March 18, 1969 W. L. FLOEHR 3,433,178

RAILWAY HOPPER GATE FLEXIBLE OPERATING ASSEMBLY

Filed Dec. 9, 1966 Sheet 1 of 2

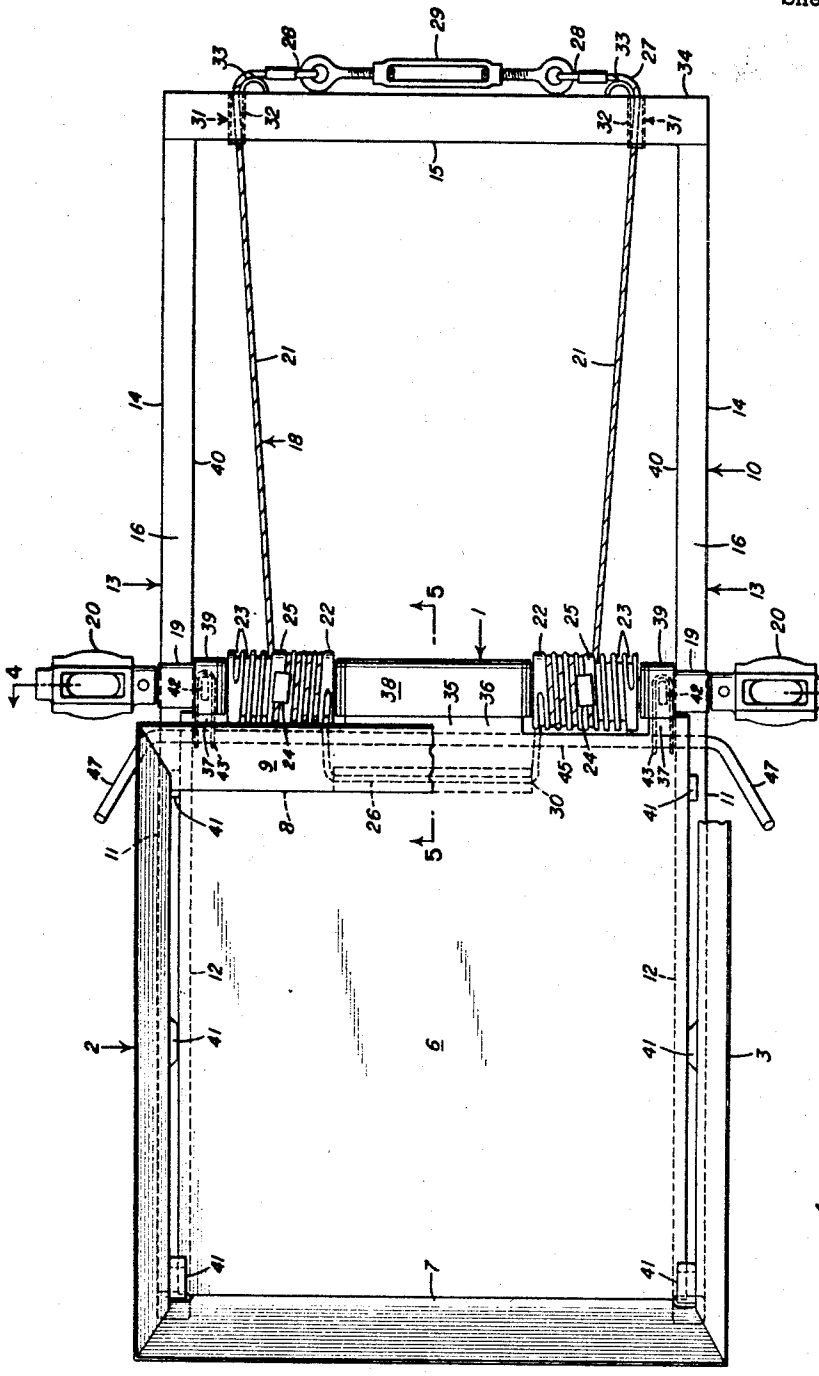

FIG. 1

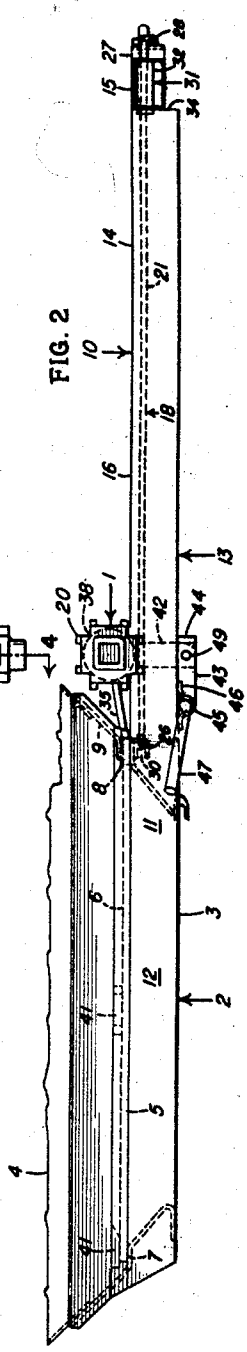

FIG. 2

Inventor:
Walter L. Floehr

By Wilmer Mechlin
his Attorney

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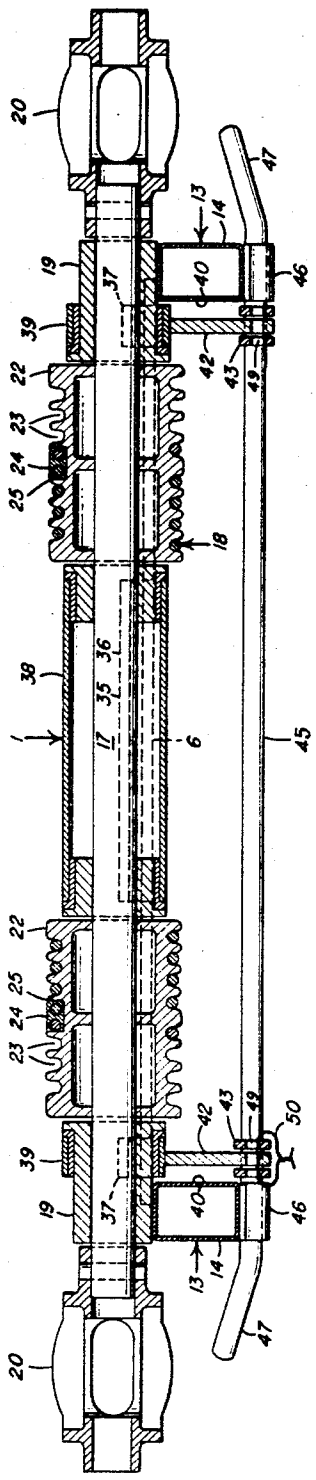

FIG. 4

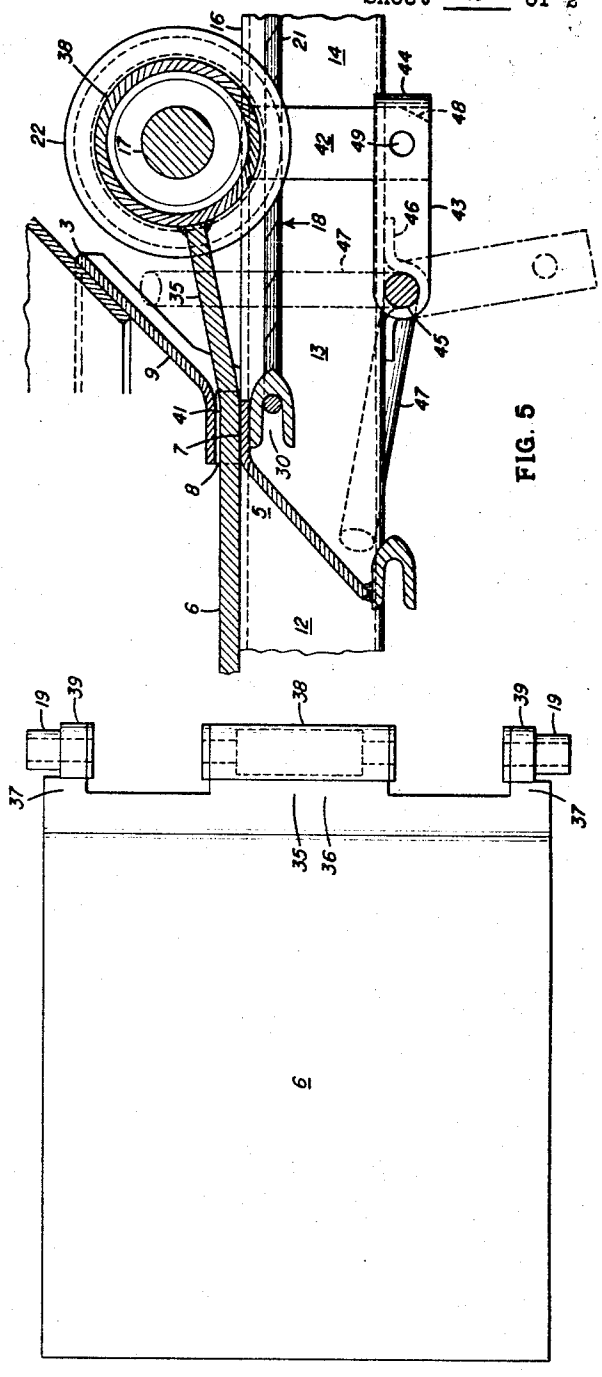

FIG. 5

FIG. 3

Inventor:
Walter L. Floehr

By Wilmer Mechlin
his Attorney

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RAILWAY HOPPER GATE FLEXIBLE OPERATING ASSEMBLY

Walter L. Floehr, Toledo, Ohio, assignor to Midland-Ross Corporation, Cleveland, Ohio, a corporation of Ohio

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Int. Cl. B61d 7/18

ABSTRACT OF THE DISCLOSURE

A railway hopper car discharge gate slidable on rails between positions to open and close a hopper opening in a gate frame and movable therealong by an operating shaft connected thereto for linear movement in unison and rollable along the rails by being rotated in turns of a cable anchored beyond the shaft to the frame.

Background of the invention

A discharge gate of a railway hopper car is adapted to close a downwardly opening discharge opening in a gate frame attached to a hopper and slides, generally horizontally, between closed and open positions on transversely spaced ways or rails fixed to and extending beyond a front wall of the frame. Conventionally, a discharge gate is moved between open and closed positions by an operating shaft mounted on the frame for rotation about a fixed horizontal axis and carrying one or more pinions each engageable with a rack on the underside of the gate. In an alternate arrangement, the operating shaft is still rotatable but it and the gate are connected for linear movement in unison and this movement is imparted on rotation of the shaft by engagement of its pinions with longitudinally extending racks fixed to the frame. While both arrangements are satisfactory under most circumstances, a rack and pinion, as their teeth mesh, are subjected to a component of the applied force which tends to separate or force them apart. Consequently, with either arrangement, the gate, as it moves longitudinally under force of the operating shaft, has a corresponding force component transmitted to it from the shaft which can present obstacles to the close fit between the gate and its seat in the frame required to prevent the escape of lading, particularly if the latter is finely divided.

Summary of the invention

The present invention relates to a discharge gate operating assembly for railway hopper cars in which a gate and its operating shaft are connected for linear movement in unison and so moved by a cable drive without the tendency toward separation attendant the use of rack and pinion drives. It therefore is the primary object of the present invention to provide an improved discharge gate operating assembly which in driving a gate between open and closed positions, is not subjected to separating forces.

Another object of the invention is to provide a discharge gate operating assembly which not only is not itself subject to separating forces but in moving the gate applies a force for holding the gate in engagement with the guideway on which it slides.

An additional object of the invention is to provide a discharge gate operating assembly wherein the gate is driven linearly through an operating shaft by a cable drive and the drive is readily adjustable for equalizing forces applied to the shaft.

Other objects and advantages of the invention will appear hereinafter in the detailed description, be particularly pointed out in the appended claims and be illustrated in the accompanying drawings, in which:

Figure description

FIGURE 1 is a plan view of a gate assembly incorporating the improved operating assembly of the present invention, with portions broken away to more clearly illustrate certain of the details of construction;

FIGURE 2 is a side elevational view of the gate assembly of FIGURE 1;

FIGURE 3 is a plan view of the gate and sleeve and collars fixed to the front end thereof, removed from the gate assembly;

FIGURE 4 is an enlarged vertical sectional view taken along lines 4—4 of FIGURE 1; and

FIGURE 5 is a further enlarged fragmentary vertical sectional view taken along lines 5—5 of FIGURE 1.

Detailed description

Referring now in detail to the drawings in which like reference characters designate like parts, the improved discharge gate operating assembly of the present invention is adapted for application to a discharge gate which in moving between open and closed positions is supported on and slides or rides along a guideway.

As exemplary of the invention, the improved operating assembly, designated as **1**, has been illustrated as part of a discharge gate assembly **2**. In the illustrated gate assembly a gate frame **3** is suitably fixed or secured to the bottom portion of a hopper **4** of a railway hopper car (not otherwise shown) and bounds a downwardly or vertically discharging or opening discharge opening **5** of the hopper. A discharge or slide gate **6** mounted in the frame in closed position rests or seats on an instanding, upwardly-facing seat **7** in the frame **3** about the opening **5**.

In opening and closing the opening **5**, the gate **6** slides or rides through a slot **8** in a front wall **9** of the frame **3** along a horizontally directed guide- or slideway **10**. In the illustrated gate assembly **2**, the frame **3** is of cast-weld construction and has as the sides **11** of its lower part **12** below the seat **7**, a pair of horizontally disposed, laterally or transversely spaced, parallel side rails or members **13**. Projecting or extending forwardly beyond the front wall **9**, the side rails **13** provide therebeyond rail extensions **14** integral or rigid with the sides **11** for supporting the gate **6** in open position. Rigid with the frame **3** and connected and spaced at their outer ends by a preferably box-shaped cross-beam or brace **15**, the side rails **13** are supporting ways or rails whose coplanar upper surfaces or webs **16** form the guideway **10** along which the gate **6** slides or rides between open and closed position, as well as the sides of the seat **7** on which the gate seats in closed position.

The improved operating assembly **1** is comprised of an operating shaft **17** which moves or slides the gate **6** between open and closed positions on the guideway **10** by itself traveling or moving longitudinally of the guideway as it is turned or rotated and transmitting or applying its longitudinal or linear movement to the gate. For converting rotary movement imparted to it by an actuating bar or other suitable turning tool (not shown) into the desired longitudinal, linear or rectilinear movement, the operating shaft **17** is made to work, winch-like, against an intermediate portion of a cable or like flexible member **18** which is anchored at its longitudinal extremities to the frame **3** beyond the shaft's limits of travel.

Disposed forwardly of and extending parallel to the front wall **9** of the frame **3**, the operating shaft **17**, rather than depending on the cable **18** for support, preferably is given a definitely rectilinear travel by supporting it on a guideway which conveniently, is the outer part on the rail extensions **14** of the gate's guideway **10** beyond the front wall **9**. Overlying and extending laterally across and normal to the rail extensions, the preferred operating shaft

rides or rolls on the upper surfaces **16** thereof, preferably on a pair of rollers **19** carried and fixed to or rotatably mounted on opposite end portions of the shaft, each above one of the rail extensions. Operating heads **20** fixed to the opposite ends of the shaft outwardly of the rollers **19** and socketed to receive an actuating bar, enable the shaft to be operated from either side of the car on which it is installed.

In the preferred operating assembly **1**, the cable **18** presents for engagement by the operating shaft **17** two legs, runs or lengths **21** which are laterally spaced on opposite sides of and equidistant from the longitudinal centerline of the guideway **10**. For drivably engaging the legs **21**, the operating shaft **17** has fixed to it, equidistantly from its own midpoint and the longitudinal centerline of the guideway **10**, a pair of axially spaced, counterpart, helically-grooved pulleys or drums **22**, whose grooves **23**, as their designation as counterparts denotes, are oppositely oblique or inclined. Concentric with each other and the shaft **17**, the pulleys **22** preferably are of a capacity to and normally do receive or contain as turns, coils or wraps in their grooves **23** substantially half of the cable in their respective cable legs **21** for enabling each leg to be fixed against slipping substantially at its center to the related pulley without interfering with the driving engagement between the pulleys and the cable. For the preferred anti-slip fastening, the cable in each leg **21** is cut or divided substantially in half and the adjoining ends of the halves are clamped in a clip **24** which is received or seated and, for holding it in place, preferably driven into a peripheral seat or socket **25**, interrupting the groove **23** of and centered axially on the related pulley **22**.

The opposite longitudinal extremities of the cable **18** are anchored to the frame **3** beyond the limits of travel of the operating shaft **17** along the guideway **10** and preferably below the level of the guideway, the latter to enable the cable to exert a downward force for holding the rollers **19** on the guideway. While anchored to locate them horizontally and vertically relative to the operating shaft, the inner and outer cable extremities **26** and **27**, respectively, are not fixed against movement to the frame **3** and, instead, are slidable laterally of the frame and linearly of the cable to ensure that the forces applied to the opposite end portions of the operating shaft **17** through the cable legs **21** are equal.

The extremities **26** and **27** differ in their own forms and those of their slide anchorages to the frame. At one extremity, here the inner **26**, the cable is continuous and at the other, more conveniently the outer **27**, the cable is cut or divided crosswise or radially, with the cable ends **28** at the latter extremity connected to and by a turnbuckle or other suitable tensioning device **9**.

In the illustrated gate assembly **2**, the inner or rear cable extremity **26** is a continuous loop extending between and rearwardly from the pulleys **22** and suitably having as a slide anchor to the frame a rearwardly opening channel **30** extending and centered laterally of and on the guideway **10** and conveniently welded or otherwise fixed or secured to the frame's front wall **9** below the gate-receiving slot **8** therein. The inner or rear extremity or loop **26** is slidable longitudinally into the channel **30** and, when received or seated therein, held against movement forwardly or toward the operating shaft **17** but permitted to slide linearly of itself or longitudinally of the channel for equalizing the resultant forces on the pulleys **22** without disturbing the angular disposition of the shaft relative to the guideway.

The outer or front cable extremity **27** is anchored to the crossbeam **15** connecting the front ends of the rails **13** beyond the corresponding limit of travel of the shaft **17** and has as its slide anchor to the beam a pair of cable guides **31** suitably having tubular portions **32** extending laterally through the beam and inturned arcuately convex turning portions **33** on the beam's front face **34**. With its parts between its outer ends **28** and pulley-wrapping or shaft-engaging legs **21** slidable in the guides **31**, the preferred cable **18** has those ends spaced laterally of the guideway **10** or longitudinally of the connecting beam **15** for receiving therebetween the turnbuckle **29**. Spacing and supported or carried by the ends **28** and having no other connection to the crossbeam **15**, the turnbuckle **29** is adapted to slide across the beam's front face **34** in the direction of the spacing of the ends, thus ensuring that the shaft engaging legs **21**, for which it acts as a common tensioning or slack take-up member, will be equally tensioned or tautened at all times.

For transmitting the longitudinal travel of the operating shaft **17** to the discharge gate **6** and, by causing their travel in unison longitudinally of the guideway **10**, effecting opening and closing of the gate, it usually will be preferred that these members be connected against any relative movement, except the rotary movement of the shaft, so that the angular disposition of both relative to the guideway will necessarily be the same. In the illustrated embodiment such a connection is obtained by forming the front end portion of the gate **6** beyond the frame's front wall **9** as an upturned lip or flange **35** extending laterally substantially the width of the gate. Longitudinally, the lip **35** extends substantially radially of the shaft for centering thereon forces transmitted therefrom to the gate.

Slotted toward either side to accommodate the pulleys **22**, the front lip **35** is thereby divided into a central segment **36** centered laterally on the gate and the guideway **10** and side segments **37** laterally spaced equally from the central segment. These several segments are fixed or secured, as by welding, the central segment **36** to a central or spacer sleeve **38** rotatably mounted centrally on the shaft between and spacing the pulleys, and the side segments **37** to collars **39** mounted for relative rotation on the end portions of the shaft immediately beyond the pulleys, conveniently on the inner portions of the inwardly headed bushings illustrated as the rollers **19**. Each, with the related roller, straddled or embraced by and substantially filling the space between the pulley **22** and operating head **20** on its end portion of the shaft **17**, the collars **39**, while rotatable on the shaft, are substantially fixed or limited in their axial movement relative thereto. If, as illustrated, the collars **39**, whether or not mounted thereon, are of larger diameter than the rollers **19**, they will project below the guideway **10** and, by confronting with slight spacing the inner surfaces **40** of the extension rails **14**, serve with fixed lateral guides **41** on the frame **3** at sides of the gate **6**, to guide both gate and shaft against lateral movement on and canting or angling relative to the guideway **10**.

The fixing of the collars **39** against rotation by their rigid connection to the gate **6** also is made use of for locking the gate in closed position. This is accomplished by fixing to and suspending from the underside of each collar a preferably radially extending or depending, vertically disposed locking lug or arm **42**, which, in the closed position of the gate **6**, is adapted to be held against forward movement by engagement by a cooperating locking member, suitably in the form of a yoke **43** having a free or closed end **44** in which the lug is receivable. The yokes **43** are pivotable or swingable on a preferably common horizontal axis below and normal to the guideway **10**, from a release position in which they are substantially vertical to a substantially horizontal locking position in which they engage the lugs **42**.

For locking from either side of the car, the lugs **42** are fixedly mounted for swinging in unison on an operating rod **45** extending across and rotatably mounted on the undersides of the extension rails **14**, as by mounting brackets **46** fixed to the rails. Conveniently, the rod **45** is bent at both ends beyond the brackets **46** to provide handles **47** on opposite sides of the car. The lugs **45** are appropriately beveled, as indicated at **48**, to facilitate

their insertion in the yokes **46** and each lug and its yoke have apertures **49** aligning in their locking position for receiving the usual car seal **50**.

Once the tension of the cable **18** has been properly adjusted by the turnbuckle **29**, opening of the gate **6** by the improved operating assembly **1** simply involves release of the locking lugs **42** from the locking yokes **43** and turning of the operating shaft **17** in an opening direction from either side of the car by an actuating bar inserted in the head **20** at that side. Although a separate stop may be provided, the gate **6** necessarily will be limited in its outward movement by the limitation on travel of the operating shaft in that direction imposed by the cross-beam **14**. After discharge of any lading, the gate is moved to closed position by turning the shaft in the opposite direction and, on reaching that position, is locked therein by swinging of the locking yokes **43** into engagement with the lugs **42**. The forces applied to the operating shaft by the cable **17**, as it turns therein, being equally distributed between the opposite end portion of the shaft by the driving engagement of the counterpart pulleys **22** thereon with the necessarily equally tensioned cable legs **21**, both end thrust and possible canting of the operating shaft is eliminated. Also, contrary to a rack-and-pinion operated gate, the vertical force applied by the cable to the shaft is always toward the guideway and, since opposed by engagement of the rollers **19** with the guideway **10**, has no resultant component for transmission to the gate.

From the above detailed description, it will be apparent that there has been provided an improved discharge gate operating assembly which will effectively open and close a gate without shortcomings to which conventional operating assemblies are subject. It should be understood that the described and disclosed embodiment is merely exemplary of the invention and that all modifications are intended to be included that do not depart from the spirit of the invention and the appended claims.

Having now described my invention, I claim:

1. In a railway hopper car discharge gate assembly having a frame secured to a hopper and bounding a discharge opening, a guideway fixed to said frame, and a discharge gate for said opening and slidable between open and closed positions along said guideway, a gate operating assembly comprising an operating shaft connected to said gate for movement therwith in unison longitudinally of said guideway, and cable means extending longitudinally of and anchored at opposite extremities against substantial movement relative to said guide and drivably engaged by said shaft for causing said shaft on rotation thereof to travel longitudinally of said guideway.

2. An operating assembly according to claim **1**, wherein the shaft is supported by and rolls on a guideway connected to the frame and removed from the discharge opening.

3. An operating assembly according to claim **2**, wherein longitudinal extremities of the cable means are anchored to the frame below the level of the shaft guideway and beyond opposite limits of travel of the shaft thereon.

4. An operating assembly according to claim **3**, wherein the shaft guideway is a part of the gate guideway disposed forwardly of a front wall of the frame.

5. An operating assembly according to claim **4**, wherein the cable means has a pair of legs on opposite sides of and laterally spaced equidistantly from a longitudinal centerline of the guideway, and each leg is engaged by one of a pair of counterpart pulleys fixed to the shaft at opposite sides of and laterally equidistant from said centerline.

6. An operating assembly according to claim **5**, wherein the pulleys are helically grooved, each pulley is of a capacity to be wrapped at any one time by substantially half of the cable in the related leg, and each leg is fixed to its pulley by a clip clamping the leg at substantially the midpoint of the cable therein and held peripherally in and centered axially on the pulley.

7. An operating assembly according to claim **5**, including a common tensioning means at one of the cable extremities for equally tensioning both of the legs.

8. An operating assembly according to claim **7**, wherein the cable at its other extremity is continuous, and both cable extremities are anchored to the frame for lateral sliding and against longitudinal movement toward the shaft.

9. An operating assembly according to claim **8**, wherein the shaft is freely rotatable and otherwise limited in movement relative to the gate.

10. An operating assembly according to claim **9**, wherein the means connecting the gate and shaft for movement in unison longitudinally of the guideway are equally distributed on opposite sides of the guideway's longitudinal centerline.

11. An operating assembly according to claim **10**, wherein the connecting means include a central sleeve and a pair of collars, each spaced from said sleeve by one of said pulleys, and said sleeve and collars are rotatably mounted on the shaft and fixed to a front end portion of the gate.

12. An operating assembly according to claim **11**, wherein the front end portion of the gate beyond the frame's front wall is upturned and disposed substantially radially of the shaft.

13. An operating assembly according to claim **11**, including rollers mounted on opposite end portions of the shaft whereon the shaft rolls on the guideway, each roller and one of the collars being positioned and substantially filling the axial space between the adjoining pulley and an operating head fixed to an adjoining outer end of the shaft for limiting axial movement thereof on the shaft, and the collars extending below the guideways for aiding in guiding the shaft in its longitudinal movement thereon.

14. An operating assembly according to claim **11**, including means operable from each side of a car and engageable with means depending from the collars for lockings the gate in closed position.

15. An operating assembly according to claim **14**, wherein the operable means include a shaft below and extending across and rotatably mounted on opposite sides of the guideway, and yokes fixed to said shaft for swinging thereby between locking and release positions, and the depending means on the collars are locking lugs each received in a closed end of the adjoining yoke swinging thereof to locking position.

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ARTHUR L. LAPOINT, *Primary Examiner.*

HOWARD BELTRAN, *Assistant Examiner.*

U.S. Cl. X.R.

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