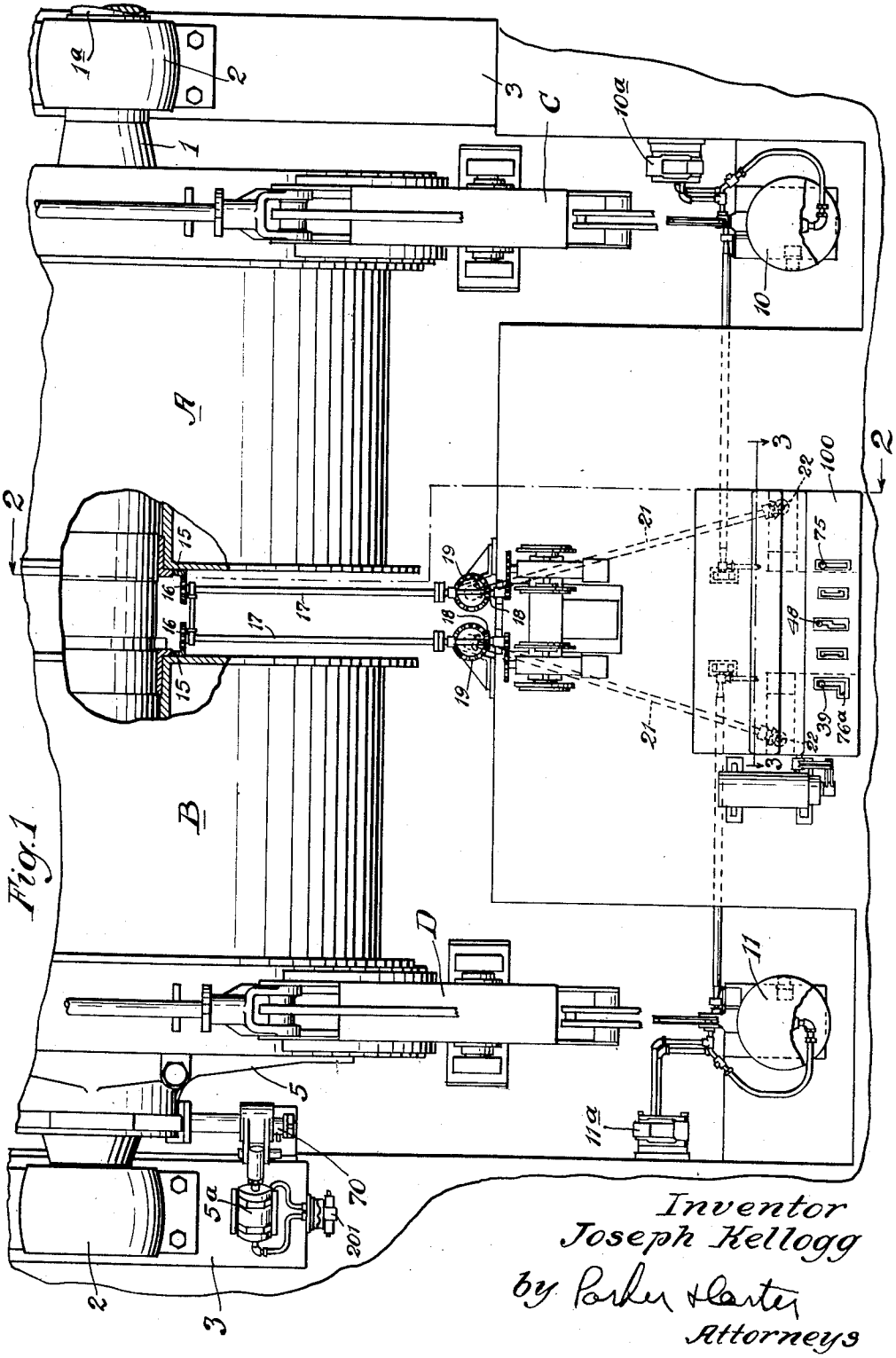
Jan. 1, 1957 J. KELLOGG 2,776,032

CAM TURN-OFF DEVICE AND CONTROL THEREFOR

Filed May 23, 1952 7 Sheets-Sheet 1



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CAM TURN-OFF DEVICE AND CONTROL THEREFOR

Filed May 23, 1952 7 Sheets-Sheet 2

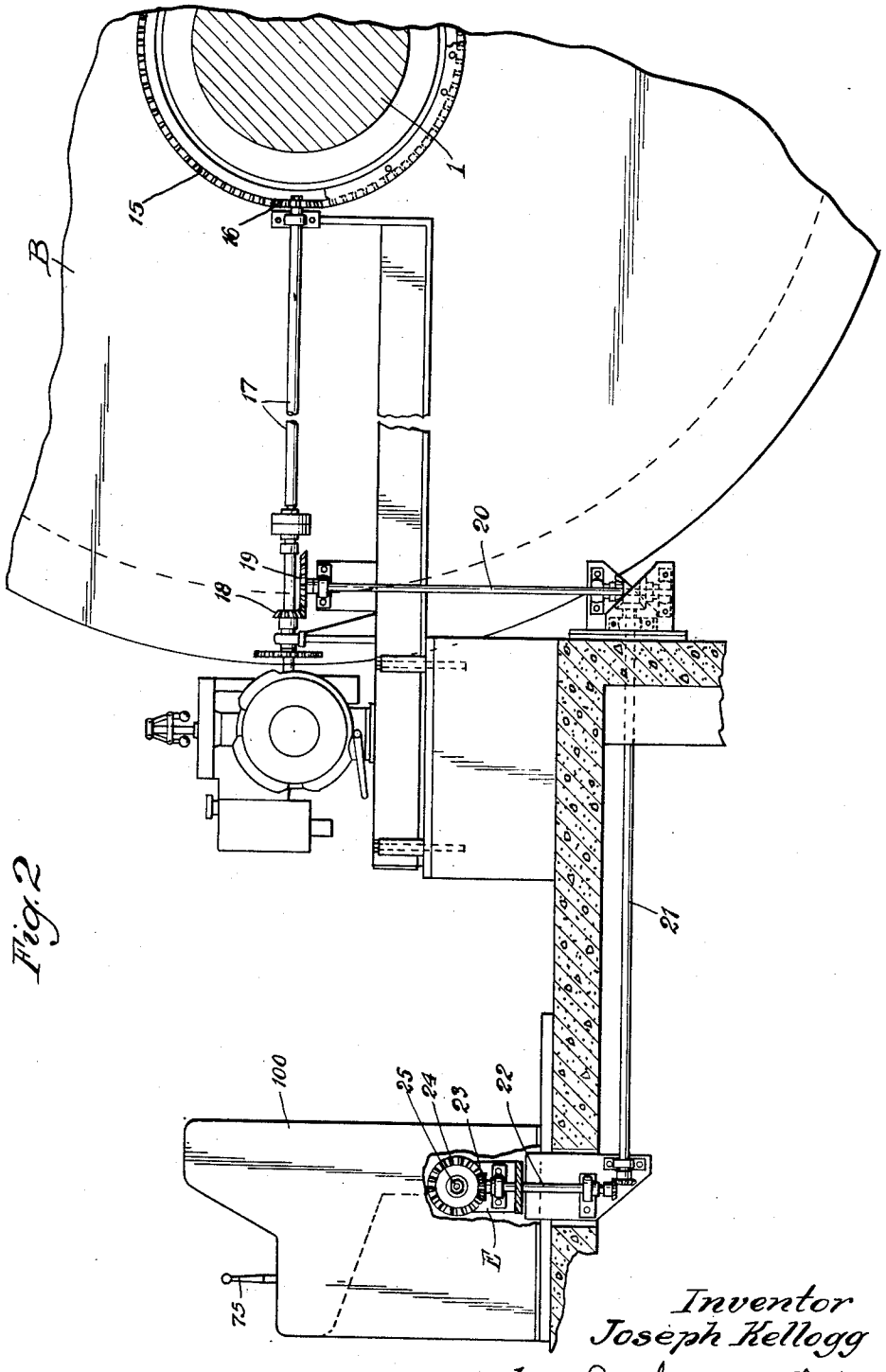

Fig. 2

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CAM TURN-OFF DEVICE AND CONTROL THEREFOR

Filed May 23, 1952 7 Sheets-Sheet 3

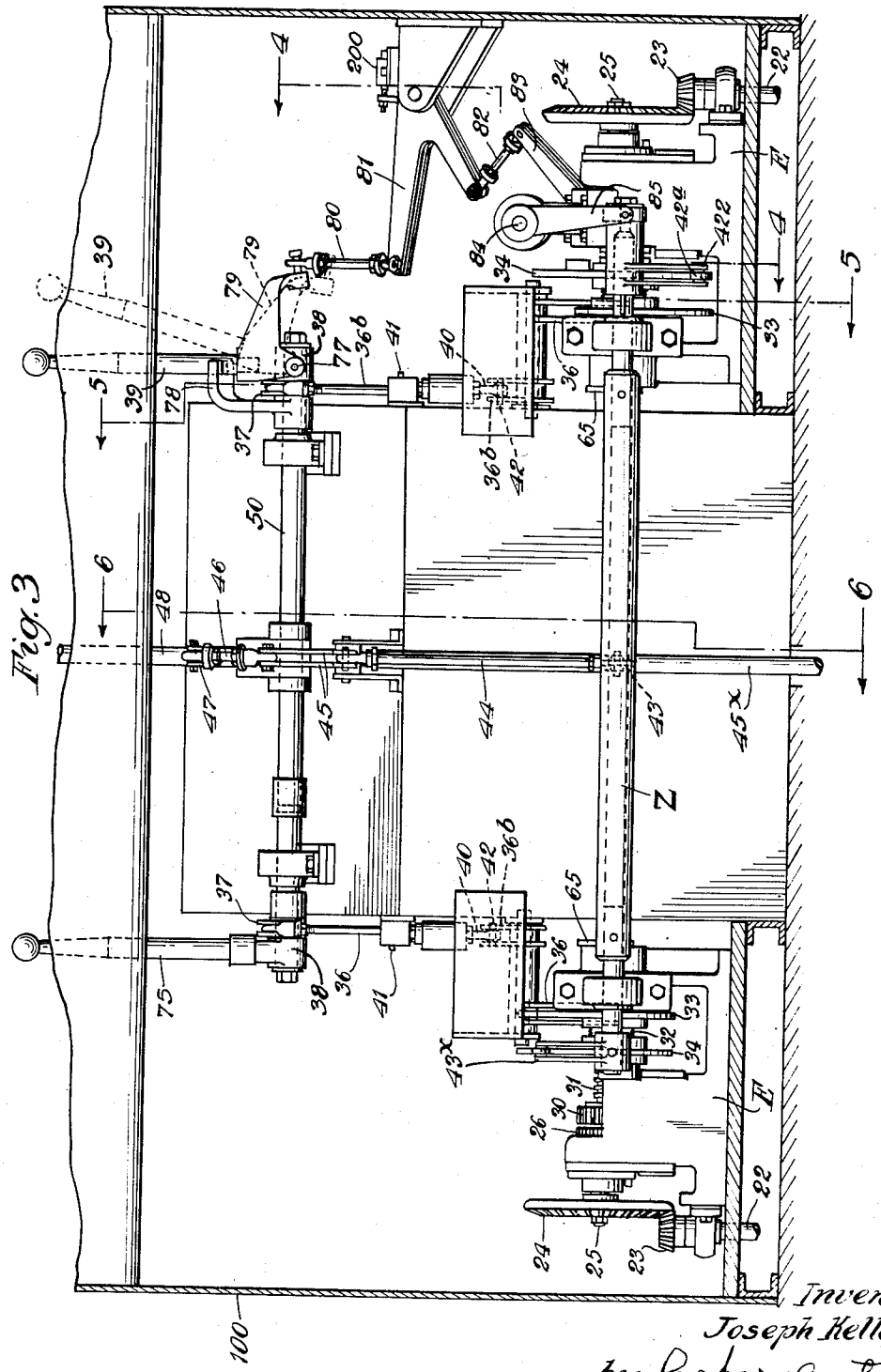

Fig. 3

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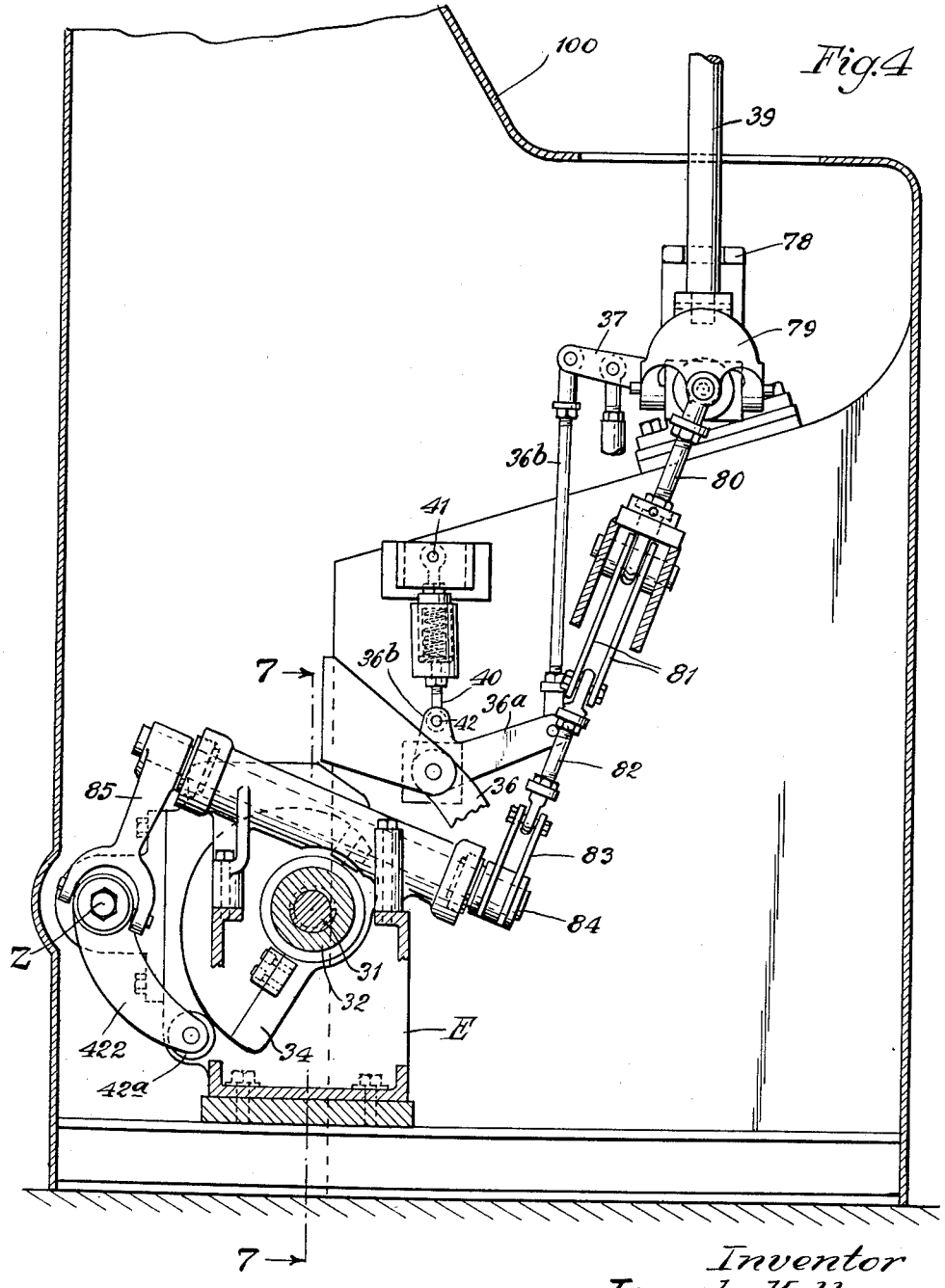
Jan. 1, 1957 J. KELLOGG 2,776,032

CAM TURN-OFF DEVICE AND CONTROL THEREFOR

Filed May 23, 1952 7 Sheets-Sheet 4

Fig. 4



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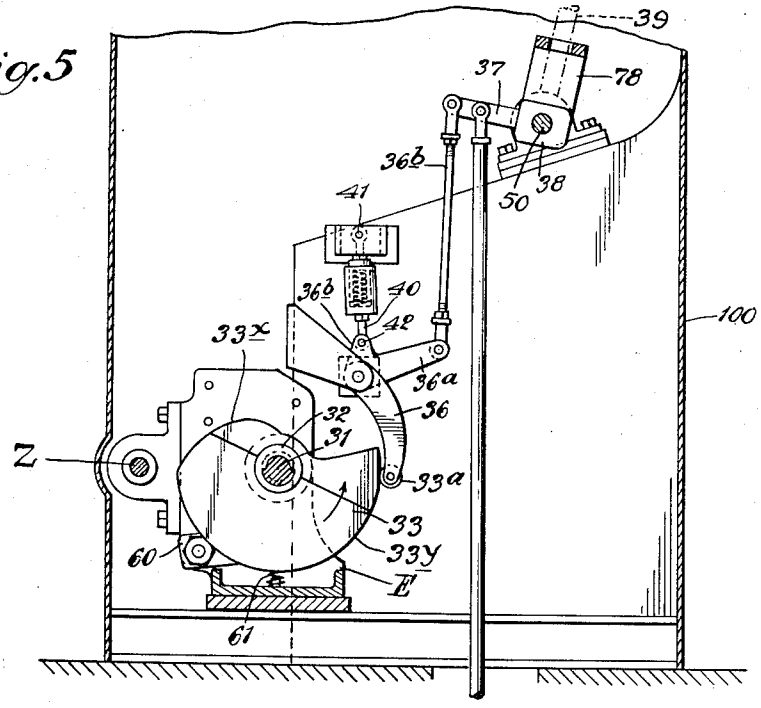
CAM TURN-OFF DEVICE AND CONTROL THEREFOR

Filed May 23, 1952 7 Sheets-Sheet 5

Fig. 5



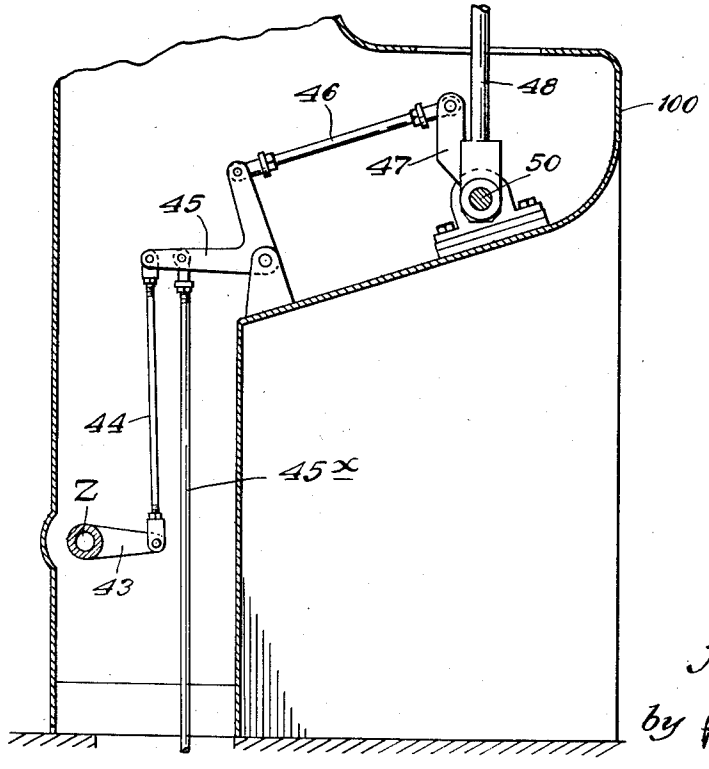


Fig. 6

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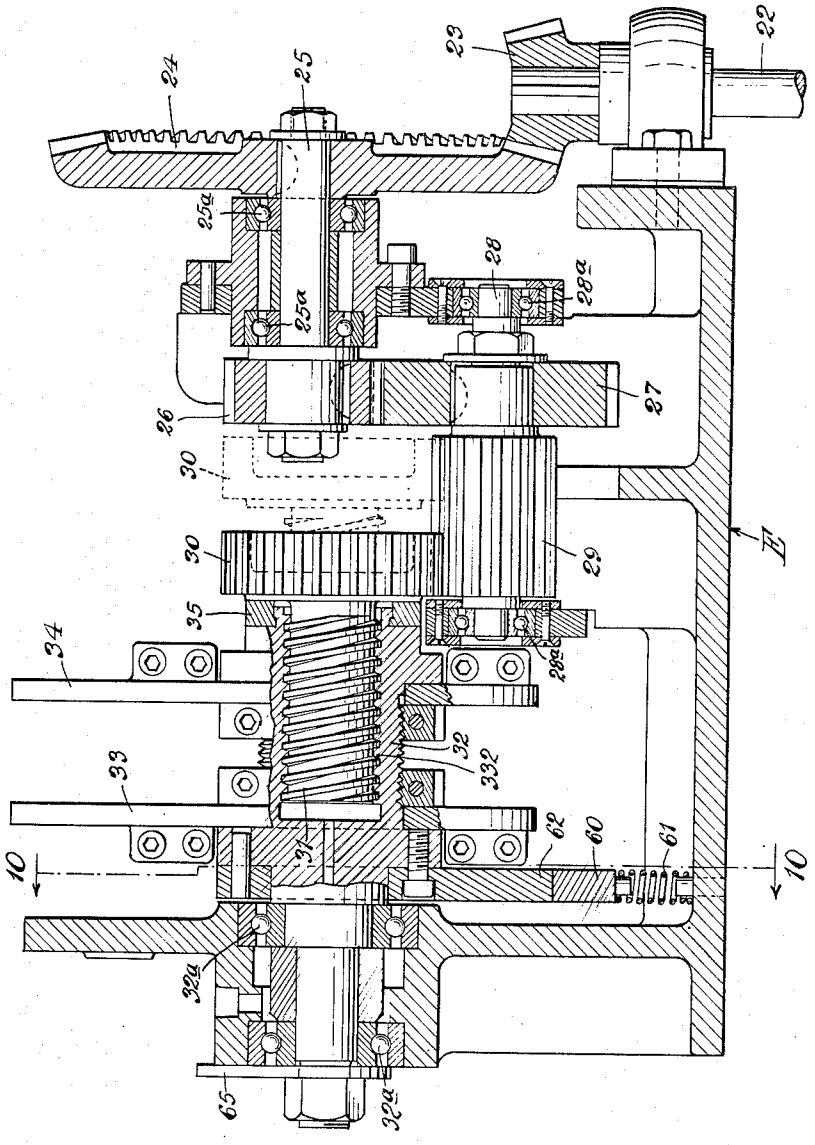
Jan. 1, 1957 J. KELLOGG 2,776,032

CAM TURN-OFF DEVICE AND CONTROL THEREFOR

Filed May 23, 1952 7 Sheets-Sheet 6

Fig. 7



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Jan. 1, 1957 J. KELLOGG 2,776,032

CAM TURN-OFF DEVICE AND CONTROL THEREFOR

Filed May 23, 1952 7 Sheets-Sheet 7

Fig. 8

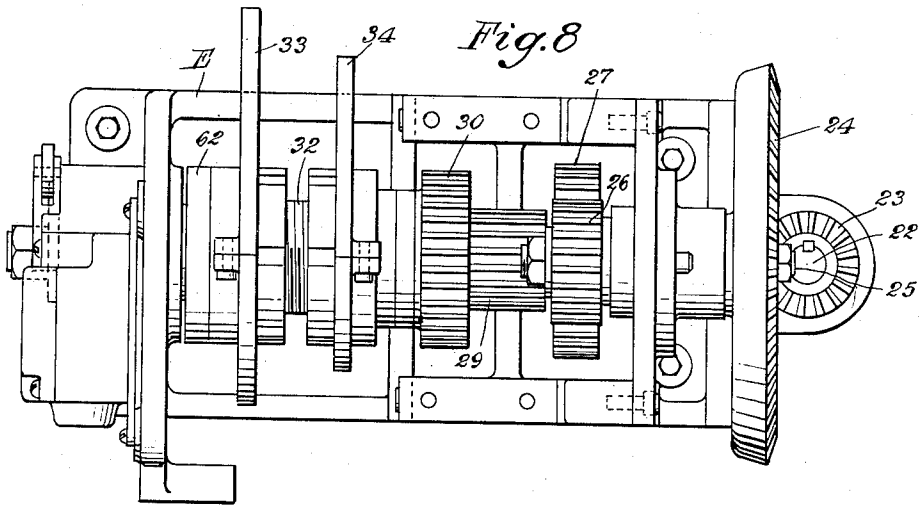


Fig. 9

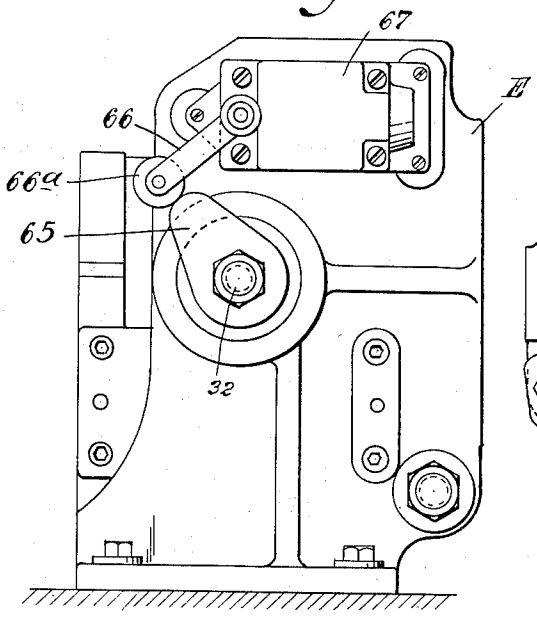
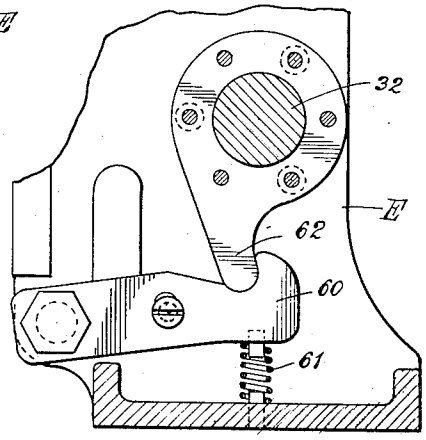


Fig. 10



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United States Patent Office 2,776,032 Patented Jan. 1, 1957

2,776,032

CAM TURN-OFF DEVICE AND CONTROL THEREFOR

Joseph Kellogg, Milwaukee, Wis., assignor to Nordberg Manufacturing Company, Milwaukee, Wis., a corporation of Wisconsin

Application May 23, 1952, Serial No. 289,515

3 Claims. (Cl. 192—141)

My invention relates to improvements in controls for hoists, for example mine hoists, one purpose of which is to privide an improved control system.

Another purpose is to provide an improved turn-off device or assembly.

Another purpose is to provide a cam turn-off device or assembly, of which one is shown for each of two drums.

Another purpose is to provide an improved lever control assembly for ready manually controllable actuation of multiple drum hoists.

Other purposes will appear from time to time in the course of the specification and claims.

I illustrate the invention more or less diagrammatically in the accompanying drawings wherein:

Figure 1 is a plan view of the hoist assembly with parts broken away and parts in section;

Figure 2 is a section with parts in elevation, the section being taken on the line 2—2 of Figure 1;

Figure 3 is a section on an enlarged scale on the line 3—3 of Figure 1, with parts of the operator's console being seen in elevation from the direction of the arrows 3—3 in Figure 1;

Figure 4 is a section on an enlarged scale on the line 4—4 of Figure 3;

Figure 5 is a section on an enlarged scale on the line 5—5 of Figure 3;

Figure 6 is a section on an enlarged scale on the line 6—6 of Figure 3;

Figure 7 is a section on an enlarged scale on the line 7—7 of Figure 4;

Figure 8 is a partial plan view of the turn-of device with parts omitted;

Figure 9 is an end view of the structure of Figure 8, as seen from a point to the left of Figure 8; and

Figure 10 is a section through the locking device taken on the line 10—10 of Figure 7.

Like parts are indicated by like symbols throughout the specification and drawings.

I illustrate my invention as applied to a double drum structure. As a matter of illustration, I illustrate a drum member A and a drum member B, of which one, for example the drum member A may be fastened to the hoist shaft 1, whereas the other is loose on the shaft and is provided with a clutch connection which will later be described. It will be understood that the general details of the hoist structure itself do not form part of my invention and are illustrated only so far as is necessary for the understanding of my invention. However, it will be seen for example from Figure 1, I employ a suitable drum shaft 1 mounted at its ends in any suitable bearing assemblies 2 on any suitable foundation structure 3, the details of which form no part of the present invention.

Any suitable clutch 5, with its associated clutch cylinder 5a, the details of which do not form part of the present invention, may be employed to clutch and declutch the loose drum B in relation to the shaft 1, where some adjustment of the hoisting excursion is necessary, as in mine hoist pracatice.

It will be understood that any suitable means for rotating the shaft 1 may be employed, but since such means do not form part of the present invention, none is illustrated. However, as shown in Figure 1, the shaft 1 may be outwardly extended as at 1a and may receive and be connected to any suitable driving connection from any suitable power source.

As shown in Figure 1, brake assemblies C and D may be employed, associated with the drums A and B respectively. I find it practical to employ a conventional hydraulic brake, with a weight application and a hydraulic cylinder for hoisting this weight. I illustrate for example, and more or less diagrammatically, the respective brake cylinders 10 and 11 as shown in Figure 1. 10a and 11a indicate emergency solenoids for applying the brake. In my structure these solenoids, which are ordinarily used in emergency use, are employed as regular operating elements. In other words, they act not only as emergency brake actuating means, but also as regular brake applying means.

I employ a cam turn-off device or assembly for each drum, one such device or assembly being illustrated in Figure 7, the drive connections for two turn-off devices being shown for example in Figure 1. The drive from the hoist drum is illustrated for example in Figures 1 and 2.

Each drum may carry a gear 15 with which meshes the pinion 16 on the shaft 17. The shaft 17 in turn, through a suitable beveled pinion connection 18, 19, drives a vertical shaft 20 which, in turn, similarly drives a horizontal shaft 21. The horizontal shaft 21 similarly drives the vertical shaft 22, which extends upwardly at its outer end. The upper end of the shaft 22 is shown for example in Figure 7 and carries at its upper end a beveled pinion 23 in mesh with the gear 24 on the shaft 25. The shaft 25 carries a gear 26 in mesh with the gear 27 on the shaft 28. It will be understood that the gears 26 and 27 are change gears, the relative ratios of which are proportioned to the particular installation or hoisting conditions with which they are to be used. The shafts 25 and 28 are mounted in suitable anti-friction bearings 25a and 28a respectively secured in the frame member E.

The shaft 28 additionally carries the gear 29 of substantial length, along which travels the gear 30. The length of the gear 29 must be sufficient to allow for a travel of the gear 30 enough for the operating conditions of the particular hoist with which the device is used. When the gear 30 is driven by the gear 29, it rotates the screw 31 to which it is suitably attached. The screw 31 rotates in a suitably screw-threaded cavity 322 within the cam head indicated at 32, which is rotatably mounted in anti-friction bearings 32a carried by the frame member E. The cam head 32, which is normally not rotated, may carry secured to it suitable cams, for example 33 and 34. As a matter of convenience, cam 33 may be used to operate the below-described brake arm and cam 34 the controller arm. Loose on the cam head is a collar 35.

With reference for example to Figure 7, let us assume that a hoisting excursion is beginning, with the gear 30 in the dotted line position of Figure 7. As the appropriate drum rotates, and drives the gear 29 through the above-described line of drive and thus rotates the gear 30, it is moved from the dotted line position to the full line position of Figure 7. The collar 35 is freely rotatable on the cam head 32, and serves as an intermediate friction drive element between gear 30 and the cam head 32. When the gear 30 reaches the full line position of Figure 7, and contacts the free collar 35 and forces the

free collar **35** into contact with the end of the cam head **32**, then the cam head **32** and its associated parts begin to rotate and the parts are preferably so proportioned that the cams **33** and **34**, together with the rest of the cam head structure **32** rotate through an excursion which may be of the order of three-fourths of a revolution. The cams **33** and **34** then operate the brake arm and the controller arm, as will now be described.

Referring first to Figure 5, the cam **33** is shown at approximately the end of its brake operating movement. The arm **36** may form part of a bell crank structure, having an upper or outer arm **36*a***, which is connected by a link **36*b*** to a brake lever **37** and sleeve **38** on the cross shaft **50** within the console, to which the manually engageable brake operating lever **39** is secured.

As will be seen from Figure 5, the brake operating cam **33** has a portion, approximately one-fourth of a turn, indicated at **33*x***, which, by contact with the roller **33*a***, imparts rather sharp or quick movement of the brake arm or lever toward the braking position. The rest of the cam surface, as at **33*y***, constitutes a dwell of about one-half a revolution. This quick movement of the brake arm toward braking position reduces to a minimum any lost time in applying the brakes and constitutes a safety factor for the quick and efficient operation of the brake. I provide a toggle structure which includes the spring link **40** pivoted at its upper end **41** to a fixed point and pivoted toward its lower end as at **42** to an arm **36*b*** and the bell crank structure **36**, **36*a***. When the parts are in the position in which they are shown in Figure 5, the effect of the spring link is to hold the cam roller **33*a*** against the cam **33**. However, if the hand lever **39** is moved clockwise through a sufficient excursion, the spring link is moved off center in relation to the axis of the above-described bell crank structure and it then tends to hold the cam roller **33*a*** away from the cam **33**, which is the manual completely "on" position of the brake. Under these conditions, the cam **33** has no control, the intent being that the hoist remain at rest for an indefinite period.

I illustrate at Z a cam lever controller shaft structure, one end of which is adjacent each of the two above-described cam turn-off units. It will be understood that one of these units is geared to each of the drums, but since the drive is substantially identical, the single description above given will be understood to apply to both. It will be understood that toward each end of the shaft Z a control lever is provided. In Figure 4 such a lever is shown at **422**, extending downwardly from the shaft Z, whereas at the opposite end of the shaft Z, the corresponding lever **43*x*** will be understood to project inwardly. This is because of the dual direction of the drive of the drums. Considering the downwardly extending arm **422** as typical, it will be seen in Figure 4 that it carries a cam roller **42*a*** opposed to a cam **34**. In the position of the parts in Figure 4, the turn off is practically complete. The result has been to rotate the shaft Z clockwise, with reference to the position of the parts as shown in Figure 4, and this clockwise rotation, as will be clear from Figure 6, has rotated the control arm **43**, which is connected by any suitable link **44**, to the bell crank lever **45**, the opposite end of which is connected by a link **46** to an arm **47**, connected to the manually operable control handle **48**, the members **47** and **48** being mounted or being free on the hand lever shaft **50**. In other words, when the cam **34** moves to the position in which it is shown in Figure 4, it moves the hand lever **48** of Figure 6 toward the neutral position.

It will be understood that there is a similar connection between the upwardly extending arm **43*x*** at the opposite end of the shaft Z which, when rotated by its associated cam, also moves the shaft Z in opposite direction of rotation with a like result of moving the manual lever **48** toward a neutral position. As will be seen in Figure 6, the bell crank lever **45** is also connected by a suitable

link **45*x*** to any suitable master switch of the reversible type which operates to control the movement of the hoist in either direction and which is not shown, since it does not form part of the present invention and can be any standard master switch.

Figure 10 illustrates the structure operated to maintain the cam head fixed until it is released or rotated by the lutching contact of the collar **35**. Before the collar **35** begins to rotate the cam head, or after the cam head has been rotated back to its original position by a retrograde rotation, it is held in position by the cam head locking lever **60**, which is spring thrust by any suitable spring **61** and which is formed to receive a tooth or lever **62** which is fixed to and forms part of the cam head structure. The locking lever **60** and spring **61** serve to maintain the cam head in a stationary position until the screw **31** has carried gear **30** into positive driving engagement with the collar **35** and cam head **32**. In other words, the cam head cannot rotate until the driving pressure between the gear **30**, collar **35** and cam head, and the resultant torsional force are sufficient to force the lever **60** down against the action of spring **61**. Thus the cam head is held in a predetermined position during the free run of the hoist, but is rotated from that position, through a predetermined arc of rotation, at the end of the free run of the hoist, and then it is thereafter rotated back into fixed position where it stays during free rotation in the opposite direction.

Fixed to the cam head as shown for example in Figure 9, is a cam lever **65** opposed to a cam roller **66*a*** on the lever **66** of a suitable limit switch generally indicated at **67**. It is preferably a switch having a snap action, but the details of the switch do not of themselves form part of the present invention. It will be understood that at the end of the rotation of the cam head **32**, in response to its clutched contact with the collar **35**, the last thing that happens is the actuation of the snap switch **67** in response to movement of the cam lever **65**. The switch **67** is connected in the control circuit in such a way that a neutral position of the control circuit is established and simultaneously the brakes are completely applied through the medium of the solenoid valves, being the earlier mentioned solenoid valves **10*a***, **11*a***. Thus, in effect, the above-described cam action eliminates or practically eliminates brake clearance and the final application of the brakes is effected by electrical operation. Thus no further operation of the hoist in that direction is possible and the final end of its movement in that direction is thus made.

It will be understood that while I may use any desired wiring arrangement, I employ a circuit which permits rotation of the hoist in the opposite direction, until such time as the turn-off device on the opposite drum comes into effect and the whole process is then reversed. Thus the hoist has gone to the limit of one run and the operator is free to start its run in the opposite direction, which has a similar ending. In other words, one of the control units operates to terminate the rotation of the drums in one direction and the other operates to terminate the rotation of the drums in the other direction. It is arranged in the wiring that when the hoist comes to a predetermined stop in one direction, the operator by merely throwing the control lever **48** in the opposite direction, will energize solenoids **10*a*** and **11*a***, releasing the brakes at the same time that power is applied for the opposite run. It will be understood, of course, that I am talking in terms of balanced hoisting, in which cable is paid out at the top of one drum and taken in at the bottom of the other, or vice versa.

I make provision so that when one drum is unclutched, the turn-off lever automatically moves off the controller cam, so that the other drum can be turned freely in either direction without cam interference. This provision is necessary only when making an adjustment, as when changing from one level to another for balanced hoisting.

In changing or resetting the hoist drum, it is necessary to prevent cam interference in my turn-off device and also to interrupt the operation of the electric limit switch **67** in Figure 9. This latter is accomplished by an extra set of contacts in the "clutch in" position switch **70** diagrammatically shown at the left end of Figure 1 which shorts out the action of switch **67** in Figure 9. It is thought unnecessary to show a wiring diagram, since this result can be obtained in so many different ways or by such a variety of wiring. The function of switch **70** is to guarantee or insure that the clutch is fully engaged before release of the brake assembly D of the drum B.

The actual construction for removing the cam lever **42** from the cam **34** is shown for example in Figures 3 and 4. The brake shaft **50** of Figure 3 carries the brake lever **75** at one end and the brake lever **39** at the other. Whereas the brake lever **75** is fixed to the shaft **50**, the brake lever **39** is pivoted to it as at **77**. When it is in the full line position in which it is shown in Figure 3, it is held against rotation about the axis of the shaft **50** by any suitable positioning device **78**. When it is rotated to the dotted line position, it then exerts no control whatsoever on the brake shaft **50**, which may then be rotated by the brake lever **75**, or by the operation of the fixed drum. However, movement of the brake lever **39** from the full line to the dotted line position, moves also its associated control arm or lever **79** and through a link **80** rotates the bell crank lever **81**. This, through the link **82**, actuates the lever **83** on the shaft **84**, on the opposite end of which is the yoke lever **85**. The yoke lever then moves the lever **422**, which is suitably splined on the shaft Z. Thus one result of moving the brake lever **39** from the full line to the dotted line position of Figure 3 is to move the cam arm **422** and the cam roller **42***a* out of line with the cam **34**. Movement of the lever **81** in a counter-clockwise direction as shown in Figure 3 actuates a switch **200**, which, through an appropriate control circuit (not shown) actuates a control valve **201** for the clutch cylinder **5***a* to disengage the clutch from the drum B. Thus, upon movement of the lever **39** to inoperative position, the drum B is unclutched from the shaft **1**, and the drum A may be moved without interference from drum B. Because brake control lever **75** is fixed to shaft **50** and control lever **39** is freely rotatable thereon, it will be apparent that brake control lever **39** will exert no control on shaft **50** when in the dotted position of Figure 3 unless control lever **75** is in "full on" position where the bifurcated portion of element **78** may receive the lever **39**, upon movement thereof to the full line position. In other words, neither drum may be moved when the clutch is being engaged. It will be understood that no lateral movement of the brake lever **39** can take place unless it is at the brake "full on" position. In other words, the lever **39**, which passes through a slot **76** in the console generally indicated at **100**, cannot be moved laterally until it is at the brake on position or brake on end of its excursion in the slot **76**, where lateral space is given for movement of the brake arm **39** and provides for the disengagement of the clutch in the brake on position of the drum B. This will be clear from Figure 1.

It will be realized that whereas I have described and shown a practical and operative device, nevertheless many changes may be made in size, shape, number and disposition of parts without departing from the spirit and scope of my invention. I therefore wish my description and drawings to be taken as in a broad sense illustrative or diagrammatic, rather than as limiting me to my specific showing herein.

The use and operation of my invention are as follows:

In considering the employment of controls for the large drums of mine hoists, an accurate and shock-free control of the brakes is important. The brakes are applied automatically and smoothly at the end of a given run.

In considering, for example, the structure of Figure 1, the solenoids **10***a* and **11***a*, which in current mine hoist practice are employed for emergency use, are in my system employed as regular operating elements or as regular brake applying means, in addition to their emergency brake operating action. I provide for each drum of my two-drum assembly an individual control unit for each drum. A typical control unit is shown for example, in Figure 7. Each unit includes an actuating member or screw **31** driven from the drum to be controlled or braked, and a normally inoperative work performing member in the form of a cam head or control member **32**. When the parts are properly set, the screw **31** winds in until a driving contact is made between the two members. The driving connection may be made, for example, by the collar **35**, which is loose on the cam head or control member **32**. At the end of the inward excursion of the screw **31**, the loose collar **35** is urged against the opposed end of the cam head **32** and the cam head or control member **32** and its associated cams **33** and **34** rotate to perform their control function. In the device as shown, the cam **33** operates the brake arm and cam **34** the controller arm, but they do not come into operation until the screw **31** has been entirely wound in by its driving connection with the drum to be controlled.

Where an adjustment is to be made, for example to control the device at the end of an excursion of the hoist, the movable manual control lever **39** may be moved from the full line to the dotted line position of Figure 3. When so moved, it exerts no control whatsoever on the brake shaft **50**. At the same time,, through linkage **80**, **81** and **82**, it interrupts the operating alignment between the cam roller **42***a* of Figure 4, and the opposed cam **34**.

It will be understood that one of the cams **33**, **34** automatically turns off the controller to the particular point necessary to keep the hoist running slowly as the returned skip or cage approaches the landing point. The other cam serves as the controlling factor for the brake. As the skip or cage, not shown in the present application, approaches a predetermined landing point, the appropriate cam will begin to take out the slack or brake clearance. In so doing, the brake lever will automatically be moved through an excursion of the order of eighty percent of its total travel from the full-off brake position toward the full-on brake position before the brake actually takes and exerts its full braking operation. Since the brake mechanism as such does not form part of the present invention, the parts are not shown in detail. It will be clear, however, that the control unit shown in Figure 7 permits a very precise adjustment and timing of the application of the braking power, it being kept in mind that the operator does not himself manually directly actuate the cam turn-off device. The controls are in response to the relatively slow motion of the hoist drum to be controlled. It however is stopped by the action of the limit switch **67**.

I claim:

1. In a control structure for multi-drum hoists, a pair of hoist drums and a pair of control assemblies, one for each drum, a common brake shaft for the two drums, a plurality of brake levers for said shaft, at least one said lever being movably mounted on the shaft, for movement between an operative and an inoperative position, means for maintaining said lever against rotation about the axis of the shaft when in operative position, said shaft being rotatable in relation to the lever when the lever is in inoperative position, and means responsive to the movement of said lever to inoperative position for rendering one of the drum control assemblies temporarily inoperative.

2. The structure of claim 1, characterized by and including an actuating connection between each said drum and one of said control assemblies, each such actuating connection including a cam and an opposed cam engaging member, and a disengaging connection extending be-

tween the movably mounted lever and one of said cam engaging members.

3. In a control assembly for multiple drum hoists, a control unit for each drum, including a work-performing member, an opposed control element, an actuating member for the work-performing member, and a connection between the actuating member and one of the drums, a brake lever movably mounted on a shaft for movement between an operative and an inoperative position, means for maintaining said brake lever against rotation relative to the axis of the shaft when said lever is in operative position, said lever being rotatable about the axis of said shaft when in inoperative position, and means responsive to the movement of said lever to inoperative position for rendering one of the drum control assemblies temporarily inoperative, including means for disconnecting its work-performing member and opposed control element.

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