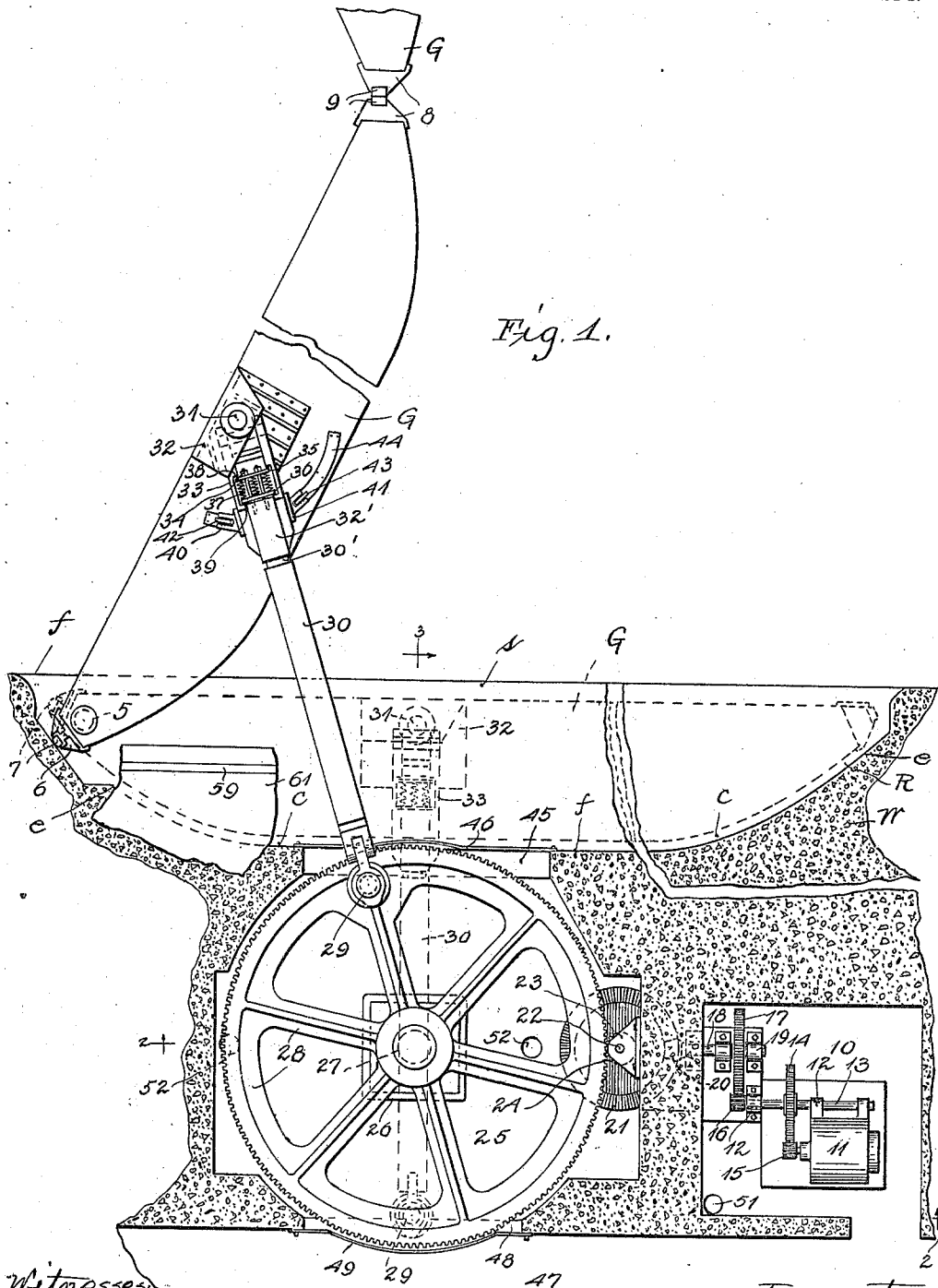


E. SCHILDHAUER.
OPERATING MECHANISM FOR CANAL LOCK GATES.
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Witnesses:
Charles J. Schmitt.
Nellie Dearborn.

Inventor:
Edward Schildhauer

By Offield, Towle, Kraus & Offield
Attys.

UNITED STATES PATENT OFFICE.

EDWARD SCHILDHAUER, OF CULEBRA, PANAMA.

OPERATING MECHANISM FOR CANAL-LOCK GATES.

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To all whom it may concern:

Be it known that I, EDWARD SCHILDHAUER, residing at Culebra, Canal Zone, Panama, have invented certain new and useful Improvements in Operating Mechanism for Canal-Lock Gates, of which the following is a full, clear, and precise specification.

My invention relates to operating mechanism for canal lock gates, particularly for gates of the miter type which are pivoted at one edge by a vertical pintle or shaft and which are to be swung from open position within recesses in the canal walls to a closed position in miter engagement.

Lock gates, particularly such as are used in large canals, are quite heavy, and the machinery for driving the gate, on account of the rest inertia alone of the gate, must be able to give a powerful starting effort. However, in constructions where the gates, when open, engage in pockets or recesses in the side walls of the canal, the resistance due to the interaction of the lock walls and the gates must receive the most serious consideration. The clearance between a closed gate and the inner wall of its containing recess is in practice quite small. Now as the gate nears the recess the opening between the free end of the gate and the end of the recess becomes gradually smaller until the operating width is equal to the clearance width. Thus the water between the gate and the lock wall will be forced out through gradually narrowing openings, one between the vertical free end of the gate and the recess end, and the other between the bottom of the gate and the sill. The effect of the narrowing of the water escape openings is to produce a difference of head on the two sides of a gate, this difference of head being dependent on the velocity of the gate, the size of the escape openings, and the frictional resistance of the lock wall and gate to the flow of water. The starting velocity of the gate should therefore be reduced in order to keep down the difference of head and thus to reduce the resistance. After the inertia of rest and the resistance due to the interaction of the lock wall and gate have been overcome, then of course the movement of the gate can be accelerated, as the resistance becomes less the farther the gate swings away from its recess. When the gates are well away from their recesses the acceleration can be quite rapid, but before

the gates are about to pass into mitering engagement their speed should be again reduced and the drive effort thereon should be increased, so that the gates will be forced into accurate and water-tight mitering engagement. The driving mechanism for the gates should, therefore, be such as will cause the gates to be slowly and powerfully started from open position, then accelerated, and then slowly and powerfully brought into mitering engagement. Likewise, when the gates are to be opened the driving apparatus should slowly and powerfully start the gates open from mitering position and should then accelerate the speed and should then slowly and powerfully return the gates into their recesses, the resistance caused by the interaction of the lock walls and gates being practically the same when the gates enter the recesses as when they leave the recesses. Besides the inertia resistance and the interaction resistance above referred to, the pivot friction, the wind resistance, jet action, and skin friction must also be overcome.

The machinery for controlling the operation of the lock gates must be installed on the canal banks adjacent the gates, and its form and the space occupied thereby are more or less limited by various conditions. For example, where traction engines ply along the edge of the canal when towing boats therethrough, the gate driving machinery must not be in the way, and the conditions usually are that such gate driving machinery must not project above the coping level of the canal walls. Owing to the varying degrees of driving effort required for operating the gates, it would not be efficient to directly connect a source of power with the gates, as the source, such as a driving motor or engine, would have to be of very large capacity to furnish sufficient power for starting the gate and bringing it into final closed or open position. The source would be working at full capacity during such starting and stopping periods but would be working only at a small per cent. of its capacity during the intermediate period. Where an electric motor is used as the driving source resistance of re-actance devices would have to be employed for adjusting for the varying resistance and for the varying velocity, and the efficiency under such conditions would of course be very low. It is also very important that the gates when carried into

their recesses be rigidly locked in the recesses, so that they will not be dislodged by heavy current flow, and the gates should also be rigidly locked after coming into mitering engagement so as not to accidentally open while a ship is within the lock.

One of the important objects of my invention, therefore, is to provide operating mechanism for gates, in which small substantially constant power from a driving source is variably multiplied and applied to the gate to automatically give the varying driving effort and acceleration thereto.

The apparatus comprises a driving source of small capacity as compared with the maximum driving effort required on the gate, and this source is connected to rotate a large wheel having a crank pin connected by a connecting rod or strut with a pivot point on the gate, the crank pin being at one side of the wheel in one dead center when the gate is within the recess and at the other side of the wheel in the other dead center when the gate is closed, this dead center arrangement carrying out another important feature of my invention, namely to automatically rigidly lock the gate within its recess or when in closed position. The connecting rod and crank lever mechanism will give a sort of harmonic movement to the gate, the power unit driving at a substantially continuous uniform small power, which the crank mechanism translates into a cycle of power beginning with very heavy power at slow speed, then accelerating, and then ending with heavy power at slow speed, this being the ideal condition for operating a miter gate under the various resistance conditions above pointed out.

Another important object is to so arrange the driving and transmission mechanism that it will be entirely below the plane of the coping of the canal walls, the crank wheel lying in a horizontal position within a suitable chamber or pit, and the connecting rod extending through a suitable opening in the wall to engage with the gate. The above arrangement enables the power source to be started without the use of speed controlling devices. For example, where the power source is an electric motor, the motor can be allowed to come up to speed and will operate during the entire gate controlling period without the use of resistance or reactance, the torque of the motor being smallest when the gate requires maximum driving effort, on account of the leverage conditions, and the motor operating at maximum torque to rapidly accelerate the gate through the water after having been started. Thus we have the ideal conditions for electric motor operation, together with the ideal conditions for controlling the driving power and acceleration of the gate.

My invention will be more clearly under-

stood from one embodiment thereof described in detail in the following specification and illustrated on the accompanying drawings, in which drawings—

Figure 1 is a plan view of a section of a canal wall and a gate, the top of the wall being removed to show the driving motor mechanism and the translating mechanism, Fig. 2 is substantially a sectional view taken on plane 2—2, Fig. 1, Fig. 3 is a sectional view taken substantially on plane 3—3, Fig. 1, and Fig. 4 is a reduced sectional view of a canal showing the position of the gates with reference to the recesses.

The recess R in the wall W of the canal is of substantially rectangular cross section with the end sections *e* of the inner face thereof rounding outwardly toward the inner face *f* of the wall W. The gate G has substantially the same cross section as the recess, but its dimensions are slightly reduced in order to leave a clearance space *c* between its rear face and the inner face *f'* of the recess and to leave a clearance *s* between its front face and the face *f* of the canal wall. The gate is of steel construction and is floated in the usual manner to reduce its weight when in the water. One end of the gate is vertically pivoted by means of a pintle 5, and this pivoted end carries a frame 6 supporting a sealing strip 7 for engaging with the adjacent rear face of the recess when the gate is closed, in order to make a water tight joint at this point. The other end of the gate carries a frame 8 supporting a strip 9, which strip engages with a similar strip on the companion gate when the gates are closed to form the water tight miter joint. When the gate is opened the water in the clearance space *c* will of course immediately drop and there will be a difference of head, water from the canal then rushing into the space behind the opening gate. This difference in head causes the interaction resistance referred to above, and it is this resistance which must be mostly considered in the operation of the gate. Likewise, when the gate moves back into its recess the water will rise in the space between the gate and the recess rear wall to raise the head at this point, and this interaction resistance must also be overcome.

Referring now to the gate driving and controlling mechanism, a pit 10 is formed in the concrete wall W, and in this pit is mounted a suitable driving source, such as the electric motor 11 shown. Mounted on suitable bearings 12 is the counter shaft 13 carrying the gear 14, which meshes with pinion 15 on the armature shaft of the motor, and a pinion 16 on shaft 13 meshes with a gear 17 mounted on shaft 18 suitably journaled in bearings 19, the outer end of this shaft carrying a bevel pinion 20, which meshes with a bevel gear 21 disposed horizontally

and carried on a vertical shaft 22 journaled in bearings 23, the upper end of this shaft carrying a pinion 24. As best shown in Fig. 2, the pinion 20 and gear 21 are within the pit 25 adjacent the pit 10, and in this pit 25 a block 26 supports a vertical stub shaft 27 to which is pivoted a large crank wheel 28 whose hub rests on the block 26. The outer periphery of this crank wheel has gear teeth which mesh with the pinion 24. Near its periphery this crank wheel carries a crank pin 29 to which is pivoted the inner end of a strut or connecting rod 30 whose outer end is connected with a pin 31 supported in a frame 32 secured to the top of the gate at a suitable distance from the pivoted end of the gate. Instead of connecting the rod 30 directly with the pin, shock absorbing mechanism is preferably interposed, the end 30' of the rod being of reduced diameter and slidable in a sleeve 32' at the end of the frame 33 which pivots to pin 30 at its other end. Screws 34 extend from the end of the rod and slidably receive abutment plates 35 and 36 between which compression springs 37 are interposed, the frame 33 having abutment shoulders 38 and 39, against which the plates 35 and 36 respectively may abut, so that the springs will be interposed to cushion the pull or thrust of the connecting rod on frame 33 and consequently on the pin 31 and the gate. Extending from the sides of the frame 33 are brackets 40 and 41 journaling rollers 42 and 43 which ride on a rail frame 44 secured to the top of the gate concentric with the center of pivot pin 31, the rail and rollers supporting the weight of the connecting rod and shock absorber frame. In Fig. 1 the full lines show the position of the various parts when the gates are closed, and the dotted lines show the relative positions when the gates are within the recesses. The crank pin is so positioned on the crank wheel that when a gate is closed the centers of the crank wheel, crank pin, and pivot pin 31 are in a common plane, or in other words, the parts are in dead center, so that the gate will be absolutely locked against self opening. Likewise, when the gate is in the recess the various pivot centers will be in line or in dead center position, so that the gate will be absolutely locked against self displacement, and it will be impossible for current to rush in behind the gate to swing it from its recess, or for current, waves, or other influences to cause the gate to accidentally open after having been brought into closed mitering position. The driving mechanism itself thus inherently automatically performs absolutely reliable locking of the gate in its open or closed position.

The connecting rod extends from the crank pin through the opening 45 in the wall, and the crank wheel also extends a

distance into this opening, the wheel being protected by a cover or guard 46 applied to the opening, as shown. Adjacent the pits 10 and 25 extends an operating tunnel 47 communicating with the pits, the crank wheel extending partway into the tunnel through opening 48 and being protected by a cover or guard 49 applied to the opening. As best shown in Fig. 3, a drainage tunnel 50 extends along below the operating tunnel, and ducts 51 and 52 connect the pits 10 and 25 respectively with the drainage tunnel in order to drain the pits of water. As best shown in Fig. 2, the lower end of the block 26 supporting the crank wheel has the passageway 53 communicating with the pit in order to drain oil or water from the crank wheel bearing. Within the pit 25 one or more pivoted rollers 54 may be provided for engaging with the rim of the crank wheel to support and balance the wheel.

Referring particularly to Figs. 2 and 3, access may be had to the motor and wheel pits through man hole frames 55 and 56 respectively set into the top of the concrete wall, these frames being provided with removable covers 57 and 58, which engage with the frames to seal the frames against the entrance of water, the covers being level with the top of the coping of the canal wall.

In modern canals tractor engines are usually provided to run along adjacent edges of the canal for towing vessels through the various locks of the canal, and the tracks for these tractor engines must be close to the canal edge, in order that proper towing may be accomplished. These tractor engines require a clear field, and all apparatus, particularly that for controlling the operation of the gates, must be well out of the way. My improved operating mechanism is particularly adaptable for such conditions, the large crank wheel being in horizontal position, and the entire operating mechanism requiring very little vertical space. In Fig. 3 I have shown two tracks 59 and 60 embedded in the concrete wall, and the crank wheel and connecting rod and the motor mechanism are mounted in pits below the coping level, so as to be entirely clear of the tracks and the tractor engines running on the tracks. The track 59 extends over the gate recess and is there supported by a ledge or shelf 61 overhanging the recess, the connecting rod being directly under the ledge.

I thus provide simple and efficient controlling mechanism, which is especially adaptable for driving swinging gates for canals, and particularly such gates which in their open position are received in recesses or pockets of the canal walls. The transmission mechanism automatically translates the comparatively small and constant

power of the driving source into such variable power and speed particularly desirable for swinging the gate. No additional mechanism is required for controlling starting, torque, or the speed of the driving engine, and if this driving engine is an electric motor the motor can be thrown directly into circuit and can operate during the entire gate controlling period without the use of resistance or re-actance or any other controlling means. Neither are additional means necessary for locking the gate in open or closed position, the crank mechanism automatically efficiently providing for such locking. The apparatus can therefore be very simple and be installed for little cost. Furthermore, the arrangement of the apparatus is extremely compact and best suited to the conditions, the large crank wheel being in horizontal position and entirely below the top surface of the canal walls, thus being entirely out of the way of tractor engines running along adjacent the canal edge. The machinery is always ready and accessible for inspection. I do not, however, desire to be limited to the precise construction and arrangements which I have described and shown, as changes and modifications are of course possible which would still come within the scope of my invention, and

I therefore claim the following:

1. In mechanism for controlling the swinging of pivoted canal lock gates, the combination of crank mechanism, means for driving said crank mechanism, and a connecting rod connecting with said crank mechanism and with the gate to be swung.

2. In combination, a lock gate pivoted to swing, a crank member having a crank pin, a driving source for driving said crank member, and a connecting rod pivoted to said pin and to said gate to translate the movement of said source into swinging movement of said gate.

3. In combination, a gate, a driving source, and translating mechanism for translating the movement of said driving source into substantially harmonic swinging movement of said gate.

4. In combination, a gate pivoted to swing, a gear wheel having a crank pin, a driving source connected with said wheel to cause rotation thereof, and a connecting rod connecting said crank pin with said gate.

5. In combination, a canal lock gate pivoted to swing, a gear wheel having a crank pin extending therefrom, a driving motor, speed reduction gearing for translating movement of said motor to said gear wheel, and a connecting rod pivoted to said crank pin and to said gate.

6. In combination, a canal lock gate pivoted to swing, a driving engine whose

driving motion is substantially uniform, and mechanism connected with said gate and said engine for translating the uniform motion of the engine into substantially harmonic swinging movement of said gate.

7. In combination, a canal lock gate pivoted to swing from a position adjacent a side of the canal to a position at an angle with said side, a wheel pivoted in horizontal position on the canal bank adjacent said gate, a crank pin on said wheel, a connecting rod pivoted to said crank wheel and to said gate, and a driving engine for causing rotation of said wheel, said wheel and connecting rod translating the movement of said engine into substantially harmonic swinging movement of said gate.

8. In combination, the side walls of a canal, a gate pivoted at one vertical edge to a canal wall and adapted to swing into open and closed position, a pit in the canal wall adjacent said gate, crank mechanism pivoted in said pit, a connecting rod extending from said pit and connecting said crank mechanism with said gate, a second pit in the canal wall adjacent the gate, and a driving motor in said pit having driving connection with said crank mechanism.

9. In combination, the side walls of a canal, miter lock gates pivoted to said canal walls to swing into open or closed positions, a pit in the canal wall adjacent each gate, a large gear wheel pivoted in each pit and disposed horizontally, a crank pin for each wheel, a connecting rod extending from each pit and pivoted to the crank pin and the adjacent gate to cause swinging of the gate upon rotation of the gear wheel, a driving motor in each pit, and speed reduction gearing in each pit for transmitting the motion of the motor to the gear wheel.

10. In combination, a canal lock gate pivoted to swing, crank mechanism, a connecting rod connecting said crank mechanism with said gate, a driving source for operating said crank mechanism, and shock absorber mechanism for cushioning the pull and thrust of said connecting rod on said gate.

11. In combination, a canal lock gate pivoted to swing, crank mechanism pivoted on the bank of the canal adjacent said gate, a connecting rod extending from said crank mechanism and pivoting to the top of the gate, and a driving motor on the bank for driving said crank mechanism.

12. In combination, a canal lock gate pivoted to swing, crank mechanism, a connecting rod connecting said crank mechanism with said gate to cause swing of the gate upon operation of the crank mechanism, and a driving motor for the crank mechanism, said crank mechanism and connecting rod being in dead center positions when said gate is fully opened or fully closed

whereby to rigidly lock the gate in such open or closed positions.

13. In combination, a canal lock gate pivoted at one edge to swing into open or closed positions, a crank wheel pivoted on the bank of the canal adjacent said gate, a crank pin on said crank wheel, a connecting rod pivoted to said crank pin and to said gate to cause swinging of the gate to open or closed position upon rotation of said crank wheel, and a driving source for operating said crank wheel, the pivot center of

the crank wheel and the pivot centers of the connecting rod with the crank wheel and gate being in line when the gate is fully closed or open, whereby to rigidly lock the gate in such positions. 15

In witness whereof, I hereunto subscribe my name this 17th day of November, A. D., 1910.

EDWARD SCHILDHAUER.

Witnesses:

WALTER W. HERRINGTON.

GEO. A. YINGLING.