Nov. 30, 1943. B. M. BIRD 2,335,635

DISCHARGE MECHANISM FOR JIGS

Filed April 20, 1942 2 Sheets-Sheet 1

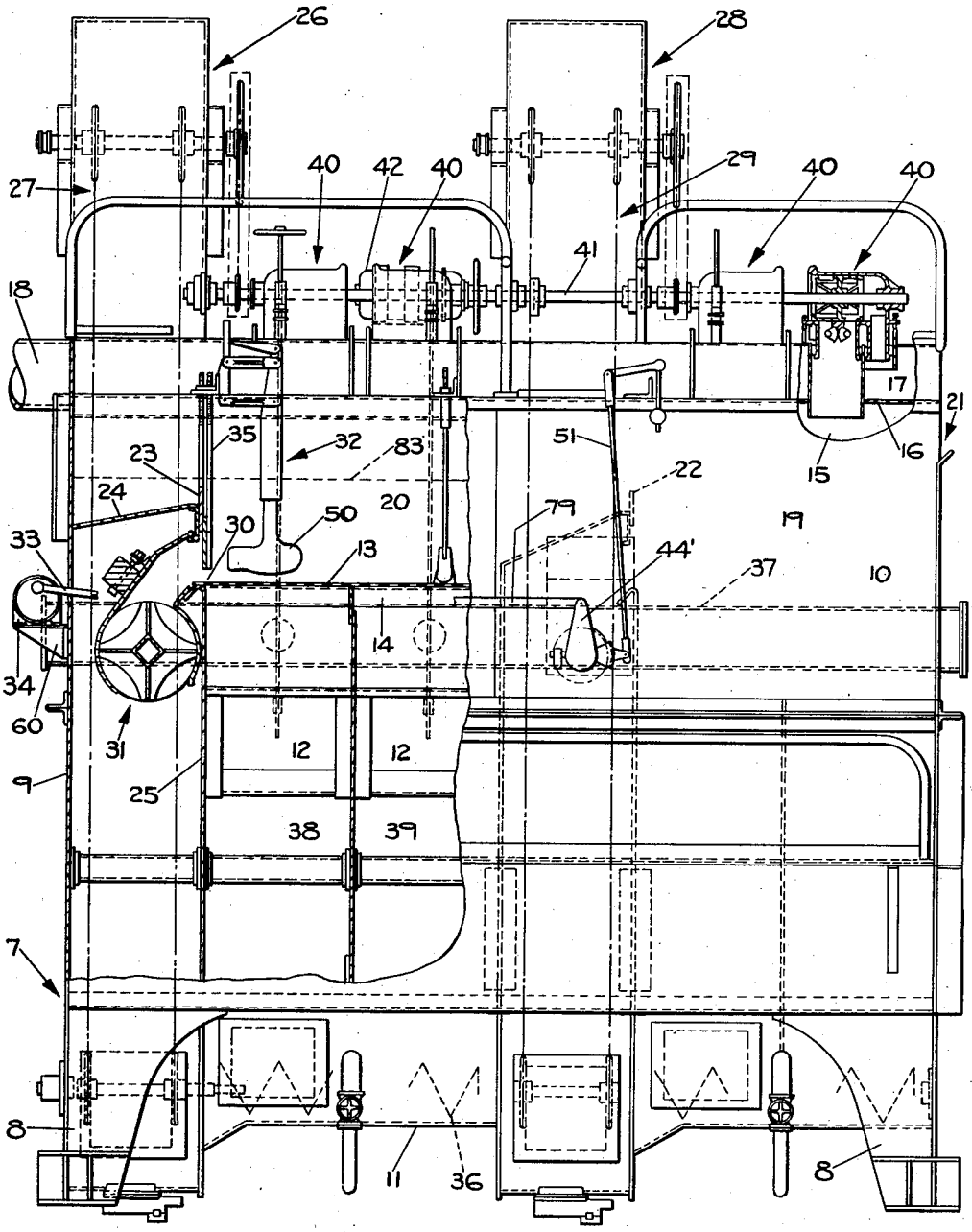

Fig. 1

INVENTOR:
BYRON M. BIRD,
BY Chas. M. Hirsch,
ATT'Y.

Nov. 30, 1943. B. M. BIRD 2,335,635

DISCHARGE MECHANISM FOR JIGS

Filed April 20, 1942 2 Sheets-Sheet 2

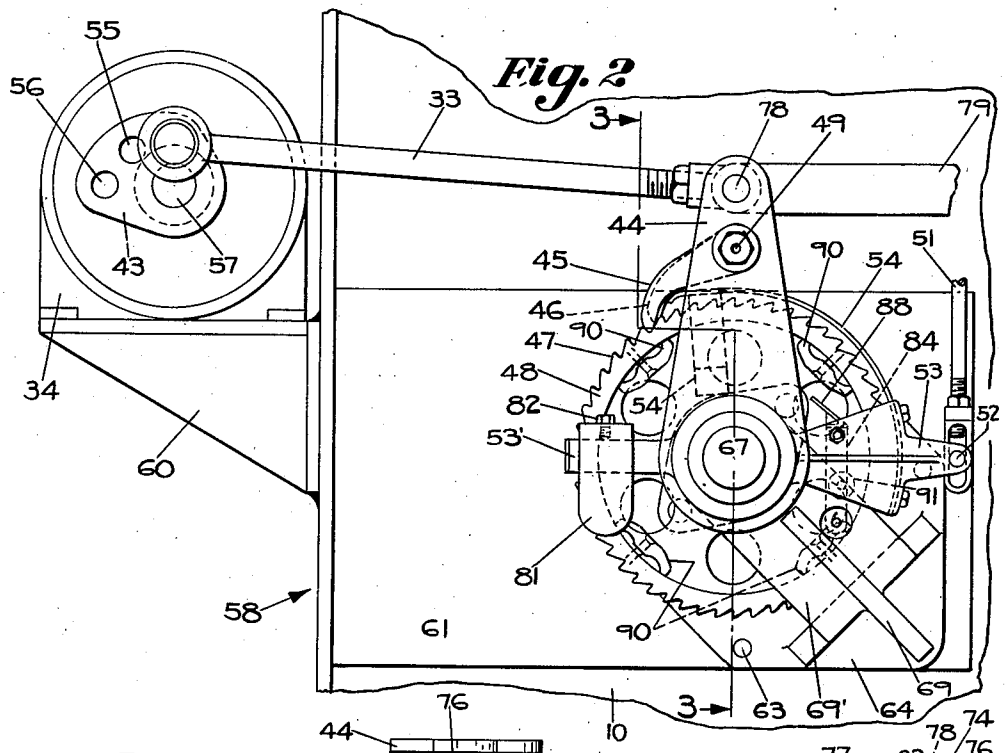

Fig. 2

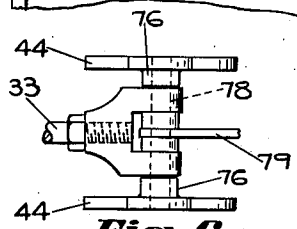

Fig. 6

Fig. 4

Fig. 5

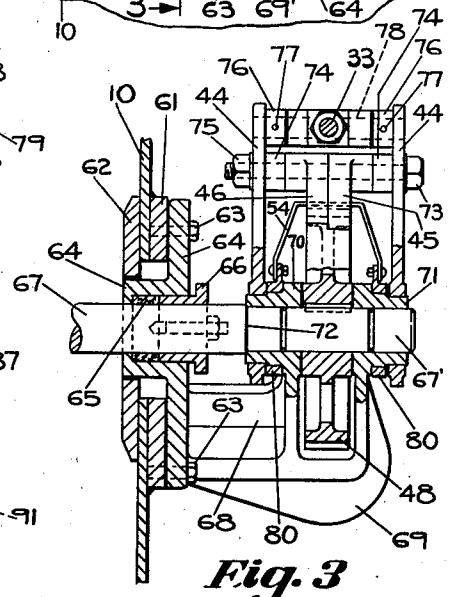

Fig. 3

INVENTOR:
BYRON M. BIRD,
BY Chas. M. Nixon,
ATT'Y.

Patented Nov. 30, 1943 2,335,635

UNITED STATES PATENT OFFICE

2,335,635

DISCHARGE MECHANISM FOR JIGS

Byron M. Bird, Columbus, Ohio, assignor, by mesne assignments, to The Jeffrey Manufacturing Company, Columbus, Ohio, a corporation of Ohio

Application April 20, 1942, Serial No. 439,696

12 Claims. (Cl. 209—496)

My invention relates to mechanism for automatically ejecting refuse which has been separated from material being collected for practical use and although my improvements are particularly adapted for use in jigs for separating impurities from coal, it may have a general application.

One of the objects of my invention is the provision of means for compelling the operation of refuse discharge mechanism at a fixed minimum rate when the amount of impurities or refuse exceeds a predetermined amount.

A further object of the invention is the provision of automatic mechanism for locking a pawl lifter of a discharge regulator in such position as to effect a minimum discharge of one-half tooth until the accumulation of refuse is reduced to a predetermined amount.

Another object of the invention is the provision of automatic mechanism for a float controlled discharge regulator to effect minimum discharge of refuse when the accumulation of such refuse exceeds a predetermined amount and to enable such regulator to automatically vary the discharge when the accumulation of refuse falls below such predetermined amount.

More particularly it is the object of the present invention to provide automatic mechanism for locking a pawl lifter to a discharge regulator in such position as to effect minimum discharge when the accumulation of refuse is above a predetermined amount, combined with latch mechanism for freeing said pawl lifter to enable said regulator to automatically vary the discharge as soon as the accumulation of refuse has dropped below said predetermined amount.

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

In the accompanying drawings,

Fig. 1 represents jigging apparatus for which my improvements are particularly adapted;

Fig. 2 is an elevational view of the automatic mechanism for securing maximum operation of the refuse ejector until the depth of the refuse material on the screen of the jigging apparatus falls below a predetermined maximum;

Fig. 3 is a sectional elevation taken on the line 3—3 of Fig. 2, looking in the direction of the arrows;

Fig. 4 is a sectional elevational view, enlarged to show the relative positions of the parts of the latch mechanism and the tripping means therefor;

Fig. 5 is a detailed view showing in elevation the details of the automatic latch mechanism; and

Fig. 6 is a plan view to illustrate the connections for the continuously operated oscillating mechanism connected to a plurality of float controlled ejector or refuse discharge devices.

My improvements shown in Figs. 2 to 6, inclusive, are particularly adapted to a jig of the Baum type as shown in Fig. 1. The jig as shown in this view comprises a main frame 7 provided at its four corners with supporting feet 8 adapted to rest on a floor or other structure of a coal cleaning plant.

Mounted on the main frame 7 is a tank or container 9 comprising a pair of longitudinally extending upright side walls 10 which extend the full length of the jig and which have integral converging bottom walls which meet to form a trough 11 in the bottom of the tank or container 9.

Between the upright side walls 10 is a longitudinally and upwardly extending partition 12. As is well understood, the tank or container 9 receives the water or other jigging liquid and the cross-sectional structure thereof, as shown in the patent to Bird et al., 2,132,378, granted October 11, 1938, for an improvement in a Jig, as well as the liquid, is formed into a U-shaped column in one leg of which, and between partition 12 and one side wall 10, is a perforated plate or screen 13, having a plurality of reinforcing bars 14 on the bottom thereof.

Above the other leg of the water column there is formed an air chamber 15 between the partition 12 and another upright side wall 10, which chamber is also provided with a top plate 16, which top plate 16 also constitutes the bottom plate of a plenum chamber 17 which extends the full length of the jig. Air under pressure is delivered to plenum chamber 17 from a blower by way of pipe 18.

While Fig. 1 illustrates a two compartment jig, it should be understood that the number of compartments may be varied as desired. The two compartments of the jig are substantially the same in structure except for certain obvious differences, and one of the compartments is indicated generally by the reference number 19 and the other by the reference number 20.

The compartment 19 is provided with a feed chute 21 by which the raw coal is fed to the jig. Between the compartments 19 and 20 is a weir 22 over which the clean coal from compartment 19 flows to compartment 20. The clean coal

from compartment 20 is discharged over weir 23 and down in chute 24 to an appropriate receiving means such as a sluiceway.

The screens 13 associated with the two compartments 19 and 20 are pivotally attached at their forward ends to partitions, one of which is shown at 25, and which forms part of a casing 26 for a refuse elevating conveyor 27 associated with the compartment 20. Compartment 19 is provided with a similar elevating conveyor casing 28 and refuse removing elevating conveyor 29.

Adjacent the forward end of each screen 13 is a refuse discharge opening 30 which leads to the refuse ejecting mechanism 31, which is automatically controlled by a float operated automatic refuse discharge regulating mechanism 32, the structure of which follows substantially that disclosed in the patent to Atwood, No. 2,132,380, granted October 11, 1938, for a Jig. It should be noted, however, that the operating pawls of this refuse discharge mechanism 31 are driven by a rod 33 which in turn is driven from an electric motor 34 as shown in Fig. 2 as well as in Fig. 1.

The effective size of the opening 30 leading to the refuse ejecting mechanism 31 may be adjusted by a vertically adjustable slide plate provided with adjustable hang rods 35 at opposite ends thereof. The weir 23 may be adjusted in elevation in a similar manner. This construction is substantially the same for each of the compartments 19 and 20.

The bottom trough 11 of each of the compartments 19 and 20 is provided with a screw conveyor 36 which conveys the hutch material to the left as viewed in Fig. 1 and discharges it into the boot of the associated elevator casing 26 or 28 where it is co-mingled with the refuse discharged thereonto by the refuse ejecting mechanism 31, and elevated by the elevating conveyor 27 or 29, by which it is discharged from the discharge opening thereof.

Water is supplied to each individual cell 38 and 39 from a water main 37 by a water control valve. Associated with each of the cells 38, 39 is an individual air valve 40. The four rotary air valves 40 are driven from a common drive shaft 41 which is driven from an electric motor 42. The elevating conveyors 27 and 29 are also driven from the shaft 41 through appropriate chain and sprocket mechanisms.

The rotary air valves are very flexible and are adapted to adjust the type of stroke provided in each cell 38 and 39 of the jig. These rotary valves are normally adjusted in operation so as to carry out the method of jigging disclosed in the patent to Byron M. Bird, 2,132,376, granted October 11, 1938, for a Method of jigging. As there pointed out, the jigging cycle includes four periods of air control comprising the air inlet period, during which air flows into the chamber 15, an expansion period during which the chamber 15 is sealed and the air therein expands, an exhaust period during which the air is free to flow from the chamber 15 to the atmosphere, and a compression period during which the air in chamber 15 is again sealed and compressed by the upward movement of the jigging liquid into said chamber 15.

In the operation of the jig, the raw coal to be treated to remove impurities or refuse therefrom, is fed through the chute 21 into the compartment 19. In the operation of the jig there are two types of water flow which are controlled. Water pulsations, forming the jig stroke under the control of a rotary valve 40 should act uniformly on all parts of the bed of material to be treated.

With the differential stroke, that is, with the expansion and compression adjusted for different periods, the upward or pulsion movement of the water through the screen 13 first causes the top of the bed to expand which is immediately followed by expansion of the entire bed so that settlement starts from the bottom of the expanded bed and enables the refuse to immediately settle to the bottom. In other words, with the differential stroke or the expansion and compression adjusted for different periods, the entire bed is opened up by the upward pulsion movement, and stratification is free to take place throughout the entire expanded bed of material. Consequently during the expansion period, the heaviest particles having settled to the bottom or directly on the screen, will prevent the fines from reaching the screen and passing through the same into the hutch. Without the differential stroke or difference in the expansion and compression periods the upward or pulsion stroke tends to move the bed "en masse" and settling takes place only from the bottom of the bed and this permits the finer pieces to work down closer to the screen openings, with the result that the hutch product as well as the tendency to clog the screen are increased. Furthermore, the effect of a jigging bed without the differential stroke is to leave the top bed still tight and with the heavier particles still imbedded therein even after compression strokes.

Circulation water pumped from a jig and passing through it, forms the conveying element in the jig. This flowing water moves the coal from one compartment 19 to the next compartment 20 and thence to the outlet chute 24. Adjustment of this incoming water also affects the jig pulsations and is provided by valves one of which is provided for each of the cells.

The potential problems of coal size, volume and washability are met by making various adjustments of expansion and compression for different periods to enable the jig to initially open the jig bed from the top instead of the bottom, permitting deeper beds of higher capacities. In other words, by independently adjusting the expansion and independently adjusting the compression, each may be widely varied to suit the periods of operation on the material being treated, thus increasing the efficiency of operation.

It should also be noted that by having coal and refuse in both compartments move in the same direction toward their respective ejectors insures a more uniform separation of the finer materials. The overlapping connections between the bottom of each screen and the upper edges of the walls of the cells confines the upward pulsation of water when passing through the screen. In order to operate a jig at maximum effective capacity, a uniform refuse bed should be maintained.

The electric motor 34 may operate at constant speed to reciprocate the pitman 33 which connects the actuator 43 to the oscillating arm 44 which carries the pawls 45, 46 which engage the ratchet teeth 47 of the ratchet wheel 48. As shown in Fig. 4, the ratchet wheel 48 is relatively wide so that the pawls 45 and 46 may occupy positions side by side, the pawl 45 extending out farther from the pawl pivot 49 than

the outer end of the pawl 46. The pawls operate a half tooth apart.

It should be understood that there is a float control mechanism 32 provided for each of the compartments 19 and 20. Each of the float control mechanisms determines the number of teeth of the ratchets to be engaged by the actuating pawls 45 and 46 and this mechanism therefore automatically controls the extent to which the rotary ejectors are moved at each step.

The float control mechanism 32 comprises a float 50 which is connected at its upper end to lever mechanism which in turn is connected to the right oscillating rod 51. As the depth of the impurities or refuse material increases on the screen 13, the float 50 will rise and the upright rod 51 will descend. The greater the rate of refuse accumulation the faster becomes its rate of removal because as the float rises, there will be an increase in the step by step rotation of the ejectors. This is because the upright rod 51 is connected at 52 to an arm 53 that is pivoted on the axis of oscillation of the arm 44. The arm 53 carries an upwardly extending arcuate shield or pawl lifter 54 which will determine the extent to which the ejector will be rotated step by step. When the depth of the refuse is at a maximum, the pawl lifter 54 will be in its extreme right-hand position and therefore when the arm 44 is moved clockwise, the pawls 45 and 46 will not be lifted from the ratchet teeth 47 until such arm 44 is moved to a maximum extent in its clockwise direction. Therefore when the arm 44 is moved anti-clockwise, as viewed in Fig. 2, the extent of rotation of the ratchet wheel 48 will be in accordance with the maximum number of teeth over which the pawls have slipped when moving in a clockwise direction. The extent of movement of the arm 44 in an anti-clockwise direction may be adjusted by reason of connecting the left-hand end of the pitman 33 to any one of a plurality of holes 55, 56 located at various radial distances from the center of rotation of the actuator 43 which is connected to the shaft 57 of the motor 34.

The pawl and ratchet mechanism shown in Fig. 2 is mounted on a frame 58 comprising a vertical supporting plate 61. A bracket 60 may be welded to the frame 58 in position to support the motor 34. The view shown in Fig. 3 is a section taken on the line 3—3 of Fig. 2 looking in the direction of the arrows. The plate 61 has a circular hole therethrough concentric with back circular plate 62. Detachably connected to the plate 61 by means of the cap screws 63 is a support 64 for a packing 65 and a gland 66. Through the gland 66 and the packing 65 extends a shaft 67 which is connected to the refuse valve 31 to rotate therewith. It should be understood that the ratchet wheel 48 is keyed to the shaft 67 and when this ratchet wheel rotates in an anti-clockwise direction, the refuse valve 31 of Fig. 1 will also be rotated in an anti-clockwise direction.

As shown in Figs. 2 and 3, the supporting plate 64 carries brackets 68, 69 which are provided with spaced-apart journal bearings 70, 71 mounted on a reduced portion 67' of the shaft 67 to the right of the shoulder 72.

The oscillating arm 44 comprises spaced-apart plates journaled on the stationary journal bearings 70 and 71. The pawls 45 and 46 are journaled on the shank of a bolt 73 which may pass through the plates 44 and spacing washers 74, 74 and then be provided with a nut 75, as shown in Fig. 3. It should be understood, however, that the pawls 45 and 46 shall always remain free to move upwardly and downwardly on their pivots 49, as shown in Fig. 2.

The upper ends of the plates 44, 44 may have secured to the inner sides thereof spacers 76, 76 to which is keyed at 77, 77 a transverse shaft 78 to serve as a journal bearing for the connections to the pitman 33 and the pitman 79, as shown in Fig. 6 which is a plan view of the upper structure associated with the arm 44 in Fig. 2. The pitman 79, as shown in Fig. 1, extends toward the right for connection to another arm 44' associated with mechanism similar to that illustrated in Figs. 2 and 3.

The arm 53 of Fig. 2 may be provided with spaced-apart rings 80, 80 journaled on the journal bearings 70 and 71, as shown in Fig. 3. The shield or pawl lifter 54 may be arranged as shown in Figs. 2 and 3 so that both of the pawls 45 and 46 will be engaged by the pawl lifter when the pawls move a certain distance to the right as viewed in Fig. 2. It can readily be seen that when the depth of the refuse material on the screen 13 is at a minimum, the float 50 will be in its lowest position and therefore the rod 51 will be in its highest position and the pawl lifter 54 will be moved to its greatest extent toward the left as viewed in Fig. 2. Therefore when the pawls are moved toward the right they will be lifted sooner than when the depth of the refuse material on the screen is greater. That is to say, after the pawls have been lifted and they are about to be moved anti-clockwise again as viewed in Fig. 2, the step movement in an anti-clockwise direction may correspond to only one-half, one, or two or more teeth, whereas when the pawl lifter 54 is in its extreme right-hand position a greater rotation will be effected corresponding to the greater number of teeth of the ratchet wheel.

The arm 53 may be diametrically extended by means of an arm 53' carrying a weight 81. This weight may be moved along the arm 53' and secured in adjusted position by the set screw 82. The weight 81 serves as a balancing weight.

It is desirable in jigs of the type shown in the drawings to maintain a certain depth of refuse in the bed. Too rapid withdrawal of the refuse is objectionable because then the refuse bed is disturbed. It is therefore desirable to secure a slow uniform movement of the refuse out of the jig. When the depth of the refuse increases, the rod 51 will be lowered which causes the shield or pawl lifter 54 to rotate in a clockwise direction as viewed in Fig. 2 so as to secure greater step by step rotation of the ratchet wheel and a consequent greater rotation of the discharge valve or refuse ejector. However, it is preferred to hold the refuse bed at as near a constant depth as possible and this condition is obtained by the use of the latch mechanism hereinafter fully described. When the refuse bed is maintained at a predetermined depth, the pawl lifter 54 is in such position that the refuse will be withdrawn at a minimum rate of one-half tooth, which minimum withdrawal is obtained by having the pawls 45 and 46 with their ends spaced one-half tooth from each other. The pawls 45 and 46 then operate alternately. That is to say, when the arm 44 is moved toward the left, the pawls engage the ratchet teeth as permitted by the pawl lifter 54, but the pawls act alternately to move the ratchet wheel to the left one-half tooth step by step.

It has been found that in the operation of the type of jig shown in Fig. 1 and hereinbefore explained, a suction stroke may take place to so affect the pawl lifter **54** as to disturb the regulation of the depth of the refuse material. For instance, the suction stroke may tend to hold the pawl lifter **54** too far to the left as viewed in Fig. 2, thus interfering with even the minimum withdrawal of the refuse material. When the accumulation of refuse is rapid, however, the float will rise and the pawl lifter **54** will be moved freely in a clockwise direction as viewed in Fig. 2 and therefore more rapid removal of the refuse will take place automatically because of the larger number of teeth that the pawls **45** and **46** can slip over and engage.

I have provided automatic latch mechanism operable to lock the shield or pawl lifter **54** in its position shown in Fig. 2 as soon as the refuse bed becomes sufficiently deep to ask for action from the ejector. The latch lever **84** is secured to a pin **85** which is pivoted to the extension **69'** of the bracket **69**. A spring **86** between the pin **85** and the bracket extension **69'** yieldingly moves the latch lever **84** toward the right as viewed in Fig. 2. An inwardly extending pin **87** is mounted on the arm **53** in such position that when the latter moves downwardly, the pin **87** will engage the cam face **88** to deflect the latch lever **84** to the left, whereupon the latch plate **89** will snap over the top of the pin **87**, as shown in Figs. 2 and 4.

The latch mechanism then acts to lock the pawl lifter **54** in the position shown in Fig. 2 where it will permit the pawls **45** and **46** alternately to move in an anticlockwise direction the ratchet wheel **48** step by step. That is to say, when the predetermined desirable depth of the refuse on the bed is reached, the latch mechanism will automatically hold the pawl lifter **54** against movement toward the left from its position shown in Fig. 2, so that the pawl and ratchet mechanism may continue to operate to effect a slow rate of discharge of the refuse from the bed. In this way, the depth of the refuse bed is regulated so as to maintain a substantially constant depth. If, however, this desired constant depth is increased, the latch mechanism does not prevent the pawl lifter from being moved clockwise as viewed in Fig. 2 and thus causing the pawls **45** and **46** to slip over a larger number of teeth so that the discharge by means of the ejector will be increased automatically.

The inner annular face of the ratchet wheel **48** is provided with spaced-apart tripping devices **90**, **90** which are located in such positions as to be able to engage the roller **91** on the inner face of the latch lever **84**. The roller **91** is pivoted to the latch lever **84** intermediate the pivot pin **85** and the latch plate **89**. When one of the tripping devices **90** engages the roller **91**, the latch lever **84** will be moved in an anti-clockwise direction as viewed in Fig. 2 to release the latch **89** from the pin **87**, whereupon the pawl lifter **54** will be released so as to be free to swing again in accordance with the rising of the rod **51** due to the falling of the float **50**. That is to say, even the half tooth or slow ejection of the refuse material is interrupted at intervals, usually of 45 or 90 degrees of rotation of ratchet wheel **48**. That is to say, as soon as the refuse ejector should be stopped entirely, the float will be lowered and the rod **51** lifted when the latch mechanism shown in Figs. 2, 4 and 5 has been released.

After the pawl lifter **54** has been released, the latch mechanism is again ready to operate to automatically hold the pawl lifter **54** in its position shown in Fig. 2 if the depth of the refuse bed has increased sufficiently since the previous release of the latch mechanism.

It will thus be seen that when the refuse bed rises above a predetermined depth, the latch mechanism will operate automatically to hold the pawl lifter **54** for slow or half tooth discharge of the refuse material so as to maintain the desired depth of the refuse material on the bed. However, at intervals the latch mechanism is released so as to put off the discharge entirely when the depth is below the minimum desired. When there is a rapid accumulation of refuse material, the float is free to act to move the pawl lifter **54** to its extreme right-hand position so that the pawls **45** and **46** will not be lifted at all but will effect maximum discharge by means of the ejector mechanism. It will therefore be seen that the latch mechanism automatically holds the pawl lifter **54** in a position which is intermediate maximum discharge and no discharge. That is to say, the latch mechanism co-operates with the pawl lifter to hold the latter for one-half tooth discharge to maintain constant the desired depth of refuse material on the bed in the jig.

Without the latch mechanism the float **50** may be affected by the pulsations of water in the jig. Therefore when the float is affected otherwise than by the variations of depth of the refuse bed, the desired operation of the pawl lifter may be disturbed. For instance, the pawl lifter may prevent any discharge of the refuse material and this causes an undesirable building up of the depth of the refuse bed, sometimes to the extent that the refuse is discharged over the weir **23** together with the coal. The latch mechanism, however, stabilizes operations and maintains discharge at least at a slow rate under the circumstances above described so that the depth of the refuse bed will be maintained substantially constant, thus rendering more efficient the stratification operations of the jig. When the accumulation of refuse is rapid the latch mechanism in no way interferes with the automatic operation of the maximum discharge of the ejector and the control of the float **50**.

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 hereunto appended, and I therefore wish not to be restricted to the precise construction herein disclosed.

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

1. In a jig for separating impurities from coal, the combination with a rotary refuse ejector, of a float positioned to determine the depth of the refuse bed in said jig, pawl and ratchet mechanism connected to operate said rotary ejector, means for continuously reciprocating the pawl of said pawl and ratchet mechanism normally to rotate said ejector step by step, a pawl lifter associated with said pawl, operating mechanism between said float and said pawl lifter operable normally to control the discharge rate of said ejector, and means constructed and arranged to be controlled by said float for automatically locking said pawl lifter in such position as to effect at least minimum rotation of said ejector for a predetermined time independently of the subsequent position of said float whenever the amount

of separated impurities accumulates in a predetermined amount and for automatically releasing said pawl lifter to a freely swinging condition under the control of said float after said predetermined time.

2. In a device of the class described, the combination with a shaft, of means comprising pawl and ratchet mechanism for operating said shaft, mechanism comprising a pawl lifter for regulating said operating means, latch mechanism acting automatically when the pawl lifter moves to a predetermined position to lock the latter in such position as to hold the said shaft operating means in slow operating condition, and mechanism movable with the ratchet in position to trip said latch mechanism to free said pawl lifter.

3. In a device of the class described, the combination with a shaft, of means comprising pawl and ratchet mechanism for operating said shaft, means comprising an oscillating member for controlling said operating means, an abutment on said member, a pivoted spring-pressed latch associated with said abutment, a cam extension on said latch in position to be engaged by said abutment to move the latch on its pivot until the latch and abutment are in interlocking positions, and a tripping device movable with the ratchet in position to release said latch from said abutment.

4. In a device of the class described, the combination with a refuse valve, of a balanced lever, a float, connections between said float and said lever to effect movement of the latter in accordance with the position of said float, a ratchet wheel connected to said refuse valve, an oscillating arm pivoted on the axis of said valve and ratchet wheel, a pawl carried by said arm in position to engage said ratchet wheel, a pawl lifter carried by said balanced lever in position to control engagement of said pawl with said ratchet wheel, means for oscillating said arm, a support, a spring-pressed latch pivotally mounted on said support, a keeper pin on said balanced lever in position to coact with said latch to lock said pawl lifter in predetermined position, and means comprising a trip block on said ratchet wheel in position to effect release of said latch from said keeper pin to free said pawl lifter.

5. In a jig, the combination with means for stratifying materials containing refuse, of a float associated with such stratified materials, mechanism for discharging refuse, means for operating said refuse discharging mechanism, float responsive means for regulating said operating means, latch mechanism adapted to be automatically operated by said float responsive means to lock the same in position for minimum discharge when the stratified material is at a predetermined depth, and means for releasing said latch mechanism after the lapse of a short period of such minimum operation of said refuse discharging mechanism.

6. In a jig, the combination with means for stratifying materials containing refuse, of a float associated with such stratified materials, mechanism for discharging refuse, means for operating said refuse discharging mechanism, a float associated with such stratified materials, float responsive means for regulating said operating means, latch mechanism operating automatically when said float responsive means reaches a predetermined position to lock the same against movement in one direction thereby to cause the refuse discharge operating means to effect discharge of refuse at a predetermined minimum rate until the stratified materials are at a predetermined depth, and means for intermittently releasing the latch mechanism until the depth of the stratified materials exceeds such predetermined amount.

7. In a device of the class described, a shaft, a ratchet wheel for rotating said shaft, reciprocating pawl means for rotating said ratchet wheel in steps, an adjustable lifter for lifting the pawl from said ratchet wheel during adjustable portions of each working reciprocation of the pawl, means for adjusting said pawl lifter from zero to a maximum ratchet wheel travel for each working pawl reciprocation, and latch means operable automatically when said lifter is moved a predetermined amount from the zero ratchet wheel traveling position toward the maximum ratchet wheel traveling position to prevent return movement of said lifter sufficient to reach its zero ratchet wheel traveling position until after a predetermined amount of rotation of said ratchet wheel.

8. In a device of the class described, a shaft, a ratchet wheel for rotating said shaft, reciprocating pawl means for rotating said ratchet wheel in steps, an adjustable lifter for lifting the pawl from said ratchet wheel during adjustable portions of each working reciprocation of the pawl, means for adjusting said pawl lifter from zero to a maximum ratchet wheel travel for each working pawl reciprocation, and means operable automatically when said lifter is moved a predetermined amount from the zero ratchet wheel traveling position toward the maximum ratchet wheel traveling position to prevent return movement of said lifter sufficient to reach its zero ratchet wheel traveling position until after a predetermined amount of rotation of said ratchet wheel.

9. In a device of the class described, a shaft, a ratchet wheel for rotating said shaft, reciprocating pawl means for rotating said ratchet wheel in steps, an adjustable lifter for lifting the pawl from said ratchet wheel during adjustable portions of each working reciprocation of the pawl, means for adjusting said pawl lifter from zero to a maximum ratchet wheel travel for each working pawl reciprocation, and means operable automatically when said lifter is moved a predetermined amount from the zero ratchet wheel traveling position toward the maximum ratchet wheel traveling position to prevent return movement of said lifter sufficient to reach its zero ratchet wheel traveling position.

10. In a device of the class described, a shaft, a ratchet wheel for rotating said shaft, reciprocating pawl means for rotating said ratchet wheel in steps, an adjustable lifter for lifting the pawl from said ratchet wheel during adjustable portions of each working reciprocation of the pawl, means for adjusting said pawl lifter from zero to a maximum ratchet wheel travel for each working pawl reciprocation, means operable automatically when said lifter is moved a predetermined amount from the zero ratchet wheel traveling position toward the maximum ratchet wheel traveling position to prevent return movement of said lifter sufficient to reach its zero ratchet wheel traveling position until after a predetermined amount of rotation of said ratchet wheel, and means for releasing said lifter for operation by said adjusting means after said predetermined rotation.

11. In a device of the class described, the combination with a ratchet wheel, of a pawl for rotating said wheel in steps variable in amount for each reciprocation thereof from zero to a maximum, means for reciprocating said pawl,

adjustable lifting means for lifting said pawl from said ratchet wheel during variable portions of the working reciprocation of said pawl, a latch operable automatically by said lifting means to insure some movement of said wheel for each reciprocation of said pawl after said latch is operated, and means operable by rotation of said ratchet wheel for releasing said latch.

12. In a device of the class described, the combination with a ratchet wheel, of a pawl for rotating said wheel in steps variable in amount for each reciprocation thereof from zero to a maximum, means for reciprocating said pawl, adjustable lifting means for lifting said pawl from said ratchet wheel during variable portions of the working reciprocation of said pawl, a latch operable automatically by said lifting means to insure some movement of said wheel for each reciprocation of said pawl after said latch is operated, and means for releasing said latch.

BYRON M. BIRD.