stiffener or like cable tensioning or tightening device 17, 17' to a stationary point 18, 18' fast for instance with the associated derrick or king-post 13, 13'.

At least one (hydraulic or pneumatic) pressure fluid operated actuator 26, preferably of the linear-displacement type consisting of a cylinder and piston assembly mounted between the intermediate ramp section 4b and the outermost ramp section 4c and pivotally connected with its cylinder bottom or back end to the end of the section 4b and with its piston rod to the end portion forming the heel part of the section 4c is located under the section 4b (see Figure 3). This actuator is desirably provided and remote-controlled for raising the outermost section 4c so that the latter rests entirely throughout its seating surface in a flat laid condition on the quay 2, so as to properly connect the runway surface of the intermediate section 4b to the quay surface and to distribute the load uniformly on the latter to avoid any buttressing effect. Figure 2 shows that it is advantageous to provide two such actuators 26 preferably arranged in symmetrical relation to the longitudinal vertical central plane of the ramp towards the side edges, respectively, of the outermost ramp section 4c. Independent segmented flap elements 27 pivoted to the transverse end edge of the section 4c in juxtaposed relationship across the latter serve to engage the quay 2 to facilitate through their wedge-shaped cross-sectional contour the access to the section 4c. Also, a set of similar flap elements 28 are likewise pivoted to the inner transverse end edge of the ramp section 4a to facilitate the access to the deck 29 of the ship while spanning the cargo port 30 in the side thereof.

The tractive reaction force at the fastening point of each handling cable 15, 15' controlling the extension of the intermediate section, on its associated derrick or king-post 13, 13' may be achieved in various ways. Thus in Figures 1 and 3, this reaction force is merely produced by the stationary fastening point 18, 18' of each cable at the top of the associated derrick or king-post. In the alternative embodiment according to Figure 4, each cable 15, 15', after having been reeved over a first guide-pulley 16 located at the free end of the jib portion of the associated derrick or king-post 13, 13'

passes on a second guide-pulley 16a located at the opposite end of this jib portion to extend downwards again along the king-post and to terminate into a movable counterweight or the like 31 mounted for instance on rollers 32 for riding on or within a corresponding guide track 33 sloping downwards from top to bottom and away from the ramp in the downward direction. This guide-track 33 is provided at its upper end with a stationary stop means 34 for limiting the upward stroke of the associated counterweight 31. The position of the counterweight obviously varies with the relative position of the ramp during operation thereof, the engagement of the counterweight 31 with the stop means 34 automatically causing the relative raising and extension of the intermediate ramp section 4b. Since no further movement of the cables 15, 15', and thus no further effective extension of these cables, is possible.

In the alternative embodiment according to Figure 5, each cable 15, 15', after passing over the associated guide-pulley 16a is reeved on a guide-pulley 35 carried by the piston rod of a linear-displacement pressure fluid operated, for example, hydraulic actuator 36 mounted on the associated king-post 13, 13' the thus returning run of each cable 15, 15' being made fast at a stationary point 37 of the corresponding derrick or king-post. Each actuator 36 thus allows the tension in the associated cable 15, 15' to be varied at will and preferably at the same time or synchronously through selective adjustment of the control fluid pressure fed into the cylinder of actuator 36.

In the embodiment shown in Figure 6, the pressure fluid operated actuator 36 has been replaced by a spring-operated actuator or the like 38 secured to the corresponding king-post 13, 13' and comprising for instance a cylinder containing at least one for instance helical compression spring with one end of which co-operates a sliding piston coaxially integral with a rod carrying at its free outer end the pulley 35. The helical spring could possibly be replaced by a compressible preferably gaseous fluid such as nitrogen.

In the embodiment shown in Figure 7, each cable 15, 15', after passing on the guide-pulley 16, 16', is wound up on a power-operated winch 39 preferably applying a constant tension to the cable and mounted on the associated king-post 13, 13', said winch being driven for example hydraulically or electrically.

The actuators 36 in the embodiment of Figure 5 or the winches 39 in the embodiment of Figure 7 allow the tension in the cables 15, 15' to be selectively varied

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in the extended and lowered working configuration of the ramp 4, thereby tending to lift the intermediate ramp section 4b upwards to thus release selectively the bearing pressure exerted on the quay 2 by the outermost ramp section 4c. Another means of producing the same relief effect consists, according to the embodiment shown in Figure 8, in providing on each projecting boom 23, 23' of the intermediate ramp section 4b a counterweight or the like 40 having for instance a selectively variable weight and desirably located endwise of the associated projecting boom 23, 23'. Each counterweight 40 thus applies a tilting moment to the section 4b about its pivot axis 5 in the upward direction or direction of raising of said section. Instead of a counterweight it is also possible to correspondingly weight the structure of the booms 23, 23' by increasing their mass.

Automatic control means are desirably provided to keep the innermost section 4a away or spaced from the quay in the lowered working configuration of the ramp in order that it never directly engages the quay. These control means consist for instance of at least one sensor or like detector 21 (see Figures 2, 3 and 8) secured for example to the intermediate section 4b in particular below same and towards its inner end and adapted to bear upon the surface of the quay 2, preferably adjacent to the edge of the quay to detect any variation in relative position in height or in the level difference between the ship 1 and the quay as caused in particular by an upward motion of the ship. Such a sensor 21 may consist for example of an electric limit switch with normally open contacts adapted to control the simultaneous or synchronized operation of the respective motors or prime movers of the handling winches 10, 10' by acting for instance either upon an electromagnetic valve in the case of pressure-fluid operated motors such as hydraulic or pneumatic motors or upon an electric switch relay in the case of electric motors.

The system is desirably fitted with automatic control means for adjusting the relative angular position of the innermost and intermediate ramp sections 4a and 4b, respectively, to keep same substantially aligned or inclined with an optimum slope in the lowered extended working configuration of the ramp, each aforesaid handling winch 10, 10' being then controlled by such control means. These control means consist for example of at least one sensor or like detector 22 mounted on one of the two adjacent ramp sections 4a, 4b, preferably in the vicinity of its pivotal connection 5 with the other

section and adapted to engage said other section so as to measure the angle formed therebetween in particular during the raising motion of the ship. In the example shown, this detector 22 is mounted on the protruding boom 23 of the intermediate ramp section 4b between the latter and the side frame member 7 of the innermost ramp section 4a. This detector 22, as well as the sensor 21, may consist advantageously of an electric limit switch or of a position pick-up or detecting means with an equivalent action.

Pushing or thrust means such as one or several linear-displacement type pressure-fluid operated for instance hydraulic or pneumatic actuators with a cylinder and piston assembly 24 mounted on the ship 1 are adapted to bear freely in abutting relationship against the innermost ramp section 4a in the fully raised position thereof (Figure 3) to initiate its downward tilting or swinging motion through gravity and possibly to brake or slow down same at the end of its raising motion at which it is engageable with stationary stop or rest means 41 forming wooden or rubber buffers or like pads provided on the ship. Alternatively these thrust actuators 24 could themselves form such stop or abutment means. Each actuator 24 instead of being mounted on the ship 1 could as well be mounted on the innermost ramp section 4a so as to be freely engageable with a stationary portion of the ship's structure at the start of the downward tilting or swinging motion of the ramp or at the end of the raising motion thereof.

The innermost section 4a is desirably enlarged or widened at 4' towards its inner end and preferably at least towards the obtuse angle defined between its own longitudinal direction and the longitudinal direction of the ship in the case of a ramp arranged towards one end for example aft of the ship with a view to facilitate access thereto.

A lashing or locking appliance 42 is desirably provided on the ship for locking or holding the ramp 4 against motion in the stowed inoperative position, i.e. when it is folded back and swung up (see Figures 3 to 7). Each locking or lashing device 42 is preferably adapted to engage the intermediate ramp section 4b folded downwards against the innermost section 4a which has come in abutment with the buffers 41 after having been run or extended through the latter. Each locking device 42 may be operated either manually or automatically for instance by hydraulic actuators and consist in particular of a latch, lock-bolt or like hook member adapted to engage a bolt-clasp or equivalent catch or keeper means integral

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with the intermediate section 4b while preferably exerting a tractive force urging said ramp to bear against its abutment pads or buffers 41. Instead of being placed on the ship 1, each locking device 42 could also be provided on the ramp 4 to be engageable with a complementary or mating stationary catch element integral with the ship's structure.

Automatic control means, not shown, are advantageously provided to selectively vary the bearing reaction of the ramp 4 on the platform or quay 2, each aforesaid load transfer means, such as in particular the hydraulic actuators 36 or the winches 39 applying a constant tension to the associated cables and being controlled by said control means. These control means consist for instance of a sensor or like detector forming a pressure pick-up device mounted on the ramp towards its outer end for bearing upon the quay 2 in the working position so as to measure the bearing reaction of said quay.

In the embodiment of the Figures 1 to 8, each aforesaid protruding boom 23, 23' is in extension of the corresponding side edge of the intermediate section 4b. It is apparent however that generally each projecting boom may be in extension of any one of the two innermost and intermediate ramp sections 4a, 4b, respectively, while extending beyond the common pivotal connection between the adjacent ends thereof towards the other section which then carries at least one main guide-pulley or tackle-block for the handling cable 15, 15' controlling the extension of the intermediate section whereas the free end of the corresponding boom then carries at least one auxiliary guide-pulley or tackle-block for this cable.

Figures 9 to 17 show another embodiment of the invention wherein the relative arrangement of said booms and sheaves or pulley-blocks has been reversed with respect to that of the first embodiment shown in Figures 1 to 8. In this alternative embodiment, it is the innermost ramp section 4a which extends beyond its pivotal connection 5 with the intermediate section 4b with at least one integral projecting longitudinal arm-like boom or outrigger and preferably with two such booms 7a, 7b substantially co-extensive in parallel relationship with the general longitudinal direction of the ramp in extension of the side frame members 7, on either side of the intermediate section 4b while being desirably transversely offset outwards so as to be spaced sidewise from the intermediate section 4b and preferably somewhat elevated or higher with respect thereto. Each projecting boom 7a, 7b then carries the or each main guide-pulley or tackle-

block 19, 19' for the handling cable 15, 15' controlling the relative extension of the intermediate section, whereas the intermediate section 4b carries at an intermediate point thereof at least one auxiliary guide-pulley or tackle-block 14, 14' for each handling cable 15, 15' controlling the extension of said intermediate section and leading from each main guide-pulley or tackle-block 19, 19'. Each handling cable 8, 8' for the ramp is made fast for instance with a tackle-block at a point 9, 9' of the innermost section 4a towards the pivotal connection 5 or outer end of same. On each king-post or derrick mast 13, 13', the free downward extending run of each cable 15, 15' terminates in a counterweight or the like 31, 31'. Each king-post 13, 13' includes a stationary stop means 34 limiting the upward vertical stroke of the associated counterweight 31, 31'. For the sake of clarity, stop means 34 is not shown in Figure 9.

Each handling cable 15, 15' controlling the relative extension of the intermediate ramp section is desirably made fast with the end of its run leading from the corresponding guide-pulley or tackle-block 14, 14' thereof and after having passed over an additional guide-pulley of which one is shown at 25, (Figures 10, 11, 13, 15) to the outermost section 4c at a point 20, 20' located outwards beyond the pivotal connection 5' of this outermost section with the intermediate section 4b. The cables 15, 15' also serve to automatically raise or lift the outermost section 4c so that the latter rests entirely throughout its seating surface on the quay 2 thereby properly connecting the runway surface of the intermediate section 4b to the quay surface and distributing the load uniformly on the latter to avoid any buttressing effect. This arrangement is also applicable to the embodiment of Figures 1 to 8 instead of the actuators 26.

As shown in particular in Figures 10 to 16, each sensor element 21 is here secured to the innermost section 4a in particular underneath the latter and towards its outer end whereas the detector 22 is mounted on the intermediate ramp section 4b between the latter and the projecting boom 7a of the innermost ramp section 4a.

The operation of the ramp 4 is then the following with reference at first to Figure 3 showing the first embodiment when assuming the ramp initially is in the position C₁ wherein it is folded back and entirely raised to an upstanding position. In this position, the ramp is held against motion in abutment against the buffers 41 by the locking arrangement 42, the ramp sections 4b and 4c being folded back against the section 4a. To lower the ramp into the

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extended working position, the locking device 42 is at first unlocked in order to disengage or release the ramp 4 and the winches 10, 10' which are desirably provided with means for automatically braking their unwinding or paying out motion, are operated in the unwinding direction so as to relieve the tension in the handling cables 8, 8' with a view to giving them some slack during the downward swinging motion of the ramp. If the tilting moment through gravity about the pivot axis 6 is then inadequate initially to start the downward swinging motion of the ramp, the pushing rams 24 are actuated to force the ramp section 4a in the downward direction thereby initiating the swinging motion. The operation for extending or relatively raising the ramp section 4b together with the ramp section 4c is effected differently according to the manner of connecting each cable 15, 15' to the ship. This operation is initiated upon tensioning the cables 15, 15' caused by the reaction of the stationary fastening points 18, 18' in the case of Figures 1 and 3 or of the stop means 34 limiting the upward stroke of the counterweights 31 in the case of Figure 4 or of the fastening points 37 in the case of Figure 5 (the ram 36 then being blocked) or also of the fastening points 37 in the case of Figure 6 when the spring-operated actuators 38 are blocked or have reached an adequate resilient stress or force to cause the relative tilting or swinging of the ramp section 4b. From that time and as the ramp section 4a is swinging downwards, this reaction of the stationary fastening point results in each cable 15, 15' in an adequate tension to provide for the gradual automatic raising or extension of the ramp sections 4b, 4c thereby using fully the potential energy of the gravity induced downward motion of the ramp as shown for instance at the intermediate position C₂ of the ramp in Figure 3. The outermost ramp section 4c is moreover raised either by the actuation of the actuators 26 in the case of Figure 3, or automatically by means of the cables 15, 15' when same are made fast, as in the embodiment of Figures 9 to 11, 13 and 15, at points 20, 20', respectively, of the ramp section 4c for causing same to swing about its pivot axis 5'. In the position C₃ of Figure 3, the ramp 4 has come to rest with its outermost section 4c on the quay 2 when the pivotal connection 6 connecting the ramp with the ship 1 is located lower than the quay. The position C₄ of Figure 3 illustrates the case where the ramp rests on the quay 2 when the pivotal connection 6 is located higher than the quay. In both of these cases, the outermost ramp section 4c presents itself in a substantially flat laid position above the quay owing to its

individual control. At the end of the operation for swinging or moving the ramp downwards, the handling cables 15, 15' for extending the intermediate section may possibly become fully slackened or loosened.

When the pivotal connection 6 between the ramp and the ship is lower than the quay 2 (position C₃ in Figure 3), the sensor 21 will then engage the quay and actuate the handling winches 10, 10' in the winding up direction to raise the ramp section 4a high enough so that it will not bear directly onto the quay. If however the pivotal connection 6 between the ramp and the ship is located higher than the quay 2 (position C₄ in Figure 3), it is then the angle detector 22 located on the ramp section 4b which becomes operative through engagement with the ramp section 4a for actuating the handling winches 10, 10' in order to adjust the angle between these two ramp sections to achieve an aligned relationship or the best slope of the ramp. The sensor 21 and detector 22 thus act automatically and separately. The sensor 21 always operates before the detector 22 and takes precedence over the latter, i.e. when the sensor 21 is allowed to act, the detector 22 is inoperative but when the detector 22 is allowed to act, the sensor 21 may operate also.

In the case of the embodiment of Figure 5 or 7, when the bearing pressure of the ramp section 4b onto the ramp section 4c hence the bearing pressure of the ramp section 4c onto the quay 2 reaches a permissible upper limit value, the pressure detector mentioned hereinabove starts to operate for actuating the hydraulic actuators 36 or the winches 39 so as to give the cables 15, 15' an adequate tension to decrease the bearing pressure of the ramp onto the quay by transferring a part of the weight and of the load of the ramp sections 4b and 4c to the ramp section 4a through the medium of the reeving through the guide pulleys 14, 19 and therefore to the handling cables 8, 8' from which the ramp section 4a is suspended from its outer end at 9, 9'. In the case of the embodiment of Figure 8, this load transfer is effected automatically through the medium of the counterweight 40.

In the case of the embodiment shown in Figures 9 to 16, the operation of the ramp is illustrated in Figure 17 wherein it is assumed that the cables 15, 15' are tensioned by the counterweights 31, 31', respectively, it being of course understood that the alternative embodiments of Figures 5 and 6 are also applicable to this form of embodiment. Referring to Figure 17, it is seen that in the position B₁ wherein the ramp is folded back and fully raised to an

upstanding position, each counterweight 31, 31' is in an intermediate position at A₁ between the lower limit level provided by the deck surface 11 and an upper limit level provided by the associated stop means 34, 34' for limiting the upward stroke of each counterweight. The operation of this embodiment is substantially the same as that described with reference to the first embodiment according to Figure 3. Thus, at the beginning of the downward swinging motion of the ramp, each counterweight 31, 31', the weight of which is not high enough to raise or extend the intermediate and outermost ramp sections 4b and 4c, respectively, is then pulled or drawn by its associated cable 15, 15' and rises until it engages the associated stationary stop means 34, 34' limiting its upward stroke when the ramp section 4a has reached the intermediate position B₂ inclined through an angle for example of about 20° with respect to the vertical direction. From that time and as the ramp section 4a is swinging downwards, the reaction produced by the stationary stop means 34, 34' provides in each cable 15, 15' an adequate tension to cause the gradual automatic raising or extension of the ramp sections 4b, 4c. At the end of the downward motion and extension of the ramp 4, the counterweights 31, 31' begin to move downwards to reach the lower end position A₁ when the ramp 4 has been caused to rest in the position B₂ onto a quay located higher than the pivotal connection 6 between the ramp and the ship 1 or to attain an intermediate level position A₂ higher than the initial position A₁ when the ramp has been caused to rest in the position B₂ onto a quay 2 located lower than said pivotal connection 6. During the extension or raising motion of the intermediate ramp section 4b, the outermost ramp section 4c is simultaneously swinging about its pivot axis 5' in the direction of its relative raising owing to the action of the cables 15, 15' acting directly upon the section 4c through the medium of their fastening points 20, 20' provided on the latter. At the end of the operation for moving the ramp downwards, the cables 15, 15' may possibly slacken or become loosened completely if in the instant lowered position each counterweight 31, 31' is allowed to rest on a stationary support provided at the final level reached by the corresponding counterweight.

Figures 15 and 16 show the relative position of the sensor 21 and detector 22 in the case where the pivotal connection 6 between the ramp and the ship is located lower than the quay 2 whereas Figures 11 and 12 show the corresponding situation in the case where the pivotal connection 6 is

located adjacent to or about the surface level of quay 2. Figures 13 and 14 show the relative position of the sensor 21 and detector 22 when the pivotal connection 6 on the ship 1 is located higher than the surface of the quay 2, the detector 22 mounted on the ramp section 4b then engaging the projecting boom 7a of the ramp section 4a. The operation sequence and the order of priority action or of precedence of these detectors are the same as in the first embodiment.

In both aforesaid embodiments the operation for raising and folding back the ramp 4 is effected in the reverse order of the operations previously described. When using tensioning or stretching devices like turn-buckles 17, 17' on the cables 15, 15' as in the embodiment shown in Figure 1, the tensioning of these cables to decrease the bearing pressure of the ramp onto the quay 2 may be effected by means of these turn-buckles or tighteners through manual operation.

It should be pointed out that, during said angular displacement by 20° of the ramp in relation to its fully raised upstanding position, no relative motion is imparted to the ramp sections 4b and 4c with respect to the ramp section 4a.

According to the exemplary embodiment of Figures 18 to 20 of the drawings, each side frame member 7 extending along one longitudinal side of the innermost ramp section 4a down to its outer or pivot end 5 preferably without projecting beyond the latter, carries a desirably hydraulic actuator in the form of a ram 101 preferably of the kind adapted to perform a linear displacement in straight translatory motion, consisting of a cylinder and piston assembly the body or cylinder 102 of which is pivotally connected with its bottom or back end by means of a substantially horizontal pivot pin 103 positioned transversely of the longitudinal direction of the ramp to a support forming a fork-like bracket, clevis or like yoke 104 for pivotal connection integral with the top of the side frame member 7 in the vicinity of the outer end of the latter. The movable piston rod 105 of the actuator 101 is thus located towards the pivotal connection 5 between the adjacent ramp sections 4a and 4b and carries at its free end a pushing or thrust head 106 carrying at least one sidewise projecting pin and preferably a pair of sidewise projecting pins 107a, 107b arranged in transversely opposed and coaxially aligned relationship and located on either side, respectively of the movable head 106 while extending substantially horizontally in transverse relation to the longitudinal direction of the ramp hence in parallel relation to the geometrical pivot axis 5. The relative

position of the ram-like actuator 101 could of course be reversed so that it is its piston rod 105 which is pivoted through a connecting pin 103 to the bracket or clevis 104 and the cylinder 102 carries the pushing head 106 at its free bottom or back end.

Guide means are desirably provided on either side for the movable pushing head 106 of the ram-like actuator 101 and advantageously consist preferably of each pin 107a or 107b which are long enough to engage an associated stationary slideway consisting desirably of a stationary upright plate 108a, 108b secured to the top of the associated side frame member 7 while extending in the longitudinal direction thereof for projecting beyond the outer end of the innermost ramp section 4a that is towards the pivotal connection 5. This guiding slideway is desirably formed with a slot, groove or like elongated recess 109 (Figure 18) wherein is relatively freely inserted and guided the associated pins 107a or 107b. The guide slot 109 has a substantially curved configuration the longitudinal centre line of which has the shape of an arc of circumference concentric with the geometrical axis of the pivotal connection 5 between both innermost and intermediate ramp sections 4a, 4b, respectively. The curvilinear or circumferential length of each guide slot 109 is long enough for accommodating a useful stroke of the movable head 106 for relative buttressing angular configurations of both ramp sections in the extended and lowered working position thereof. Both parallel guide slideways 108a, 108b are thus constantly supporting the free end of the actuator 101 in particular in all of its positions wherein it does not exert any buttressing effect.

The adjacent intermediate ramp section 4b is also provided on its longitudinal sides and on at least one portion of the length thereof with a side frame member or like girder 110 which is possibly formed with an associated longitudinal boom 23 projecting as a cantilever beam beyond the pivotal connection 5 generally in parallel relation to the longitudinal direction of the intermediate ramp section 4b when such booms are not provided on the innermost ramp section 4a to extend beyond the pivotal connection 5 but in the reverse direction that is towards the intermediate ramp section 4b. Each side frame member 110 carries substantially at its inner end, i.e. the end located towards the pivotal connection 5, a kind of thrust bearing or recessed abutment bracket forming a stop pad adapted to be engaged by and to receive the thrust of each thrust pin 107a, 107b of the movable head 106 of the actuator 101. There are thus

advantageously provided one pair of such abutment pads 111a, 111b located in symmetrical relation to a substantially central longitudinal vertical plane of the associated side frame member 110 while being spaced from each other by a distance large enough to accommodate with clearance or loosely the free end of the movable head 106 between both aforesaid abutment pads (see Figure 20). The relative position in the longitudinal direction of the pad assembly 111a, 111b with respect to the intermediate ramp section 4b, the relative position and the curvilinear or circumferential length of the guide slots 109 as well as the relative position and the total length of each actuator 101 in its fully retracted configuration are preferably determined so that in the buttressing position shown in Figure 19 wherein both ramp sections 4a, 4b are substantially aligned with and in straight extension of each other, each actuator 101 is in its fully or utmost retracted state so that the piston is in mechanical abutment against the bottom or back end wall of the corresponding cylinder 102. The thrust pins 107a and 107b of each movable pushing head 106 therefore project sidewise by a distance long enough beyond the associated respective pads 111a, 111b for engaging the parallel guide slideways 108a, 108b, respectively, extending outside on either side.

In Figures 18 and 19, the top level of the respective runway surfaces of the ramp sections 4a, 4b have been shown in straight dotted lines at 112a, 112b and these runway surfaces project in overhanging relationship at their adjacent ends above the pivotal connection section 5 to provide a continuous passageway in the extended working position of the ramp.

As mentioned hereinbefore, each abutment pad or like thrust plate 111a, 111b is desirably square shaped with its concavity facing the innermost ramp section in the extended working position thereof and with each pad is associated a locking means adapted to block one thrust pin 107a, 107b of the movable head 106 when it is accommodated in the recess or depression of the corresponding abutment pad. Each locking means advantageously comprises one retaining member having the shape of at least one arm actuated in particular by an associated power-operated control or positioning means and swinging in a plane substantially at right angles to said thrust pin while being adapted on the one hand to be lowered until abutting engagement preferably substantially with the tip of its free end having for example a mating and complementary bearing shape with the thrust pin involved on that face of

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the latter which is opposite to the corresponding pad to hold said thrust pin against motion and on the other hand to be moved upwards away from said thrust pin to release or be disengaged from the latter. As in this instance the movable pushing head 106 comprises a pair of transversely opposite coaxial thrust pins 107a, 107b adapted to co-operate with both corresponding pads 111a, 111b, respectively, the respective locking means for these thrust pins are desirably combined into one single retaining member which consists for instance of a fork-like or yoke-shaped part 113 which is substantially symmetrical with respect of said plane of symmetry of both pads 107a, 107b and the substantially parallel legs 113a, 113b form locking arms spaced from each other according to the spacing of said pads so as to be located substantially above the thrust pins 107a, 107b, respectively. The fork 113 is rotatably mounted on a substantially horizontal transverse shaft 114 supported in stationary bearings 115 of the associated side frame member 110, said shaft being desirably located higher than the pads and being longitudinally offset with respect to the latter towards the innermost ramp section 4a in the extended working position of the ramp. The fork or clevis 113 is rotatably mounted on this shaft by means of its transverse portion 116 having the shape of a tubular sleeve slipped over the shaft 114. This sleeve carries desirably a radial bracket or like clevis 117 forming a kind of crank arm through which the fork 110 is connected to an associated rotary control member consisting desirably of an auxiliary linear-displacement type preferably hydraulic actuator 118 mounted on the side frame member 110 of the intermediate ramp section 4b. This auxiliary actuator 118 is pivotally connected for instance with the back end or bottom of its cylinder to a supporting bracket 119 fast with the side frame member 110 and with the outer end of its piston rod to the clevis 117 fast with the fork 113 in a vertical plane substantially at right angles to the transverse shaft 114.

As shown in particular in Figure 19 when the auxiliary actuator 118 moves its piston rod outwards in extended position, it causes the fork 113 to rotate in the clockwise direction in Figure 19 thereby moving the legs 113a, 113b away from the thrust pins 107a, 107b, respectively, whereas upon the retracting motion of the piston rod of actuator 118, the legs 113a, 113b are lowered into buttressing engagement in abutting relationship with said respective thrust pins to thereby hold same against motion onto their respective pads 111a, 111b. For this purpose the relative position of the fork 113 and the lengths of the legs

113a, 113b are designed so as to achieve such a buttressing effect on the thrust pins and the free end of each leg 113a, 113b is advantageously formed with an arcuate concave recess 120 conforming to the curved side surface of the associated thrust pin when the corresponding locking leg is caused to rest upon that portion of this side surface which is away or opposite from the corresponding pad 111a, 111b. The fork 113 thus locks or jams in the position shown in Figure 19 the thrust pins of the movable head 116 substantially in the re-entrant angles of the pads to exert a slantwise directed action from top to bottom and towards the pads at least approximatively in the vicinity of the bisecting plane thereof thereby to prevent the movable head 106 from being lifted off or leaving said pads.

Preferably self-acting safety means for rendering the system fail-safe are provided on the intermediate ramp section 4b and adapted to check and detect the relative position of said locking means at the ends of the locking and unlocking strokes, respectively, thereof. These safety means consist desirably of electric limit switches 121, 122 for limiting the locking and unlocking strokes, respectively, which are adapted to be actuated separately by a suitable striker, dog or lug 123 integral with the locking fork 113.

Preferably automatic means are provided to check or control the relative position at the end of the stroke of the movable push head 106 of the actuator 101 against said abutment pads 111. The check or control means consist for instance of a proximity detector or sensor 124 controlling the operation of said locking means, i.e. of the auxiliary actuator 118. According to Figure 19, this proximity detector 124, mounted on the side frame member 110 of the ramp section 4b, is located somewhat behind or rearwards of the pads 111a, 111b substantially in the vertical plane of symmetry thereof to face the space between the pads hence the movable head 106 of the ram 101 when said head is engagingly co-operating with the pads. This detector 124 thus enables the position of the movable push head 106 to be detected and accurately located.

One of the two ramp sections 4a or 4b is moreover desirably provided with means for detecting the end of the relative movement of maximum extension of both successive ramp sections when they are registering in substantially aligned relationship as shown in Figure 19, such a position corresponding advantageously to the end of the maximum retracting stroke of the actuator 101 until its piston is mechanically stopped by abutting against the inner end wall inside of the ram cylinder

102 thereby forming an actual mechanical stop means for the end of the stroke of relative angular rotation of both ramp sections with respect to each other in the direction of extension of said ramp sections. These detecting means consist desirably of at least one electric limit switch mounted on the terminal end face of the side frame member 110 of the ramp section 4b substantially in front of the terminal end face of the side frame member 7 of the ramp section 4a thereby being adapted to be operated by a corresponding striker integral with the side frame member 7 of the ramp section 4a. This electric switch when it is actuated by the striker in the relative position of the ramp sections 4a and 4b shown in Figure 19, is adapted to switch or cut off the power supply energizing the actuator 101, i.e. to discontinue the feeding thereof with pressure fluid or to prevent such a power supply.

In the foregoing description has been disclosed the buttressing device and its locking arrangement as mounted on the side frame members on one side of the ramp and this description is of course fully applicable to the buttressing and locking devices mounted on the side frame members on the opposite longitudinal side of the ramp in substantially symmetrical relationship with respect to the longitudinal vertical central plane of the ramp.

The operation of said device is then the following with the assumption that initially the ramp assumes an intermediate relative position shown in Figure 18 while being moved to its operating working position. When the ramp has been lowered and extended into working position to bear upon the quay with its outermost section, the actuators 101 are together fed with pressure fluid simultaneously so as to cause their piston rods 105 to move outwards into their extended position until the movable push heads 106 move into abutting engagement through their thrust pins 107a, 107b with the associated pads 111a, 111b. When each movable push head 106 assumes the proper buttressing position relative to the associated pads, the proximity detector 124 connected in series to the electric limit switch 122 checks that the movable push head 106 has been caused to assume its proper position in the recesses of the associated abutment pads. The function of this proximity detector is thus to prevent the locking fork 113 from being actuated before the movable push head 106 has reached its proper buttressing position. At this time each locking fork 113 is initially raised in inoperative or unlocking position due to the action of the associated auxiliary actuator 118 which is kept energized or fed

with pressure fluid so as to retain its piston rod in its outward extended position, this actuator being adapted to carry out the unlocking step only so that for this purpose it may be a single-acting actuator only. The initial unlocking position of the fork 113 is indicated by the electric limit switch 122 actuated by the striker 123.

To cause the movable push head 106 to be locked it is then only necessary to allow the auxiliary unlocking actuator 118 to be exhausted by discharging its pressure fluid therefrom so that the locking fork 113 then drops through the action of gravity i.e. of its own weight by swinging downwards about the shaft 114 until its legs 113a, 113b are caused to rest on the associated thrust pins 107a, 107b, respectively, to embrace same with the mating complementary recessed tips or end portions of the fork legs. During this swinging locking motion, the striker 123 rigidly connected to the fork 113 has been moved into engagement with the electric limit switch 122 for operating same, the latter indicating that the buttressing operation has been properly carried out. The handling winches are then actuated and adjusted to keep the handling cables 8 taut with a substantially constant tension during the loading or unloading of goods or cargo according to a roll on-roll off process to restrict the pressure exerted upon the quay. The handling cables 15 for extending the intermediate section may however remain substantially slack or untensioned or may be loosened or slackened during the loading or unloading steps.

When raising and folding back the ramp, the aforesaid operations are carried out in their reverse order of succession or sequence. Thus the auxiliary unlocking actuators 118 are first supplied with pressure fluid to raise the locking forks 113 thereby releasing the movable push heads 106. The electric limit switches 121 are then checking or monitoring through the action of the strikers 123 the proper inoperative or unlocking position of these forks and then allow the following steps to be carried out consisting successively in energizing the double-acting actuators 101 to retract their piston rods 105 the push heads 106 of which then move away or disengage the pads 111 and afterwards actuating the handling winches to swing upwards and fold back the ramp.

It should be pointed out that in the relative position shown in Figure 19, the electric limit switch on the terminal end face of the frame member 7b is operated by the striker on the frame member 7 of the ramp section 4a thereby causing each associated actuator 101 to have its pressure fluid exhausted or discharged since this actuator then forms a mechanical stop

means for the intermediate ramp section 4b. In the locked buttressing position the combination of each actuator 101 and of its mechanical locking arrangement 113 then achieves an invariable connection between both ramp sections 4a, 4b both of which are then together equivalent to a rigid beam.

The device according to the invention thus offers the following main advantages:

simplicity of handling operation which may use only one of the two handling winches 10, 10'. The use of the two handling winches 10, 10' is more advantageous than the use of one single winch provided with a double drum since it is then possible to operate with one of the two winches only at half speed in particular upon failure of the other winch;

automatic compensation for variations in the difference between the levels of the ship and quay respectively, due to the tide and to a variation in the draught of the ship;

no outside power supply is required for operating the ramp sections 4b and 4c whereas in most of the prior art systems there are provided one or several electric winches for operating these sections 4b, 4c or hydraulic winches setting requirements or limitations regarding the installations of wiring and piping as well as the requirement of providing accommodations for receiving their power generating means;

simplicity of construction since in particular the pivotal connections between the various ramp sections remain free thereby allowing for a simple arrangement to achieve an automatic compensation for the differences in height or level of the quay with respect to the ship;

automatic raising of the outermost ramp section 4c when approaching the quay to avoid any damage through buttressing effect;

mobility of the end of each handling cable 15, 15' controlling the outward extension of the intermediate ramp section, on the ship, due to the mobility of the associated counterweight 31, 31' thereby enabling the slack in these cables to be taken up at the start and at the end of operation;

utilization of the potential energy of the ram and especially of the innermost ramp section 4a for operating the two other ramp sections 4b and 4c during their downward motion. During the ramp raising operation towards the upstanding stowing position of the ramp, it is the potential energy of both ramp sections 4b and 4c which assists in swinging the innermost ramp section 4a upwards thus relieving the handling winches 10, 10' and the handling cables 8, 8' by a corresponding amount;

in the lowered working position of the ramp, the innermost ramp section 4a is

always suspended from its handling cables 8, 8' so that it does not bear upon the two other ramp sections 4b, 4c, the ramp section 4b merely resting through its pivotal connection 5 on the ramp section 4a; possibility for selective adjustment of the bearing pressure of the ramp onto the quay through transfer of at least one part of the weight and load sustained by the intermediate ramp section 4b to the ramp section 4a hence to the cables 8, 8' when the cables 15, 15' are connected on the ship, respectively, either to variable pressure hydraulic actuators, or to hydraulic or electric winches keeping the cable tension constant, or to hand operated turn-buckles or like cable tighteners or to suitable counterweights on the intermediate ramp section 4b.

WHAT WE CLAIM IS:—

1. An access ramp for a vehicle, which comprises a first ramp section adapted to be pivotally connected at one end to the body of a vehicle, a second ramp section pivotally connected at one end to the other end of the first ramp section, at least one first handling cable for connecting the first ramp section to the vehicle body whereby to enable the ramp sections to be moved between an extended position in which they provide access to the vehicle and a stowed position in which the ramp sections are substantially vertical and the second ramp section is folded downwardly against the first ramp section on the side remote from the vehicle, and at least one second handling cable for connecting the second ramp section to the body of the vehicle in a manner to act as a restraint controlling the attitude of the second ramp section during movement of the ramp sections between the said two positions thereof, wherein the or each said second handling cable is connected to means for automatically tensioning the cable through the action of potential energy, said means being adapted to form a stationary fastening means for generating, by limiting the effective useful length of the cable, a tractive reaction force tending to raise the second ramp section into its extended position during lowering of the first ramp section into the extended position.

2. An access ramp according to claim 1, comprising selectively adjustable load transfer means for varying at will the bearing reaction force of said ramp onto a platform in the extended position of the ramp to thereby transfer at least one selectively variable part of the weight and instant load of said second ramp section to said first ramp section or to independent auxiliary supporting means provided on said vehicle.



means for the intermediate ramp section 4b. In the locked buttressing position the combination of each actuator 101 and of its mechanical locking arrangement 113 then achieves an invariable connection between both ramp sections 4a, 4b both of which are then together equivalent to a rigid beam.

The device according to the invention thus offers the following main advantages:

simplicity of handling operation which may use only one of the two handling winches 10, 10'. The use of the two handling winches 10, 10' is more advantageous than the use of one single winch provided with a double drum since it is then possible to operate with one of the two winches only at half speed in particular upon failure of the other winch;

automatic compensation for variations in the difference between the levels of the ship and quay respectively, due to the tide and to a variation in the draught of the ship;

no outside power supply is required for operating the ramp sections 4b and 4c whereas in most of the prior art systems there are provided one or several electric winches for operating these sections 4b, 4c or hydraulic winches setting requirements or limitations regarding the installations of wiring and piping as well as the requirement of providing accommodations for receiving their power generating means;

simplicity of construction since in particular the pivotal connections between the various ramp sections remain free thereby allowing for a simple arrangement to achieve an automatic compensation for the differences in height or level of the quay with respect to the ship;

automatic raising of the outermost ramp section 4c when approaching the quay to avoid any damage through buttressing effect;

mobility of the end of each handling cable 15, 15' controlling the outward extension of the intermediate ramp section, on the ship, due to the mobility of the associated counterweight 31, 31' thereby enabling the slack in these cables to be taken up at the start and at the end of operation;

utilization of the potential energy of the ram and especially of the innermost ramp section 4a for operating the two other ramp sections 4b and 4c during their downward motion. During the ramp raising operation towards the upstanding stowing position of the ramp, it is the potential energy of both ramp sections 4b and 4c which assists in swinging the innermost ramp section 4a upwards thus relieving the handling winches 10, 10' and the handling cables 8, 8' by a corresponding amount;

in the lowered working position of the ramp, the innermost ramp section 4a is

always suspended from its handling cables 8, 8' so that it does not bear upon the two other ramp sections 4b, 4c; the ramp section 4b merely resting through its pivotal connection 5 on the ramp section 4a; possibility for selective adjustment of the bearing pressure of the ramp onto the quay through transfer of at least one part of the weight and load sustained by the intermediate ramp section 4b to the ramp section 4a hence to the cables 8, 8' when the cables 15, 15' are connected on the ship, respectively, either to variable pressure hydraulic actuators, or to hydraulic or electric winches keeping the cable tension constant, or to hand operated turn-buckles or like cable tighteners or to suitable counterweights on the intermediate ramp section 4b.

WHAT WE CLAIM IS:—

1. An access ramp for a vehicle, which comprises a first ramp section adapted to be pivotally connected at one end to the body of a vehicle, a second ramp section pivotally connected at one end to the other end of the first ramp section, at least one first handling cable for connecting the first ramp section to the vehicle body whereby to enable the ramp sections to be moved between an extended position in which they provide access to the vehicle and a stowed position in which the ramp sections are substantially vertical and the second ramp section is folded downwardly against the first ramp section on the side remote from the vehicle, and at least one second handling cable for connecting the second ramp section to the body of the vehicle in a manner to act as a restraint controlling the attitude of the second ramp section during movement of the ramp sections between the said two positions thereof, wherein the or each said second handling cable is connected to means for automatically tensioning the cable through the action of potential energy, said means being adapted to form a stationary fastening means for generating, by limiting the effective useful length of the cable, a tractive reaction force tending to raise the second ramp section into its extended position during lowering of the first ramp section into the extended position.

2. An access ramp according to claim 1, comprising selectively adjustable load transfer means for varying at will the bearing reaction force of said ramp onto a platform in the extended position of the ramp to thereby transfer at least one selectively variable part of the weight and instant load of said second ramp section to said first ramp section or to independent auxiliary supporting means provided on said vehicle.



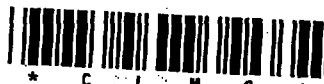
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3. An access ramp according to claim 1 or claim 2, wherein said means for automatically tensioning the second handling cable(s) are arranged so as to be operative only from a given angle of slope of said first ramp section with respect to the vertical direction during the starting period of downward motion thereof.
4. An access ramp according to any preceding claim, wherein the or each second handling cable is reeved over at least one elevated loose guide pulley mounted on said vehicle and terminates in a movable counterweight forming said automatic tensioning means and wherein is provided on the said vehicle a means for stopping said handling cables and unidirectionally holding the same against motion wherein said stopping means consists of a stationary stop means limiting the upward motion of said counterweight.
5. An access ramp according to claim 4, wherein the weight of the or each counterweight is selectively adjustable.
6. An access ramp according to claim 2, wherein the or each second handling cable is connected to a stationary fastening point provided on said vehicle through the medium of an adjusting member having a selectively variable length and forming one aforesaid tensioning and load transfer means.
7. An access ramp according to claim 2, wherein the or each second handling cable is connected to a linear-displacement type pressure fluid operated actuator generating a selectively adjustable force and forming one aforesaid tensioning and load transfer means.
8. An access ramp according to claim 1, wherein the or each second handling cable is connected to a stationary fastening point provided on said vehicle through the medium of at least one resiliently deformable spring-like member constituting said automatic tensioning means and wherein the or each said handling cable is stopped and unidirectionally held against motion by a stationary stop means limiting the strain of said spring-like member under maximum stress.
9. An access ramp according to claim 1, wherein said automatic tensioning means comprise a self-acting winding-up appliance.
10. An access ramp according to claim 9, wherein the winding-up appliance is provided with braking means for braking said appliance at the end of useful paying out motion of said second handling cable(s).
11. An access ramp according to claim 2, wherein the or each second handling cable is connected to a power-operated winch providing for constant cable tensioning and located on said vehicle to form one aforesaid load transfer means.
12. An access ramp according to claim 2, wherein said load transfer means consist of at least one counterweight having a selectively adjustable weight and located on a lever arm integral with said second ramp section so as to urge the latter towards its extended position.
13. An access ramp according to any preceding claim, comprising a third or outermost ramp section forming a supporting pad to bear on an outside platform and pivotally connected to the corresponding outer end of said second ramp section forming now an intermediate ramp section, said device further comprising operated means for raising said outermost ramp section.
14. An access ramp according to claim 13, wherein each handling cable controlling the extension of said intermediate ramp section is reeved over at least one associated loose main guide pulley carried by said intermediate ramp section and said cable is secured with its outer end to said outermost ramp section at a point located outwards beyond the pivotal connection of the latter with said intermediate ramp section to form said operated raising means.
15. An access ramp according to claim 13, wherein at least one ram-like pressure fluid operated actuator is provided between said intermediate and outermost ramp sections to form said operated raising means.
16. An access ramp according to any preceding claim, wherein one of said first and second ramp sections extends beyond its pivotal connection with the other ramp section with at least one longitudinal projecting integral boom carrying towards its free end at least one auxiliary guide pulley for the or each second handling cable controlling the relative outward extension of said second ramp section and the or each first handling cable for operating said first ramp section is reeved over several elevated auxiliary guide pulleys mounted in the same pulley block provided on said vehicle and on a plurality of main guide pulleys mounted in the same pulley block carried by said innermost of first ramp section, so as to form a reeving and the or each second handling cable is reeved over several guide pulleys mounted on two pulley blocks, respectively, carried by each projecting boom, respectively, and by said other ramp section so as to form a reeving.
17. An access ramp according to claim 16, wherein said second ramp section extends beyond its pivotal connection with



said inner-most or first ramp section with at least one integral projecting longitudinal boom carrying towards its free end each aforesaid main guide pulley whereas said innermost ramp section carries at least one auxiliary guide pulley for the or each second handling cable controlling the relative outward extension of said second ramp section and leading from each main guide pulley.

18. An access ramp according to any preceding claim, comprising automatic control means for keeping said first ramp section spaced from a platform in the extended position, said control means consisting of at least one sensor member secured to one of said first and second ramp sections adjacent to their pivotal connection and adapted to bear upon said platform for detecting any variation in the difference between the levels of said ramp section and said platform.

19. An access ramp according to any preceding claim, comprising automatic control means for adjusting the relative angular positions of said first and second ramp sections to keep same in substantially aligned registering relationship or at an optimum slope, said control means consisting of at least one sensor member mounted on one of said ramp sections in the vicinity of its pivotal connection with the other ramp section, said sensor member being adapted to engage said other ramp section so as to measure the angle formed therebetween in particular during any upward motion of said vehicle.

20. An access ramp according to claim 2, comprising automatic control means for adjusting the bearing reaction of said ramp onto a platform, said load transfer means being controlled by said control means which consist of at least one pressure detecting sensor member mounted on said ramp towards its outer end for bearing upon said platform in the working position of said ramp and for measuring said bearing reaction.

21. An access ramp according to any preceding claim, comprising push ram means mounted on said vehicle and adapted to freely engage said first ramp section in its raised position to initiate its downward swinging motion through gravity and to brake or slow down its upward swinging motion at the end thereof, abutment and rest means being provided on said vehicle and engageable by said ramp in its raised and stowed position.

22. An access ramp according to any preceding claim, wherein said first ramp section is provided with a pair of side frame members at least one of which carries an actuator the line of action of which is spaced from the geometrical axis of pivotal

connection between said adjacent innermost and second ramp sections, said actuator being adapted to bear removably against an abutment means integral with the corresponding side of said adjacent ramp section in the lowered and extended working position of said ramp for blocking said pivotal connection in the direction of rotation of increasing extension of the ramp, in a relative angular position which is selectively variable through the adjustable operative length of stroke of said actuator, whereas selectively variable connecting means are provided between said side frame member and said corresponding side, respectively, of both ramp sections for blocking said pivotal connection in the direction of rotation of folding back said ramp, in the same relative angular position, and wherein on the one hand said actuator is of the double-acting kind and pivotally connected with its body onto said side frame member of said inner-most ramp section while extending in substantially parallel relation to the longitudinal relative vertical plane of said side frame member, said actuator being located higher than the geometrical axis of said pivotal connection between both ramp sections in their working position and said adjacent second ramp section also comprising a pair of side frame members on its opposite sides, respectively whereas on the other hand said actuator is provided with a movable push head adapted to freely and directly engage at least one substantially concave abutment pad forming said abutment means and secured to the adjacent end of said corresponding side frame member of said second ramp section; operated locking means being provided on said corresponding side frame member of said adjacent second ramp section to rigidly connect said movable push head with said abutment pad thereby to form said selectively variable connecting means.

23. An access ramp according to claim 22, wherein said movable push head of said actuator comprises at least one sidewise projecting portion adapted to engage said abutment pad; said abutment pad being substantially square shaped and said locking means comprising at least one movable retaining member actuated by an associated actuator and mounted on said adjacent second ramp section, said retaining member being adapted to bear against said sidewise projecting portion to keep same in engagement with said abutment pad.

24. An access ramp according to claim 23, wherein each retaining member is automatically urged constantly towards its operative locking position by a resilient biasing means or through gravity so that its



associated actuator is only used for unlocking purposes.

5 25. An access ramp according to any one of claims 22 to 24, wherein said retaining member consists of at least one arm adapted to swing in a plane substantially at right angles to said sidewise projecting portion and to be lowered into engagement with said sidewise projecting portion on that surface portion thereof which is 10 opposite from said abutment pad to hold said sidewise projecting portion against motion, said swinging arm being adapted to be swung upwards and away from said sidewise projecting portion to release same, 15 said arm being engageable with said sidewise projecting portion through the tip of its free end portion, said tip having a mating shape which is complementary of that of the lateral surface of said sidewise projecting portion. 20

26. An access ramp according to claim 25, wherein said movable push head of said actuator comprises a pair of transversely opposite and coaxially aligned thrust pins forming said sidewise projecting portions and adapted to co-operate with a pair of corresponding associated transversely spaced abutment pads and wherein said 30 retaining member is a fork-shaped part the legs of which form locking arms spaced from each other according to the spacing between said abutment pads, said fork-shaped part being rotatably mounted on a transverse shaft fitted on said adjacent 35 second ramp section and being connected through a radial crank arm to an auxiliary linear-displacement type pressure fluid operated actuator mounted on said adjacent second ramp section for rotating 40 said fork-shaped part.

27. An access ramp according to any one of claims 22 to 26, comprising automatic safety means for avoiding any wrong

operation and rendering the device fail-safe, said means being mounted on said adjacent second ramp section and adapted to check the relative position of said locking means at the ends of the locking and unlocking strokes, respectively. 45

28. An access ramp according to any one of claims 22 to 27, comprising self-acting means for controlling the relative position of said movable push head of said ram, at the end of its stroke, against each abutment pad, said means consisting of at least one proximity detector controlling means 50 operating said locking means. 55

29. An access ramp according to any one of claims 22 to 28, comprising means for detecting the maximum motion of outward extension of said ramp sections into their substantially aligned registering position and accordingly the end of maximum retraction stroke of said ram, said ram comprising inner mechanical stop means and said detecting means being adapted to discontinue the energizing of said actuator. 60 65

30. An access ramp according to claim 25, wherein means are provided for guiding the movable push head of said actuator, said means consisting of a sidewise projecting portion which is of elongated shape so as to project sidewise beyond said associated abutment pad and engage a 70 guide slot carried by an associated supporting structure integral with the side frame member of said first ramp section. 75

31. An access ramp substantially as described herein with reference to and shown in the accompanying drawings. 80

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