July 9, 1963 M. J. BELL ET AL 3,096,727

LIFT FOR FOUNDRY CARS

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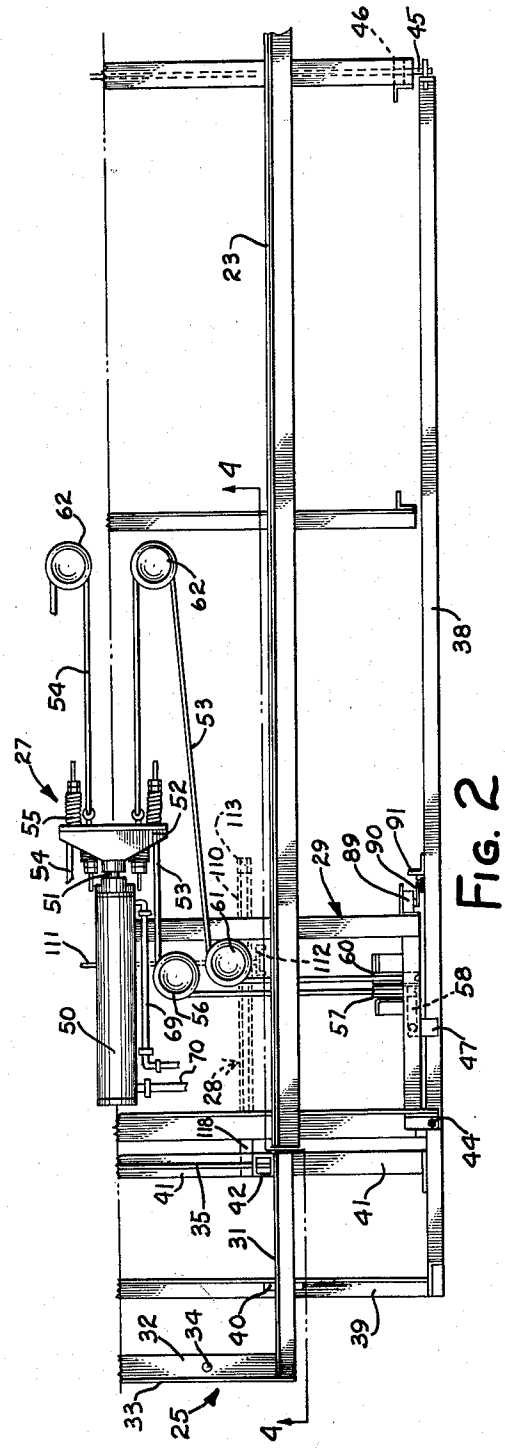


FIG. 2

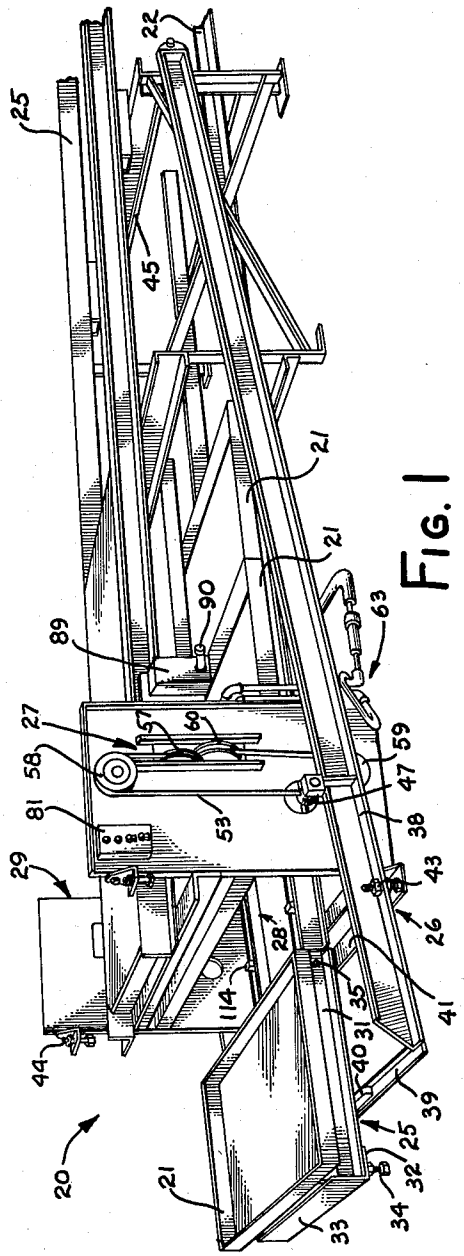


FIG. 1

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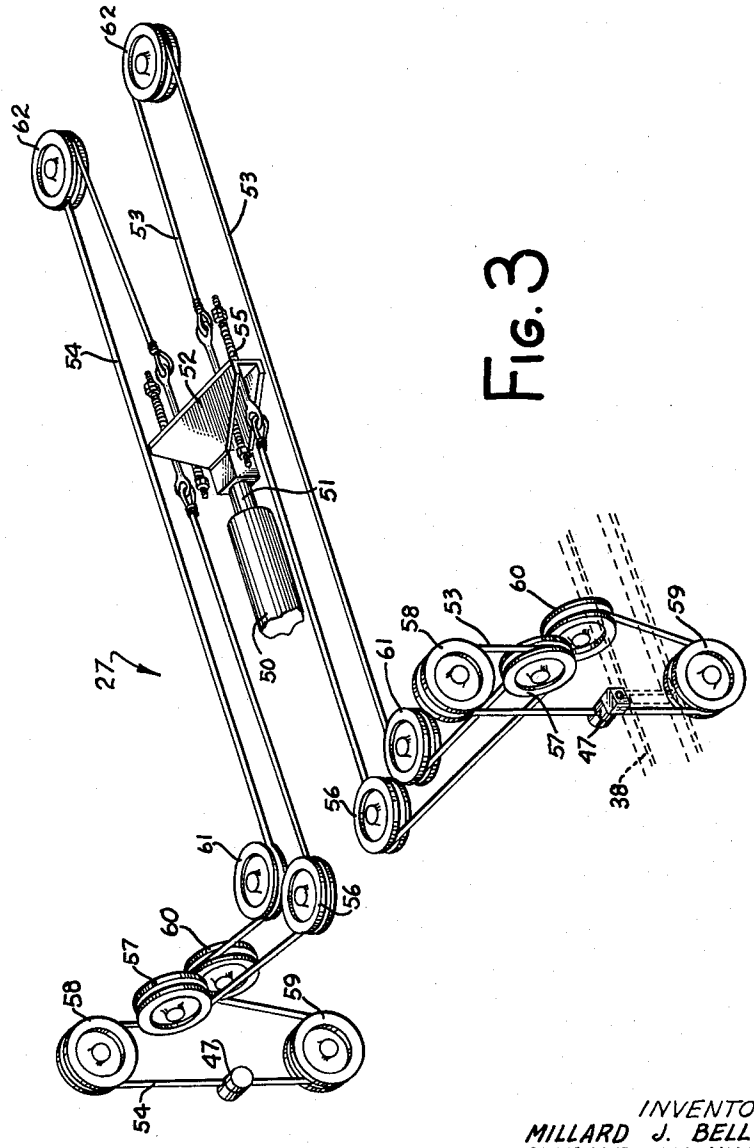


FIG. 3

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LIFT FOR FOUNDRY CARS

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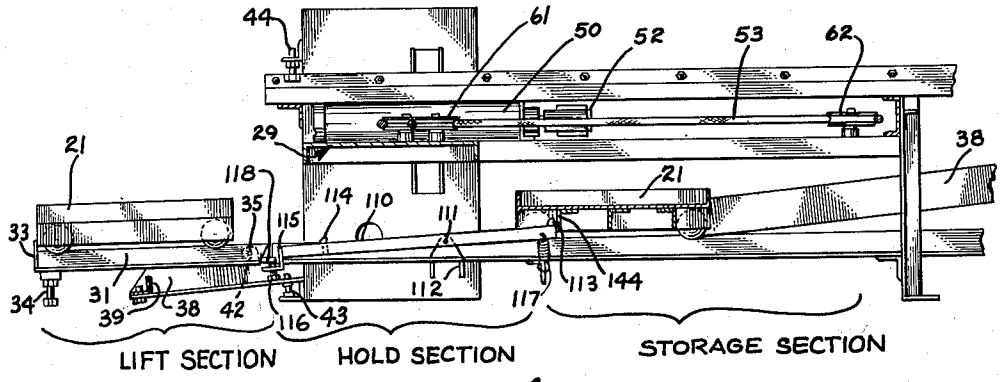


FIG. 4

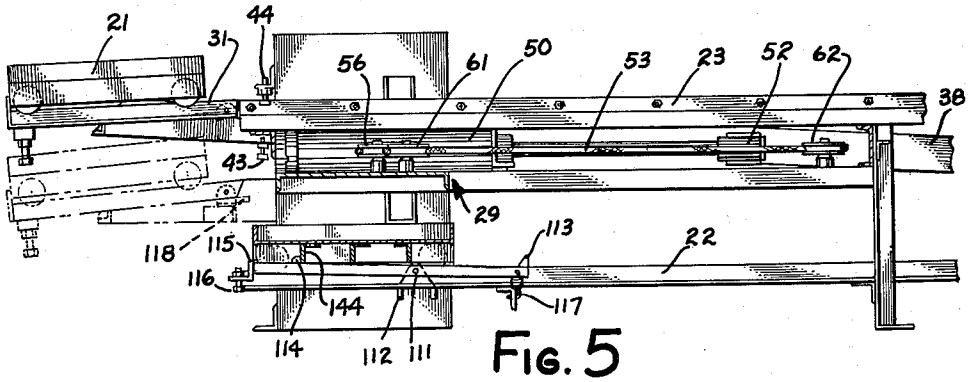


FIG. 5

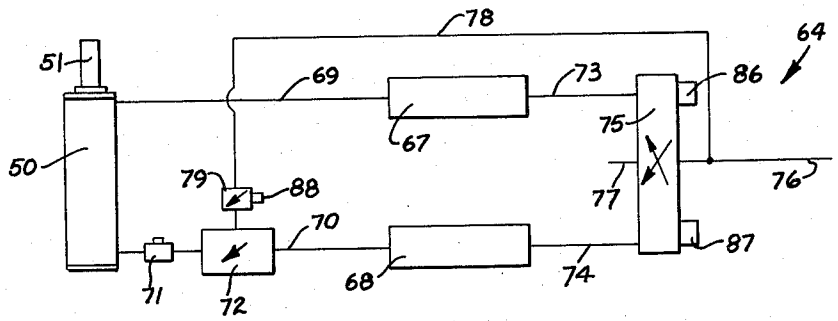


FIG. 6

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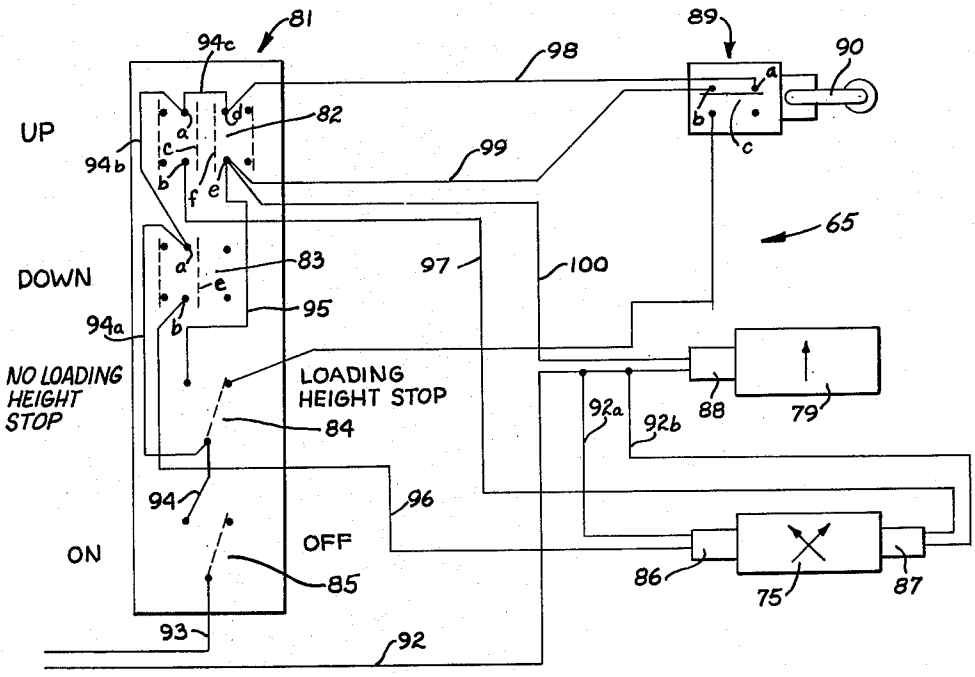


FIG. 7

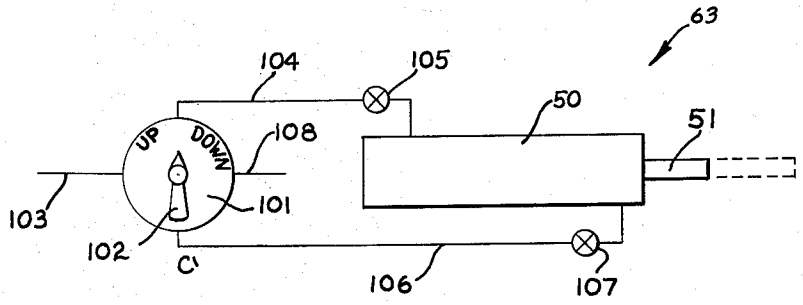


FIG. 8

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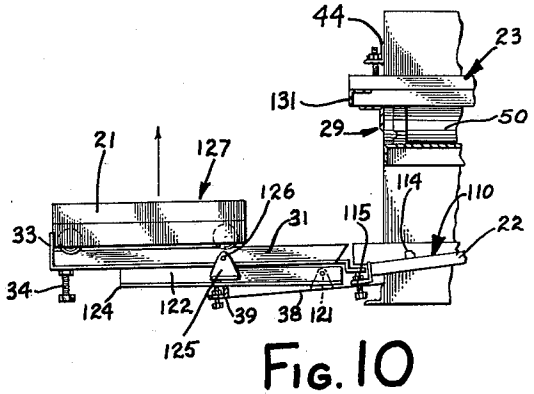


FIG. 10

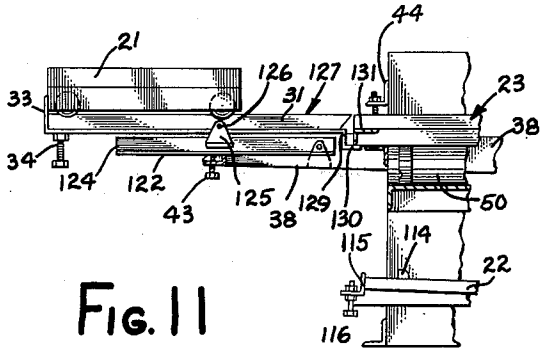


FIG. 11

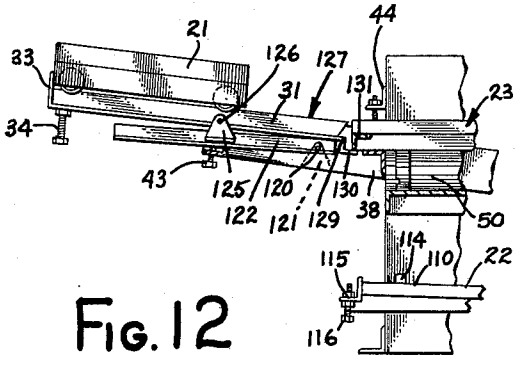


FIG. 12

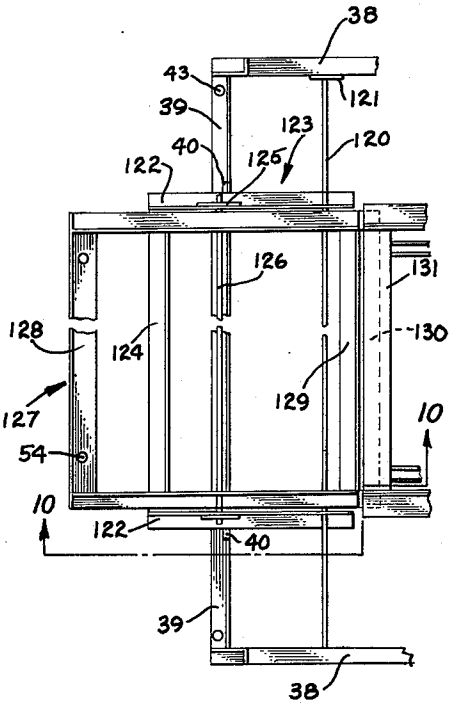


FIG. 9

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LIFT FOR FOUNDRY CARS

Filed Feb. 23, 1960 6 Sheets-Sheet 6

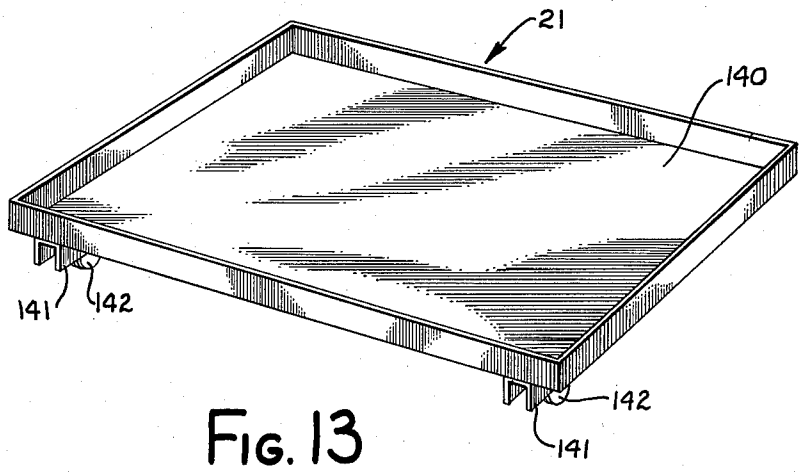


FIG. 13

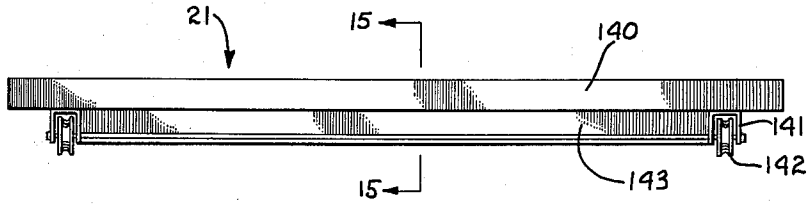


FIG. 14

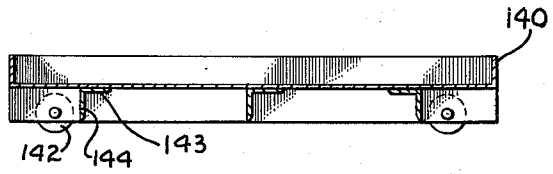


FIG. 15

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United States Patent Office

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LIFT FOR FOUNDRY CARS

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Filed Feb. 23, 1960, Ser. No. 10,388
4 Claims. (Cl. 104—131)

This invention relates to foundry equipment. More particularly, it relates to a foundry car lift machine, the working parts of which are all above ground.

In large scale foundry operations, it is customary to use parallel production line techniques, especially in casting small parts. The basis for such operations is a foundry car (sometimes called tray car and pallet car) and a track on which the foundry car is moved from one foundry station to another on each production line. Each production line usually involves a mold-forming station, a casting or pouring station and a dumping station whereat, when the metal is sufficiently cooled, the mold with casting in place is removed from the car and placed on a conveyor. The conveyor leads to a "shake-out" station whereat the mold and casting are separated. Upon removal of the mold from the car the empty car is returned to the beginning of the production line via another track. It is also usual for the rails of the tracks to be horizontal from the beginning of the production line to the dumping station and downwardly inclined from the dumping station to the beginning of the production line in order to facilitate control of the movement of the cars through the production line and then return them to the starting point by gravity. Hence, at the beginning of the production line in many foundries, it is necessary to lift the empty foundry cars from the bottom end of the track from the dumping station to the top end of the track serving the production line in order to place the empty foundry cars back into service. This is usually accomplished by means of a foundry car lift machine.

One type of foundry car lift machine heretofore used involves a horizontal, elevatable platform with a track on it. The end of the car return track (i.e. the track coming from the mold dumping station) is positioned directly beneath the beginning of the production line track. The platform is mounted for vertical movement from a bottom position where its tracks form a continuation of the car return or lower track to a top position where its tracks form a continuation of the upper or production line track. The platform, with a foundry car on it, is elevated and lowered from one track and elevation to the other by means of a vertically disposed pressure fluid cylinder.

Because the bottom end of the lower track is usually at or near floor level it is necessary in installing this type of machine, in order to accommodate the platform and the pressure fluid cylinder, to provide a pit below the floor level. This has many disadvantages.

One disadvantage resides in the fact that in installing this type of machine in an existing foundry, the pit has to be excavated and the walls and bottom thereof poured. This may take several days and a substantial number of personnel. Moreover, when it is considered that in many instances the lift machine is installed at the mold-forming station, such may cause a lengthy and, hence, expensive shut-down of the foundry production line involved.

Another disadvantage arising out of the presence of the pit resides in the fire and personnel safety hazards involved. Under normal use conditions dirt, oil and grease tend to accumulate in the pit and create a fire hazard. Moreover, precautions must be taken to prevent personnel from falling into the pit.

Because of the bulk and loads involved it is usually necessary in installing and in using this type of machine to provide vertical guides and a mechanical leveling structure for the pressure fluid cylinder in order to avoid as much as possible binding of the vertical guides under operating conditions. Hence, not only is the initial cost of this type of foundry machine excessive, but service and maintenance expense is high because of the careful initial and periodic adjustments of the leveling structure by skilled technicians.

Therefore, there is a need for an improved foundry car lift machine. An object of this invention is to fulfill this need.

A general object of this invention is to provide an improved pressure fluid cylinder type of lift machine for foundry cars.

More particularly, it is an object of this invention to provide a lift for foundry cars which does not require a pit for the pressure cylinder.

A specific object of this invention is to provide a foundry car lift which is self-leveling and in which mechanical leveling devices are not needed.

Another specific object of this invention is to provide a foundry car lift machine simple in structure and simple to service and maintain.

These and other objects which may appear as this specification proceeds are achieved by this invention which shall be described in the context of the drawings which form a material part of this disclosure. A brief listing of the drawings is as follows.

FIG. 1 is a perspective view of a preferred embodiment of the foundry car lift machine of this invention showing a foundry car in position for elevation from the lower track to the upper track.

FIG. 2 is a plan view of one side of the machine of FIG. 1 along the longitudinal center line thereof.

FIG. 3 is a perspective view of the cable and pulley system of the machine of FIG. 1.

FIG. 4 is a side sectional view of the machine taken along the cutting planes 4—4 of FIG. 2 and showing foundry cars in two of the sections of the machine.

FIG. 5 is another sectional view taken along the sectioning planes 4—4 of FIG. 2 and showing a foundry car in fully elevated position and showing in phantom a foundry car at a loading height elevation.

FIG. 6 is a diagrammatic illustration of a pressure air-hydraulic system for actuating the pressure fluid cylinder of the machine.

FIG. 7 is a diagrammatic illustration of an electrical system for actuating the pressure air-hydraulic fluid system of FIG. 6.

FIG. 8 is a diagrammatic illustration of a pressure air system for actuating the pressure fluid cylinder of the machine.

FIG. 9 is a plan view of the back end of another preferred embodiment of the machine of this invention.

FIG. 10 is a side view of the portion of the machine of FIG. 9 taken along the line 10—10, and with a foundry car in position to be elevated.

FIG. 11 is another view of the machine of FIG. 9 showing the foundry car in an elevated position just prior to its fully elevated position.

FIG. 12 is still another side view of the machine of FIG. 9 showing the foundry car in fully elevated position.

FIG. 13 is a perspective view of a foundry car.

FIG. 14 is a front end view of the foundry car of FIG. 13.

FIG. 15 is a sectional view of the foundry car of FIG. 13, which view is taken as indicated by the sectioning plane 15—15 of FIG. 14.

In general, the drawings disclose a foundry car lift

machine having an elevatable platform means. The elevatable platform has a car receiving position at one elevation and a car delivering position at another elevation. Between these two positions there may be included an intermediate position at an intermediate elevation. Mounted on the platform means are track means, the receiving end of which, when the platform means in is car receiving position, is in alignment with and adjacent to, a lower or car return track and which, when the platform means is in car delivering position, is in alignment with, and adjacent to an upper or production line track. The machine of this invention is based on the concept of a horizontally disposed pressure fluid cylinder in combination with lift arm means and a flexible member and pulley assembly for raising and lowering the platform means. Another concept is that of placing the flexible member means under spring tension and providing thereby a self-leveling effect.

In a preferred embodiment of the machine of this invention, car stop and release means are provided for preventing foundry cars from rolling off the end of the lower track when the platform means is out of car receiving position and for releasing a car onto said track means of said platform means when the platform means is in car receiving position.

In the preferred embodiment, when the platform means is in car delivering position, it is intended that the foundry car on the platform means be manually pushed therefrom onto the upper track. Another embodiment (FIGS. 9–12) is based on the concept of means for tilting the front of the platform means (i.e. the left end of the platform in FIG. 1) to a higher elevation than the car receiving or rear end of the platform means when the platform means is in car delivering position whereby the foundry car on the platform means can roll off the platform and onto the upper track under the influence of gravity.

Structure

More specifically, FIG. 1 of the drawings discloses a lift machine **20** for elevating a foundry car **21** from the bottom end of a downwardly inclined, car return track **22** at a lower elevation to the beginning of a horizontal production line track **23** at a higher elevation. The lift machine comprises car carrier or carriage means **25**, a lift arm assembly **26**, a fluid pressure cylinder, cable and pulley assembly **27**, a car stop and release assembly **28** and a support frame assembly **29**.

In the embodiment shown in FIGS. 1, 2 and 4–5, the carriage means or carrier **25** comprises the horizontal rails of a track **31**. It is preferred that the rails of the track **31** on the carrier **25** be inclined downwardly from the car receiving ends thereof to the opposite ends thereof. The reasons are to facilitate the rapid movement of foundry cars from the lower track **22** into position on the car carrier **25** and to prevent a foundry car **21** on the carrier **25** from rolling off the car receiving end thereof until the carriage means is in car delivering position relative to the upper track **23**. Between the rails and secured to the front ends thereof is a cross bar **32** having a vertically disposed flange **33**. The flange **33** extends upwardly to a higher elevation than the ends of the rails of the track **31**. This elevation is selected with reference to the foundry car **21** and is so selected that the flange **33** functions as a barrier to prevent a foundry car on the track **31** from rolling off the front end thereof. Mounted on the front cross bar **32** are a pair of leveling bolts **34**, the bottom ends of which, when the carrier **25** is in car receiving position, rest on the floor. The leveling bolts **34** are useful in adjusting the vertical position of the front end of the carrier **25** relative to the car receiving end thereof and for leveling the front end of the carrier **25** when in car receiving position. Adjacent the car receiving end of the carrier **25**, the rails of the track **31** are mounted on a horizontally disposed pivot shaft **35**. The car receiving ends of the rails of the track **31** are in alignment with,

and adjacent to, the ends of the corresponding rails of the lower or car return track **22** when the carrier **25** is in car receiving position and the ends of the corresponding rails of the upper or production line track **23** when the carrier **25** is in car delivering position.

The lift arm assembly **26** comprises a generally horizontally and longitudinally disposed lift arm **38** on each side of the support frame assembly **29**.

Between the front ends of the lift arms **38** and joined thereto is a front cross bar **39** shown in FIGS. 2 and 4 in the the form of an angle bar. The front cross bar **39** underlies the carrier **25** and under normal operative conditions bears against the rails of the carrier tracks **31**. Where such bearing occurs, in each case, there is provided an auxiliary bearing block **40**. Behind the front cross bar **39**, underneath the pivot shaft **35** and between the lift arms **38** there is provided a rear cross bar **41**, the ends of which are secured to the lift arms **38**. Mounted on the rear cross bar **41** are pivot shaft mountings **42** which pivotally secure the pivot shaft **35** to the lift arm assembly **26**. The front portion of each lift arm **38** is also provided with a pair of bottom leveling bolt assemblies **43** which enables the vertical position of the front ends of the lift arms **38** to be adjusted and the arms to be leveled when the lift arms **38** are in down position, as shown in FIG. 1. To adjust the vertical position of the front ends of the lift arms **38** and to level the same when they are in fully elevated position, there is provided on each side of the support frame assembly **29** a top leveling bolt assembly **44**.

The rear end of each lift arm **38** is mounted on a horizontally and transversely disposed pivot shaft **45** which is pivotally secured above the floor level as by suitable ball bearing mounts **46** to the support frame assembly **29**. Rearwardly of the juncture of the rear cross bar **41** with each lift arm **38**, each lift arm **38** is provided with an inwardly extending cable clamp assembly **47**.

The pressure fluid cylinder, cable and pulley assembly **27** comprises a horizontally and longitudinally disposed pressure fluid cylinder **50**. The cylinder is positioned above the floor level and along the longitudinal center line of the machine. Preferably it is positioned between the rails of the upper track **23** and secured to the support frame assembly **29**. The cylinder **50** is arranged so that the piston rod **51** thereof is in the direction of the rear end of the lift arms **38**. The outer end of the piston rod **51** is secured to a bracket **52**. Fastened to the bracket **52** are the ends of cables **53** and **54**. Each end of each cable **53** and **54** is secured to the bracket **52** by means of an eye bolt-tension spring assembly **55** such as shown in FIGS. 2 and 3. Tension on the cables in each case is established and maintained by a tension spring in each assembly **55**.

Cable **53** is associated with the right hand lift arm **38** while cable **54** is associated with the left hand lift arm **38**, as shown in FIG. 3. This association in each case is brought about by means of the cable clamp assemblies **47** and a rotatable pulley system.

Thus, with reference to the pulley system for the cable **53**, there is provided forwardly of the bracket **52** a horizontal pulley **56** having a vertically disposed axis of rotation. Outwardly from the horizontal pulley **56** and preferably over the right hand lift arm **38** there is provided a vertical pulley **57** with the axis of rotation thereof disposed longitudinally and horizontally. Above the vertical pulley **57** is an upper, vertical pulley **58** with a generally horizontal but transverse axis of rotation. Below the upper pulley **58** but in alignment therewith and below that portion of the lift arm **38** about the cable clamp assembly **47** when the lift arm is in down position, there is provided a lower, vertical pulley **59** with an axis of rotation likewise horizontally and transversely disposed. Intermediate the heights of the upper and lower vertical pulleys **57** and **59** there is provided another vertical pulley **60** which has a horizontally and longitudinally disposed

axis of rotation. Inwardly spaced from the vertical pulley 60 there is provided a horizontal pulley 61 with a vertically disposed axis of rotation. Rearwardly of the bracket 52 there is provided another horizontal pulley 62 with a vertically disposed axis of rotation. The shafts for each of these pulleys 56—62 are mounted on the support frame assembly 29.

In conjunction with the pulley system therefor, the cable 53 extends forwardly from the bracket 52 to the horizontal pulley 56 and then around said pulley to the vertical pulley 57. Here the cable 53 passes upwardly around the vertical pulley 57, upwardly to the upper pulley 58 and then downwardly through the cable clamp assembly 47 which is secured both to the cable 53 and to the lift arm 38. From the cable clamp assembly 47 the cable 53 extends downwardly to the vertical pulley 59, around the same, and upwardly to the vertical pulley 60. Here, the cable 53 changes direction about the pulley 60 to the horizontal and passes to the horizontal pulley 61. At this point the cable direction is again changed to the longitudinal direction whereby the cable is directed to the horizontal pulley 62 whereat it passes around the same and returns to its connection via an eye bolt and tension spring assembly 55 with the bracket 52.

The pulley system for the cable 54 and arrangement of the cable 54 is similar to that just described for the cable 53.

The pressure fluid cylinder 50 is associated with a pressure fluid actuating system 63 which can be of the pressure air-hydraulic fluid type, such as shown in FIG. 6, of the pressure air type, such as illustrated in FIG. 8, and of the hydraulic fluid type which is not illustrated but which is similar to the pressure air type. The system may be manually actuated, as in the case of the system of FIG. 8, or it may be actuated by an electrical switch arrangement 65 as in the case of the system of FIG. 7.

The pressure fluid actuating system 63, as illustrated in FIGS. 6 and 8, involves a pressure air-hydraulic fluid arrangement 64 and an electrical switch arrangement 65 (FIG. 7).

With reference to FIG. 6 the hydraulic fluid arrangement 64 comprises a pair of hydraulic fluid reservoir tanks 67 and 68. Between the reservoir tank 67 and the piston rod retract fluid inlet of the pressure fluid cylinder 50 is a conduit 69. Leading from the hydraulic fluid reservoir tank 68 to the piston rod extend fluid inlet of the pressure fluid cylinder 50 is a conduit 70. The conduit 70 is provided with a cock valve 71 for regulating the speed of retraction and extension of the piston rod 51. Conduit 70 also is provided with an air actuated shut-off valve 72 which is normally open. To compel hydraulic fluid to flow from the reservoir tank 67 into conduit 69 there is provided a piston retract, pressure air conduit 73 which is coupled at one end to a pressure air inlet of the reservoir tank 67 and at the other end to an outlet of a solenoid operated, four way valve 75. To induce the flow of hydraulic fluid from the reservoir tank 68 through conduit 70 to the pressure fluid cylinder 50, there is provided a piston extend pressure air conduit 74. One end of conduit 74 is coupled to the air inlet of the reservoir tank 68 while the other end is connected to the appropriate outlet of the solenoid operated, four way valve 75. In addition to the two pressure air outlets just mentioned, the solenoid operated, four way valve 75 is also provided with a pressure air inlet which is coupled to a pressure air supply conduit 76 and an exhaust outlet which may be coupled to an exhaust conduit 77. When the valve body of the valve 75 is actuated by one of solenoids 86 and 87 associated therewith, so as to bring the valve outlet coupled to the retract air conduit 73 in communication with the air supply conduit 76, the valve outlet associated with the extend air conduit 74 is in communication with the exhaust conduit 77. When the valve body of the valve 75 is actuated by the solenoids 86 and 87 to place the valve outlet coupled to the extend air conduit 74 into communication with the pressure air inlet coupled to the supply line 76, the valve outlet coupled to the retract air conduit 73 is brought into communication with the exhaust conduit 77.

The system of FIG. 6 also involves an auxiliary pressure air supply conduit 78 which is coupled to the main air supply line 76 and to the air operated valve 72. It will be observed that the auxiliary air supply conduit is provided with a normally closed air valve 79 which is actuated by a solenoid 88.

The electrical switch arrangement 65 for the pressure air-hydraulic fluid system 64 shown in FIG. 6 is best illustrated in FIG. 7. The electrical switch arrangement 65 involves a switch box 81 which may be mounted on the support frame assembly 29 as shown in FIG. 1 or which may be mounted at a more convenient location away from the machine 20. The switch box 81 is provided with an "up" push button station 82, a "down" push button station 83, a "loading height stop" selector switch station 84 and an "on-off" selector switch station 85. The "up" push button station 82 comprises contacts 82*a* and 82*b* in combination with a normally open armature 82*c*, and a pair of contacts 82*d* and 82*e* in combination with a normally open armature 82*f*. The "down" push button station 83 comprises a pair of contacts 83*a* and 83*b* in combination with a normally open armature 83*e*. The push buttons 82 and 83 of the switch box 81, which carry the armatures 82*c* and 82*f* and 83*e*, respectively, are spring loaded and upon release of manual pressure thereon return to open position.

In addition to the switch box 81, the electrical switch arrangement 65 comprises solenoids 86 and 87 which actuate the four way valve 75, a solenoid 88 for actuating the air valve 79 and a limit switch 89. The limit switch 89 as shown in FIGS. 1 and 2 is provided with a trip arm 90 which is actuated by a striker bar 91 mounted on the inside of the lift arm 38. The limit switch 89 comprises a pair of contacts 89*a* and 89*b* and associated therewith a normally closed armature 89*c* which is opened only upon upward movement of the trip arm 90. The limit switch 89 is mounted on the support frame assembly 29 with the trip arm 90 at an adjustable intermediate elevation between the lower track 22 and upper track 23. This elevation is selected according to a desired loading height of the car carrier 25, i.e. in such a manner that the switch 89 will open when the car 21 is at a level where it is most comfortable to the operator to load a mold thereon.

The various components of the electric switch arrangement 65 are electrically connected to a source of electrical potential by means of lines 92 and 93. Line 92 is connected to a first terminal of solenoid 88 and by branch lines 92*a* and 92*b* to corresponding first terminals of solenoids 86 and 87. Line 93 is connected to the switch arm of the "on-off" selector switch station 85.

Within the switch box 81 the "on" contact of the "on-off" selector switch station 85 is connected by line 94 to the switch arm of the "loading height stop" selector switch station 84, by branch line 94*a* to contact 83*a* of the "down" push button station 83 and by branch line 94*b* to contact 82*a* of the "up" push button station 82. Contacts *a* and *d* of the "up" push button station 82 are connected together by line 94*c*. The "no loading height stop" contact for the switch arm in the "loading height stop" selector switch station 84 is connected by way of electrical line 95 to contact 82*e* of the "up" push button station 82.

In the "down" push button station 83, the contact 83*b*, is connected by way of electrical line 96 to the second terminal of solenoid 86. In the "up" push button station 82, the contact 82*b* is connected by electrical line 97 to the second terminal of the solenoid 87. Contact 82*d* is connected through electrical line 98 to the contact 89*a* of the limit switch 89. Contact 82*e* is connected by line 99 to contact 89*b* of the limt switch 89 and by electrical line 100 to the second terminal of the solenoid 88.

As already indicated, the pressure fluid system **63** may be a simple, manually manipulated, pressure air system. Such a system is illustrated in FIG. 8. This system comprises a four way, manually operated air valve **101** with the valve body thereof connected to a valve handle **102**. The inlet of the four way valve **101** is coupled to a pressure air supply line **103**. One outlet of the air valve **101** is coupled to a pressure air conduit **104** which is coupled to the piston rod extend fluid inlet of the pressure fluid cylinder **50**. Disposed in the conduit **104** is a speed control valve **105** for regulating the speed of extension and retraction of the piston rod **51**. The four way air valve **101** has another outlet thereof coupled to a pressure air conduit **106** which is coupled to the piston rod retract fluid inlet of the pressure fluid cylinder **50**. Also disposed within the conduit **106** is a speed control valve **107**. The four way air valve **101** has an exhaust air outlet which may be coupled to an exhaust air conduit **108**. In this arrangement, when the valve handle **102** is manipulated so as to bring the air supply line **103** into communication with the piston rod extend fluid conduit **104**, the piston rod retract air conduit **106** will be in communication with the exhaust conduit **108**. Similarly, when the valve handle **102** is manipulated so as to place the air supply line **103** into communication with the piston rod retract fluid conduit **106**, the piston rod extend fluid conduit **104** will be brought into communication with the exhaust conduit **108**. In this system, no special provision is made for stopping the pressure fluid cylinder piston rod **51** at an intermediate position corresponding to a desired loading height of the car carrier **25**. However, by manipulation of the valve handle **102**, the piston rod **51** can be extended or retracted to any intermediate position within the inherent limits of extension and retraction created by the fluid cylinder **50** and by such external structure as the lift arms **38** in combination with the bottom leveling bolt assembly **43** and top leveling bolt assembly **44**.

The car stop and release assembly **28**, as best shown in FIGS. 4 and 5, comprises a pair of rocker arms **110**, each of which is pivotally mounted on the inner side of, and adjacent to, a corresponding rail of the lower track **22** and each of which is generally horizontally and longitudinally disposed. The rocker arm **110**, preferably rearwardly of the center of balance thereof, is rockably mounted on a horizontal, transversely arranged, pivot rod **111**. Each end of the pivot rod **111** is mounted on a corresponding bracket **112** secured to the lower track **22**. In the rocker arm embodiment shown in the drawings, the rocker arm **110** in each case actually is an assembly involving two, spaced apart, parallel bars which are horizontally and longitudinally disposed. At the rear end of the bars, between the same and secured thereto is an upwardly extending, rear stop block member **113**. In the region of the front end of the bars, between the same and secured thereto is an upwardly extending, front stop block member **114**. At the front end of the bars of each rocker arm **110** is a forwardly facing, L-shaped striker bar member **115**.

The long leg of the L is secured to the front ends of the bars of the rocker arm **110** while the short leg of the L extends forwardly. Mounted on the rear cross bar **41** of the lift arm assembly **26** are a pair of rearwardly extending hold down bars **118**. Each bar is in alignment with a corresponding short leg of the L-shaped striker bar member **115** and over the rear cross bar **41** of the lift arm assembly **26**. Indeed, when the lift arms **38** are in down position, the hold down bars **118** bear down against the short legs of the L-shaped striker bars **115** and depress the same sufficiently to lower the front end of each rocker arm **110** and tilt the rear end of each rocker arm **110**. To adjust the degree of this tilt, there is provided on the short leg, in each case, a vertically disposed adjustment bolt **116**, the head of which is positioned to be in contact with the hold down bar **118** of the lift arm assembly **26** when the same is in down position. Rearwardly of the pivot rod **111**, the rocker arms **110** are connected to tension springs **117** which, in turn, are connected to brackets mounted on the rails of the lower track **22**. When the lift arm assembly **26** is elevated, the spring **117** functions to tilt downwardly the rear end of each rocker arm **110** and to tilt upwardly the front end of each rocker arm **110**.

Up to this point, the lift machine of this invention has been so constructed what when the car carrier **25** has been elevated into its fully elevated position, a foundry car **21** thereon must be manually pushed from the carrier track **31** onto the upper track **23**. In another preferred embodiment of this machine, arrangements are made to enable the foundry car **21** to move by itself from the carrier track **31** to the upper track **23**. Such a preferred embodiment is shown in FIGS. 9–12. Except for the construction of the carrier **25**, the machine of these figures is essentially the same as that previously described. However, in the embodiment of FIGS. 9–12, the carriage means structure **25** has been arranged so that when the carriage means **25** is in car delivering position, the front end thereof will be tilted upwardly in relation to the rear end thereof whereby a foundry car **21** will be impelled therefrom onto the upper track **23**. In this construction, the lift arm assembly **26** is the same as that of the embodiment previously described except that the rear cross bar **41** has been eliminated. Instead, there is provided a horizontal pivot shaft **120** which is arranged transversely of the machine between the lift arms **38**. The ends of the pivot shaft **120** are mounted on pivot shaft mountings **121** on the inner sides of the lift arms **38**. Mounted on the pivot shaft **120** are the side rails **122** of a horizontally disposed frame **123**. The side rails **122** are pivotally mounted on the pivot shaft **120** in the region of the car receiving end of the frame **123**. At the front end of the frame **123** there is provided a transverse connecting bar **124**. Between the ends of the side rails **122** and secured to the side rails are auxiliary pivot shaft mountings **125**. These mountings provide support for a pivot **126** which is generally horizontally and transversely disposed. Pivotally mounted on the pivot shaft **126** is a platform **127**. The side rails of the platform comprise the rails of the carrier track **31**. At the front end of the carrier track there is provided a cross bar **128**. At the car receiving end of the platform **127** and mounted between the rails of the carrier track **31** there is provided a Z-bar **129**, the legs of which are generally horizontally and transversely disposed. The bottom leg **130** of the Z-bar extends rearwardly from the car receiving end of the platform **127**. When the lift arms **38** are in down position, the leg **130** of the Z-bar **129** bears down on the short leg of the striker bar **115** of the rocker arms **110**. Between the rails of the upper track **23** and at the car receiving end of the upper track **23** there is provided an angle bar **131**. The angle bar **131** is arranged with one leg thereof horizontally and rearwardly disposed between the rails of the upper track **23** and with the other leg thereof extending downwardly. The downwardly extending leg is in alignment with the rear leg **130** of the Z-bar **129** so that when the lift arms **38** elevate the carrier **25** into car delivering position, the rear leg **130** will engage the vertical leg of the angle bar **131** and serve as a fulcrum to hold the car receiving end of the platform **27** in place and tilt the front end thereof upwardly about the pivot shaft **126**.

Before proceeding to a detailed discussion of the operation of the preferred embodiments of the machine of this invention, reference is made to FIGS. 13–15 for a detailed description of the structure of the foundry car **21**.

As shown in the drawings, the foundry car **21** comprises a shallow tray **140**. Adjacent each side of the tray and secured to the bottom thereof is a channel **141**, the legs of which extend downwardly. Mounted on axles in the channels **141** in the front end region and back end

region thereof are rotatable, flanged wheels **142**. Between the channels **141** and mounted to the bottom of the tray **140** are ribs **143** in the form of angles. One leg of each angle is secured to the bottom of the shallow tray **140** while the other leg **144** extends downwardly.

Operation

As indicated in FIG. 4, the machine **20** may be considered with reference to the lower or car return track **22** as involving a car lift section, a car hold section and a car storage section. The car lift section, of course, involves the car carrier **25** and the carrier track **31**. The car hold section is the terminal portion of the car return track **22** in which the rocker arms **110** function. The car storage section comprises the remaining portion of the car return track **22**. In addition, in order to describe the operation of the machine **20**, it is assumed that the machine **20** has just been installed and the carrier **25** is in down or car receiving position. With this assumption in mind, it will be seen that in both embodiments of FIGS. 1–5 and FIGS. 9–12, the rocker arms **110** will be positioned with the rear stop block members **113** up and the front stop block members **114** down. Hence, when foundry cars **21** rolling down the car return track **22** move into the storage section of the machine, the first one of the foundry cars **21** rolls through the storage section until the foremost, downwardly extending flange **144** thereof comes into contact with the rear stop block member **113**. Other foundry cars **121** moving down the car return track **22** enter into the storage section and are stopped by the foundry car at the head of the line in the storage section.

To operate the machine **20** under these conditions, and with reference to the pressure air system illustrated in FIG. 8, the valve handle **102** of the four way valve **101** is turned to the up position. This causes the piston rod **51** of the fluid cylinder to be extended. In turn, because of the cable and pulley arrangement associated with the piston rod **51**, the lift arms **38** are lifted, thereby elevating the carrier **25**. As the car carrier **25** lifts, the front ends of the rocker arms **110** are permitted to elevate and so do because of the springs **117** connected to the rear ends thereof. This, of course, lowers the rear stop block members **113**. When the rear stop block members **113** are sufficiently lowered to clear the foremost, downwardly extending flange **144** of the lead foundry car **21**, because of the downward inclination of the car delivery track **22**, the lead car rolls over the car return track **22** into the hold section until the foremost, downwardly extending flange **144** thereof comes into contact with the front stop block members **114**. At this point the lead foundry car **21** stops. The next foundry car in the storage section moves up into position and so on down the line of foundry cars. The position of the second foundry car **21** is determined by the end of the foundry car **21** in the hold section.

As soon as the lead foundry car **21** has entered the hold section of the machine, the valve handle **102** of the air valve **101** is turned to the down position whereupon the piston cylinder **51** is retracted. In turn, the car carrier **25** is lowered to its car receiving position. As it reaches its car receiving position, because of the hold down bar **118** of the lift arm assembly **26** in the embodiment of FIGS. 1–5 and the rear leg **130** of the Z-bar **129** in the embodiment of FIGS. 9–12, engaging the short legs of the L-shaped striker bars **131**, the front ends of the rocker arms **110** are driven downwardly and the rear ends thereof driven upwardly. This causes the front stop block members **114** to clear the foremost, downwardly extending flange **144** on the lead foundry car **21**. In addition, the rear stop block members **113** are elevated into blocking position relative to the foremost, downwardly extending flange **144** of the next foundry car in the storage section of the machine **20**. The foundry car **21** in the hold section of the machine, because of the downward inclination of the lower track **22**, moves from the end of the track **22** onto the carrier track **31** until the end of the foundry car **21** strikes the upright flange **33** on the front cross bar **32** of the carrier **25**. In such fashion, the car carrier **25** is loaded with a foundry car.

To elevate the car carrier with the pressure fluid system **63** of FIG. 8, the valve handle **102** of the valve **101** is turned to its up position whereby the piston rod **51** of the fluid cylinder **50** is extended. This causes movement of the cables **53** and **54** and thus lifting of the lift arms **38**. When the lift arms **38** come into contact with the top leveling bolt assemblies **44**, the operator releases handle **102** to its neutral position. The car carrier **25**, in the meantime, has been elevated to its car delivering position as shown in FIGS. 5 and 12. In this position the carrier track **31** is in alignment with, and adjacent to, the car receiving end of the upper track **23**. Hence, by manually pushing the foundry car **21** onto the car carrier track **31**, in the embodiment of FIGS. 1–5, and without more in the embodiment of FIGS. 9–12, the car **21** moves onto the upper track **23**, whereupon the car is manually impelled along the production line track from the machine **20**.

Since in most situations the lift machines of this invention will be placed at the mold-forming stations in a foundry, it should be observed that during the upward travel of the car carrier **25**, the same may be stopped at any desired loading height convenient to the operator between the car receiving and car delivering position of the car carrier **25** merely by turning the valve handle **102** from its up position to the neutral position at such height. When a load has been transferred to the foundry car **21** on the carrier **25**, the valve handle **102** is then turned to its up position and the carrier **25** fully elevated to its car delivering position.

As the car carrier **25** moves from its down position through the loading height position to the up position, the release of the hold down bars **118** form the striker bars **115** of the rocker arms **110** plus the action of the springs **117** causes the front ends of the rocker arms to incline upwardly and the rear ends thereof to move downwardly. Thus, the rear stop block members **113** are enabled to clear the forwardly extending flanges **144** of the lead foundry car in the storage section whereupon the lead foundry car moves into the hold section of the machine until the foremost downwardly extending flange **144** thereof strikes the front stop block members **114** of the rocker arms **110**.

When the foundry car **21** on the carrier **25** has moved therefrom onto the upper track **23**, the valve handle **102** is then moved to its down position, causing the piston rod **51** of the cylinder **50** to retract. The cables **53** and **54** thereupon move to lower the front ends of the lift arms **38**, bringing the carrier **25** into car receiving position as determined by the leveling bolt assemblies **43**. As carrier **25** moves downwardly, the striker bars **115** of the rocker arms **110** are contacted by the hold down bars **118** in the embodiment of FIGS. 1–5 and by the leg **130** of the Z-bar **129** in the embodiment of FIGS. 9–12 and are pushed downwardly. When the carrier reaches its car receiving position, the front ends of the rocker arms **110** have been depressed sufficiently such that the front stop block members **114** clear the foremost, downwardly extending flange **144** of the foundry car in the machine's hold section whereupon the foundry car in the hold section moves onto the carrier track **31**. The process can then be repeated.

To operate the machine with the pressure air-hydraulic fluid system **64**, illustrated in FIGS. 6 and 7, the limit switch **89** is first adjusted to the height corresponding to the desired loading height. The selector switch **81** is turned to its on position and the selector switch **84** is turned to its loading height stop position. Assuming the starting conditions mentioned at the outset of this description of the operation of the machine, the up button **82**

is pressed. This completes the electrical circuit of the solenoid 87 and solenoid 88. Solenoid 87 thereupon causes the four way valve 75 to direct pressure air into conduit 74 and to exhaust air from conduit 73. Solenoid 88 closes the air valve 79 which causes the valve 72 to open. Hydraulic fluid from the rservoir 68, accordingly, is impelled through the conduit 70 into the pressure fluid cylinder 50, causing the piston rod 51 to be extended and hydraulic fluid from the other side of the piston in the cylinder 50 to return through conduit 69 into the reservoir 67. As the piston rod 51 extends, the bracket 52 connected thereto pulls on the cables 53 and 54, thereby raising the lift arms 38. When the striker bar 91 on the lift arm 38 contacts the trip arm 90 of the limit switch 89, the limit switch armature 89c opens, thereby opening the electrical circuit of solenoid 88. This causes the air valve 79 to open and thereby admit air to the air operated valves 72. This stops the flow of hydraulic fluid through conduit 70 to the pressure fluid piston 50. Elevation of the lift arms 38 thereupon ceases whereby the car carrier 25 is brought to a stop at the loading height as indicated in phantom in FIG. 5. The reason for providing the valve 72 in the hydraulic circuit is that, air being compressible, the platform 25 would move downward slightly when the heavy mold is placed on the car 21, if the hydraulic fluid were held only by the air pressure in reservoir 68. When the valve 72 is closed, however, the platform 25 is firmly held, regardless of the weight thereon, by the incompressible hydraulic fluid.

When a mold has been transferred to the foundry car 21, the operator punches the up button 82 whereby the electrical circuit of the solenoid 88 is again completed. Air valve 79 is thereby closed and the air operated valve 72 opened, permitting the hydraulic fluid to flow from the reservoir 68 through conduit 70 into the piston 50. The piston rod 51 further extends, thereby lifting the lift arms 38 until the same come in contact with the top leveling bolt assemblies 44. In the embodiments of FIGS. 1–5, the foundry car with load is manually pushed from the carrier track 31 onto the upper track 23. In the embodiment of FIGS. 9–12, upon the car carrier 25 reaching the up position therefor, the upward tilting of the front end of the track 31 relative to the rear end of the track 31 causes the foundry car 21 to roll off the track 31 onto the upper track 23.

To bring the empty car carrier 25 into down position, the operator pushes the down button 83 of the switch box 81. Solenoid 86 thereupon connects the pressure air line 76 with the conduit 73 and the conduit 74 with the exhaust conduit 77. This in turn causes hydraulic fluid to flow from the reservoir 67 through conduit 69 into the pressure fluid cylinder 50 and hydraulic fluid to flow from the pressure fluid cylinder 50 through conduit 70 into the reservoir 68. The piston rod 51 is thereby caused to retract. By virtue of the cable and pulleys, the lift arms 38 and thus car carrier 25 are lowered into down position. As the lift arms move downwardly, the trip arm 90 of the limit switch 89 will again contact the corresponding striker bar 91 on one of the lift arms 38. However, striking the trip arm 90 from above does not affect the armature 89c of the limit switch 89. It will remain closed. Hence, the piston rod 51 will continue to be retracted until the lift arms 38, and thus the car carrier 25, reach the car receiving position. When the car receiving position is reached, the procedure is then repeated.

In the event that one or more foundry cars 21 are to be transferred from the lower track 22 to the upper track 23 without placing a mold thereon, the selector switch 84 of the switch box is turned to its no loading height stop position. This causes the limit switch 89 to be shorted out of the circuit and to directly complete the electrical circuit of the solenoid 88. Upon pushing the up button 82 in the switch box 81 and elevating of the lift arms 38, tripping of the trip arm 90 and thus opening of the armature 89c in the limit switch, has no effect on the operation of the machine under these conditions.

Thus, there is presented a foundry machine for transferring foundry cars from a car return track at one elevation to a production line track at another elevation. A feature of advantage of the machine of this invention is the relative simplicity of its structure and operation. Another feature of advantage is the ease of operation. No particular skill is involved on the part of the operator of the machine.

An important advantage of this machine is that it can pick up foundry cars at a lower than satisfactory loading height elevation, present the foundry car to the operator for loading at a safe and satisfactory loading height elevation and then deliver the foundry car with the mold in place thereon to the production line track at a higher than loading height elevation.

Of particular importance is the fact that all working parts of the machine of this invention are located above ground.

Another advantage of this invention is that all of the working parts of the machine are readily accessible for service and repair.

Still another feature of advantage of this invention is that in installing the machine, mechanical leveling devices and vertical guides are not needed. Indeed, the machine of this invention is self-leveling in operation because of the eye-bolt and tension spring assemblies 55 for connecting the cables 54 and 53 to the bracket 52.

These and other advantages as well as other embodiments will occur to those in the exercise of ordinary skill in the art upon reading the foregoing description.

Since this invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, the embodiments just described are therefore illustrative and not restrictive because the scope of the invention is defined by the appended claims rather than by the description preceding them.

We claim:

1. A foundry car lift comprising an upper and a lower track, platform means having track means thereon and movable between a position where said track means form a continuation of said lower track and a position where they form a continuation of said upper track while remaining generally horizontal, pivoted supporting means for supporting and moving said platform means, drive means located entirely between the levels of said tracks for moving said supporting means, and flexible means for transmitting motion from said drive means to said supporting means.

2. A foundry car lift comprising an upper and a lower track, platform means having track means thereon and movable between a position where said track means form a continuation of said lower track and a position where they form a continuation of said upper track while remaining generally horizontal, pivoted supporting means for supporting and moving said platform means, drive means located entirely between the levels of said tracks for moving said supporting means, and closed circuit flexible means fastened to said supporting means for transmitting motion from said drive means to said supporting means.

3. A foundry car lift comprising an upper and a lower track, platform means having track means thereon and movable between a position where said track means form a continuation of said lower track and a position where they form a continuation of said upper track, pivoted supporting means for supporting and moving said platform means, drive means located above the level of said lower track for moving said supporting means, flexible means for transmitting motion from said drive means to said supporting means and platform tilting means comprising a platform carrying element pivotally mounted on said supporting means and pivotally supporting said platform means, and stop means associated with said upper track and engageable with a portion of said platform means

for tilting said platform means with respect to said platform carrying element when said track means reach a position in register with said upper track.

4. In a foundry car lift comprising an upper and a lower track, platform means having track means thereon and movable between a position where said track means form a continuation of said lower track and a position where they form a continuation of said upper track, moving means for moving said platform means between said positions, and control means actuated only during the upward movement of said platform for stopping said platform at a position intermediate its extreme positions, the improvement comprising said moving means including a drive element operated by hydraulic fluid pressure, compressed gas means for controlling the flow of said hydarulic fluid, and said control means including a valve positioned in the hydraulic fluid supply line to said drive element for preventing reverse flow of hydraulic fluid when said platform receives a load at said intermediate position.

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