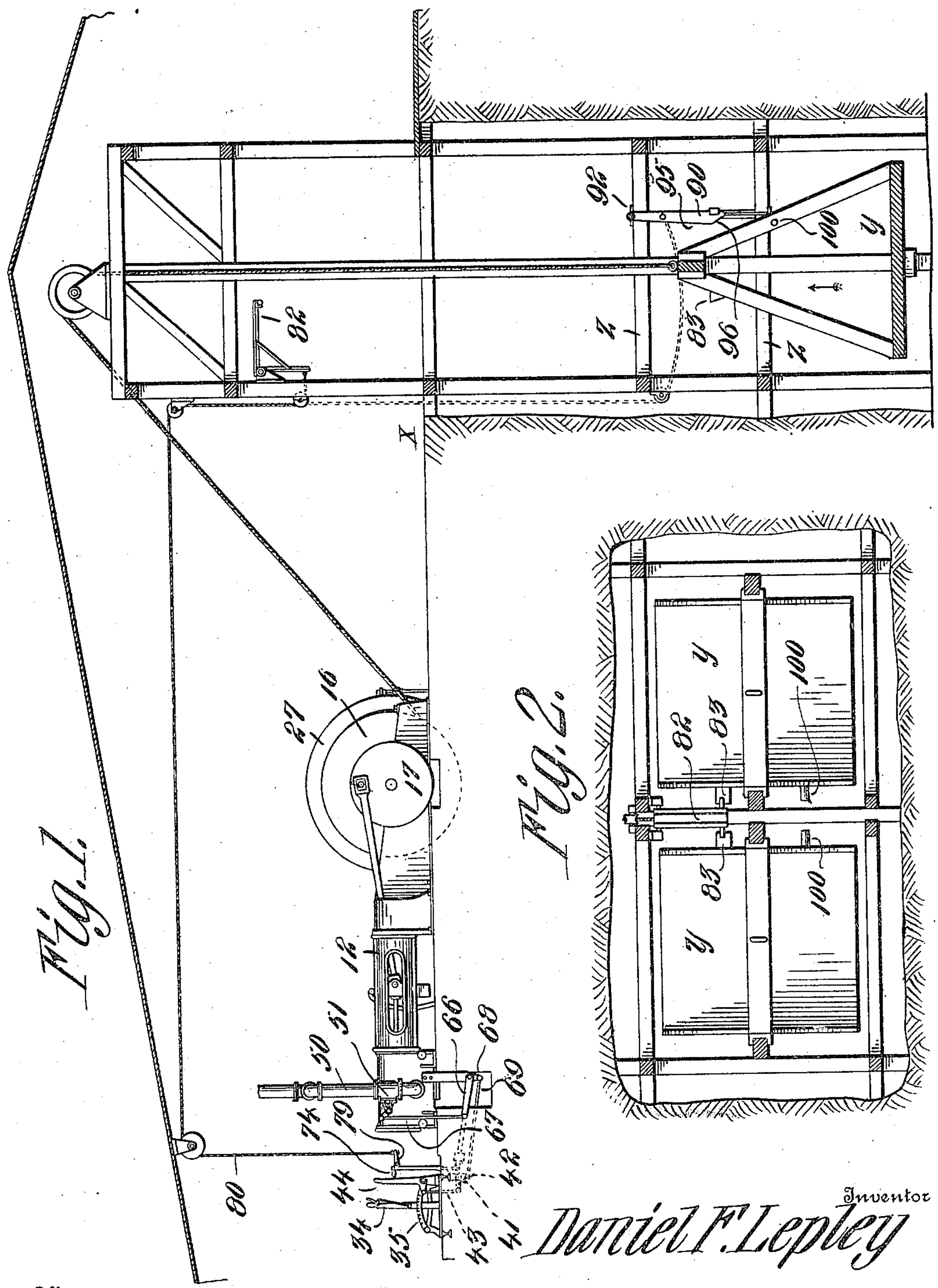
D. F. LEPLEY.

SAFETY APPARATUS FOR HOISTING ENGINES.

APPLICATION FILED OCT. 11, 1907.

949,022. Patented Feb. 15, 1910.

5 SHEETS—SHEET 1.



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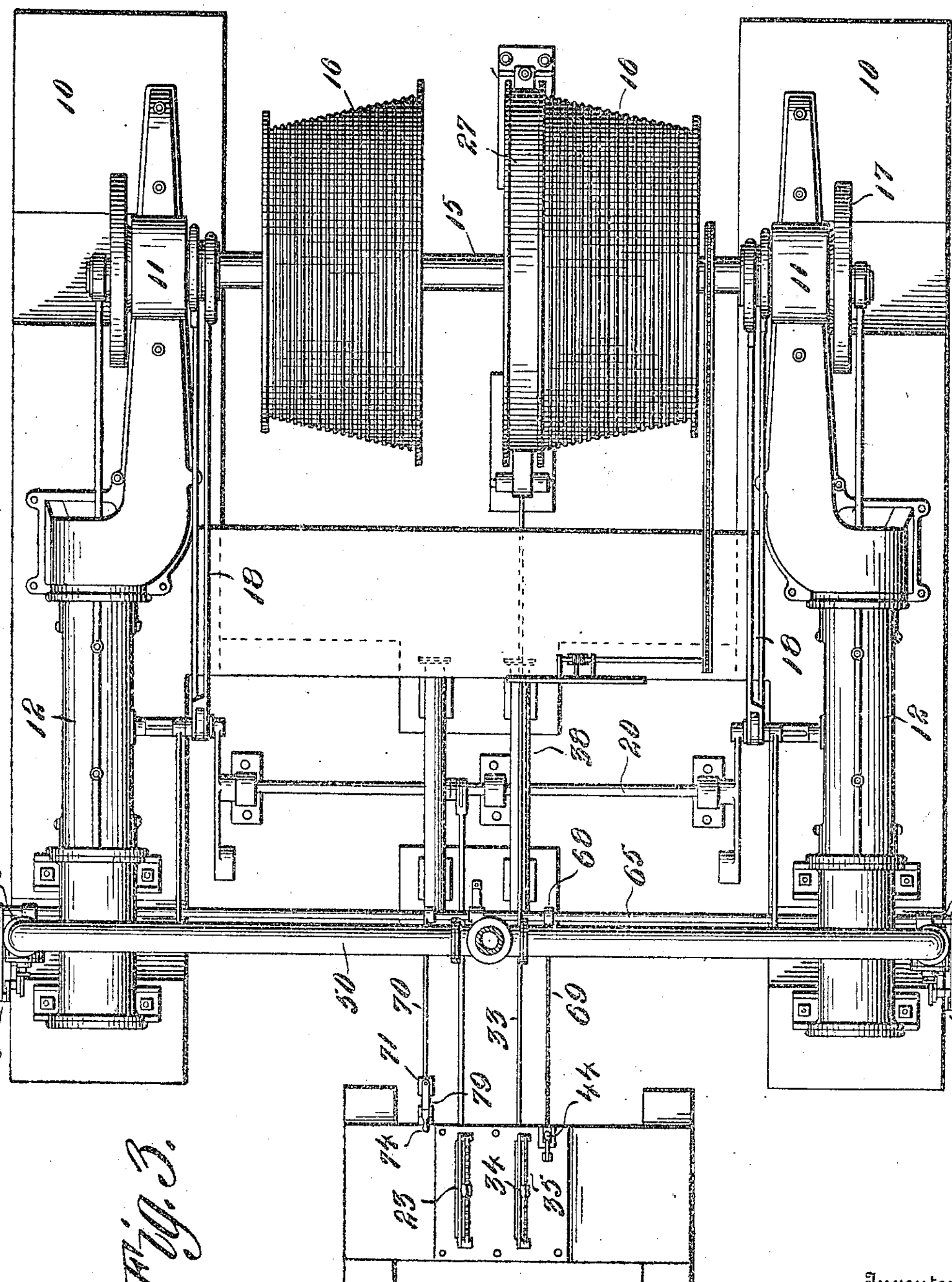

Fig. 3.

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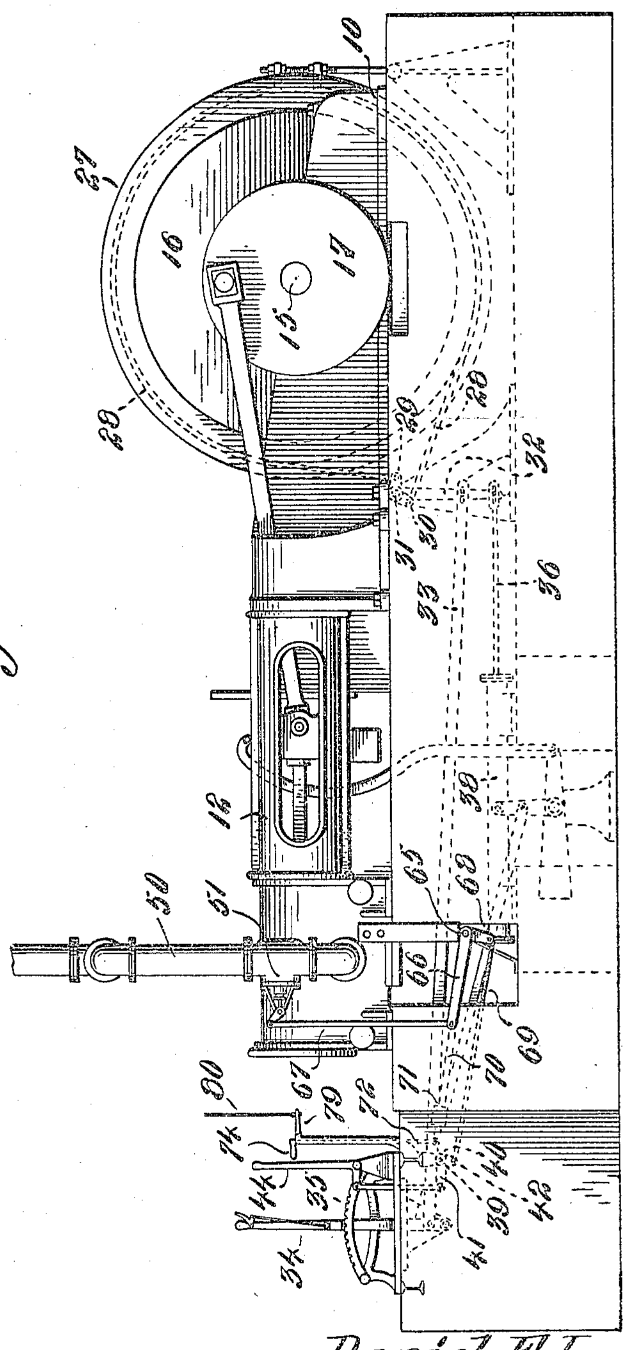

Fig. 4.

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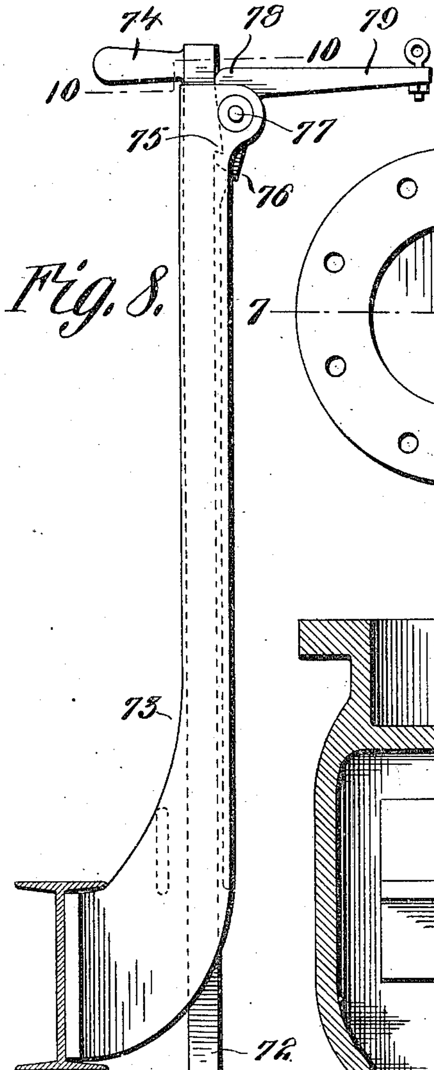


Fig. 8.

Fig. 5.

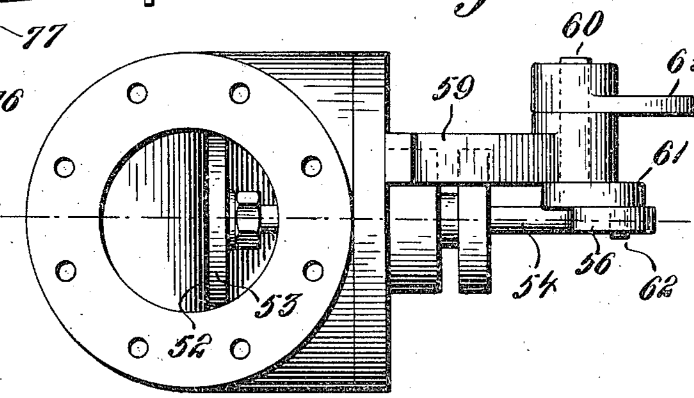
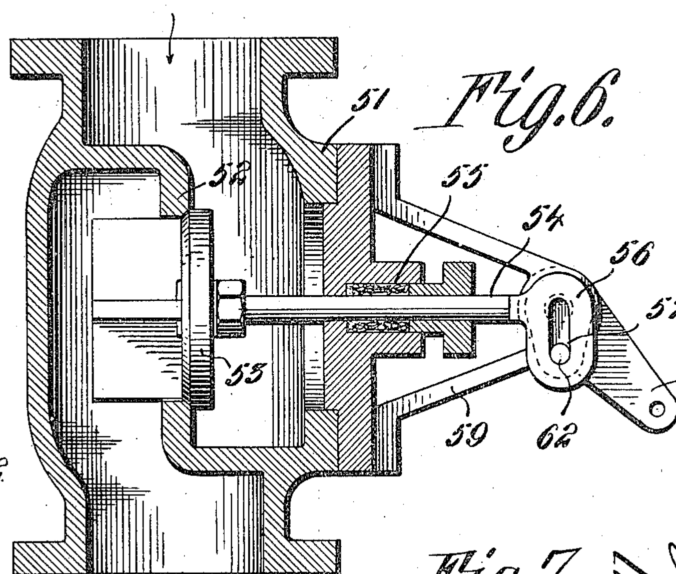


Fig. 6.



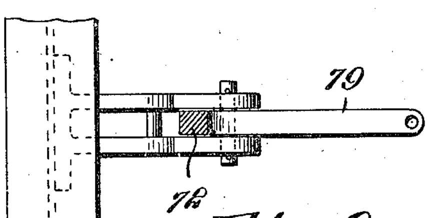
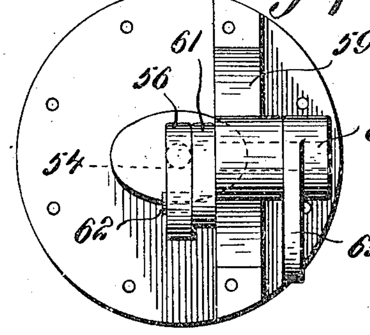


Fig. 9.

Fig. 7.



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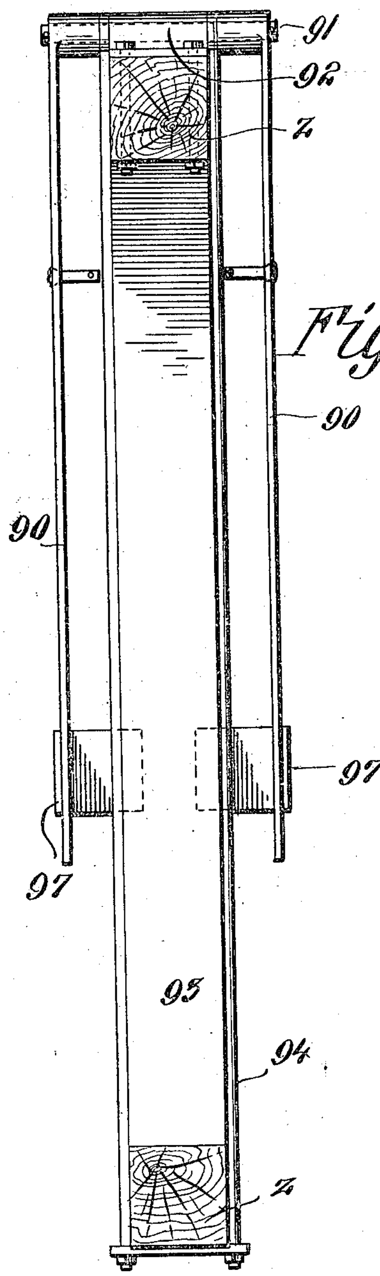

Fig. 11.

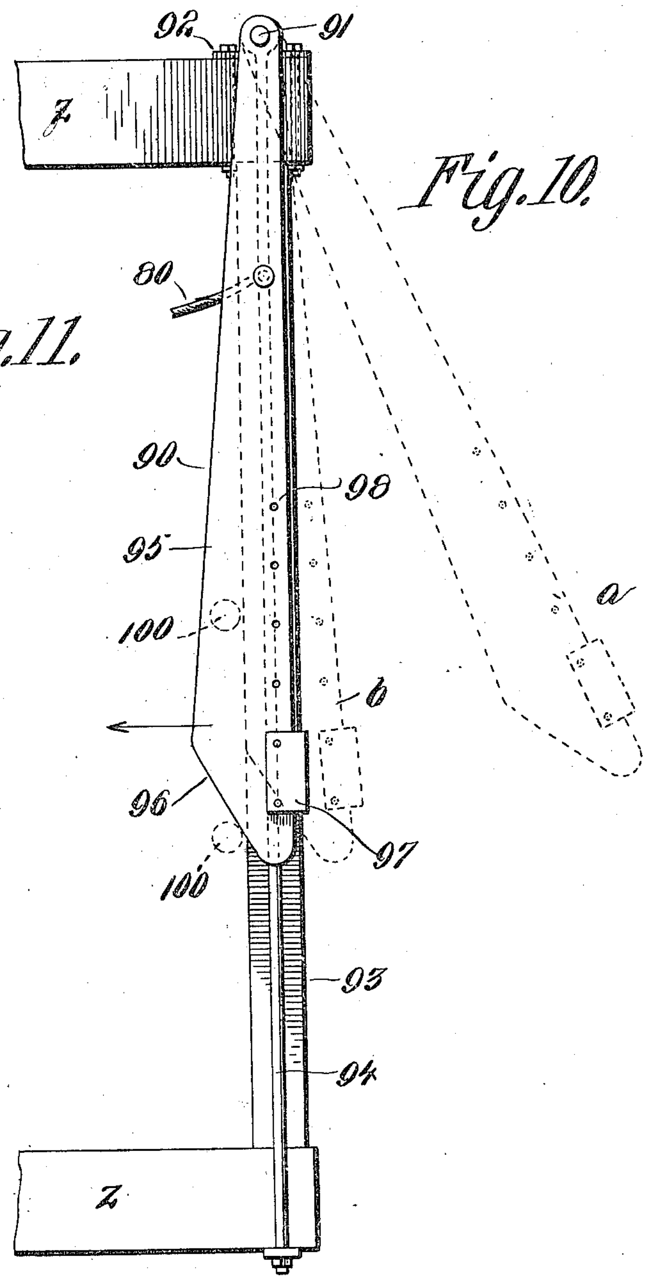

Fig. 10.

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UNITED STATES PATENT OFFICE.

DANIEL F. LEPLEY, OF CONNELLSVILLE, PENNSYLVANIA.

SAFETY APPARATUS FOR HOISTING-ENGINES.

949,022. Specification of Letters Patent. **Patented Feb. 15, 1910.**

Application filed October 11, 1907. Serial No. 397,019.

To all whom it may concern:

Be it known that I, DANIEL F. LEPLEY, a citizen of the United States, residing at Connellsville, in the county of Fayette and State of Pennsylvania, have invented a new and useful Safety Apparatus for Hoisting-Engines, of which the following is a specification.

This invention relates to apparatus for preventing or minimizing accidents to mine cages and hoists or elevator cars in general through over winding of a hoisting cable.

In mines where the shafts are of great depth it is necessary to run the cable at very high speed during the greater portion of the lift in order to secure the necessary out-put and the hoisting engines are frequently run at a rate of one hundred revolutions per minute during the earlier portion of the lift, and then reduced in speed to ten or twelve revolutions per minute as the car approaches the top of the shaft, the slowing down being necessary in order that the engine may be placed under perfect control and the cage brought to a gradual stop at the right point without excessive jar or wear on the engine or cage. Where the engine is not under full control when the cage reaches the top of the shaft, serious accidents frequently occur through overwinding of the cable, and many attempts have been made to avoid these accidents, the cage in some instances being detachably connected to the cables, and in other cases the cage has been employed as a means for setting into motion some engine controlling mechanism. Another frequent cause of accident is the hoisting of the car through neglect of the engineer to reverse his engine. In such cases the cage, instead of being lowered, is raised to the hoisting sheaves, and serious damage results, inasmuch as a single turn of the engine frequently results in a lift of thirty feet, more or less, of the cage.

One of the principal objects of the invention is to provide a safety governor which will operate to stop the engine in case the cage is moving too rapidly as it nears the top.

A further object of the invention is to provide an engine governing means that is idle during all of the lift up to within a short distance of the top, and is then set into operation at a speed determined by the speed of travel of the cage, so that if the speed is normal, the operation of the engine will not be interfered with, but if the speed is excessively high the governor will be actuated in such manner as to stop the engine and apply the brake to the hoisting drum.

A still further object of the invention is to provide an inertia governor that is set into operation by the cage or car.

A still further object of the invention is to provide a governor or controlling device that receives movement from the cage or car at a predetermined point in the lift of the latter, the extent of movement of the governor being determined by the momentum of the cage or car.

A still further object of the invention is to provide an improved engine controlling mechanism including a steam cut off valve and a braking device which are set into operation by the cage or car in the event of the speed of the latter being excessively high as it nears the landing, or in case the cage passes beyond the landing.

With these and other objects in view, as will more fully hereinafter appear, the invention consists in certain novel features of construction and arrangement of parts, hereinafter fully described, illustrated in the accompanying drawings, and particularly pointed out in the appended claims, it being understood that various changes in the form, proportions, size and minor details of the structure may be made without departing from the spirit or sacrificing any of the advantages of the invention.

In the accompanying drawings:—Figure 1 is a general view, partly in the nature of a diagram illustrating a hoisting engine, a cage, and the connections between them and the location and arrangement of the safety mechanism. Fig. 2 is a sectional plan view through a portion of the shaft, showing two mine cages arranged side by side in the usual manner. Fig. 3 is a plan view of the hoisting engine. Fig. 4 is a side elevation of the same. Fig. 5 is a plan view of the governor controlled throttle or cut off valve. Fig. 6 is a transverse sectional view of the same on the line 7—7 of Fig. 5. Fig. 7 is an end view of the valve. Fig. 8 is a side elevation of the tripping mechanism for controlling movement of the throttle and brake applying valves. Fig. 9 is a sectional plan view of the same on the line 10—10 of Fig. 8. Fig. 10 is an elevation of the inertia governor. Fig. 11 is a front view of the same showing the two inertia governors arranged in position in the mine shaft.

Similar characters of reference are employed to indicate corresponding parts throughout the several figures of the drawings.

The base or sole plate 10 is provided with pillow blocks 11 which generally form a part of the frame of reciprocating engines 12. The pillow blocks support a shaft 15, carrying a pair of winding drums 16 around which pass the usual hoisting cables one running in one direction, and the other in the opposite direction, and these being connected, respectively, to two mine cages, so that when one cage is ascending, the other is descending. The shaft 15 is provided with crank disks 17 connected in suitable manner to the pistons of the engines. The engines are provided with suitable valve gears 18 and may be reversed in any ordinary manner, the reversing mechanism being shown in the present instance, as connected to a tumbling shaft 20 that is connected in the usual manner to the links. The reversing mechanism is under the control of a hand lever 23 which may be operated in the ordinary manner.

At the larger ends of one of the winding drums is a brake drum or disk 27 with which engages a brake band 28, the opposite ends of the band being secured to short rocker arms 29 and 30 that are carried by a rock shaft 31 journaled in brackets immediately in front of the drum. Secured to this shaft is a rocker arm 32 that is connected by a rod 33 to the lower end of a brake applying lever 34 that is movable over the notched segment 35 and which may be provided with the usual locking bolt for engagement with said notches. By moving the lever 34 in the proper direction, the band brake may be tightened or loosened, as desired. The lower end of the rocker arm 32 is, also, connected to a piston rod 36 carrying a suitable piston that is arranged within a cylinder 38, and said cylinder is connected to a valve casing 39 containing a valve of any type, which valve when moved in one direction permits steam or other actuating fluid to flow to the cylinder 38 for the purpose of applying the brake, and when moved in the other direction permits the escape of the steam and the release of the brake. The stem 40 of the valve is provided with two rocker arms 41 and 42, the arm 41 being connected by a link 43 to a hand lever 44 that is arranged adjacent the brake applying lever 34, so that the engineer, when necessary, may use the steam for applying the brake instead of using the hand lever 34. The arm 42 of the valve stem is connected in the manner hereinafter described to the mechanism for automatically opening the valve in case of overwinding of the cable, or in the event that the speed of the cage is in excess of the normal as the cage nears the top of the shaft.

The steam main 50 is extended down to the steam chests of both engines, and at a point close to the steam chest a valve 51 is arranged in each branch of the main. The construction of the valve is best shown in Figs. 5, 6 and 7, and it comprises a casing having a partition 52 in which is formed an opening having a seat for the reception of a disk valve 53 that is carried by a stem 54 extending through a stuffing box 55. The outer end of the stem is provided with a laterally extended arm 56, in which is formed an elongated slot 57, the direction of the length of the slot being at a right angle to the length of the stem. Secured to the bonnet of the valve is a bracket 59 in which is mounted a short rock shaft 60 having at one end a crank arm 61 from which projects a crank pin 62 that enters the slot 57. From the opposite end of the shaft extends a rocker arm 63 that preferably is disposed at an angle of about 45° to the plane of the rocker arm 61. When the valve is in open position shown in Fig. 4 and the pin 62 is then at the inner end of the slot, its center is approximately in the longitudinal axial plane of the stem 54, so that the valve will be locked in the open position. If the arm 63 is pulled down from the position shown in Fig. 4 to the position shown in Fig. 6, the crank pin 62 will tend to force the valve to closed position, and as soon as the valve movement starts, it will be assisted by the pressure of steam which flows downward through the main and the valve will instantly be closed and will be held closed by steam pressure, thus instantly cutting off the supply of steam from the engine. The location of the valve adjacent the steam chest is of the highest importance, for the reason that it cuts off the flow of steam from the main, thus avoiding one of the disadvantages incurred where the usual throttle valve is operated, the throttle valve being ordinarily disposed in the main at a distance from the steam chest, and when the throttle is closed, there is always a body of steam under boiler pressure between the throttle valve and the steam chest, and the expansive force of this steam is sufficient to keep the engine moving for one or more revolutions, so that it cannot come to a quick stop. As a single revolution of the engine generally means a wind up of twenty-five to thirty feet of cable, it is apparent that serious accidents may occur where the engine continues to operate after the valve has been closed. In the present case by cutting off the steam close to the chest, the only working steam left is that left in the cylinder, and its force is expanded at the end of the stroke on which it is then acting.

Extending across the winding engines at a point below the cylinders is a rocker shaft 65 from which project crank arms 66 that are connected to the rocker arm 63 by links 67. This shaft is further provided with a crank arm 68 that is connected by a flexible cable or chain 69 to the rocker arm 42 on the brake cylinder valve, so that if the shaft 65 is turned for the purpose of closing the emergency valves 51, movement will, also, be transmitted through the flexible cable 69 to the brake cylinder valve and steam will be admitted to the brake cylinder for the purpose of applying the band brake. This flexible cable will yield when the hand lever 44 is operated for the purpose of applying the steam brake by hand, and movement will, therefore, not be transmitted through the cable to the emergency valve 51, when the hand lever is in use.

Extending from the shaft 65 is a long arm 70 that is provided with an adjustable weight 71 for the purpose of operating the shaft. This weighted arm 70 is retained in normal position by a rod 72 that extends up through a suitable guide 73 carried by the frame and is provided with a lift handle 74 near its upper end. Near the upper end of the rod is a tooth 75 that is arranged to be engaged by a pawl 76 that is pivoted on a pin 77 carried by the standard 73. This pawl is provided with a cam face 78 that extends above and beyond the pawl proper and engages with the forward face of the upper end of rod 72 and from the pawl extends an arm 79 that is connected to an operating cable 80. When the cable 80 is pulled upward, the movement is transmitted to the lever 79, whereupon the cam 78 acts to force the upper end of the rod 72 to the rear, and at the same time the lower end of the pawl tends to ride out from under the tooth 75 and from this double movement of the pawl and the rod the pawl will be positively disengaged and the rod will be allowed to drop, the weight of the rod added to that of the weighted arm 70 serving to further turn the shaft 65 for the purpose of closing the emergency valves and applying the brake.

The mine cage may be arranged to stop at any level either at the top of the shaft or at the top of the runway of the tipple. In the diagram shown in Fig. 1 the stopping point is indicated at x and on the frame above this stopping point is arranged a bell crank lever 82 having an approximately horizontal arm that is disposed in the line of travel of a lug 83 that projects from the cage y. The vertical arm of this bell crank lever is connected to the operating cable 80 and if the cage runs up beyond the stopping point through overwinding, the lug 83 will engage the bell crank lever 82, and a pulling strain will be exerted on the cable 80 to an extent sufficient to disengage the pawl and thus close the emergency valves and apply the brake in the manner hereinbefore described.

One of the principal dangers in the operation of mine cages is in the failure of the engineer to place his engine under control as the car nears the stopping point. To provide for this, an inertia governor is employed in each shaft. This governor is best shown in Figs. 10 and 11 and comprises a pendulum 90 that is hung on a shaft 91 mounted in a bracket or bearing 92 that is carried by one of the cross beams or timbers of the shaft. In the present case two of these adjacent cross timbers z are connected by a vertical strut 93 in order to prevent their moving together, and they are then clamped by tie bolts 94. The shaft 91 extends across the upper timber z for a distance sufficient to carry the inertia governors or pendulums 90 in both shafts. The inertia governor or pendulum 90 may be of any length, and is preferably in the form of a flat bar of iron or steel, one edge of the bar being vertical and the opposite edge having two surfaces at an acute angle to the straight edge and at an obtuse angle to each other. The inclination of the longer surface 95 is very gradual, extending from the top down to a point near the lower end, while the other inclined surface 96 is more abrupt and extends for a comparatively short distance upward from the bottom. The construction of the bar proper is such that if allowed to swing free, its straight edge will be drawn somewhat to the right of that shown in Fig. 10 by gravity. To correct this and maintain the straight edge in a strictly vertical plane or approximately so, an auxiliary weight 97 is employed, this weight being formed of an angle bar, one web of which is secured to the bar 90, while the opposite web engages against the vertical strut 93 and forms a stop for limiting movement of the bar 90 in the direction indicated by the arrow in Fig. 10. In order to more accurately adjust the vertical plane of the center of gravity of the bar, the latter is provided with a large number of openings 98 to permit the securing of the weight 97 at different distances from the fulcrum of the bar, and thus alter the effectiveness of the weight.

To the upper portion of the inertia governor 90 is connected one branch of the operating cable 80 and when this governor is swung from the full line position to the dotted line position a of Fig. 10, a pulling strain will be exerted on the cable 80 to an extent sufficient to operate the emergency valves and the brake applying valve. If swung to the position shown by the dotted lines d in Fig. 10, the distance which the cable moves will not be sufficient to apply the emergency valves and brake, it being noted that the attaching end of the cable is somewhat slack and it is only when the inertia governor is thrown out a considerable distance that the pulling strain on the cable will be sufficient to bring the engines to a stop.

Arranged on the car is a projection 100 that preferably is in the form of a roller, although it may be a lug or pin, and it may be employed for engaging the inertia governor alone, or may have other functions in connection with the controlling and dumping of the load. In the present case it is illustrated merely as a projecting roller for engaging the inertia governor. This inertia governor is arranged some distance below the landing point, say at a distance of forty feet or more, and if the engine is running at an abnormally high speed when the cage reaches this point, and, therefore, is not under full control, the roller 100 will strike the sharply inclined surface 96 of the inertia governor and throw the same violently to the right, (Fig. 10), thereby exerting a pulling strain on the rod or cable 80 and closing the emergency valves and applying the brake. If on the other hand the engine is under control, and is running at the proper speed, the roller 100 will strike the inclined surface 96 and will move the same but only for a short distance, the distance to which the inertia governor moves, being strictly governed by the speed at which the cage is traveling, and it may swing idly for a short distance if the cage is moving at relatively slow speed, but if the speed is too great, it will be thrown a considerable distance, and, as before described, will stop the engine.

The gradual inclination of the surface 95 of the inertia governor permits the descent of the cage at relatively high speed without throwing the governor a sufficient distance to stop the engine, and while the cage may move down very rapidly, the angle presented for contact with the roller is so slight that the blow will not be effective to an extent sufficient to effect the operation of the automatic stopping devices.

It will be observed that the controlling mechanism described does not in any manner conflict with the control of the engine by the engineer so long as the latter is properly attending to his duties, but if the engineer fail to give proper attention through neglect or accident, the automatic devices will operate and the engine will be stopped before serious damage can occur.

I claim:—

1. In combination, a hoisting mechanism, and a normally idle inertia governor for controlling the same, said governor being actively responsive to an impact blow of predetermined force and having supporting means whereby it is adapted to reset itself on either effective or ineffective operation.

2. In combination, a hoisting mechanism, and a normally idle inertia governor arranged to be actuated only during the latter part of the hoisting operation, said governor having supporting means whereby it is adapted to reset itself on either effective or ineffective operation.

3. In combination, a hoisting mechanism including a movable member, and an inertia governor arranged to be engaged by said member near the completion of the hoisting movement, said governor having supporting means whereby it is adapted to reset itself after the passage of said movable member on either effective or ineffective operation.

4. In combination, a mine cage, a hoisting engine therefor, and an engine controlling means including an inertia governor arranged to be engaged by the mine cage near the completion of its upward movement, said governor being adapted to automatically reset after effective operation.

5. In combination, a hoisting apparatus including a movable member arranged to travel at high speed, and an inertia governor arranged to be engaged by said member near the completion of its movement, said governor having supporting means whereby it is adapted to reset itself after such engagement on either effective or ineffective operation.

6. In combination, a mine cage, a hoisting engine therefor, a valve controlling the flow of the engine actuating fluid, and an inertia governor operatively connected to the valve and disposed in the path of movement of the mine cage, said governor having supporting means whereby it is adapted to reset itself after the passage of the mine cage on either effective or ineffective operation.

7. In combination, a mine cage, a hoisting engine therefor, a valve for controlling the flow of the actuating fluid to the engine, a valve actuating device, a trip mechanism therefor, and an inertia governor connected to the trip mechanism, the governor being disposed in the path of movement of the mine cage, said governor having supporting means whereby it is adapted to reset itself.

8. In combination, a mine cage, a hoisting engine therefor, a valve for controlling the flow of actuating fluid to the engine, a rock shaft, a rocker arm arranged thereon, means for connecting the rocker arm to the valve, a weighted rocker arm for actuating the shaft, a lifting rod connected to the weighted arm and provided with a tooth, a pawl engaging said tooth, an inertia governor arranged in the path of movement of the mine cage, and a flexible connecting means between the governor and the pawl.

9. In combination, a mine cage, a hoisting engine therefor, a valve for controlling

the flow of the actuating fluid to the engine, a rock shaft, a rocker arm arranged thereon and connected to the valve, a weighted arm for actuating the rock shaft, a lift rod connected to the weighted arm and provided with a tooth near its upper end, a pivoted pawl lever having a toothed end engaging the tooth of the lift rod, and a cam face engaging said rod above the teeth, an inertia governor arranged in the path of movement of the mine cage, and means for connecting the governor to the pawl.

10. In combination, a movable member, a hoisting engine connected thereto, an inertia governor having supporting means whereby it is adapted to reset itself and arranged to be engaged by said movable member, said governor comprising a pivoted bar having an inclined face with which the movable member engages, the speed at which said member is traveling determining the extent of movement of the governor, an engine controlling means, and mechanism connecting the controlling means to the governor.

11. In apparatus of the class described, an inertia governor comprising a pendent bar having an inclined face arranged to receive the impact of the object to be controlled, and having supporting means whereby it is adapted to automatically reset after effective operation.

12. In apparatus of the class described, an inertia governor comprising a pendent bar having upper and lower inclined faces, the lower face being at a greater angle to the vertical than the upper face, and a movable member arranged to engage both of such faces, the extent to which the governor is moved being dependent on the speed at which the movable member is traveling.

13. In apparatus of the class described, an inertia governor comprising a movable element having a variable amplitude of movement, and provided with an inclined face to receive the impact of the object to be controlled whereby the amplitude of movement is dependent upon the strength of the impact, said governor having supporting means whereby it is adapted to automatically reset after effective operation.

14. In an apparatus of the class described, an inertia governor comprising a pendent element having its center of gravity below the point of support, said element being capable of a variable amplitude of movement and provided with an inclined face to receive the impact of the object to be controlled, whereby the amplitude of movement of said element is dependent upon the strength of impact.

15. In apparatus of the class described, an inertia governor comprising a pendent element having an inclined face designed to receive the impact of the object to be controlled, and means for shifting the center of gravity of said element toward and from the point of suspension to vary the amplitude of vibration of the governor.

16. In an apparatus of the class described, an inertia governor comprising a pendent element having an inclined face to receive the impact of the object to be controlled, and an adjustable weight variable in position on said element with reference to the distance from the point of suspension.

17. In an apparatus of the class described, an inertia governor having a pendent bar provided with an inclined face to receive the impact of the object to be controlled, and means for varying the position of the center of gravity of said bar toward and from its point of suspension, said means consisting of a weight adjustable on the bar and constituting a stop to limit the movement of the bar in one direction.

18. In an apparatus of the class described, the combination with a movable object to be controlled, of an inertia governor capable of variable amplitude of movement and disposed to receive the impact of the said object, whereby the amplitude of movement of the governor is dependent upon the strength of the impact, said governor having supporting means whereby it is adapted to automatically reset after effective operation.

19. In an apparatus of the class described, the combination with a movable object to be controlled, of an inertia governor capable of variable amplitude of movement and disposed to receive the impact of the said object, whereby the amplitude of movement of the governor is dependent upon the strength of the impact, said governor having supporting means whereby it is adapted to automaticaly reset after effective operation, and means for varying the resistance to impact of said governor.

20. In apparatus of the class described, a mine cage, a hoisting drum, a brake for the drum, a brake actuating cylinder, a valve for controlling the flow of steam or other fluid to the cylinder, an engine for operating the drum, an emergency valve controlling the flow of the actuating fluid to the engine, an operating means common to both valves, a trip for holding said operating means normally idle, an inertia governor arranged in the mine shaft below the stopping point of the cage and in the path of movement of the cage, a movable member arranged above the stopping point and in the path of movement of the cage, and a flexible connecting means extending from the trip device to the movable member and to the inertia governor.

21. In a hoisting apparatus, a hoisting mechanism, a cage movable thereby, and a member in the path of the cage and movable actively to the full extent of its travel by an impact blow of predetermined force delivered by the cage, said member being directly

connected to the controlling devices of the hoisting mechanism.

22. In a hoisting apparatus, a hoisting mechanism, a cage movable thereby, and a member in the path of the cage in both directions of its travel, said member being movable actively to the full extent of its travel by an impact blow of predetermined force delivered by the cage when traveling in one direction and being directly connected to the controlling devices of the hoisting mechanism.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

DANIEL F. LEPLEY.

Witnesses:
W. H. Soisson,
Lloyd J. Shaw.