Sept. 1, 1964 R. B. DOORLEY 3,146,728

CAR SPOTTER WITH RETARDING ACTION

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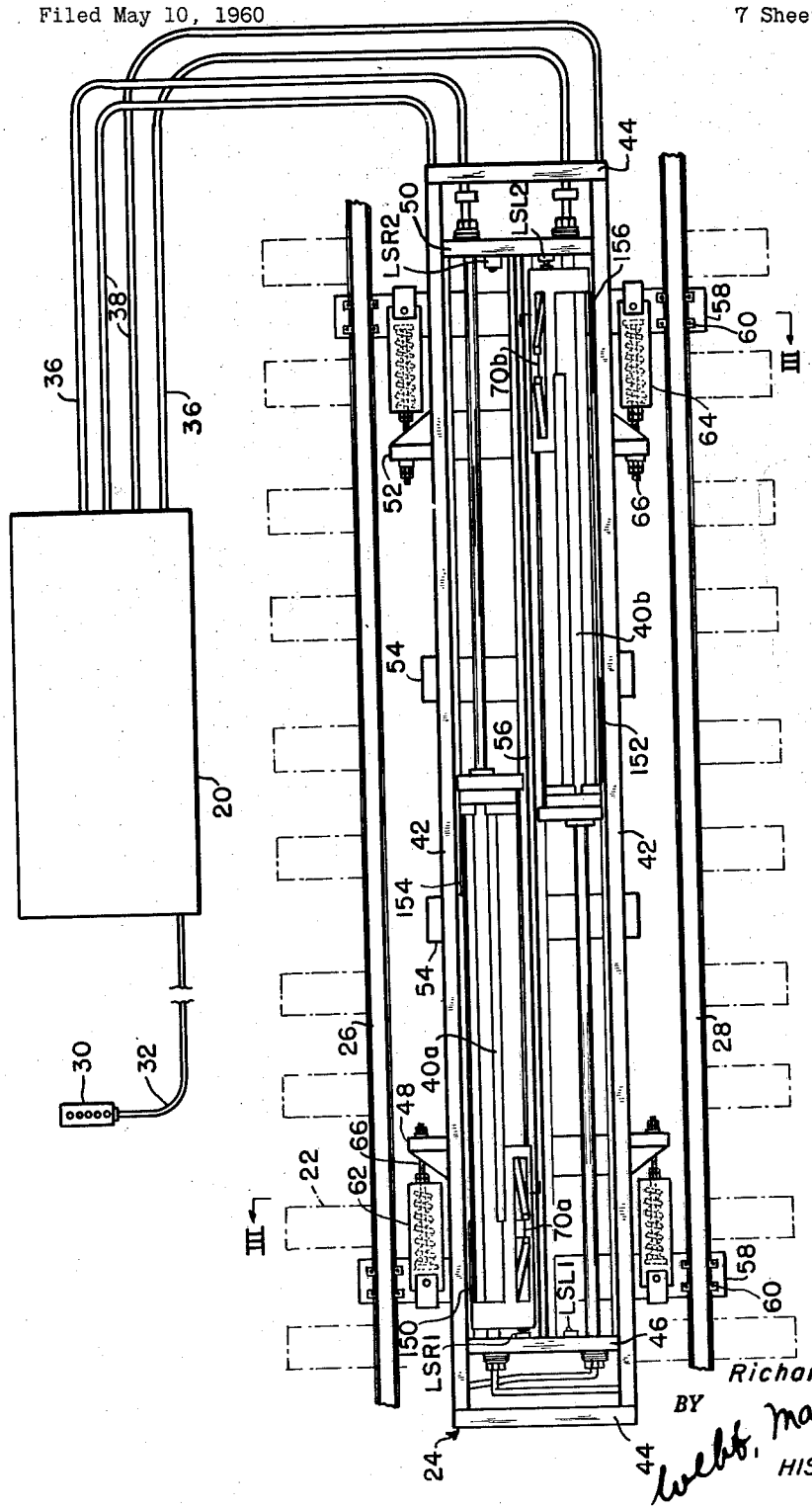


Fig. 1

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Sept. 1, 1964 R. B. DOORLEY 3,146,728

CAR SPOTTER WITH RETARDING ACTION

Filed May 10, 1960 7 Sheets-Sheet 2

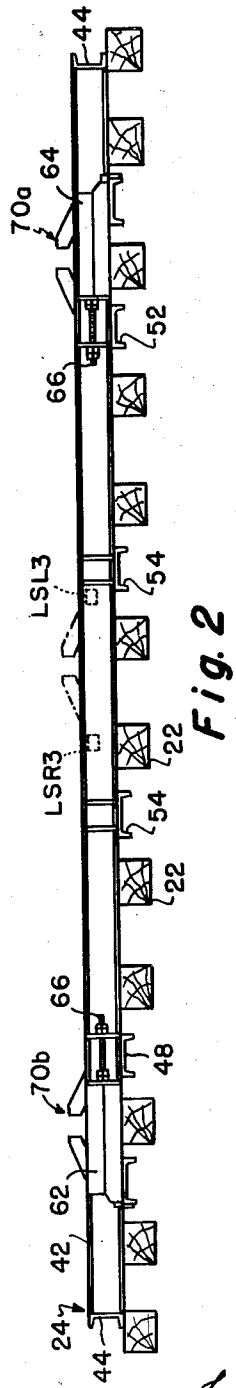


Fig. 2

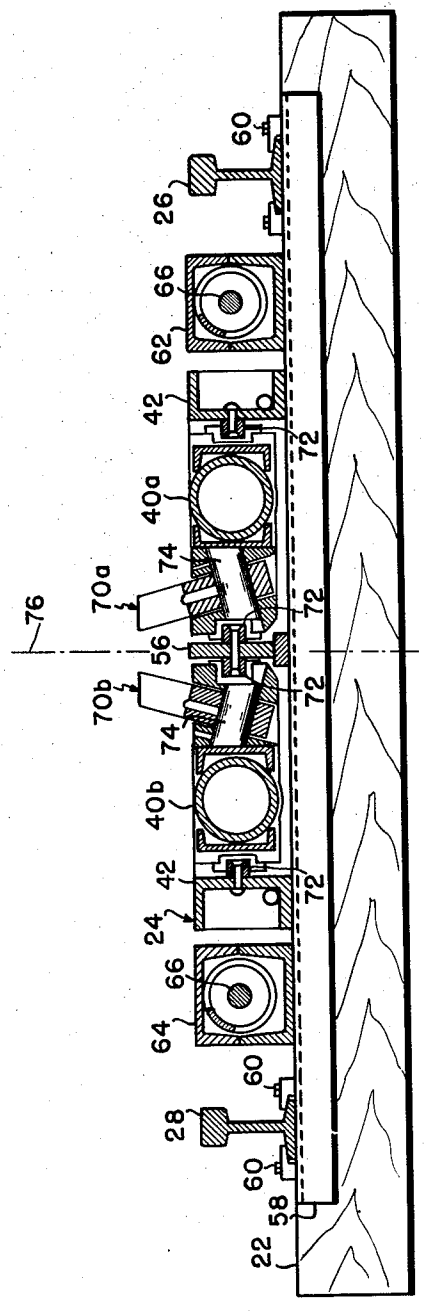


Fig. 3

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CAR SPOTTER WITH RETARDING ACTION

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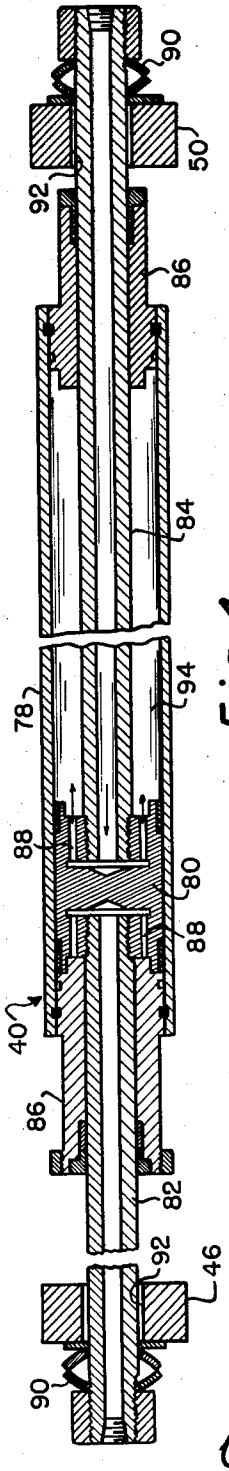


Fig. 4

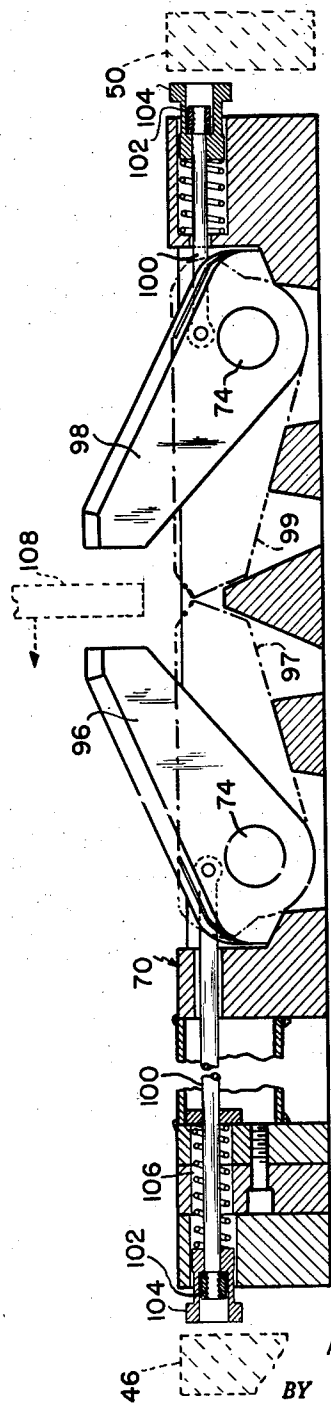


Fig. 5

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CAR SPOTTER WITH RETARDING ACTION

Filed May 10, 1960 7 Sheets-Sheet 4

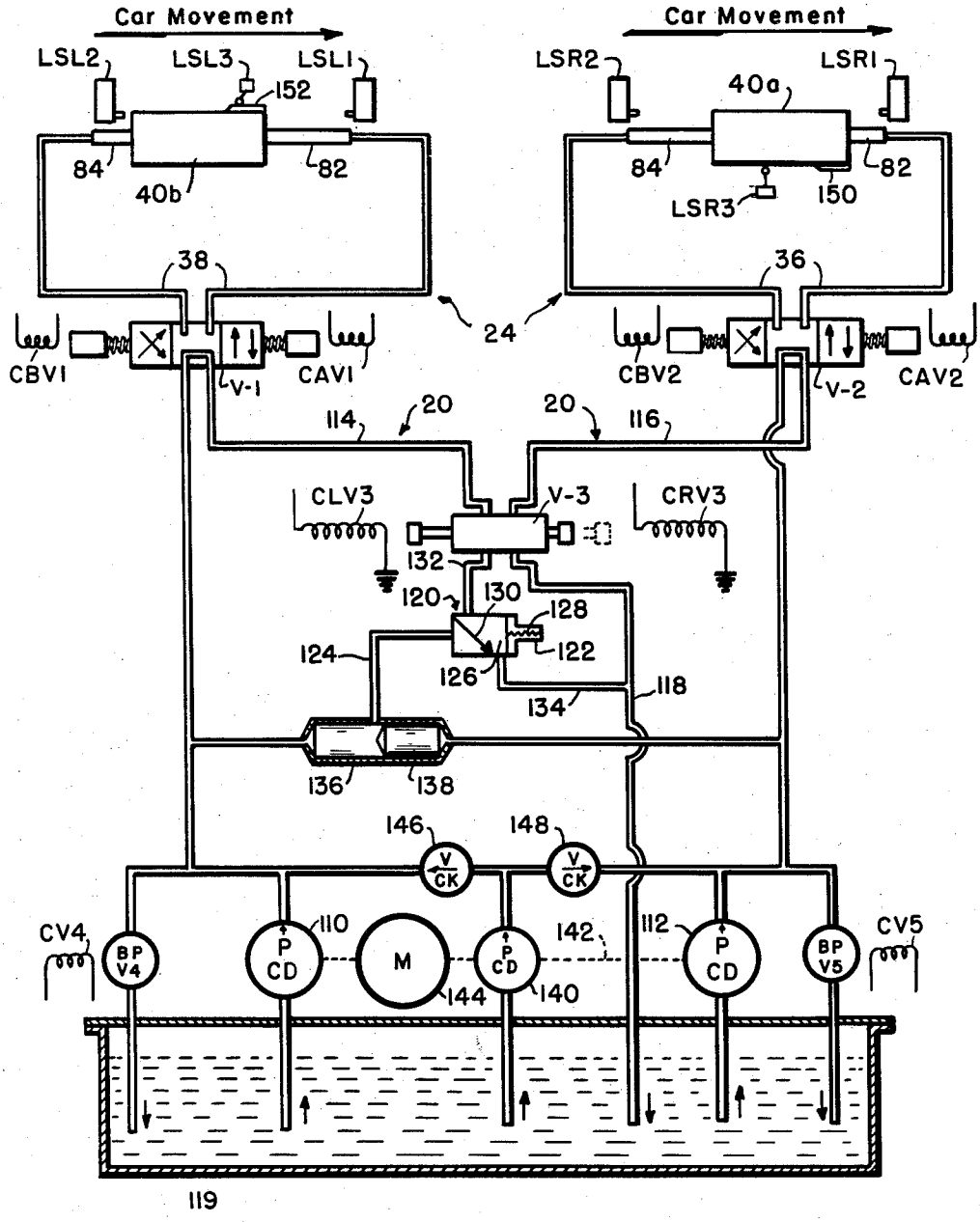


Fig. 6

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CAR SPOTTER WITH RETARDING ACTION

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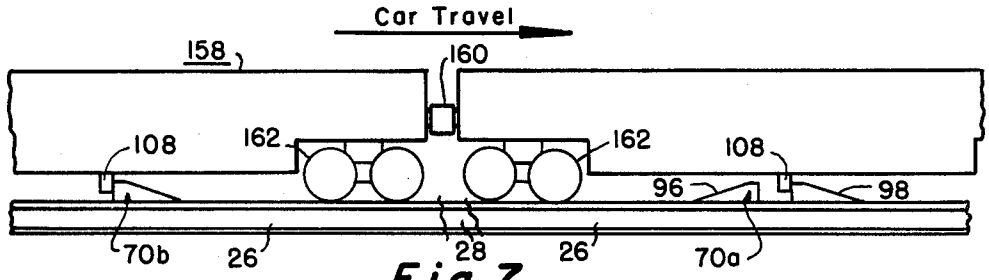


Fig. 7

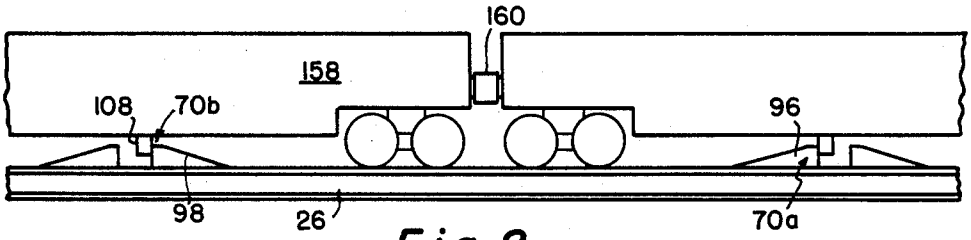


Fig. 8

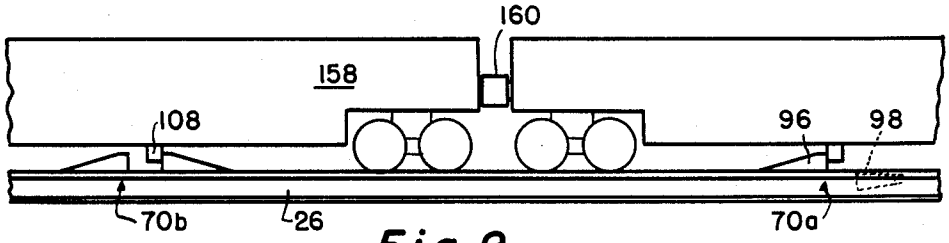


Fig. 9

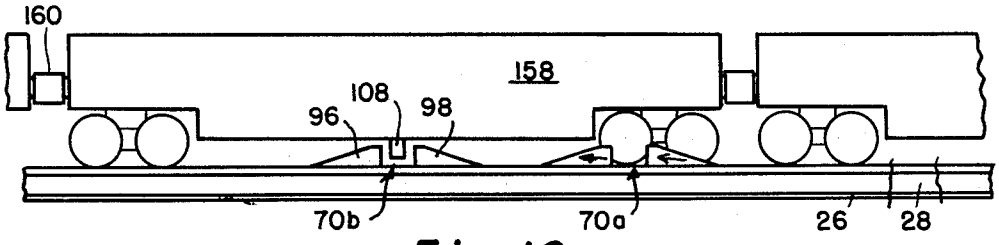


Fig. 10

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CAR SPOTTER WITH RETARDING ACTION

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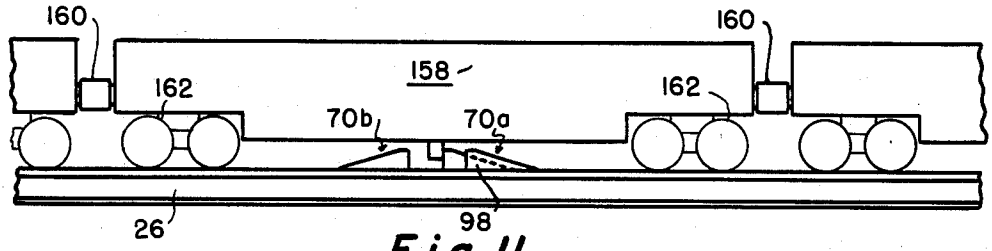


Fig. 11

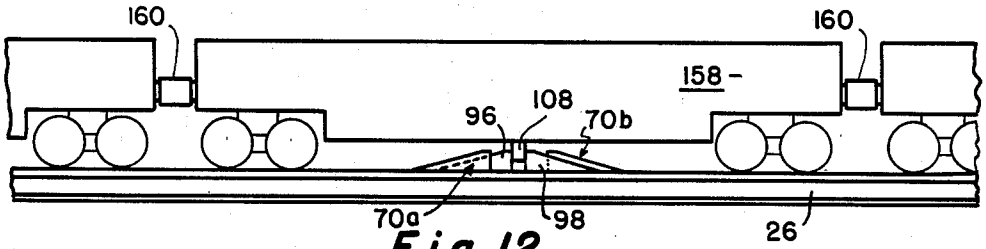


Fig. 12

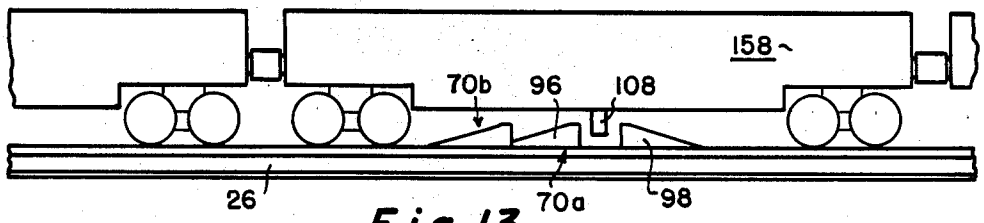


Fig. 13

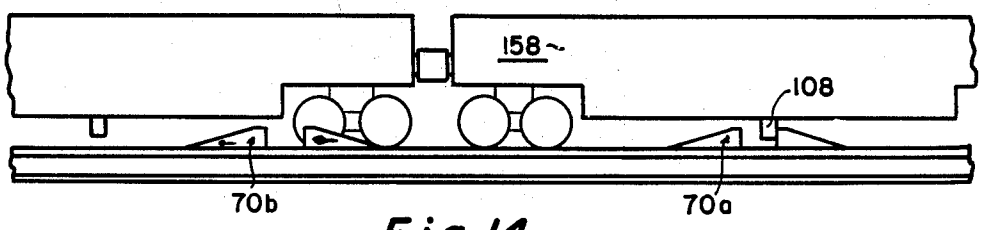


Fig. 14

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Sept. 1, 1964 R. B. DOORLEY 3,146,728

CAR SPOTTER WITH RETARDING ACTION

Filed May 10, 1960 7 Sheets-Sheet 7

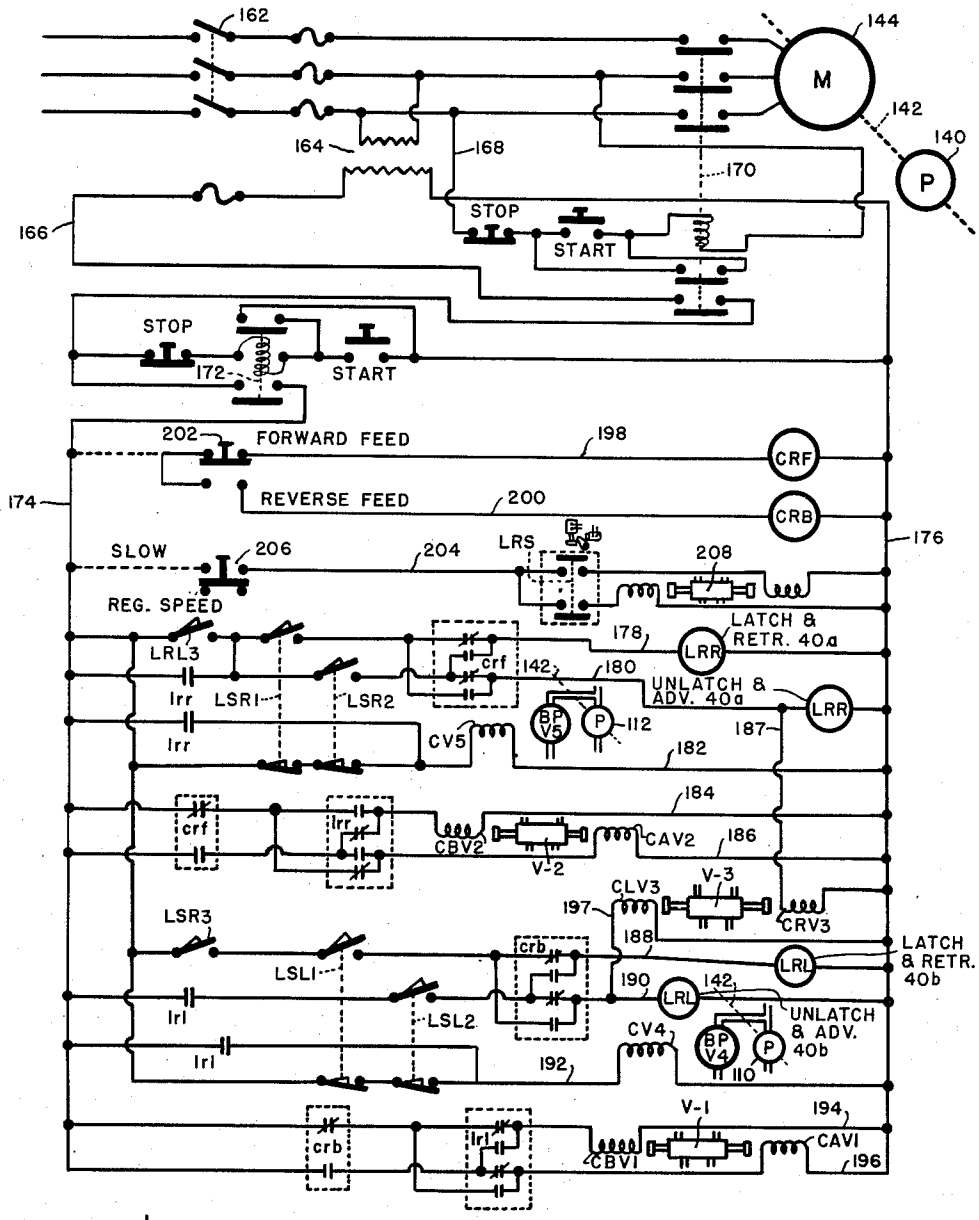


Fig. 15

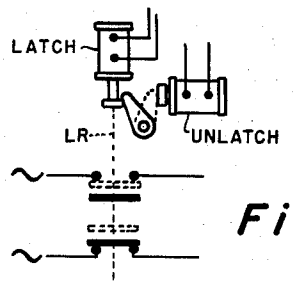


Fig. 16

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United States Patent Office 3,146,728 Patented Sept. 1, 1964

3,146,728

CAR SPOTTER WITH RETARDING ACTION

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Filed May 10, 1960, Ser. No. 28,038
14 Claims. (Cl. 104—162)

This application relates to a car spotter with retarding action. It more particularly relates to a spotter for sequentially positioning an intercoupled series or trip of track-borne mine cars adjacent a loader, the object being to keep the cars moving step by step as each one, or as portions of each one, are loaded with mine material such as coal, ore, slate, rock, or the like.

Car spotting, according to the present invention, requires disposing guided feeders in a suspended position in a track bed, which feeders act in alternation to one another with relatively short strokes and which engage lugs provided in the cars on the track so as to move them as indicated for feeding sequentially past a trackside loader. Each of the feeders, and they are customarily provided in pairs, consists of a guided hydraulically actuated slide carrying double pawls for two-way action. The paired slides, commonly referred to as barneys in mine car work, are mounted in a common track unit framework along with appropriate hydraulic cylinders for the necessary hydraulic actuation to reciprocate the feeders. Their movement is, in the main, out of phase with one another so that one slide reaching its most advanced position of reciprocation may be retracted and restarted while another continues the active advance of the line of mine cars in the trip. For securing this coordination, the present invention relies solely on the interaction of hydraulic controls which give the system complete freedom from mechanical interconnection as between one of the cylinders and its barney slide and the companion cylinder of the pair and its barney slide.

The noted hydraulic interaction of the controls in this invention enables the track unit to have relatively short length mechanically in terms of the effective hydraulic cylinder stroke and the transverse dimensions of the cylinders and barneys enable each pair to readily fit side by side within the physical gauge of the rails constituting the car track.

The double-pawl control lends itself to and, in fact, makes possible several significant features which are provided in this spotter inventon in addition to the customary push-feed function, namely: two-way feed control; automatic retarding action so that the cars can be readily controlled irrespective of upgrade, downgrade, or level feed conditions of the track; reversible feed; and finally, a safe and substantially fool-proof operation owing to the fact that electrically interlocked hydraulic barney circuits are a fully compatible addition to the double-pawl control simply through the provisions of appropriate interlocking switches associated with the barney cylinders.

The method and apparatus which comprise this invention accomplish the foregoing and other functions in novel way, as will now be explained. Further features, objects and advantages will either be specifically pointed out or become apparent when, for a better understanding of the invention, reference is made to the following written description taken in conjunction with the accompanying drawings which form a part hereof and in which:

FIGURE 1 is a plan view of a car spotter installation embodying the present invention;

FIGURE 2 is a side elevational view;

FIGURE 3 is a transverse sectional view taken along the lines III—III of FIGURE 1;

FIGURES 4 and 5 are longitudinal sectional views of the barney connected cylinders and barneys respectively in the spotter of FIGURE 1;

FIGURE 6 is a schematic hydraulic diagram showing controls for the present spotter;

FIGURES 7–14 are sequence views of the spotter in operation;

FIGURE 15 is a schematic electrical diagram showing controls for the spotter; and

FIGURE 16 is a schematic view of a latching relay detail appearing in FIGURE 15.

More particularly, in FIGURES 1, 2 and 3 of the drawings, the spotter is a multiple-unit apparatus comprising a motor and hydraulic pump unit **20** disposed in a track-side location offset from the line of ties **22** in a mine car track bed, a track unit **24** disposed between and suspended from the rails **26** and **28** of a two-rail track on the ties in the track bed, and a push button type remote control unit **30** which is connected by a 20-foot electrical cable **32** to a motor and pump unit **20** to control the operation of the track unit **24**. Two hoses **36** leading from the unit **20** connect pumps thereon (not shown) to the opposite ends of a right barney cylinder **40***a* and two hoses **38** leading from the unit **20** connect pumps thereon (not shown) to the opposite ends of a companion left barney cylinder **40***b*.

The cylinders **40***a* and **40***b* are in the track unit **24**, being reciprocally mounted in a frame therein including two longitudinal members **42** which are disposed one at each side of the frame and which are joined together at their opposite ends by a pair of short end cross members **44**. At the front end, there is a cylinder supporting cross member **46** and a snubber attachment cross member **48** there adjacent which are joined to the longitudinal members **42**. At the rear end, the longitudinal members **42** are further joined together by means of another cylinder supporting cross member **50** and another snubber attachment cross member **52**. Intermediate frame cross members are indicated at **54** and they cooperate with the other cross members to support a central longitudinal frame member **56**.

Adjacent each end, the longitudinal frame members **42** rest on a common track-attachment cross member **58** which bridges between the opposite track rails **26** and **28**, being secured to the lower flanges of each by means of appropriate lugs and bolts **60**. A spaced apart pair of longitudinal snubbers **64** connected between each end of the snubber attachment member **48** and the adjacent track cross members **58** cooperates with another longitudinally extending pair of snubbers **64** connected between each end of the snubber attachment member **52** and the adjacent rail cross member **58** so as to afford a spring centering action on the frame of the unit **24** enabling it to recoil a few inches each way to shock in the longitudinal direction. Each of the snubbers **64** has a protruding spike **66** providing a lost motion connection in conventional fashion with the adjacent snubber attachment cross member so as to allow the springs of the snubbers to be preloaded and give one-way action in opposed yield directions to one another.

A double-pawl barney **70***a* is secured to the right barney cylinder **40***a* to form a slide and rides on longitudinal guides **72** carried by the adjacent longitudinal frame

members 42 and 56. Similarly, a double-pawl barney 70*b* is secured to the left barney cylinder 40*b* to form a slide and rides on corresponding longitudinally extending guides 72. The pivot pin 74 for the double pawls on the barneys are disposed in vertical planes transverse to the track unit frame in a manner sloping inwardly and downwardly with respect to a longitudinal midplane 76 through the track unit 24 so that with respect to the latter, the pawls cant inwardly; they thus minimize any tendency of producing offset loading with respect to the centerline of the cars (not shown) to be spotted. The attachment of the pawls of the barneys 70*a* and 70*b* to noncorresponding ends of their respective cylinders is a feature of practical importance because it affords parallel stroke paths which, for their major portion, are staggered in the longitudinal direction and yet the cylinders and cylinder attachment cross members 46 and 50 retain a square relationship to one another consistent with minimal overall length.

The general reference numeral 40 in FIGURE 4 designates one but no particular one of the cylinders previously referred to which are identical to one another. It has an outside, double-acting cylinder member 78 which constitutes the movable or working element and which slidably receives the stationary element consisting of a piston 80. Two fixed hollow rods 82 and 84 are threaded axially into the piston 80 at opposite sides and extend in opposite directions from each of the respective ends of the cylinder member 78 through a sealed end closure means 86 at that end. A series of small axial passages 88 in opposite sides of the piston establish communication between the hollow interior of the rods 82 and 84 and the working chamber space in the cylinder member 78 defined between each side of the piston 80 and the confronting end closure means 86.

The cylinder 40 slides relative to the piston 80 and the fixed rods in a path between the two cylinder-supporting frame cross members 46 and 50. The rods 82 and 84 are held prestressed under tension by Belleville spring units each consisting of a stack of dished washers 90 which are compressed by a nut at a point on each rod adjacent an oversize opening 92 wherefrom it emerges outwardly from each cylinder-supporting frame cross member. One of the opposite working chambers within the cylinder member 78 is indicated at 94, wherein it can be seen that internally applied pressure for driving the cylinder will cause the associated piston rod 84 to be placed under further tension, resulting in the desirable condition whereby the rods are consistently under tension to obviate any tendency to buckle. The oversize openings 92 at their opposite ends allow the rods to float both axially and in the plane of the openings in the cylinder-supporting frame cross members and, thus, cures expansion and misalignment problems together with other irregularities which are encountered in the installation.

In FIGURE 5, the general reference numeral 70 indicates either one of the barneys previously referred to which in principle are of the same design. The double-pawls thereon consist of a working dog or pawl 96 pivoted on one of the pins 74 and an opposing dragging or retarding dog 98 pivoted on the other pin 74. Individual pull rods 100 support the pawls in the solid line position shown, from which they are pivoted into the inoperative dotted line positions shown by the respective dotted lines 97 and 99. Each pull rod has an enlarged head 102 forming a lost motion connection with and received in the socket of a pawl-controlling plunger 104. When, due to movement of the appropriate barney cylinder, the plungers 104 are brought into contact with the cylinder-supporting cross member 46 and the cylinder supporting cross member 50 at either opposite end of the cylinder strokes, the plunger compresses a return spring 106 allowing the enlarged head of the associated pull rod to follow the socket of the plunger as the associated pawl tends by gravity to pivot to its inoperative position. The return spring 106 is thereafter effective to re-erect the pawl as soon as the plunger 104 is separated from the associated cross member. In one physically constructed embodiment of the invention, the clearance gap between the opposing pawls 96 and 98 was sufficient to allow a car lug indicated at 108 to move between two and three inches in transferring from contact with one of the pawls to the opposed pawl.

In FIGURE 6, one main pump 110 in the motor and pump unit 20 delivers hydraulic fluid under pressure to the left barney cylinder 40*b* in the track unit 24 and a companion main pump 112 delivers hydraulic fluid to the right barney cylinder 40*a* in the track unit 24. A solenoid-controlled, three-position valve V1 is illustrated in its spring-centered "off" position from which it can be moved by the respective solenoid coils CBV1 and CAV1 to control the application and the exhausting of hydraulic fluid with respect to the opposite working chambers within the cylinder 40*b* supplied by the main pump 110. Another valve V2 in the motor and pump unit 20 is controlled by similar solenoids CBV2 and CAV2 to connect the main pump 112 and the right barney cylinder 40*a*. The hydraulic fluid lines 38 previously discussed establish communication between the conduit forming, hollow interior of the fixed piston rods 82 and 84 of the barney cylinder 40*b* and the valve V1; and the hydraulic fluid lines 36 establish communication between the hollow interior of the piston rods 82 and 84 of the cylinder 40*a* and the valve V2.

The outflow from the cylinders is conducted by the valves V1 and V2 through a discharge path having separate portions 114 and 116 which reach a juncture at 118 in a common discharge line which returns the exhausted fluid to a common sump 119. It is desirable that the valves V1 and V2 operate to respective right and left barney cylinders 40*a* and 40*b* generally out of phase with one another, enabling one to make a rapid recovery stroke while the other continues the advance of the load of cars. Because of the fact that each barney carries a double pawl, as above indicated, it is further desirable, when the barney is functioning to retard, that in their brief period of overlap while the load is being transferred from one barney to the other, that the barneys avoid a load-sharing relationship and, instead, operate according to the unobvious manner of a load-opposing relationship to another; in this manner, they can free the barney about to reach its most advanced position to insure that it leads, but never lags behind, the load. When functioning to feed the cars, rather than to retard, the barneys tend to share the load during the load transferring period, thereby requiring less power input than would be used if the load opposing relationship were maintained. The choosing between the load opposing and load sharing relationships is accomplished by a pressure responsive rate control means and is a function of whether the trip load is positive (resistive) or negative (overhauling) irrespective of the direction of feed.

Rate control means may be provided causing, among other things, the load-receiving barney to start off in load-opposing relation to the load-releasing barney, thus relieving the load-releasing cylinder from speed regulation so that it can move unimpededly ahead with its barney to clear the retarding pawl from possible interference with the car lug which almost immediately passes thereover as soon as the latter barney reaches its fully advanced position.

Third pump means may be provided as double insurance that the foregoing takes place, so as to cause that load-releasing barney to actually strike ahead by accelerating the load-releasing cylinder immediately prior to the latter reaching its fully advanced position. An equally, if not more important result of providing the third pump means, is that it insures that the load-releasing barney, while retracting, will negotiate its recovery stroke to the fully reset position in rapid fashion so as to allow a margin of time to await the next car lug.

Illustrative of a rate control means suited to the above purpose is piloted throttle valve **120** which is common to the second-discussed path portions **114** and **116** from the outlet. It comprises an exterior casing **122** connected to the pressure of a pump discharge line **124** and a valve body **126** disposed in the casing **132** for transverse movement. The valve body **126** is urged to the left as viewed in FIGURE 6, i.e., against the pressure in line **124**, by means of an adjustable force spring **128**. The valve body **126** is provided with a fluid flow passage **130** alignable, to produce a progressively throttling effect, with a flow passage **132** and a return passage **134** connected to the common discharge juncture **118** in the return to sump, when the pressure in the line **124** overcomes the mechanical force of the spring **128**.

A selector valve V3, controlled by the solenoids CLV3 and CRV3 respectively selectively connects or cross connects the second fluid passage portions **114** and **116**, one or the other, to the flow passage **132** so that the entire oil ejected from the discharge side of the appropriate one of the cylinders **40***a* and **40***b* passes through the throttle valve **120**, whereas the discharge from the other cylinder goes directly to the common discharge juncture **118** for return to sump. Thus, the valve **120** affords a regulated rate control to brake the appropriate cylinder for automatically retarding the trip of cars when necessary.

A shuttle valve in the center of FIGURE 6 has a casing **136** communicating at the opposite ends with the discharge head from the respective main pumps **110** and **112** and a shuttle element **138** disposed in the casing **136** moves transversely in response to the discharge pressure from the pumps **110** and **112**. It is evident that the pressure applying means constituted by the element **138** and the flow passage **124** selectively communicates piloting pressure to the piloted throttle valve **120** from one of the individual pump discharge fluid paths having the higher pressure. Thus, despite the fact that the entire oil ejected from the discharge side of the working one of the cylinders **40***a* or **40***b* must pass through the rate control throttle valve **120**, the working cylinder receives compensation. In other words, as the work load effort increases as evidenced by the fact that the pump discharge pressure increases, piloted valve element **126** offers automatically decreasing resistance to flow in the valve **120** in proportion to the increasing control pressure communicated thereto through the fluid flow passage **124**.

Illustrative of such third pump means is the augmenting pump **140** of FIGURE 6 which is mounted on a shaft **142** common to the two main pumps **110** and **112**. A single motor **144** drives the common shaft **142**. The third pump **140** has a split output which is made common to the individual pump discharge paths of the pumps **110** and **112** through valves **146** and **148**, respectively; these latter valves constitute one-way check valves, however, preventing the higher pump output discharge pressure from escaping to the discharge of the other main pump and at the same time enabling the output from the third pump **140** to join with the discharge flow from the other main pump which makes the higher volume of flow available to the barney cylinder moving toward its fully reset position in a rapidly executed recovery stroke. Obviously, the output of the augmenting pump **140** seeks the path of least resistance so that as either main pump is bypassed, so also the pump **140** is being bypassed by same combination pressure relief and bypass valve unit BPV4 or BPV5 as appropriate.

It is evident that a high discharge pressure from the main pumps **110** and **112** is not only unnecessary but in general undesirable when cylinders **40***a* and **40***b* are idle at the extreme ends of their strokes. Therefore, controlled pressure relief valve units just noted at BPV4 and BPV5 and schematically illustrated in FIGURE 6 are installed in bypassing relationship to the main pumps and, as shown, they are held open by respective control valve solenoids CV4 and CV5. In practice, however, they will preferably include piloted throttle valves of the counterbalance type so that, while thus held open, these units will nevertheless afford progressively less and less relief as the discharge pressure drops below a preset maximum and which, when the units are closed owing to deenergization of the solenoids CV4 and CV5, restore the pumps immediately to unbypassed, full operation.

They thus prevent the pumps from unnecessarily heating while idle.

To insure against unnecessary damage to the system, it is preferred that the opposite working chambers of each cylinder **40***a* and **40***b* be interconnected through a conventional safety device such as a dual relief valve (not shown), which is pre-loaded to unseat two-ways in response to excessive pressure either way. In this manner the piston is prevented from hydraulically locking the cylinder immovably in such a situation as where a locomotive bumps the minecars while they are being positioned by the car spotter.

Each step in the use of the present spotter apparatus may, if desired, be separately actuated or manually performed, but it is preferred to join the operation of all steps through provision of automatic electric control circuits including limit and interlocking switches positioned about the apparatus so as to be actuated at the right time. These switches and their actuators will be described briefly and thereafter a more detailed description of the sequential operation of the spotter and its control circuits will be given.

Limit switches LSL1 and LSR1.—These switches which include both normally open and normally closed sets of contacts are mounted in line with the respective left and right barney cylinders **40***b* and **40***a* according to FIGURES 1 and 6 and they are operated by the cylinders reaching their fully advanced position when car movement is in the direction shown. Among other results, the bypass valves BPV4 and BPV5 for the main pumps operatively open in response to these switches to stop the cylinder advance, and the cylinder control valve circuits (not shown) prepare to reverse the appropriate cylinder although momentarily prevented therefrom by means of interlock switches described below.

Limit switches LSL2 and LSR2.—These switches which include both normally open and normally closed contacts are mounted in line with the rear end of the barney cylinders **40***b* and **40***a*, respectively, and they are operated by the barneys reaching their fully reset positions when car movement is in the direction shown. Among other results, the pump bypass valves BPV4 and BPV5 operatively open to disable the main pumps in response to actuation of these switches and the barney cylinder valves V1 and V2 are reversed each at a point to await its next stroke of advance despite the fact that the associated main pump is temporarily disabled.

Interlock switches LSL3 and LSR3.—These fixed switches are mounted at the side of the paths of motion of the respective barney cylinders **40***b* and **40***a* according to FIGURES 2 and 6 and they are cam-released thereby to close only after predetermined initial movement of each cylinder. Among other results, the other cylinder which has completed its working phase is caused to commence a recovery stroke to its fully reset position in response to closure of the appropriate one of the switches.

Interlock switch actuating cams 150, 152, 154 and 156.—These cams are carried on the sides of the barneys and barney cylinders **40***a* and **40***b* at the front and rear, respectively. The cams **150** and **152**, according to FIGURES 1 and 6, establish continuous disabling contact with (by holding open) the respective limit switches LSR3 and LSL3 so long as, and only so long as, the barney cylinders are effecting predetermined initial forward movement from their fully reset positions. The companion cams **154** and **156** are omitted from FIGURE 6 to simplify the understanding of the operation, but are

briefly referred to hereinafter following a discussion of the cams 150 and 152.

Consecutive FIGURES 7–14, inclusive, show a sequence of operation of the double-pawl barney 70*b* as it is assisted by and assists the other barney 70*a* in moving a car lug 108 for the full length of the track unit. In FIGURES 10 and 13 thereof, the car lug 108 is shown in the ideal midposition between the work and retarding pawls 96 and 98 of the working barney 70*b*; in practice, however, when the car rails 26 and 28 are level or on an upgrade, the lug 108 will ride against the work pawls 96, whereas, on the downgrade, the cars will be tending to run ahead under gravity and the car lug 108 will drag against the retarding pawl 98.

In FIGURE 7, a mine car 158 has a coupling at the front at 160 to the preceding car in the direction of car movement shown by the arrow and has a similar coupling at the rear to the next car. Each car further has a four-wheel truck 162 at the front and another four-wheel truck at the rear by which it rolls on the supporting track rails 26 and 28. The lug 108 on the car 158 is shown at the moment of contact with one of the double pawls of the barney 70*b* of which, in the fully reset position shown, the retarding pawl is the only one in the operative position. The line of cars is at the moment under full control of the right barney 70*a*.

The car lug shown between the pawls of the double-pawl barney 70*a* illustrates the most difficult condition to control, namely, an overhauling situation in which the car lug continues to ride the retarding pawl 98 due to momentum or to the force of gravity on the cars.

In FIGURE 8, the left barney 70*b* has been advanced sufficiently from the position of FIGURE 7 by the movement of car 158 so that both pawls are in their operative position and the retarding pawl 98 thereof restrains the rate of advance of the lug 108 of the car 158. Meantime, the unloaded barney 70*a* has accelerated so that irrespective of whether the tracks have a grade or not, the work pawl 96 thereof strikes ahead faster than the car movement so as to engage the car lug on the preceding car.

In FIGURE 9, the right barney 70*a* has progressed from the position of FIGURE 8 and reached its fully advanced position where the retarding barney pawl 98 is inoperative and where the car lug is free to separate from the work pawl 96 and leave the right barney. Meantime, the lug 108 on the car 158 is disposed at some point between the pawls of the double-pawl left barney 70*b* which is exerting full control over the car 158 and the others in the line.

FIGURE 10 illustrates the same condition as FIGURE 9 except that the double-pawl right barney 70*a* is proceeding on its rapid recovery stroke toward the reset position.

In FIGURE 11, the right barney 70*a* has reached its fully reset position with only its retarding pawl 98 occupying the operative position.

In FIGURE 12, the same as FIGURE 11, the left barney 70*b* has control of the car 158 but the car lug 108 has meantime progressed to a point advancing the double-pawl barney 70*a* sufficiently that the work pawl 96 thereof pivots upwardly but rides free of contact with the car lug. The retarding pawl 98 of the right-hand barney 70*a* in the foreground is in contact with and resists the lug 108 on the car 158 allowing the work pawl 96 of the left barney 70*b* in the background to accelerate into contact with the lug 108 so that the other pawl of the barney 70*b* rides free.

In FIGURE 13, the left barney 70*b* is shown fully advanced with its work pawl only in the operative position; the lug 108 on the car 158 is between the pawls of and under the control of the right barney 70*a*.

In FIGURE 14, the double-pawl barney 70*b* is shown in progress through a recovery stroke toward the fully reset position of FIGURE 7, whereas the car lug 108 continues under the control of the right barney 70*a*.

Following is an example of the dimensions and ratings of components for one physically constructed embodiment of the invention.

Track gauge	4′ 8½″.
Stroke per cylinder	7′ 2½″.
Total stroke of track unit 24	13′ 5″.
Gap between opposing pawls 96 and 98	3¾″.
Length of piston 80	7′ ⅛″.
Length of cylinder member 78	8′ 2⅝″ without closure members 9′ 1⅛″ with closure members 86.
Rating of motor 144	40 H.P.
Capacity per main pump	30 g.p.m.
Capacity of augmenting pump 140	10 g.p.m.
Maximum operative pressure in system	2,000 p.s.i.

A specific example of the manner in which the referred to limit and interlock switches can be connected in an automatic electrical control circuit is illustrated in FIGURE 15. For purposes of clarity, the illustrated diagram is executed in conventional manner of schematically showing control and power circuits, the relays in large part not being shown mechanically connected to the relay switch contacts operated thereby; the solenoids or relay operators being indicated by capital letters and the switch contacts operated thereby being shown by corresponding small letters. Switches which are normally closed have a diagonal line extending across the symbol.

In FIGURE 15, the common pump motor 144 shown at the head of the diagram has three phase power made available thereto from service lines through a master switch 162. A transformer 164 connected across two of the phases supplies low voltage control current to a control circuit 166, whereas another circuit 168 connected across the two phases includes a stop and a start switch at the points indicated in series with the coil of a relay switch 170 which is operated for running the motor 144. Operation of the switch 170, in addition, causes the lower contacts thereof to connect the control circuit 166 across the output leads of the transformer 164.

The control circuit 166 includes a start and a stop switch which are indicated in series with the coil of a holding type relay switch 172, the lower contacts of which energize a feed conductor 174 in the control circuit. Current flows from the conductor 174 to a companion return conductor 176 through circuits as follows: Circuits 178 and 180 contain the dual coils LRR and LRR of a latching relay which latches and unlatches for respectively retracting and advancting the right barney cylinder 40*a* as indicated in FIGURE 15 and an adjacent circuit 182 contains the valve solenoid CV5 for closing the bypass valve BPV5 to keep the main pump 112 operative so long as the barney cylinder 40*a* is moving toward fully advanced or fully reset position.

When FIGURE 15 is considered in conjunction with FIGURE 1, it is noted that the right barney cylinder 40*a* in its fully advanced position operates the limit switch LSR1 to operate the two sets of contacts thereof, thus preparing the circuit 178 for operation and deenergizing the circuit 182 and bypass solenoid CV5 therein to immobilize the main pump 112 whereby the cylinder 40*a* can advance no further. From an examination of FIGURE 15 in conjunction with FIGURE 6, it is noted that the load receiving barney cylinder 40*b* once having undertaken the load, will move the cam 152 out of disabling contact with the interlock switch LSL3, thus completing the circuit 178 so that the latching coil LRR of the latching relay forthwith causes the barney cylinder 40*a* to retract, simultaneously releasing the limit switch LSR1 so that it resumes its solid line position shown. The speed with which the cylinders retract to reset position is quite high, averaging about 65 f.p.m. in one physically constructed embodiment of the invention.

In considering FIGURE 15 in conjunction with FIGURE 11, it is noted that when the right barney **70***a* and the right barney cylinder *40a* are fully reset so as to actuate the limit switch LSR2, the upper contacts of the switch LSR2 conduct current from the temporarily closed latching relay contacts *lrr* through the circuit **180** to the unlatching coil LRR of the latching relay to prepare the right barney cylinder **40***a* for a stroke of advance; simultaneously, the lower contacts of the limit switch LSR2 open so to deenergize the circuit **182** for disabling the main pump **112** whereby the right barney cylinder *40a* is momentarily rendered unable to advance. In considering FIGURE 15 in conjunction with FIGURE 12, it is noted that if and when, and only if and when the right barney **70***a* connected to the right barney cylinder **40***a* has been dragged by an oncoming lug **108**, if any, a predetermined initial amount from fully reset position, the limit switch LSR2 will be released thereby and thereupon the circuit **182** which controls the bypass valve BPV5 is reenergized so that the pump **112** is restored to fully operative condition enabling the barney to get back into action.

The dual coil latching relay referred to has sets of normally open contacts *lrr* in a pair of parallel circuits **184** and **186** which cooperatively include the respective coils CBV2 and CAV2 for operating the valve V2 whereby the right barney cylinder *40a* will move and take the required direction when it starts to move.

The reset-responsive circuit **180** has a branch **187** including one of the control solenoids CRV3 which operates the rate control selector valve V3. Therefore, the instant that the right barney cylinder *40a* reaches its fully reset position so as to contact the switch LSR2, the result is that the circuit branch **187** is completed and the valve V3 removes the rate control from the working cylinder **40***b* and inserts the rate control in the outlet of the cylinder **40***a*. The completion of the circuit branch is made possible owing to the fact that the latching relay contacts *lrr* will remain closed in the main circuit **180** until the instant at which the limit switch LSR2 is contacted and completes that circuit, whereupon the latching relay unlatches and the contacts *lrr* thereof in the circuit **180** immediately open the circuit **180**.

In FIGURE 15, a similar series of circuits **188**, **190**, **192**, **194**, **196** and **197** is operated by a set of similar switches as indicated to control the dual coils LRL and LRL and single coils CV4, CBV1, CAV1, and CLV3 for operating the various latching relay and valve **V1**, **V3** and BPV4 for controlling the cylinder *40b*. The operation is apparent from the preceding discussion and is unnecessary to be detailed here.

The provision of circuits **198** and **200** in FIGURE 15 enables the sense of the valves V1 and V2 to be changed for reverse feed so that the cars will move from right to left, as viewed in FIGURES 7–14, instead of as previously described. A switch **202** controlling the circuits **198** and **200** has a double effect when moved from its upper to its lower position. In so moving, it first deenergizes a control relay CRF whose contacts *crf* in the circuits **184** and **186** forthwith cause the function of the solenoids CBV2 and CAV2 to be interchanged; thus the valve V2 and the advance stroke for the cylinder **40***a* takes a different direction from the one previously taken and so does the retraction stroke. Secondly, the relay CRB in the circuit **200** has contacts *crb* in the respective circuits **194** and **196** which due to energization of that relay by switch **202** reverse the sense of the valve V1 by electrically interchanging the functions of the respective solenoids CBV1 and CAV1. Thus, the stroke of advance of the barney cylinder **40***b* is in the opposite direction from previously and a similar change is effected in the retractive stroke. Current is continuously supplied to the switch **202** at or before the time the control circuit **166** is energized, and for convenience in the schematic, a dotted line connection is shown leading directly from the switch to the adjacent feed conductor **174** in FIGURE 15.

In a manner known to the art, it is apparent that if a circuit **204** is provided with a proper manual switch **206** and a latching relay LRS, this circuit can be employed to control a suitable bypass valve **208** common to the main pump discharges. By automatically bypassing the main pumps a proper amount at the right time, the barney cylinders **40***a* and **40***b* can be appreciably slowed down for service, installation, and trouble shooting purposes.

A latching relay under the general designation LR schematically appears in FIGURE 16. The coil marked "latch" corresponds to the upper coil LRR and the other upper coil LRL and the uppermost appearing coil of the latching relay LRS, all of FIGURE 15. The coil marked "unlatch" corresponds to the lowermost coils of the dual coil latching relays of FIGURE 15.

Preparatory to a spotting operation, a trip of cars which can be assumed to be empty is drawn by and immediately uncoupled from a locomotive or the like which has moved the trip onto the track section in which the spotter has been temporarily anchored. The operator positions the spotter switch **202** in the proper one of the positions of FIGURE 15 and positions the switch **206** in the lower position. He then temporarily closes the start switches controlling the holding relay switches **170** and **172** and the spotter begins feeding the trip of cars at a substantially uniform rate.

To stop the cars at any desired spot, the operator temporarily closes the stop switch controlling the holding relay switch **172** which immediately deenergizes the holding circuit and which in fact deenergizes the entire control circuit **166**. The valves V1 and V2 are spring centered to turn "off" the moving cylinders **40***a* and **40***b*, inasmuch as their solenoids CBV2, CAV2, CBV1 and CAV1 within the control circuit are deenergized. The bypasses BPV4 and BPV5 open to unload the main pumps (caused by deenergization of solenoids CV4 and CV5) although the main and third pumps continue running.

To restart the cars, the operator re-closes the start switch controlling the relay switch **172** and the uniform rate feeding phase of the cycle re-continues.

Variations within the spirit and scope of the invention described are equally comprehended by the foregoing description.

I claim:

1. Car spotter for an intercoupled car trip on a track, said spotter comprising in combination with a motor and pump unit located offside said track, a track unit secured within the gauge of the track and comprising a plurality of hydraulic drive cylinders arranged side by side, pawl means connected to the cylinders for being actively driven thereby and engageable with means on each car to advance the trip of cars from spot to spot, valve-controlled hydraulic means connecting said motor and pump unit to said track unit for independently controlling said cylinders so that the pawl means driven by one cylinder may be advanced at a greater rate than the other pawl means to thereby disengage said pawl means from said means on said car while the pawl means driven by another cylinder continues the active advance of the trip of cars, there being solenoid valve operating means and valving operated thereby on said motor and pump unit for controlling the aforesaid hydraulic means, and a remote control hand switch unit having a flexible electrical connection to said solenoid valve operating means to control said cylinders through operation of said valving from a vantage point remote to the offside location of said motor and pump unit.

2. Car spotter for a line of mine cars carrying car lug means, said car spotter comprising first and second hydraulic drive cylinders arranged side by side, guided barney means individual to the drive cylinders for being actively driven thereby and each provided with two operatively opposed pawls for trapping the car lug means therebetween, and controlled motor operating means comprising at least one set of devices sensitive to motion of the

barney means for independently controlling said hydraulic drive cylinders so that one barney means upon reaching its most advanced position may be retracted and restarted while another barney means continues the active advance of the line of mine cars, said operatively opposed pawls being pivoted to and disposed in spaced apart relation on the barney means a distance materially greater than the thickness of the car lug means trapped therebetween so as to provide an operative clearance sufficient to pivot a non-working pawl on an active barney into inoperative position while the companion pawl on that barney continues working.

3. A car spotter according to claim 2 wherein said one set of devices comprises means sensitive to predetermined initial movement of advance of each of said cylinder-driven barney means to cause a reverse stroke of motion of the other cylinder and the associated barney means driven thereby so as to retract same.

4. A car spotter according to claim 2 wherein said barney means carry rod type depressing means connected to pivot their pawls into inoperative position and engageable with fixed means in the path of the barney means at their most advanced position so as to temporarily enable the non-working pawl to drop non-interferingly below the passing car lug means.

5. Method for transferring the mine car load from a load-releasing barney to a load-receiving barney, there being double car-engaging pawls on each of the barneys, each of which having a double-acting power-operated cylinder for reciprocating same and alternating with the other barney in the load-receiving and load-releasing functions aforesaid, said method comprising the steps of operating the cylinder of one barney in the direction of car advance while another barney cylinder continues its advance in the final phases of a carload working stroke in that direction, applying hydraulic rate control means to the cylinder of said one barney to retard its speed of advance, and operating power delivery means for applying augmenting power to accelerate the cylinder of the other barney.

6. Car spotter for a line of track-borne cars, comprising a plurality of power drive cylinders arranged side by side within the gauge of the track, double pawl means individual to the drive cylinders for being actively driven thereby and engageable with means on each car to advance the line of cars from spot to spot, and means to independently control the movement of each of said double pawl means so that one of said double pawl means may be advanced at a greater rate than the other double pawl means to thereby disengage one of said double pawl means from said means on said car while the other double pawl means continues the active advance of the line cars.

7. For use with a line of mine cars carrying car lug means and supported on the rails of a car track, a track unit frame disposed in the bed of said track, said frame having means of attachment to the rails of said track comprising snubbers for providing a plurality of elastic connections between said frame and said track, first and second fluid motors mounted side by side in said frame, each of said motors comprising a pair of fixed and movable elements and each of said pairs of elements consisting of a piston and a cylinder, guided barney means in said frame individual to the movable elements of the first and second motors for being actively driven thereby, and provided with pawls for engaging the car lug means, and controlled motor operating means comprising devices sensitive to motion of said movable elements and the accompanying barney means for independently operating said fluid motors so that one barney may be advanced at a greater rate than the other barney to thereby disengage pawls on one of said barneys from said car lug means while another barney continues the active advance of the line of mine cars.

8. For use with a line of mine cars carrying car lug means and supported on a car track, the combination comprising a track unit frame disposed in the bed of said car track, fluid motors mounted side by side in said frame each comprising a pair of fixed and movable elements and each pair of said elements consisting of a cylinder and a piston within said cylinder, guided barney means in said frame individual to the fluid motors for being actively driven by the movable element thereof and each provided with two operatively opposed pawls for trapping the car lug means therebetween, said barney means and said pawls being guided for rectilinear movement parallel and in closely spaced adjacency to the longitudinal midplane of said frame, means on said barney means to pivot the pawls from an inoperative position upwardly about an inclined axis so that in the operative position, the pawls are canted toward said longitudinal midplane, and controlled motor operating means comprising devices sensitive to motion of the barney means for independently controlling said fluid motors so that one barney means may be advanced at a greater rate than the other barney means to thereby disengage pawls on one of said barneys from said car lug means while another barney means continues the active advance of the line of mine cars.

9. The combination according to claim 8 wherein said barney means carry depressing means connected to the pawls for causing them to pivot between said operative and inoperative positions, said depressing means being engageable with fixed means in the path of the barney means at their most advanced positions and comprising a lost motion connection whereby the pawls are released to drop in response to such engagement so as to pivot by gravity into their inoperative position.

10. For use with a line of mine cars carrying car lug means and supported on the rails of a car track, the combination comprising a track unit frame disposed in the bed of the track and having means of attachment to the rails of said track, fluid motors mounted side by side in said frame and each comprising a piston and a movable cylinder thereabout, a piston rod connected between the piston and each end of the frame and each end of each piston rod passing through an oversize opening provided in that end of the frame, guided barney means in said frame individual to the cylinders of said motors for being actively driven thereby and provided with pawls for engaging the car lug means, and controlled motor operating means comprising devices sensitive to motion of the cylinders and the accompanying barney means for independently controlling said motors so that one barney means may be advanced at a greater rate than the other barney means to thereby disengage pawls on one of said barneys from said car lug means while another barney means continues the active advance of the line of mine cars, there being elastic means included at the point of connection between said frame and each piston rod affording a floating action whereby the latter are capable of limited movement both axially with respect to said oversize opening and transversely in the plane of that opening.

11. For use in moving a line of mine cars carrying car lug means and supported for rolling along rails in a track bed, the combination including a track unit frame in said bed having guided barney means each provided with two operatively opposed pawls for trapping the car lug means therebetween, double-acting power means individual to the respective barney means for actively driving same and arranged side by side in the track unit frame, and independently operating means for operating said power means so that one barney means may be advanced at a greater rate than the other barney means to thereby disengage pawl means on one of said barneys from said car lug means while another barney means continues the active advance of the line of mine cars, said power means comprising power cylinders hydraulically cross-connected through means so as to be opposed to one another in undertaking to transfer the load and so that each cylinder prior to reversal, in the opposed load rela-

tion described, makes a short strike ahead with its barney means against the resistance of the next barney before the cylinder driving the latter barney means undertakes the carline in full.

12. The combination according to claim 11 wherein said operating means comprises an electrically interlocked control system for automatically controlling same, said system including limit switches sensitive to motion of the barney means into their fully advanced positions for reversing same, and interlock switches sensitive to predetermined initial movement of advance of each barney means to prevent said reversal until, but only until, the point of accomplishing said predetermined initial movement of advance.

13. For use in conjunction with mine cars equipped with lugs and supported for rolling movement on a car track, a feeder for feeding the cars past a track-side loading point comprising a track unit frame with two double pawl barney means having guided movement in said track unit frame so as to provide straight line feeding action for each barney means, said double pawls on each barney means consisting of two operatively opposed pawls for trapping the car lugs therebetween, fluid power means individual to each barney means for actively driving same and arranged side by side in said track unit frame, operating means for independently operating said fluid power means so that one barney means may be advanced at a greater rate than said other barney means to thereby disengage said pawl means on one of said barneys from said car lug while another barney continues the active advance of a line of cars, and means connected to said operating means for reversing the feeding action of the barney means so as to feed the cars in both directions past said track-side loading point.

14. For use in conjunction with a line of mine cars equipped with car lug means and supported for rolling movement along a track, feeder for unidirectionally feeding the cars past a track-side loading point, comprising a track unit having fluid power means arranged side by side therein, each of said power means consisting of a longitudinally elongated, double-acting cylinder having a transversely aligned length of stroke with another cylinder, and a fixed piston fitting within each cylinder, barneys individual to the fluid power means and each provided with two operatively opposed pawls for trapping the car lug means therebetween, said barneys being mounted to non-corresponding ends of said cylinders so as to afford parallel paths of stroke which slightly overlap and which, for their major portion, are longitudinally staggered with respect to one another, and means for independently operating said cylinders so that one of said barneys may be advanced at a greater rate than the other of said barneys to thereby disengage said pawls on one of said barneys from said car lug while said other pawl means driven by another cylinder continues the active advance of a line of mine cars.

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