May 16, 1967 K. H. ANDRAE 3,319,425

SLUICE GATE AND OPERATING MECHANISM THEREFOR

Filed Aug. 9, 1963 2 Sheets-Sheet 1

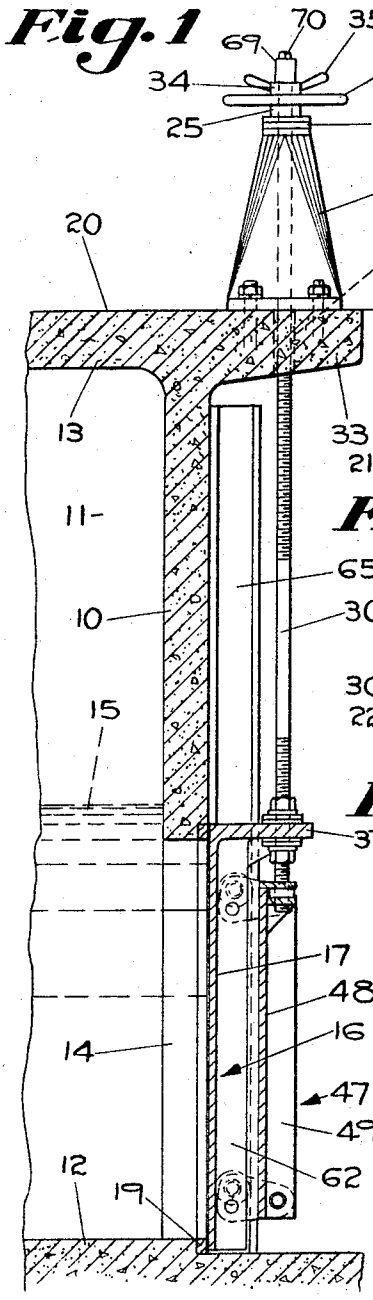

Fig. 1

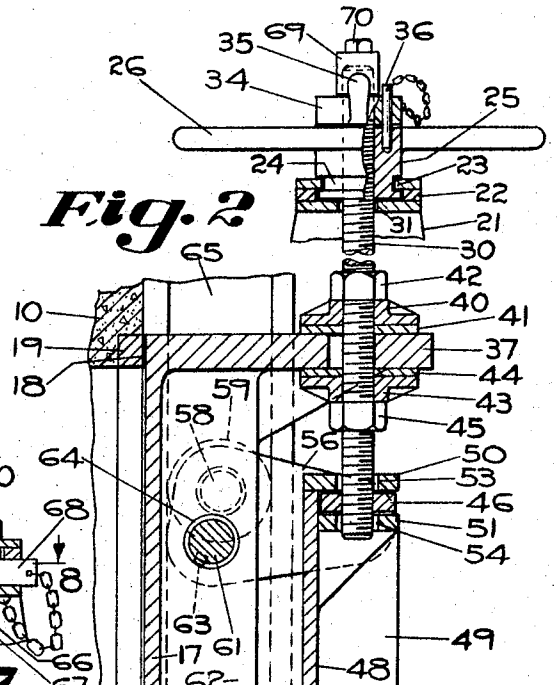

Fig. 2

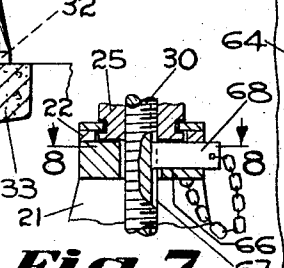

Fig. 7

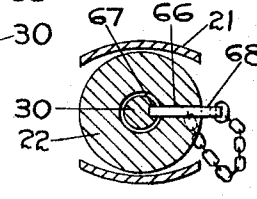

Fig. 8

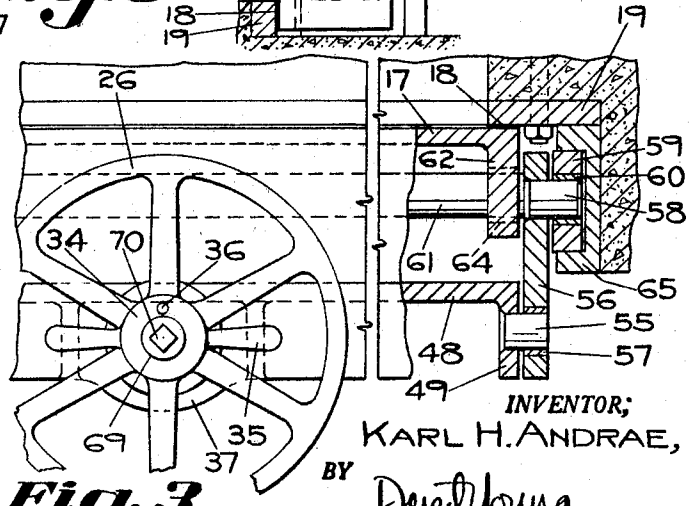

Fig. 3

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May 16, 1967 K. H. ANDRAE 3,319,425

SLUICE GATE AND OPERATING MECHANISM THEREFOR

Filed Aug. 9, 1963 2 Sheets-Sheet 2

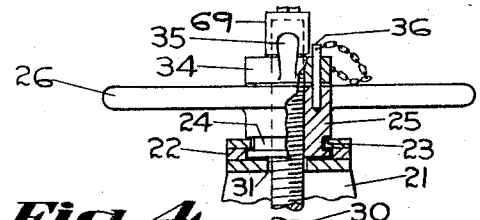

Fig. 4

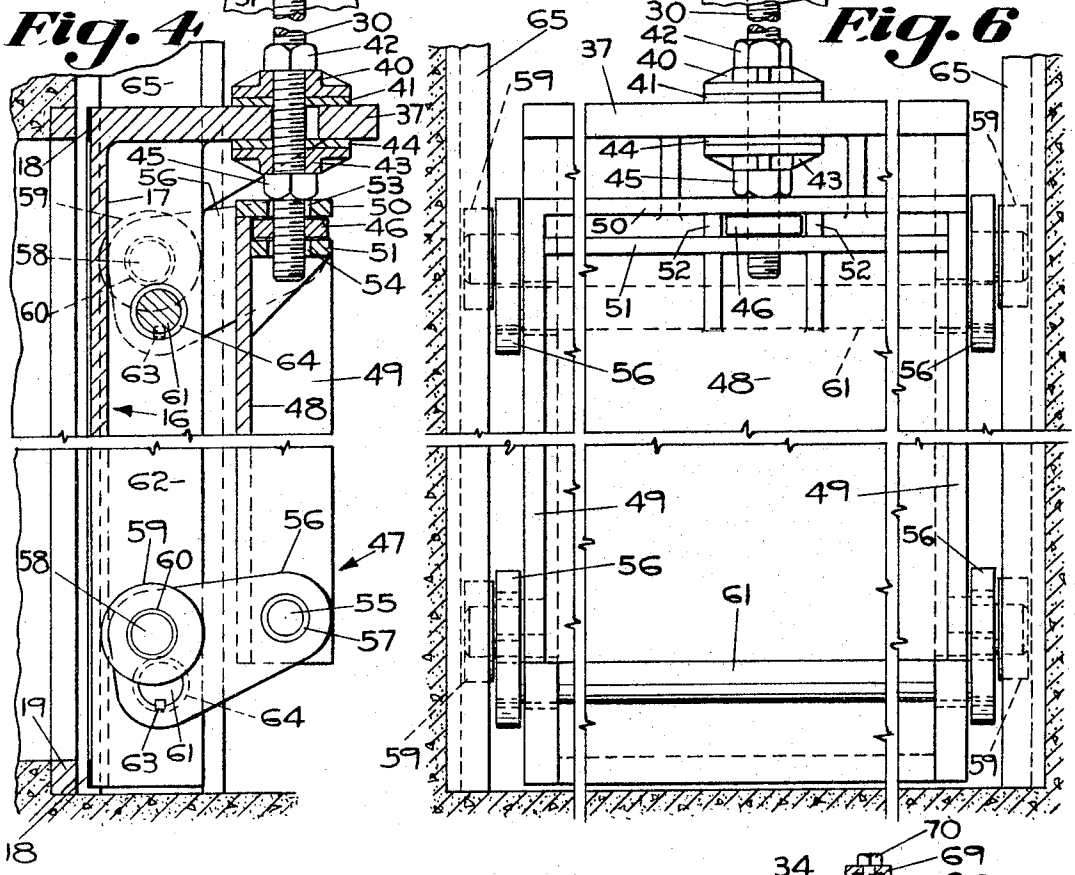

Fig. 6

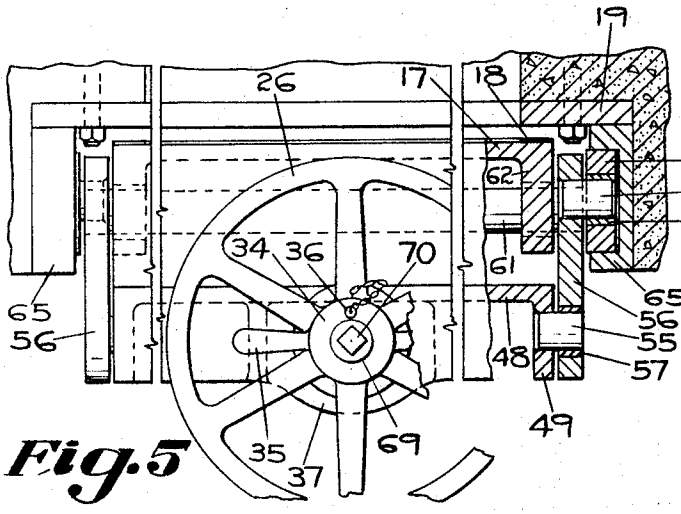

Fig. 5

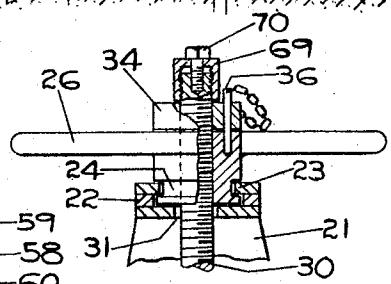

Fig. 9

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United States Patent Office 3,319,425
Patented May 16, 1967

3,319,425

SLUICE GATE AND OPERATING MECHANISM THEREFOR

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Filed Aug. 9, 1963, Ser. No. 300,970
6 Claims. (Cl. 61—28)

The instant invention relates to sluice gates, and more particularly, to an improved operating mechanism for opening and closing the sluice gate.

It is the prime object of this invention to provide a sluice gate having an improved operating mechanism which operates in a dependable and efficient manner to open and close a sluice gate.

It is a further object of the instant invention to provide an improved sluice gate operating mechanism which is operative to first remove the sluice gate from its seated position, and then to raise the sluice gate, or alternatively, first to lower the sluice gate and then to move it to its seated position.

It is another object of the instant invention to provide an improved sluice gate operating mechanism which is selectively operable to move the sluice gate to its seated position and to remove the sluice gate therefrom, or to raise and lower the sluice gate.

It is also an object of the instant invention to provide an improved sluice gate operating mechanism which is capable of applying maximum forces to the sluice gate for moving it to its seated position and for removing it from its seated position, and to apply lesser forces for raising and lowering the sluice gate.

Still another object of the instant invention is to provide a sluice gate and an improved operating mechanism therefor, in which the sluice gate is opened and closed in a two-step operation, in one of which the sluice gate is moved from or to its seated position, respectively, and in the other of which the sluice gate is raised or lowered.

Still a further object of the instant invention is to provide an improved operating mechanism for a sluice gate, in which there is provided screw operating means, which is selectively operable to move the sluice gate to and from its seated position, or to raise and lower the sluice gate.

It is yet another object of the instant invention to provide an improved sluice gate operating mechanism in which there is provided a mechanical linkage, by which a force of large magnitude can be applied to the sluice gate for moving it to its seated position or to remove it from the seated position.

Other objects of the invention will appear hereinafter, the novel features and combinations being set forth in the appended claims.

In the drawings:

FIG. 1 is an elevational view in section, illustrating a representative installation of the sluice gate and operating mechanism therefor, of the instant invention;

FIG. 2 is a side elevational view, partially in section, of the sluice gate and its operating mechanism, with the sluice gate in its seated position;

FIG. 3 is a plan view, partially in section, of the sluice gate and its operating mechanism, with the sluice gate in its seated position;

FIG. 4 is an elevational view, partially in section, of the sluice gate and its operating mechanism, with the sluice gate removed from its seated position;

FIG. 5 is a plan view, partially in section, of the sluice gate and its operating mechanism, with the sluice gate removed from its seated position;

FIG. 6 is an elevational view of the sluice gate and its operating mechanism, viewed from the rear, with the sluice gate removed from its seated position;

FIG. 7 is a partial sectional view of the screw operator with the means for preventing rotation thereof;

FIG. 8 is a sectional view operator taken on the line 8—8 in FIG. 7; and

FIG. 9 is a partial sectional view of the screw operator with the means for limiting downward movement thereof.

Referring to FIG. 1 of the drawings, there is illustrated therein a representative installation of the sluice gate and the operating mechanism therefor, of the instant invention. The sluice gate is typically used to contain a body of water within a tank, reservoir, channel, or the like, which is represented in FIG. 1 by the walls **10**, **11**, the bottom **12** and the top wall **13**, all of which may be formed of reinforced concrete. The wall **10** includes a flow opening **14** through which the water **15** may be released for flow thereof downstream of the flow opening **14**. The sluice gate **16** is normally disposed in a seated position to close the flow opening **14**, and thereby to block the flow through such opening. As illustrated in FIG. 1, the pressure of the water **15** acting against the face of the sluice gate **16** opposes the seating of the same, and therefore, the operating mechanism for the sluice gate must overcome the force acting on the face of the sluice gate **16** by reason of the pressure of the body of water **15**. Alternatively, the sluice gate **16** may be installed so that the pressure of the body of water acts to apply a seating force to the sluice gate **16**.

The sluice gate **16** comprises a face plate **17**, which covers the flow opening **14**. A suitable sealing gasket **18** is secured to the perimeter of the face plate **17**. For an installation such as this, it is desired that the sealing gasket **18** have a degree of yieldability, so that it will form a proper seal, and in addition, it should be extremely durable, since it is not feasible to sluice gate instllations to replace the sealing gasket **18** at frequent intervals. A seating rim **19** is secured to the wall **10** around the opening **14**. The sluice gate **16** is seated against the perimetal seating rim **19**, with the sealing gasket **18** forming a complete seal between the sluice gate **16** and the opening **14**.

In accordance with this invention there is a two-step operation of the sluice gate **16**. Thus, with the sluice gate **16** in seated position, as shown in FIGS. 1, 2 and 3, the first step of the operation would be to remove the sluice gate **16** from its seated position, which is a lateral movement of the sluice gate **16** away from the opening **14**, to the position shown in FIG. 4. Then, the second step of the operation is to raise the sluice gate **16** upwardly to completely remove it from the area of the flow opening **14**, whereby there will be an unimpeded flow of the water **15** through the opening **14**. The reverse operation is also in two steps, in which the sluice gate **16** is first lowered to a position in front of the flow opening **14**, and then the second step of the operation is to move the sluice gate **16** laterally toward the opening **14**, to effect a closure of the opening **14**, and thereby to block the flow of the water **15** through said opening **14**.

The upper surface of the top wall **13** forms a platform **20**, to which there is secured a floor stand **21**. At the upper end of the floor stand **21** there is provided a collar **22**, which may be fabricated of a plurality of disc elements, as illustrated in section in FIG. 2. The collar **22** is provided with a flange **23** that extends inwardly to engage with a peripheral notch **24** formed at the lower end of the hub **25** of a hand wheel **26**. By such construction, the hand wheel **26** is rotatably mounted at the top of the floor stand **21**, and is fixed in an axial direction with respect to the floor stand **21**.

The hub **25** is threaded to receive and engage with a screw operator **30**, that extends through the hub **25** and through the collar **22**, the latter having an opening **31** to freely receive the screw operator **30** without engaging

the threads of the same. The screw operator 30 extends downwardly through the floor stand 21 and through an opening 32 formed in an overhanging portion 33 of the top wall 13. The opening 32 is substantially larger than the screw operator 30, to permit free passage of the same through the overhang 33.

Above the hand wheel 26 there is provided a locking nut 34 that is threaded on the screw operator 30. The locking nut 34 includes a pair of oppositely directed handles 35, by which the locking nut 34 may be turned down against the hub 25 of the hand wheel 26, whereby the hand wheel 26 is secured to the screw operator 30 in an axially fixed position. Rotation of the hand wheel 26 then causes the screw operator 30 to rotate, rather than to move axially through the hub 25 of the hand wheel 26. The locking nut 34 may be maintained in a spaced position with respect to the hand wheel hub 25 by means of a pin 36 that is inserted into the locking nut 34 and the hand wheel hub 25, as seen in FIG. 4, whereby the locking nut 34 and the hand wheel 26 are maintained in fixed position relative to each other. Then rotation of the hand wheel 26 causes the screw operator 30 to move axially with respect thereto, upwardly or downwardly through the hand wheel hub 25, depending upon the direction of rotation of the hand wheel 26.

The screw operator 30 extends downwardly from the overhang 33 to the sluice gate 16. A laterally extending flange 37 is formed at the top of the sluice gate 16 and extends rearwardly from the face plate 17. A slot 38 is formed in the flange 37, and such slot 38 is substantially larger than the screw operator 30, for the latter to pass freely through the flange 37. The long axis of the slot 38 is disposed at right angles to the plane of the face plate 17 to permit the sluice gate 16 to move to and from its seated position, without interference with the screw operator 30.

Above the flange 37 there is provided a thrust collar 40 that is threadedly engaged with the screw operator 30. A bearing element 41, having a disc form, is interposed between the thrust collar 40 and the upper surface of the flange 37. The bearing element is formed of a suitable bearing material which will permit freedom of relative movement between the sluice gate flange 37 and the thrust collar 40. A locking nut 42 is turned down against the thrust collar 40 to lock it in position.

Below the flange 37 of the sluice gate 16 there is provided another thrust collar 43, a bearing element 44 and a locking nut 45, which are of the same construction as the corresponding elements 40, 41, 42 at the opposite side of the flange 37. By means of the thrust collars 40, 43, the screw operator 30 is fixedly secured in an axial direction with respect to the flange 37 of the sluice gate 16. Thus, the sluice gate 16 may be raised and lowered with respect to the opening 14 by rotation of the hand wheel 26 relative to the screw operator 30, which results in axial movement of the screw operator 30, as previously described.

The screw operator 30 extends downwardly beyond the locking nut 45 and is threadedly engaged with a square nut 46, by which the screw operator 30 is connected to a crank operator 47, the latter forming one element of the actuating mechanism by which the sluice gate 16 is moved to and from its seated position.

The crank operator 47 is formed with a web 48 disposed in an upright position with an upright flange 49 at each side of the web 48. A flange 50 is laterally disposed and extends across the top of the web 48 and the side flanges 49. A rib 51 is spaced below and is parallel to the top flange 50, and extends between the side flanges 49. A square pocket is formed between the top flange 50 and the rib 51 by a pair of spaced blocks 52. The square nut 46 is received within the square pocket between the spaced blocks 52 and is non-rotatable therein. Thus, rotation of the screw operator 30 produces axial movement of the square nut 46 relative to the screw operator

30, such movement being transmitted to the crank operator 47 to move it upwardly and downwardly, as will appear in greater detail hereinafter. The top flange 50 and the rib 51 are formed with openings 53, 54, respectively, which are substantially larger than the screw operator 30, to permit the latter to freely pass through the top flange 50 and the rib 51.

When the hand wheel 26 is locked on the screw operator 30 by the locking nut 34, rotation of the hand wheel 26 produces rotation of the screw operator 30. The square nut 46 is then caused to move axially upwardly or downwardly with respect to the screw operator 30, depending upon the direction of rotation thereof. Such movement of the square nut 46 is transmitted to the crank operator 47 and causes the latter to move upwardly or downwardly.

Each side flange 49 of the crank operator 47 has secured thereto a pair of pivot pins 55, one near the upper end of the side flange 49, and the other near the lower end thereof, as seen in FIGS. 2, 3, 4 and 5. The pivot pins 55 are fixedly secured to the crank operator 47 and extend laterally outwardly therefrom. Each pivot pin 55 forms a pivotal connection for a crank 56 to the crank operator 47. The crank operator 47 and the four cranks 56 are elements of a mechanical linkage, by which the sluice gate 16 is moved to and from its seated position. All the cranks 56 and the elements associated therewith are the same in construction, and therefore, the description will proceed with respect to one crank 56 only, and although such description may be in the singular sense, it will be understood that it is applicable to the plurality of elements disclosed in the drawings.

The crank 56 is pivotally mounted on the pivot pin 55 by means of a suitable bearing sleeve 57, which permits free rotation of the crank 56 on the pivot pin 55. The crank 56 extends from the crank operator 47 toward the sluice gate 16. A pivot pin 58 is fixedly secured to the crank 56 and extends laterally outwardly therefrom. A roller 59 is rotatably mounted on the pivot pin 58 by a bearing sleeve 60. The axis of the pivot pin 58 is the pivot axis for the crank 56.

A rod 61 extends laterally across the sluice gate 16 and through the opposite side flanges 62 of the sluice gate 16, and projects beyond said side flanges 62. A projecting end of the rod 61 is connected to the crank 56, and is fixedly secured with respect thereto by means of a key 63. A bearing sleeve 64 is interposed between the rod 61 and the side flange 62, whereby the rod 61 is freely pivotable with respect to the sluice gate 16.

Referring to FIG. 2, the sluice gate 16 is illustrated therein in its seated position. When the screw operator 30 is rotated in the clockwise direction it will produce upward movement of the crank operator 47. Such movement of the crank operator 47 causes the cranks 56 to rotate in a counterclockwise direction, as viewed in FIG. 2, about the axes of the pivot pins 58. Such axes remain substantially fixed by reason of the rollers 59 being engaged in the tracks 65. The rods 61 are caused to move in a counterclockwise direction around the axes of the pivot pins 58, thereby moving the sluice gate 16 away from the opening 14 to its unseated position, as illustrated in FIG. 4.

Comparing the positions of the mechanism, as shown in FIGS. 2 and 4, it is seen that the axes of the rods 61 are disposed on one side of the plane defined by the axes of the pivot pins 58 when the sluice gate 16 is seated, and at the opposite side of the plane defined by the axes of the pivot pins 58 when the sluice gate 16 is unseated.

In the instant invention, the sluice gate 16 is removed from its seated position by lateral movement away from the flow opening 14. Such operation makes it substantially easier to unseat the sluice gate 16, and requires a substantially lesser force than would otherwise be required. Further, the magnitude of the force required at the hand wheel 26 for removing the sluice gate 16 from

its seated position, as well as for moving the sluice gate **16** to its seated position, is reduced by the fact that the force is transmitted in a highly efficient manner, with a mechanical advantage that multiplies the force that is utimately applied directly to the sluice gate **16**. In the operation of removing the sluice gate **16** from its seated position, the screw operator **30** is in torsion for the major part of its length to approximately the level of the laterally extending flange **37**. The lower portion of the screw operator **30** below the approximate level of the laterally extending flange **37** is in compression or tension, depending upon the direction of operation. Thus, only a relatively short length of the screw operator **30** is in tension or compression. The force that is transmitted in this manner by the screw operator **30** is applied to the crank operator **47**.

The crank **56** has two lever arms, the first lever arm being between the pivot pin **55** and the pivot pin **58**, and the second lever arm between the pivot pin **58** and the rod **61**. As seen in FIGS. 2 and 4, the first lever arm of the crank **56** is substantially longer than the second lever arm thereof. The force applied by the crank operator **47** to the crank **56** is applied to the first lever arm, and is transmitted by the crank **56** to the sluice gate **16** on the second lever arm. Thus, there is produced a mechanical advantage, and the force which ultimately acts on the sluice gate **16** to move it to either its seated or unseated position, is substantially greater than the force applied to the crank **56** by the crank operator **47**.

So far as the actual raising and lowering of the sluice gate **16** is concerned, there is no great problem with respect to the forces involved, for the reason that the screw operator **30** merely acts to raise or lower the weight of the sluice gate **16**, including of course, the actuating mechanism for the same. Accordingly, the screw operator **30** is merely required to have a capacity sufficient to handle the weight of the sluice gate **16** and the associated mechanism, and this will be well within the capacity of the screw operator **30**, since it is designed for the greater forces that are required to seat and unseat the sluice gate **16**.

After the sluice gate **16** has been removed from its seated position, as shown in FIG. 4, the locking nut **34** is backed off the hand wheel hub **25** and is rotatably fixed relatively to the hub **25** by the pin **36**. Then the hand wheel **26** is rotated in a clockwise direction, moving the screw operator **30** in an axial direction upwardly to raise the sluice gate **16**. At each side of the sluice gate **16** there is the track **65** which extends upwardly for a substantial distance. The rollers **59** ride in the track, and the upward movement of the sluice gate **16** is guided by engagement of the rollers **59** in the tracks **65**. The rollers **59** and the tracks **65** thus serve a dual function of guiding the upward and downward movement of the sluice gate **16**, as well as providing fixed pivot axes for operation of the cranks **56**. The sluice gate **16** rides upwardly and downwardly on the rollers **59**, providing a further operating advantage in that the friction is rolling friction, rather than sliding friction. The sluice gate **16** is lowered and seated by counter-clockwise rotation of the screw operator **30**.

The foregoing description has been with respect to the basic structure of the sluice gate **16** and the operating mechanism therefor, by which the sluice gate **16** is moved to and from its seated position and is raised and lowered with respect to the flow opening **14**. When the sluice gate **16** is moved from its seated position, as illustrated in FIG. 2, to its unseated position, as illustrated in FIG. 4, it is desirable that such movement be limited to the extent of movement necessary for separating the sluice gate **16** from the seating rim **19**. Such limitation of movement is accomplished by reason of the top flange **50** of the crank operator **47** abutting against the locking nut **45**, which prevents further upward movement of the crank operator **47**. Thereafter, the sluice gate **16** is raised by axial movement of the screw operator **30**, as previously described. Such axial movement of the screw operator **30** is accomplished by clockwise rotation of the hand wheel **26**. There can be no rotation of the screw operator **30**, for the reason that the abutment of the top flange **50** against the locking nut **45** effectively locks the screw operator **30** against such rotative movement. The upward movement of the screw operator **30** is limited by abutment of the locking nut **42** against the overhang **33**.

The sluice gate **16** is lowered by moving the screw operator **30** downwardly in an axial direction, which is accomplished by counter-clockwise rotation of the hand wheel **26**. Due to friction in the elements, it may be that rotation of the hand wheel **26** in the counter-clockwise direction will not only cause the screw operator **30** to move downwardly, but will also produce some rotative movement of the screw operator **30**. This, of course, would cause the crank operator **47** to move downwardly, and the sluice gate **16** would be moved towards the wall **10**. The total effect could be that the sluice gate **16** may inadvertently be brought against the wall **10** before it is fully lowered, whereby the sluice gate **16** would jam in a mid-position.

In FIGS. 7 and 8 there is illustrated means by which such rotative movement of the screw operator **30** may be prevented. The collar **22** of the stand **21** is formed with a thickened lower portion, in which there is provided a radial slot **66** that has a rectangular cross-section. The screw operator **30** is formed with an axially extending keyway **67** that may be aligned with the radial slot **66**. A rectangular key **68** is inserted in the slot **66** to engage with the screw operator **30** in the keyway **67**. Such engagement of the key **68** with the screw operator **30** prevents the latter from rotating as it is moved downwardly by rotation of the hand wheel **26** in a counter-clockwise direction.

It is desirable that there be provided a device for limiting the downward movement of the screw operator **30**, so that it may be determined when the sluice gate **16** has reached its lowered position opposite the flow opening **14**. In FIG. 9 there is illustrated a form of device to serve this purpose. A cap **69** is threaded onto the end of the screw operator **30**. The position of the cap **69** on the screw operator **30** is determined in accordance with the distance that the screw operator **30** must be moved downwardly to properly locate the sluice gate **16** in front of the flow opening **14**. The threaded cap **69** is fixedly secured to the end of the screw operator **30** by a locking bolt **70**. In operation the screw operator **30** is lowered until the cap **69** abuts the locking nut **34**.

After the sluice gate **16** has been lowered, the locking nut **34** is turned down on the hand wheel **26** and the screw operator **30** is then rotated in the counter-clockwise direction to move the crank operator **47** downwardly, whereby the sluice gate **16** is moved laterally towards the flow opening **14**, to its seated position against the seating rim **19**. Prior to rotation of the screw operator **30**, the rectangular key **68** is removed to free the screw operator **30** for such rotation.

Other devices than those illustrated herein may be utilized for determining and limiting the movement of the screw operator **30**. In addition, there may be provided an indicating device to show intermediate positions of the sluice gate **16** in which it only partially covers the flow opening **14**. In any intermediate lowered position of the sluice gate **16** it can be moved towards the flow opening **14** and seated to partially cover the flow opening **14**, for the purpose of partially restricting the flow through the flow opening **14**, rather than completely shutting off such flow.

The sluice gate **16** and operating mechanism of the instant invention are particularly advantageous, in that there is provided the means whereby a large force may be applied to move the sluice gate **16** to its seated position and to remove the sluice gate **16** from its seated position, and a lesser force is applied to raise and lower the

sluice gate 16. The mechanism by which this is accomplished operates in two steps, in one of which the sluice gate 16 is either seated or unseated, and in the other of which the sluice gate 16 is either raised or lowered. The two-step operation is accomplished by the same screw operator 30, which may be selectively operated in the appropriate direction for accomplishing any of the steps as stated. The actuating mechanism for the sluice gate 16 is a relatively simple, mechanical linkage, which does not require any great maintenance effort. The mechanism has the very desirable characteristics of trouble-free operation over long periods of time, even though it may be continuously immersed in a body of water during such time.

Obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of the invention as defined by the claims hereto appended, and applicant therefore wishes not to be restricted to the precise construction herein disclosed.

Having thus described and shown an embodiment of the invention, what it is desired to secure by Letters Patent of the United States is:

1. Sluice gate mechanism in which there is a seated position for the sluice gate to close an opening and to block flow through said opening, comprising a sluice gate, sluice gate actuating means for moving the sluice gate to its seated position and for removing the sluice gate from its seated position, said sluice gate actuating means including a gate operator that is disposed oppositely and in parallel, upright adjacent disposition to said sluice gate, said sluice gate actuating means further including a plurality of cranks to connect said gate operator to said sluice gate and to maintain the parallel disposition of the gate operator with respect to the sluice gate in all operative positions of said gate operator, an elongated screw disposed in upright alignment with said gate operator and the upright disposition thereof, a threaded connection between said screw and said gate operator for moving the gate operator up and down by rotation of the screw in said connection, a flange portion of said sluice gate being disposed across said screw, a connection above said operator and between said screw and said sluice gate flange portion which is fixed in the axial direction to raise and lower the sluice gate when the screw is raised and lowered, (i) a first pivot connection between each of said cranks and said gate operator, (ii) a second pivot connection between each of said cranks and said sluice gate, and (iii) each of said cranks having a third pivot means to provide a center about which each crank is rotated when said gate operator is moved down or up relative to the gate by the rotation of the screw thereby to move said sluice gate inwardly to its seated position or away from its seated position on said second pivot connections.

2. Sluice gate mechanism as recited in claim 1, in which said threaded connection of the elongated screw to the gate operator comprises a threaded nut that is threadedly engaged with said screw, a socket on said gate operator for receiving said nut and holding the nut against turning, and said socket being larger than said nut to loosely receive the nut within the socket.

3. Sluice gate mechanism as recited in claim 1, in which said flange portion of the sluice gate has an elongated slot for said screw, and said connection of said screw to said sluice gate flange portion includes said elongated slot for movement of said sluice gate to and from its seated position.

4. Sluice gate mechanism as recited in claim 1, including a roller on said third pivot of each of said cranks and an upright track for said roller to guide the up and down movement of said sluice gate in the upright direction.

5. Sluice gate mechanism as recited in claim 1, in which said plurality of cranks are disposed in pairs at opposite sides of said sluice gate and said gate operator, each of said cranks including a roller, an upright track at each side of said sluice gate and said gate operator, and said rollers being engaged with said opposite upright tracks to guide the up and down movement of said sluice gate in the upright direction.

6. Sluice gate mechanism as recited in claim 1, in which said flange portion of said sluice gate is disposed above said gate operator and said elongated screw extends through said flange portion to said gate operator.

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