April 16, 1968 C. G. HUNT 3,377,961

FLUID-ACTUATED CAR MOVER

Filed July 12, 1966 9 Sheets-Sheet 1

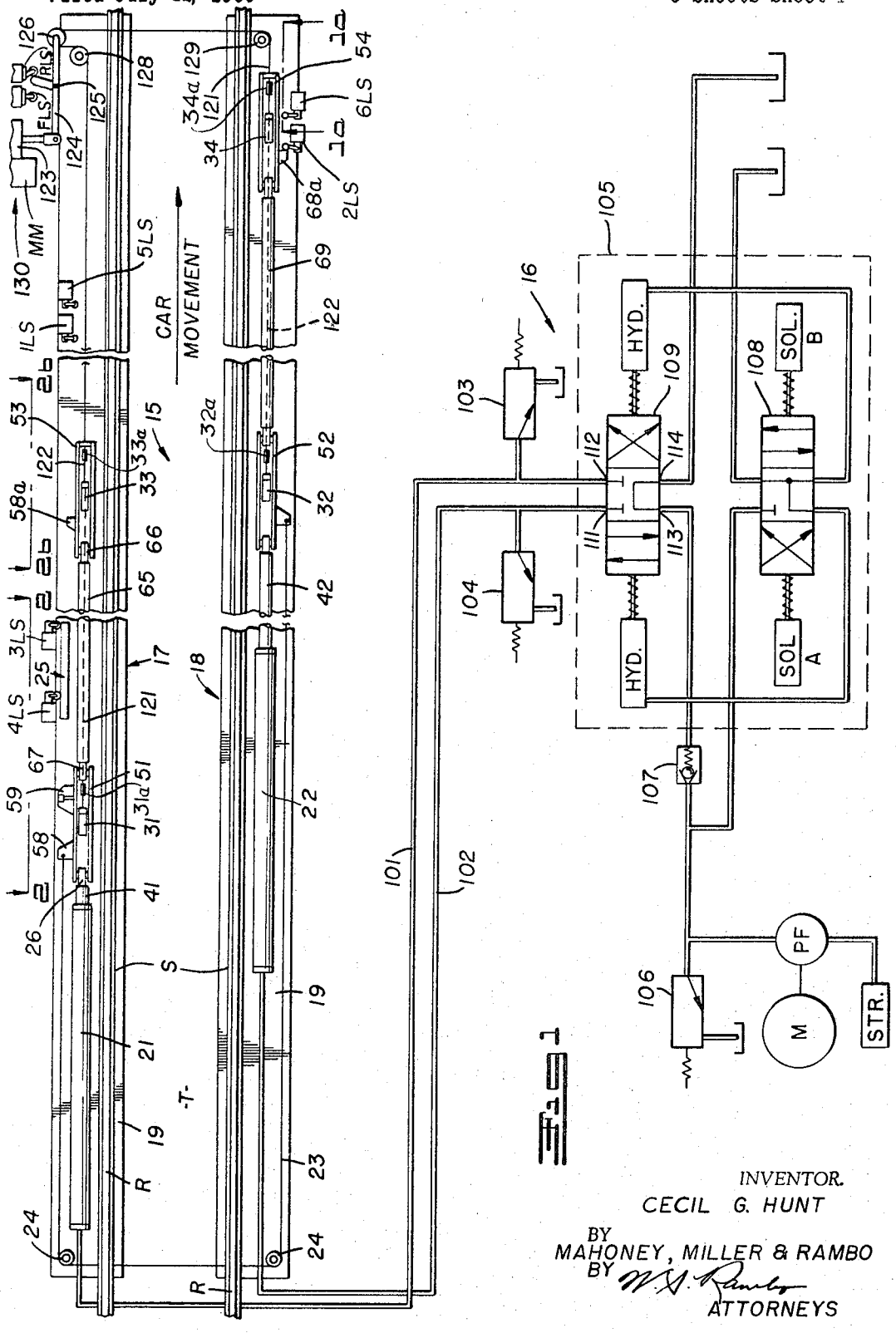


Fig. 1

INVENTOR.
CECIL G. HUNT

BY
MAHONEY, MILLER & RAMBO
BY
ATTORNEYS

April 16, 1968 C. G. HUNT 3,377,961

FLUID-ACTUATED CAR MOVER

Filed July 12, 1966 9 Sheets-Sheet 2

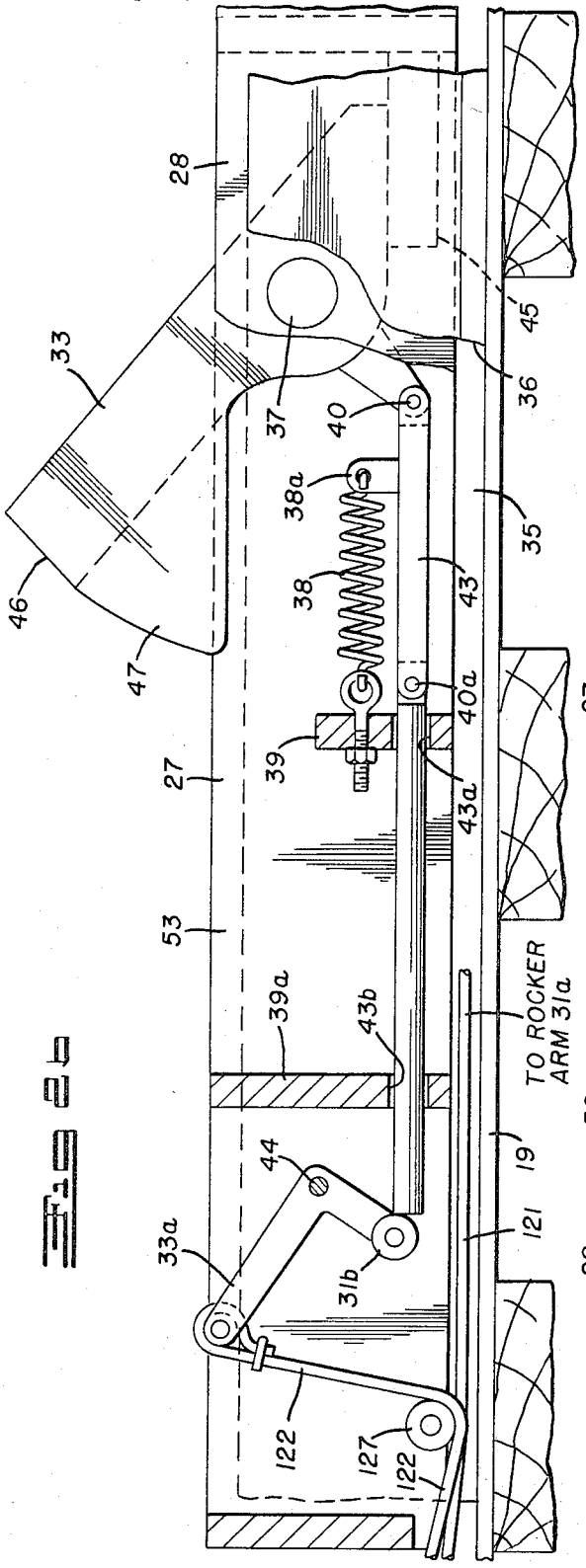


Fig 2a

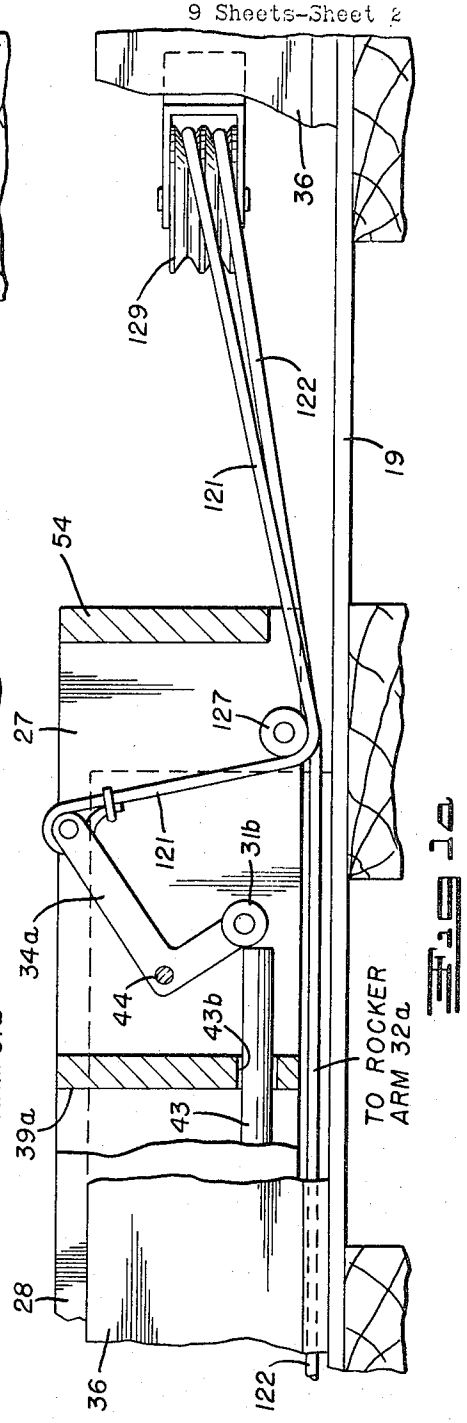


Fig 1a

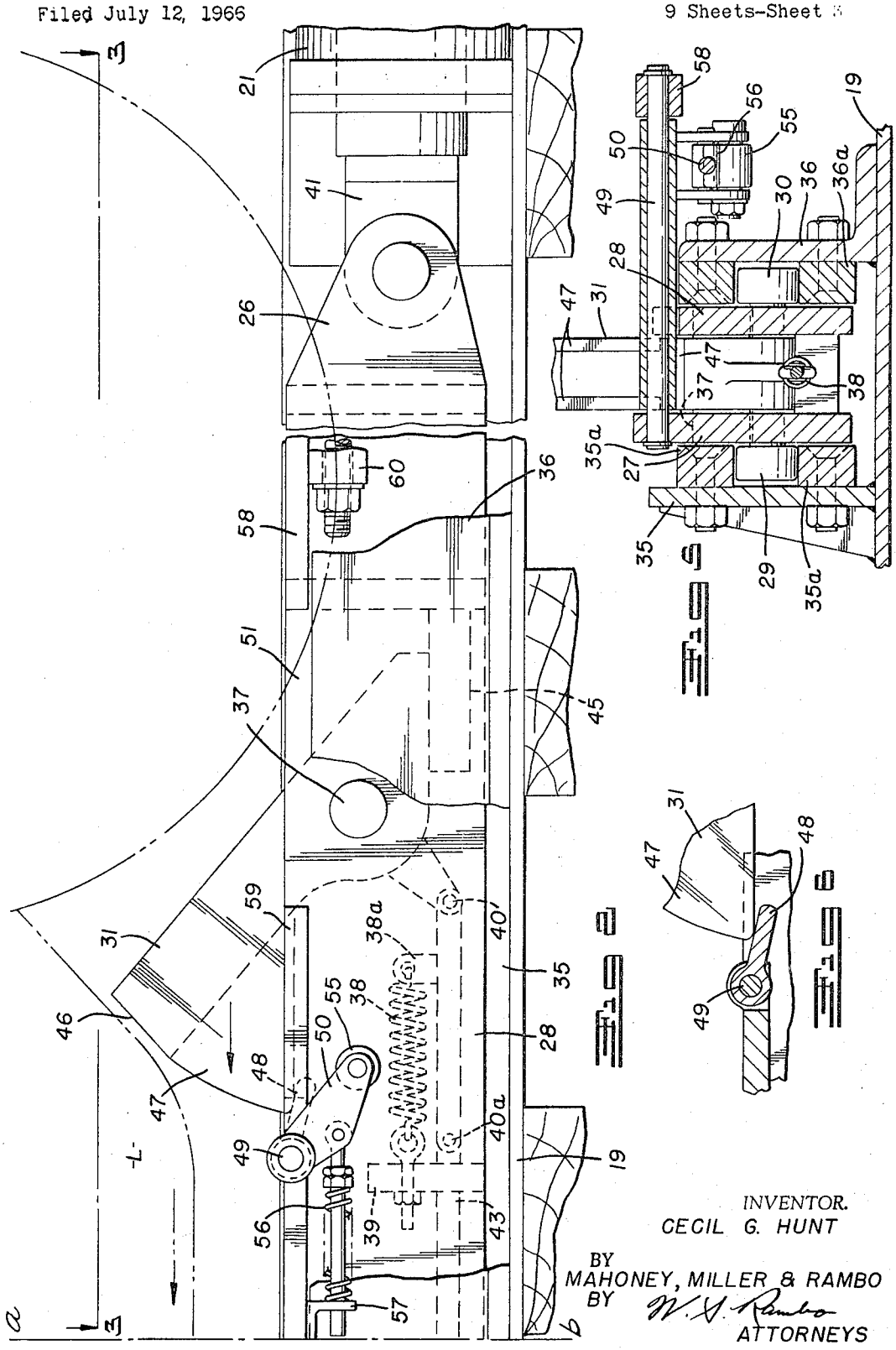
INVENTOR.
CECIL G. HUNT

BY
MAHONEY, MILLER & RAMBO
BY W. Y. Rambo
ATTORNEYS

April 16, 1968 C. G. HUNT 3,377,961

FLUID-ACTUATED CAR MOVER

Filed July 12, 1966 9 Sheets-Sheet 3



INVENTOR.
CECIL G. HUNT

BY
MAHONEY, MILLER & RAMBO
BY
ATTORNEYS

April 16, 1968 C. G. HUNT 3,377,961

FLUID-ACTUATED CAR MOVER

Filed July 12, 1966 9 Sheets-Sheet 4

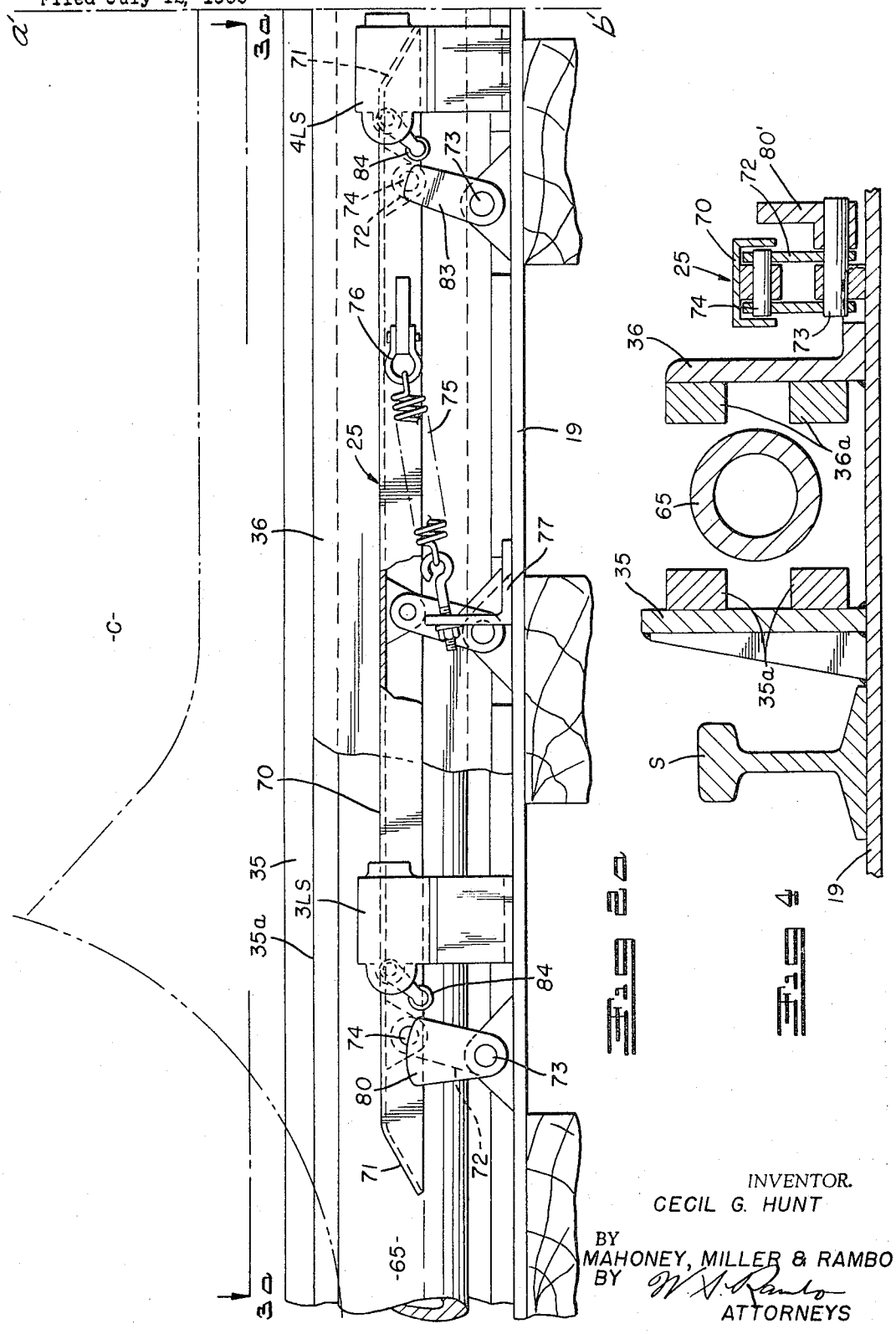


Fig. 3a

Fig. 4

INVENTOR.
CECIL G. HUNT

BY
MAHONEY, MILLER & RAMBO
BY W. V. Rambo
ATTORNEYS

April 16, 1968 C. G. HUNT 3,377,961

FLUID-ACTUATED CAR MOVER

Filed July 12, 1966 9 Sheets-Sheet 3

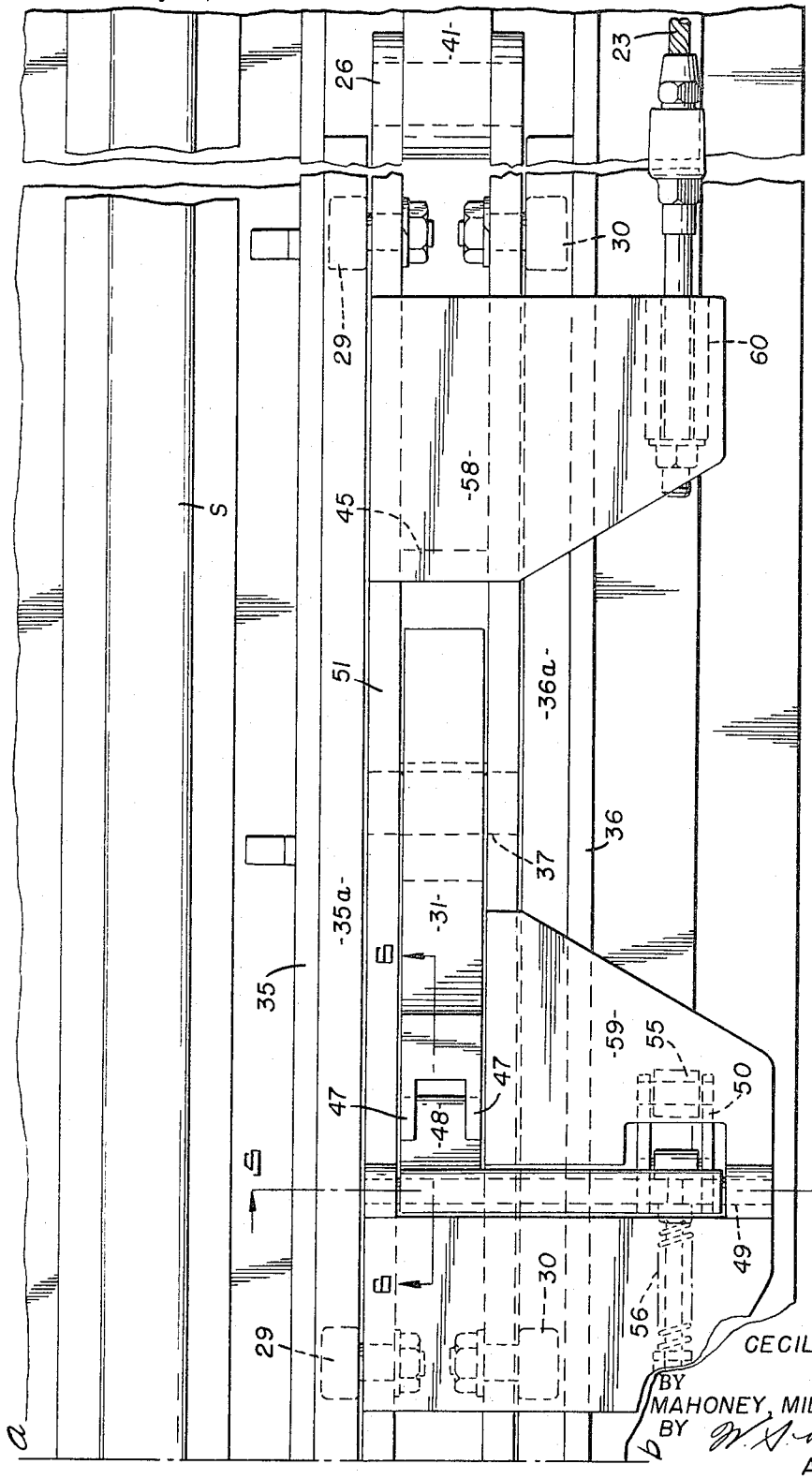


Fig. 3

INVENTOR.
CECIL G. HUNT
BY
MAHONEY, MILLER & RAMBO
BY
ATTORNEYS

April 16, 1968 C. G. HUNT 3,377,961

FLUID-ACTUATED CAR MOVER

Filed July 12, 1966 9 Sheets-Sheet 6

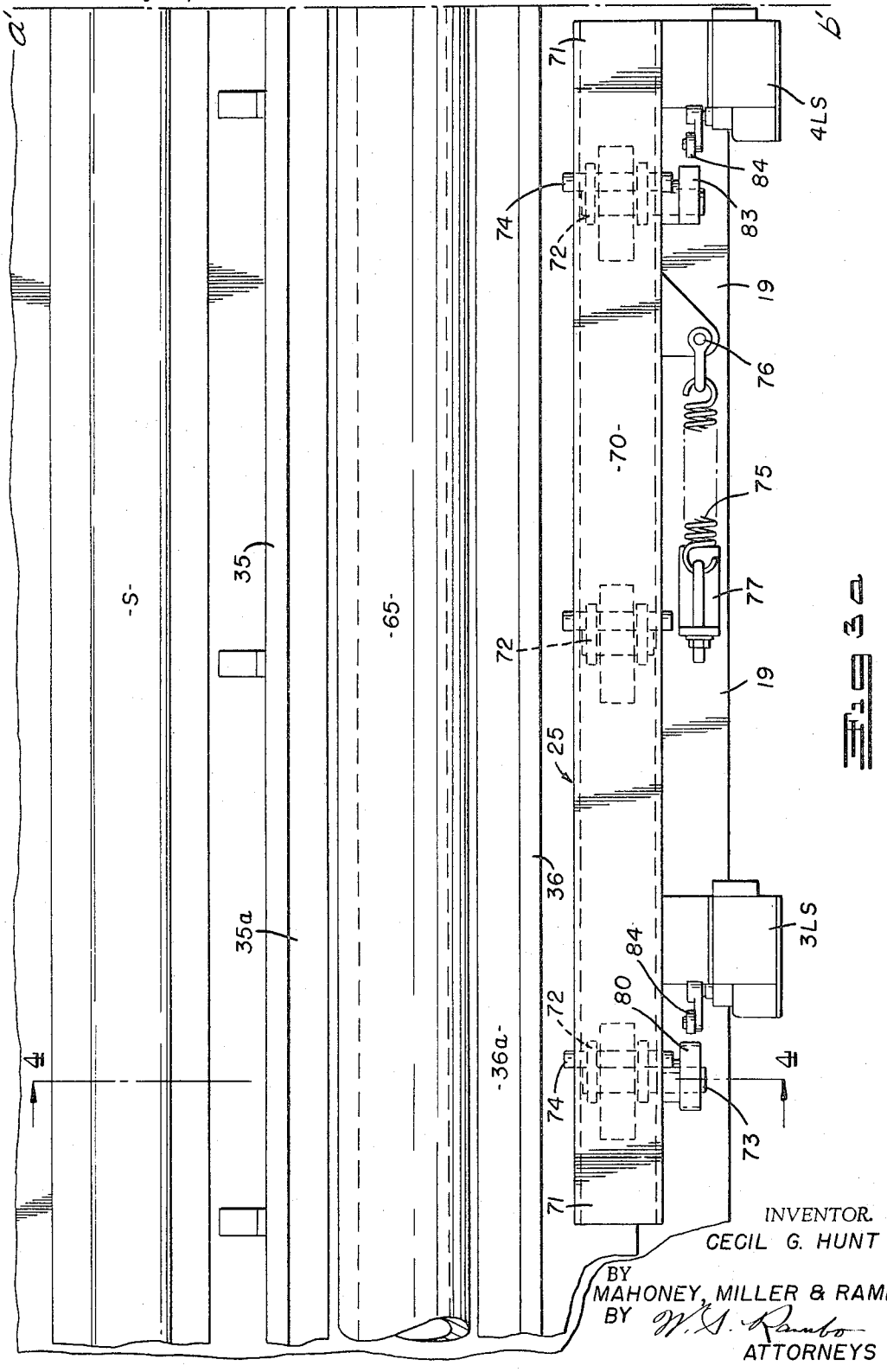


Fig. 3a

INVENTOR.
CECIL G. HUNT
BY
MAHONEY, MILLER & RAMBO
BY W. S. Rambo
ATTORNEYS

April 16, 1968 C. G. HUNT 3,377,961

FLUID-ACTUATED CAR MOVER

Filed July 12, 1966 9 Sheets-Sheet 7

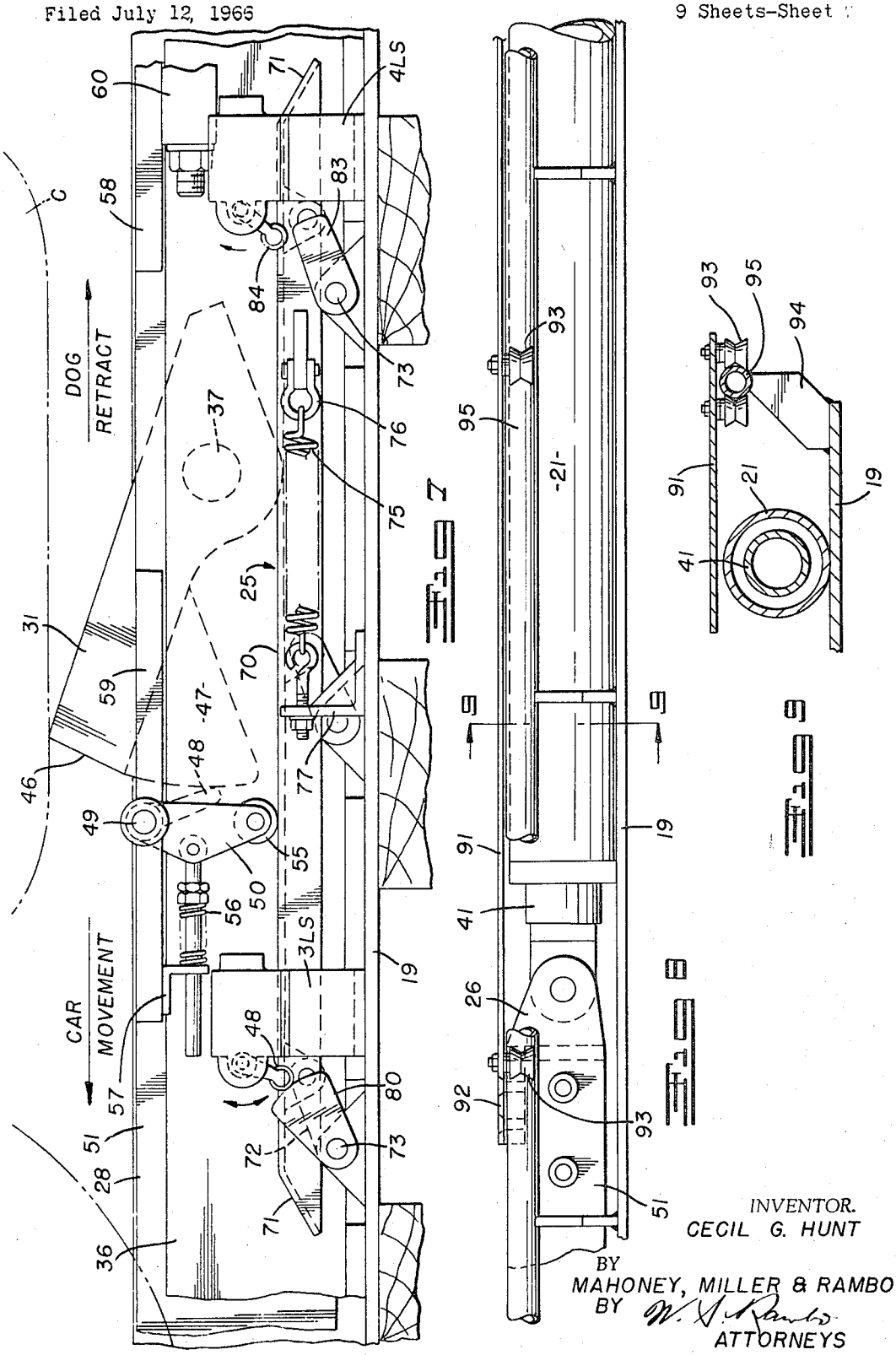


FIG. 7

FIG. 9

FIG. 8

INVENTOR.
CECIL G. HUNT

BY
MAHONEY, MILLER & RAMBO
BY W. H. Rambo
ATTORNEYS

April 16, 1968 C. G. HUNT 3,377,961

FLUID-ACTUATED CAR MOVER

Filed July 12, 1966 9 Sheets-Sheet

Fig 10

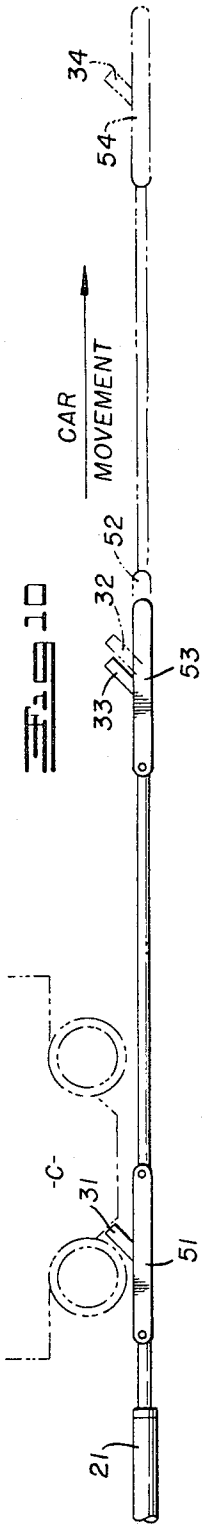


Fig 11

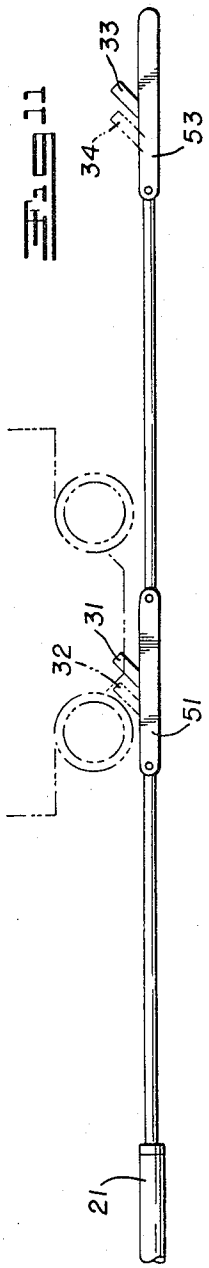


Fig 12

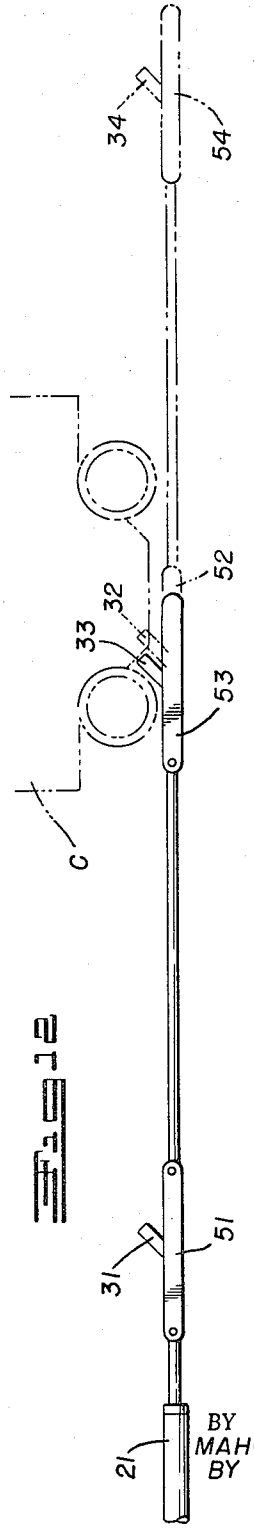
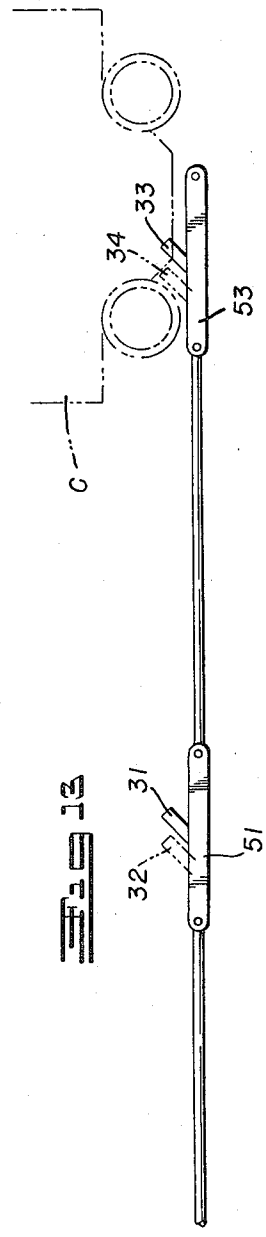


Fig 13



INVENTOR.
CECIL G. HUNT

BY
MAHONEY, MILLER & RAMBO
BY W. S. Rambo
ATTORNEYS

April 16, 1968 C. G. HUNT 3,377,961

FLUID-ACTUATED CAR MOVER

Filed July 12, 1966 9 Sheets-Sheet 9

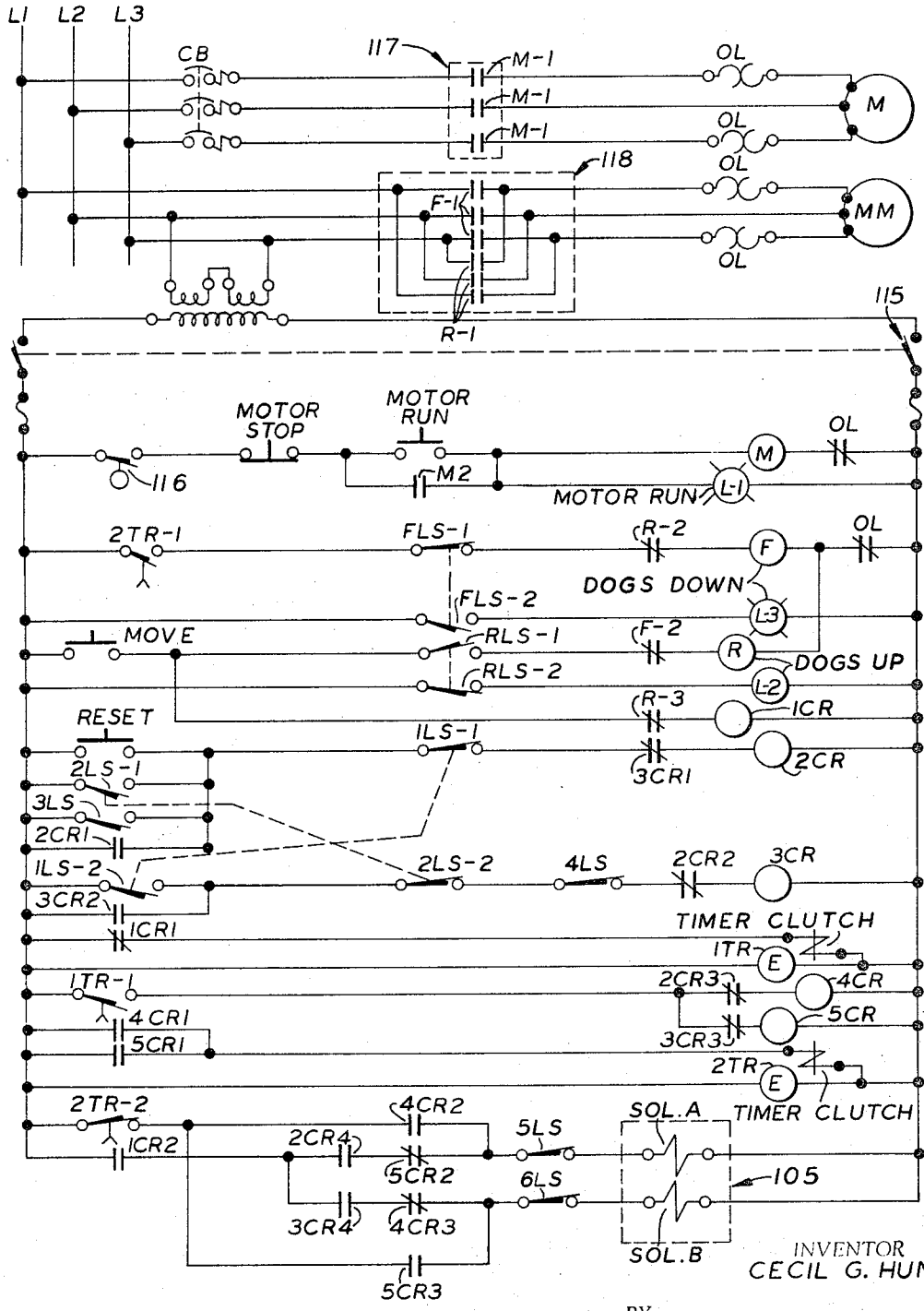


Fig 14

INVENTOR
CECIL G. HUNT

BY
MAHONEY, MILLER & RAMBO
BY
ATTORNEYS

United States Patent Office 3,377,961 Patented Apr. 16, 1968

3,377,961

FLUID-ACTUATED CAR MOVER

Cecil G. Hunt, Bowerston, Ohio, assignor to The Nolan Company, Bowerston, Ohio, a corporation of Ohio

Filed July 12, 1966, Ser. No. 564,592
25 Claims. (Cl. 104—162)

This invention relates to a fluid-actuated car mover. It has to do, more particularly, with a fluid actuated system, preferably hydraulic-actuated, designed to move or advance a railroad car, or similar car, or a string of railroad cars, along a trackway which supports the wheels thereof for relatively short distances, generally for the purposes of loading or unloading the car or cars. However, it is to be understood that the car mover of this invention is not limited to these specified uses but can be adapted to many other uses. It relates to the general type of fluid-actuated car-moving apparatus disclosed in the patent to Merritt No. 2,847,945, issued Aug. 19, 1958 but includes a number of important and substantial improvements not disclosed in that patent.

It is the main object of this present invention to provide a car-moving system of the general type indicated which includes an automatic stroke selector arrangement that functions to adjust the ram stroke from its maximum stroke to a stroke suitable to cars of various types in the same string of cars thereby eliminating lost or unnecessary retracting and subsequent car-engaging movement of the ram piston with possible excessive impact damage which might otherwise result due to the travel of the ram piston through the entire extent of its stroke, and excessive impact upon overtaking the car, if there was no compensation for variations in the types of cars.

Various other objects will be apparent.

In the accompanying drawings there is illustrated a preferred embodiment of this invention but it is to be understood that this is by way of example only and that specific details can be varied without departing from basic principles of the invention.

In the drawings:

FIGURE 1 is a schematic view of the entire car mover system including the car pusher unit and the hydraulic units.

FIGURE 1*a* is a side elevational view taken from the position indicated at line 1*a*—1*a* of FIGURE 1.

FIGURE 2 is an enlarged side elevational view, partly broken away, taken from the position indicated at line 2—2 of FIGURE 1 but showing only the dog carriage indicated at the left of the hydraulic cylinder or ram shown at the top of FIGURE 1.

FIGURE 2*a* is a view similar to FIGURE 2 also taken on line 2—2 of FIGURE 1 and being a longitudinal continuation of the structure of FIGURE 2 to show the automatic stroke-selecting treadle, FIGURE 2*a* matching at the line *a'–b'* with FIGURE 2 at the line *a–b*.

FIGURE 2*b* is a view similar to FIGURE 2 but showing the dog carriage to the extreme right of the cylinder shown at the top of FIGURE 1.

FIGURE 3 is a side elevational view taken from the position indicated at line 3—3 of FIGURE 2.

FIGURE 3*a* is a side elevational view taken from the position indicated at line 3*a*—3*a* of FIGURE 2*a* matching at the line *a'–b'* with FIGURE 3 at the line *a–b*.

FIGURE 4 is a transverse vertical sectional view taken along line 4—4 of FIGURE 3*a*.

FIGURE 5 is a transverse vertical sectional view taken along line 5—5 of FIGURE 3.

FIGURE 6 is a detail in longitudinal vertical section of one of the dog structures taken along line 6—6 of FIGURE 3.

FIGURE 7 is a side elevational view of the treadle showing it depressed as compared to FIGURE 2*a*.

FIGURE 8 is a side elevational view showing the end portion of one of the rams or cylinders and indicating an automatically adjustable cover plate for the piston rod thereof.

FIGURE 9 is a transverse vertical sectional view taken along line 9—9 of FIGURE 8.

FIGURES 10 to 13 are diagrammatic views illustrating the sequence of operations of the car-pusher system, showing successive longitudinal positions of the ram-controlled dog carriages of the system.

FIGURE 14 is a diagram of the electrical circuit of the system.

With reference to the drawings, the hydraulic car mover of this invention is illustrated schematically in FIGURE 1 and is composed of two main assemblies which consist of the car pusher unit shown at the top of the figure and indicated generally by the numeral **15** and the hydraulic power unit shown at the bottom of the figure and indicated generally by the numeral **16**. The general structure and operation of these units will first be described and later a more detailed description thereof will be given.

The car pusher unit is composed of two separate assemblies, designated **17** and **18**, mounted in cooperative relationship with the respective opposed running rails R of the railroad trackway T. Each of the assemblies **17** and **18** includes a bed plate **19** upon which is mounted a single-acting hydraulic cylinder and associated parts. Each bed plate is also arranged to receive one of the running rail sections S which will be disposed in alignment with the other sections of the rail at that particular side of the trackway as illustrated in FIGURE 1.

In FIGURE 1, the upper cylinder unit will be designated by the numeral **21** and as the right-hand unit, and the lower cylinder unit will be designated by the numeral **22** and as the left-hand unit, as viewed from the right-hand end of the figure which is in the direction the cars will be advanced by the system, as indicated by the arrow in FIGURE 1. The cylinder unit **21** has its piston connected to the car-engaging dogs **31** and **33** and the cylinder unit **22** has its piston connected to the car-engaging dogs **32** and **34**. Also, the right-hand cylinder and car-engaging dogs are arranged in a staggered manner with respect to the left-hand unit, such that the right-hand cylinder **21** is disposed rearward, relative to the direction of movement of the cars, as compared to the left-hand cylinder **22**. The piston rods of the opposed cylinders **21** and **22** are connected together by a suitable flexible member, such as a cable **23**, which runs around the idler sheaves **24** at the rear ends of the respective bed plates **19**. The result of this arrangement is that when cylinder unit **21** is fully extended and cylinder unit **22** is fully retracted, the pusher dogs **31** and **32** will be disposed on opposite sides of the trackway in slightly longitudinally overlapping relationship and the pusher dogs **33** and **34** will be similarly relatively disposed. This makes it possible to move a car in four successive steps.

When the controls for the hydraulic unit **16** are properly actuated to supply power to the cylinder units **21** and **22**, pusher dog **31** moves the car forward to the limit of its travel while pusher dog **32** is being simultaneously retracted. When pusher dog **31** reaches the limit of its travel, engagement with the car is transferred to pusher dog **32** on the opposite side of the track. Action of the cylinder units is reversed and the car is advanced by pusher dog **32**, while pusher dog **33** is retracting. When dog **32** reaches the limit of its travel, engagement with the car is transferred to dog **33** which continues to advance the car until it reaches the limit of its travel, at which time engagement

with the car is transferred to dog 34 for further advancement.

The track assembly 17 is further equipped with an automatic stroke selector device, indicated generally at 25 in FIGURE 1 to adjust the cylinder strokes for cars of varying types which have different or differently spaced trucks, interposed within the same string. This automatic stroke selector device consists of a treadle, and associated control parts, so arranged that when dogs 32 or 34 are advancing the cars and dogs 31 and 33 are retracting, if the next following set of car trucks causes dog 31 to be depressed (as it is retracted) to pass beneath the advancing trucks, means will be actuated to depress the treadle which will set up an electric control circuit to control the hydraulic unit 16 so that the action of the cylinders will be automatically reversed as soon as dog 31 has passed from beneath the truck and raised into car-pushing position to engage the truck when reversed. Dog 31 will then move forward, advancing the cars until it reaches the limit of its travel, at which time engagement with the cars will be transferred to dog 32 as previously described. This automatic stroke selection will occur each time dog 31 is depressed, during its retracting motion, thus preventing any long unnecessary retracting movement and subsequent free forward travel before car engagement with resulting excessive impact which might otherwise occur with cars of various length.

The details of the car pusher unit are illustrated in FIGURES 2 to 9, inclusive. Each bed plate 19 is preferably a heavy steel plate upon which is mounted the respective cylinder 21 or 22, in a replaceable manner, such as by bolts and clip angles. Also, each plate will have fixed thereto, by means of rail clips or other suitable means, the rail section S which is located inwardly of the cylinder.

The cylinder 21 has the piston rod 41 projecting forwardly therefrom and the cylinder 22 has the piston rod 42 projecting forwardly therefrom. The rod 41 is connected by a clevis connection 26 to the rear dog carriage 51 which carries the rear dog 31. This carriage 51, as shown in FIGURES 2, 3 and 5, comprises the pair of longitudinally extending, parallel plates 27 and 28 which are disposed on edge and which are fixed in laterally spaced relationship. The plates 27 and 28 carry at the exterior thereof the carriage-supporting rollers 29 and 30 or guide shoes which are disposed at longitudinally spaced positions and are designed to engage dog carriage guideways 35 and 36 which are fixed to the bed plate 19, as by welding or bolting, in longitudinally extending, laterally spaced, parallel relationship. The guideways may be equipped with replaceable guide bars 35*a* and 36*a*, respectively, which are removably mounted by bolts, as shown in FIGURE 5. The dog 31 is pivoted for vertical swinging or rocking movement between the plates 27 and 28 by means of a transverse pivot pin 37. Normally the dog 31 is biased upwardly to the position shown in FIGURE 2 by means of a tension spring 38. The spring 38 has one end anchored to a bracket 39 which is fixed between the plates 27 and 28 and has its other end connected to an upstanding lug 38*a* on a slidable rod 43. The rod 43 is suitably mounted in guide openings 43*a* and 43*b* formed respectively in the bracket 39 and another bracket 39*a* also fixed between the plates 27 and 28 which are not shown in FIGURE 2 but are shown in FIGURE 2*b* on the identical structure provided for the dog 33. One end of the rod 43 is pivoted at 40*a* to a link which, in turn, is pivoted at 40 to the dog 31 so that normally the spring biases the dog upwardly as indicated. However, as shown in FIGURES 1*a* or 2*b*, this spring bias can be overcome by a rocker lever or arms provided at its opposite end. These rocker arms will be rocked by a rope or cable system which will be described later. In FIGURES 1*a* and 2*b* the rocker arms associated with the dogs 33 and 34 are shown and are designated, respectively, 33*a* and 34*a* and it is indicated that the cables run to rocker arms 31*a* and 32*a* which are associated with the respective dogs 31 and 32 shown only diagrammatically in FIGURE 1. Each rocker arm is in the form of a bell crank pivoted at 44 for vertical swinging movement between the plates 27 and 28. Its lower end is enlarged at 31*b* and is in engagement with the adjacent end of the rod 43. A stop 45 (FIGURE 2*b*) limits the upward swinging of the dog into this biased position and is rigidly fixed between the plates 27 and 28. It will be noted that the upper or forward end of each dog 31 is blunt, as indicated at 46, for engaging the truck of a car C.

The dog 31 is provided with parallel depending cam portions 47 of arcuate form (FIGURES 2, 3, 6, and 7) for engaging a rocker plate 48 which is mounted for vertical swinging movement at the inner end of shaft 49 rotatably carried at the upper edges of the plates 27 and 28 by a plate 59 which projects outwardly over and beyond the carriage guideway 36. The outer end of this shaft has keyed thereon a bifurcated treadle-actuating rocker arm 50 which carries a roller 55 between its outer ends which will reciprocate with the carriage 51 in a longitudinal path over the treadle 25 and will be forced into contact therewith at certain times. The arm 50 is normally biased forwardly and upwardly by means of a spring plunger 56 connected between it and a lug 57 depending from the plate 59. The arm 50 and rocker plate 48 are in predetermined, fixed, angular relationship relative to the shaft 49 and the plunger 56, therefore, normally biases the plate 48 into an upward position where it remains until it is moved downwardly by engagement of the cam portions 47 of the dog 31 therewith. The plate 59 and associated parts are at the forward end of the carriage 51 and another plate 58 is rigidly secured to the upper edges of the plates 27 and 28 at the rear end of the carriage. This plate extends laterally outwardly from the carriage and is provided with a connection 60 for connecting the forward end of the cable 23 thereto.

The same side of the car pusher also has another or forward carriage 53 connected thereto which carries the forward car pusher dog 33. The carriage 53 is practically identical with the carriage 51 and is mounted on the carriage guideways 35 and 36 in the same manner. However, it is not provided with the cable connector nor the cam-operated rocker arm 50, but is provided with a cam plate 58*a* (FIGURE 1) which projects outwardly therefrom and is provided with a lower cam surface adapted to successively engage the reversing limit switch 1LS and the overrun switch 5LS located in successive positions along the bed plate 19 ahead of the cylinder 21, as shown in FIGURE 1, as the cylinder 21 reaches the extent of its forward or car-advancing stroke. The forward carriage 53 is connected to the rear carriage 51 in longitudinally spaced relationship by means of a connector and spacer rod 65 which is connected, respectively, to the carriages 53 and 51 by the clevis joints 66 and 67. The dog 33 is normally biased upwardly by a spring 38 in the same manner as the dog 31. Also, as previously indicated, it is provided with an identical cable-controlled lever system, including the rocker arm 33*a*, for overcoming the bias to cause lowering or retracting of the dog into inoperative or nonobstructing position as shown in FIGURE 2*b*. The dog 35 is shown with the cam portions 47 but on this dog they have no function. As previously indicated, this side of the pusher is provided with the treadle device 25 which is located just forwardly of the cylinder of the unit 21 and which will be described in detail later.

At the other side of the car pusher, the rear and forward carriages 52 and 54 are provided and carry the rear and forward car pusher dogs 32 and 34, respectively. These carriages are connected together in longitudinally spaced relationship by means of the rod 69 and are mounted for guided movement along the base plate 19 in the same manner as the carriages 51 and 53. The carriage 52 is identical but opposite hand to the carriage 51 except that it does not have the cam-operated arm 50 and the carriage 54 is identical but opposite hand to the carriage

53. The carriage 54 is provided with an outwardly projecting cam plate 68*a* which will have a lower cam surface that is adapted to successively engage the reversing limit switch 2LS and the overrun limit switch 6LS, located along the bed plate 19 ahead of the cylinder 22, as shown in FIGURE 1, so that they will be engaged as the piston of the cylinder unit 22 reaches the extent of its forward or car-advancing stroke. Both of the carriages 52 and 54 are provided with cable-actuated dog lowering or retracting lever systems for lowering or retracting the dogs 32 and 34 which are identical with that described with reference to the carriage 51 for the dog 31 and which include the rocker arms 32*a* and 34*a*. As will be described later, the cable system can be selectively actuated under a suitable control system to rock all the arms 31*a*, 32*a*, 33*a*, and 34*a* and thereby move all the dogs 31, 32, 33, and 34 simultaneously downwardly to an inoperative position to permit free movement of cars over the car mover.

The treadle device 25, as shown in FIGURES 2*a*, 3*a*, 4 and 7, comprises the treadle itself which is in the form of an elongated shoe 70 of inverted channel form disposed parallel with the cylinder axis and having its opposite ends inclined or beveled as indicated at 71. This shoe is carried by parallel linkage comprising the pairs of links 72 disposed at longitudinally spaced intervals and each pair is pivoted by a pin 73 to an upstanding lug carried by the plate 19 and at 74 to a lug depending from the shoe. The shoe 70 is biased into its raised position, where the links 72 are upright, by means of a tension spring 75 connected to the shoe at 76 and anchored to the plate 19 at 77. The forwardmost pair of links 72 is keyed on the pivot pin 73 which has an outwardly projecting end that has keyed thereon a rocker arm 80. The rearwardmost pair of links has a similar rocker arm 83. At the outer side of the shoe 70 and adjacent the forward and rearward ends thereof are the limit switches 3LS and 4LS which have arms that carry rollers 84. The rocker arm 80 operates the limit switch 3LS on both its clockwise and counterclockwise rotation during the upward movement of the treadle shoe.

In order to protect each of the piston rods, when extended, from material spilling out of the cars or damage by other objects, the cover arrangement shown best in FIGURES 8 and 9 is provided. The cover arrangement for each cylinder is the same and in this example, the cylinder 21 is shown with its piston rod 41 protected by the cover plate 91. The plate 91 is supported at a level just above the cylinder 21 and its one end is rigidly connected at 92 to the carriage 51. The plate will reciprocate with the piston rod and is supported and guided by means of pairs of opposed grooved rollers 93 which cooperate with a rod 95. The rod 95 is supported by upstanding brackets 94 from the plate 19 in longitudinally extending, parallel relationship outwardly of the cylinder 21. The grooved rollers 93 are mounted on vertical axles depending from the plate 91 and engage the rod 95 at opposite sides to support and guide the plate 91 as it is automatically moved with the piston rod 41 during its extension and retraction. With this arrangement, the piston rod is completely covered and protected regardless of its extended position.

The hydraulic power unit 16 indicated in FIGURE 1 is usually mounted on a skid base (not shown) and may be located at any convenient place along the trackway R adjacent to the car pusher unit 15. The unit 16 is connected to the cylinders 21 and 22 of the unit 15 by the hydraulic lines 101 and 102, respectively, which have pressure relief valves 103 and 104, respectively, connected thereto. Flow of fluid to and from the cylinders 21 and 22 is controlled by a solenoid-controlled pilot operated four-way valve indicated generally by the numeral 105. This valve includes the pilot portion 108 controlled by the solenoids A and B and the hydraulic four-way reversing valve portion 109 which is controlled by the pilot portion. This latter portion is provided with the cylinder ports 111 and 112, the port 113, which is connected to a high pressure fluid supply line, and the port 114 which is connected by a return line to a supply reservoir. When solenoid A is energized, port 113 is connected to port 112 and cylinder 21 is energized and ports 111 and 114 are connected to permit fluid return flow from cylinder 22 to the fluid reservoir. When solenoid B is energized, the connection of the ports are reversed and cylinder 22 will be energized and cylinder 21 may then be exhausted to the fluid reservoir. When both solenoids are deenergized, the ports 111 and 112 are blocked preventing return fluid flow from either cylinder 21 or 22 and the ports 113 and 114 are connected to permit a fluid supply pump PF to work at a relatively low pressure as the high pressure supply line is then directly connected to the reservoir.

The pump PF pumps into the high pressure fluid supply line which also has a pressure relief valve 106 connected thereto. A suction line connected with the pump PF has a strainer STR connected to its inlet which is submerged in the hydraulic fluid reservoir. The pump PF is driven by an electric motor M. A spring biased check valve 107 is interposed in the high pressure fluid supply line to the valve 105 to assure that the pump PF will work against a predetermined pressure when the valve portion 109 is in the center position and the high pressure supply line is connected directly to the reservoir.

In addition to the normally operating mechanism of the car pusher described above, the cable system, previously referred to, for moving the dogs 31, 32, 33, and 34 down to inoperative position is provided. This system is shown best in FIGURES 1, 1*a* and 2*b* and will automatically lower the pusher dogs from engaging position with the cars and hold them in lowered or inoperative position if the operator should leave his station for more than a predetermined period of time. This system is desired to minimize the possibility of jamming the dogs by reverse movement of the train of cars when the operator is not on duty.

As indicated previously, this system consists of wire ropes or cables, two separate cables being provided, which are operatively connected to the lever arrangements provided in each of the carriages 51, 52, 53, and 54 that are associated with the respective dogs 31, 32, 33, and 34 in such a manner as not to interfere with the normal advancing and retracting movement of these dogs. One cable 121 is operatively connected to the levers 31*a* and 34*a* of the respective carriages 51 and 54 and the other cable 122 is operatively connected to the levers 32*a* and 33*a* of the respective carriages 52 and 53. Both cables are controlled by a hydraulic unit 130 which may be mounted at the front end of the bed plate 19 which is at the side of the pusher where the cylinder unit 21 is located. The use of two cables 121 and 122, each of which is connected between pusher dog carriages at opposite sides which are longitudinally spaced, accommodates any relative motion or play between the carriages on the same side. If one cable were connected successively to all carriages, there could be some variance as to the amount each dog is retracted. When power is supplied to this unit, the cables 121 and 122 are simultaneously retracted to lower the dogs or extended to permit the dogs to raise.

The hydraulic unit 130 may be of a common type self-contained unit with a hydraulic pump and associated system operated by energizing a motor MM. The pump supplies fluid to a cylinder 123 which has a rod projecting therefrom that is pivoted to the inner end of a lever 124 which, in turn, is fulcrumed at 125 and carries a cable-retracting double sheave 126 at its outer end. Limit switches FLS and RLS are associated with the unit 130 and actuated thereby.

The cable 121 has its rear end connected to the carriage 51 as indicated in FIGURE 1. It is fixed to the rocker arm 31*a* thereof. The cable 121 passes downwardly and then forwardly under a small single idler pulley 127 like that shown in FIGURE 2*b*. The cable 121 passes forwardly above the plate 19 and then around a double

idler **128**, carried by that plate, and then laterally outwardly before passing through the double take-up pulley **126**. It then passes laterally to the opposite side of the pusher through a double idler **129** carried by the plate at that side. Then, the cable **121** passes rearwardly and is connected to the rocker arm **34***a* of the carriage **54** (FIGURE 1*a*). Similarly, the rear end of the cable **122** is connected to the rocker arm **33***a* of the carriage **53**, passes forwardly through the double pulley **128**, laterally outwardly through the double pulley **126**, across the pusher laterally, rearwardly through the double pulley **129**, rearwardly past the carriage **54** to the carriage **52** where it is connected to the rocker arm **32***a* thereof. It will be apparent that when the unit **130** is actuated, a pull is applied to both cables **121** and **122**, which simultaneously rocks all the levers **31***a*, **32**, **33***a*, and **34***a*, and pushes each of the slide rods **43** actuated thereby to overcome the bias of each spring **38** and lower the associated dog. Thus, all of the dogs can be lowered or retracted into inoperative position simultaneously by actuation of the unit **130**. When the pull on the cables **121** and **122** is relieved, the dogs will again be biased by the springs **38** to their original upright position. During normal reciprocation of the dog carriages **51**, **52**, **53**, and **54**, the cables **121** and **122** will merely move back and forth through the various pulleys or sheaves **128**, **126** and **129**.

The electric circuit for controlling the motor M and the cylinders **21** and **22** of the hydraulic unit **16** of the motor MM of the hydraulic circuit **130** is illustrated schematically in FIGURE 14 which also indicates schematically how it is associated with the hydraulic circuit. It includes a main on and off switch **115** and a shut-off switch **116** of the float type actuated by fluid in the reservoir, both switches being connected in the circuit as indicated. The four-way valve **105** is controlled by the solenoids A and B which are also indicated in FIGURE 1. Solenoid A controls the cylinder **21** and solenoid B controls the cylinder **22**. The limit switch **5LS** controls the solenoid A and the limit switch **6LS** controls the solenoid B. These two switches serve as over-travel switches and are only engaged and actuated when the respective piston rods **41** and **42** of the cylinders **21** and **22** move beyond their normal stroke in pushing the cars and will deenergize either of the respective solenoids A and B to stop all movement of the piston rod in the event that the normal reversing sequence fails to occur upon engagement of the respective normal reversing switches **1LS** and **2LS**. The reversing switches **1LS** and **2LS** and the treadle-operated stroke-selecting switches **3LS** and **4LS** are connected in the circuit as indicated. The control sequence relays **1CR**, **2CR**, **3CR**, **4CR**, and **5CR** and the timer-operated relays **1TR** and **2TR**, controlled by the various limit switches, are connected in the circuit as indicated.

The sequence of operations of the entire car pusher system will be apparent from the diagrams in FIGURES 10 to 13, as well as the hydraulic circuit diagram of FIGURE 1 and the electrical diagram of FIGURE 14, and from the following summary:

(1) Position first car C of string with leading truck just forward of pusher dog **31**, as shown in FIGURE 10. Close switch **115** to energize control circuit thereby energizing the continuously operating motors E1 and E2 of the time delay relays **1TR** and **2TR**.

(2) Depress "Motor Run" pushbutton (FIGURE 14) to energize solenoid of starter **117** for pump motor M closing contacts **M1** and start pump motor M. Contact **M2** closes forming a holding circuit for the pump motor and an indicator light **L–1**.

(3) Depress "Reset" pushbutton to energize control relay **2CR**, thus closing **2CR1** and **2CR4** contacts and opening **2CR2** and **2CR3** contacts. Control relay **2CR** will maintain itself through **2CR1** contacts.

(4) Depress "Move" pushbutton to energize control relay **1CR** thus opening **1CR1** contacts and closing **1CR2** contacts, which in turn energizes solenoid A (through previously closed **2CR4** contacts) to pressurize cylinder **21** and cause pusher dogs **31** and **33** to advance. At this time it is assumed that the hydraulic unit **130** had been operated to place the lever arm **124** in the illustrated position and operate RLS to maintain **RLS–1** open and **RLS–2** closed which will energize **L–1** to indicate that the dogs are up. Solenoid R will not be energized since **RLS–1** is open and contact **R–3** will be closed. Pusher dog **31** will engage truck side frame to move cars C forward. As pusher dogs **31** and **33** advance, dogs **32** and **34** will be retrated by the cable **23**, as shown in FIGURE 11. Contacts **1CR1** will be opened preventing energization of clutch of timer **1TR** and initiation of a time delay in the operation of contacts **1TR1** for as long as the "Move" pushbutton is maintained closed.

(5) Pusher dog **31** (and **33**) will continue to advance (as long as "Move" pushbutton is held depressed) until it reaches the limit of its travel and trips limit switch **1LS** momentarily, thus simultaneously opening contacts **1LS–1** and closing contacts **1LS–2**.

(6) Opening contacts **1LS–1** deenergizes **2CR**, thus opening **2CR1** and **2CR4** contacts and closing **2CR2** and **2CR3** contacts. Opening **2CR4** contact deenergizes solenoid A to depressurize cylinder **21**.

(7) Closing contacts **1LS–2** energizes control relay **3CR**, thus opening **3CR1** and **3CR3** contacts and closing **3CR2** and **3CR4** contacts. Control relay **3CR** will maintain itself energized through **3CR2** contacts.

(8) Closing **3CR4** contacts will energize solenoid B thus pressurizing cylinder **22**, causing pusher dogs **32** and **34** to advance and dogs **31** and **33** to retract, as indicated in FIGURE 12.

(9) When pusher dog **31** reached the limit of its travel and dog **32** was fully retracted, engagement with the truck frame by dog **31** was transferred to dog **32** (FIGURE 11) on the opposite side of the car.

(10) Cars will continue to advance (as long as "Move" pushbutton is held depressed) by action of dog **32** until dog **32** reaches the limit of its travel and trips limit switch **2LS** momentarily, thus simultaneously opening contacts **2LS–2** and closing contacts **2LS–1**.

(11) Action resulting from tripping limit switch **2LS** is just the opposite of that described in paragraphs 6, 7 and 8 above. Control relay **3CR** is deenergized, thus closing **3CR1** and **3CR3** contacts and opening **3CR2** and **3CR3** contacts and deenergizing solenoid B. Solenoid A is again energized as previously described.

(12) Engagement with cars is transferred from pusher dog **32** to pusher dog **33** (FIGURE 12). The cars will continue to advance by action of pusher dog **33** until cylinder **21** again reaches the limit of its extension and the above reversing sequence is repeated and engagement with the cars is transferred to pusher dog **34** (FIGURE 13) for further movement.

(13) Movement of the cars can be interrupted at any time during the operation by releasing the "Move" pushbutton. Movement would be resumed in proper sequence by again depressing the "Move" pushbutton.

(14) The above described operating sequence is normal for a string of cars of uniform length within the limits of the overall stroke of the car mover (dog **31** retracted and dog **34** extended). For cars of varying types having different or differently spaced trucks, intermingled within the same string, automatic stroke selection is provided as described hereafter.

(15) Automatic stroke selection is achieved through limit switches **3LS** and **4LS** as indicated best in FIGURES 2*a* and 7. These limit switches are actuated by the spring positioned treadle shoe **70** which, in turn, is depressed at appropriate times, by rocker arm **50** mounted on dog carriage **51**. This rocker arm is rotated downward in position to engage the treadle when pusher dog **31** is depressed, by the truck frame, during its retracting movement while the cars are being advanced by either dog **32** or **34**.

(16) When either dog 32 or 34 is in engagement with the truck frame of a car and causing cars to advance, dogs 31 and 33 are retracting. If dog 31 is depressed by the next following car truck frame, the rocker arm 50 will rotate downward thus operating limit switches 3LS and 4LS. Limit switch 4LS is of a type such that its contacts operate only when its actuating arm 83 is rotated in a counterclockwise or upward direction. Thus, as the treadle 70 is depressed, the contacts in 3LS are closed by the arm 80, but no contact movement occurs in 4LS. Since dog 31 is retracting, 2CR is deenergized, 3CR is energized and 3CR4 contacts are closed and solenoid B is energized. Now, when dog 31 passes from beneath the truck frame which had caused it to be depressed, the treadle 70 resumes its normal upward position thus causing 4LS to open to deenergize 3CR and close 3CR1 and 3CR3 contacts and open 3CR2 and 3CR4 contacts thus deenergizing solenoid B and energizing 2CR through 3LS to energize solenoid A by closing 2CR4 contacts. This results in instant reversal of dog motion and dog 31 then moves forward to engage the cars. This action repeats each time dog 31 is depressed, during its retracting motion, to pass beneath the trucks of an advancing car.

(17) Limit switches 5LS and 6LS are simply overtravel switches which will deenergize either of the solenoids A and B to stop all movement in the event the normal reversing sequence fails to occur.

(18) Operation of the apparatus in its normal control sequence continues for as long as the "Move" pushbutton is maintained closed. Relay 1CR will remain energized and contact 1CR1 will be maintained open to prevent energization of the clutch of the time delay relay 1TR and the contacts 1TR1 will remain open and prevent energization of either relay 4CR or 5CR.

(19) If the "Move" pushbutton is released opening its contacts, relay coil 1CR will be deenergized resulting in closing of contacts 1CR1 which will complete a circuit to energize the clutch of time delay relay 1TR and initiate a timing cycle which may be of the order of several minutes. Simultaneously with initiation of the timing cycle, contacts 1CR2 will open and deenergize whichever solenoid, A or B, may have been connected in circuit and prevent energization of either solenoid through contacts 2CR4 or 3CR4. If the "Move" pushbutton is not depressed again before the timing period expires, the timer contacts 1TR1 will close upon expiration of the timing period completing a circuit to either relay coil 4CR or 5CR depending on whether solenoid A or B had been energized through operation of the respective relay 2CR or 3CR which will have opened associated contact 2CR3 or 3CR3.

(20) If relay coil 2CR had been previously energized resulting in energization of solenoid A advancement of pusher dogs 31 and 33, relay coil 3CR will be energized through the normally closed contacts 3CR3 and contacts 5CR1 will close and complete a circuit for energization of the clutch of time delay relay 2TR and initiate a timing cycle which is relatively short, such as a few seconds. Concurrently, contacts 5CR3 will close and complete a circuit to solenoid B through the timer contacts 2TR2 which remain closed until expiration of the delay time of 2TR. Energization of solenoid B results in pressurization of cylinder 22 and advancement of pusher dogs 32 and 34, causing retraction of pusher dogs 31 and 33 which is a reversal of the direction of movement. Contacts 5CR2 will also be opened to prevent energization of solenoid A.

(21) If relay coil 3CR had been previously energized resulting in energization of solenoid B with pressurization of cylinder 22 and advancement of pusher dogs 32 and 34 at the instant timer contacts 1TR1 close, relay coil 4CR will be energized through the normally closed contacts 2CR3. Timer 2TR clutch will be energized through contacts 4CR1 which will now be closed and initiate a timing cycle. Contacts 4CR2 will also close completing a circuit through timer contacts 2TR2 to energize solenoid A which results in pressurization of cylinder 21 and reverses the direction of movement of the pusher dogs. Contacts 4CR3 will also open and prevent energization of solenoid B.

(22) The operation of time delay relay 1TR upon opening of the "Move" pushbutton is to effect a reversal in the direction of movement of the pusher dogs causing the dogs which would have been in engagement with the truck side frame to back away and become disengaged from the truck. Since the delay time of 2TR is only of the order of a few seconds, the pusher dogs previously engaged with the truck side frame will only be able to back away a few inches before timer contacts 2TR2 will open upon expiration of the time delay interval. Opening of contacts 2TR2 will result in deenergization of whichever solenoid, A or B, may have been energized through operation of time delay relay 1TR and stop further movement of the pusher dogs.

(23) Simultaneously with opening of contacts 2TR2, contacts 2TR1 will close and complete a circuit through limit switch FLS–1 to solenoid F of the reversing starter-controller 118 for motor MM of the hydraulic unit 130. Energization of solenoid F closes the respective contacts F–1 to energize the motor MM for operation in a direction to extend the piston rod causing counter clockwise movement of the lever arm 124 and resulting in locking of all pusher dogs in a down position. Concurrently, contacts F–2 will open and prevent energization of solenoid R of the starter-controller 118 while solenoid F is energized. As soon as the piston rod of the hydraulic unit 130 begins ct extend, limit switch RLS will operate to close contacts RLS–1 and open contacts RLS–2. If the "Move" pushbutton should be depressed at this time, F–2 will prevent energization of solenoid R. Contacts RLS–2 will also open and the light L–2 indicating that the pusher dogs are up will go out.

(24) Motor MM will continue to operate until the piston rod of the hydraulic unit reaches the limit of its travel and causes operation of limit switch FLS. Operation of limit switch FLS opens FLS–1 which deenergizes solenoid F causing its contacts F–1 and F–2 to open and motor MM will stop. Contacts FLS–2 will now be closed to complete a circuit to light L–3 which will now be illuminated indicating that all pusher dogs are in the "down" position.

(25) The apparatus will now remain in this configuration until the "Move" pushbutton is again depressed to close its contacts. This will complete a circuit through RLS–1, which is now closed, to solenoid R which will be energized to close its respective contacts R–1 to energize the motor MM of the hydraulic unit 130 for operation in a direction to retract the piston rod of that unit causing the lever arm 124 to pivot in a clockwise direction and permit the pusher dogs to raise to an upright position. Limit switch FLS will operate at this time to open FLS–2 and close FLS–1 but contact R–2 is now open and will prevent reenergization of solenoid F.

(26) When the piston rod of the hydraulic unit 130 reaches its fully retracted position, limit switch RLS will be operated to open RLS–1 and deenergizes solenoid R stopping motor MM. Contacts RLS–2 will again be closed to cause light L–2 to illuminate indicating that the pusher dogs have raised to the "Up" position.

(27) While RLS–1 is closed and solenoid R is energized, contact R3 connected in series with relay coil 1CR will be open and prevent operation of the remainder of the control circuit. When RLS–1 opens, solenoid R will be deenergized and contacts R–3 will close to permit energization of relay coil 1CR through the closed contacts of the "Move" pushbutton and operation of the circuit and apparatus as previously described. Energization of relay coil 1CR opens contacts 1CR1 and stops operation of the timer relays 1TR and 2TR permitting contacts 1TR1 and 2TR1 to open and contact 2TR2 to close. Simultaneously, contact R–2 closes placing the circuit in

condition for subsequent operation of hydraulic unit 130.

It will be apparent from the above that this invention provides a rugged car pusher which will function efficiently with single cars or with cars of various types intermingled in the same string of cars. The automatic stroke selector arrangement functions to adjust the ram or cylinder stroke to cars of varying types in the same string of cars. This eliminates lost or unnecessary retracting and subsequent car-engaging movement of the piston, with possible excessive impact and car damage, which would otherwise result due to travel of the piston through the entire extent of its predetermined maximum stroke if there was no compensation for variations in the nature of the cars. The dogs will engage the trucks outside the rails at a readily accessible position and due to the staggered arrangement of the cylinder units at opposite sides of the trackway, with the staggered car-engaging dogs, a maximum advance of the cars will be obtained with a minimum stroke of the cylinders, thereby making it possible to use cylinders of less length. The pusher dogs will be automatically lowered to an inoperative position if the operator should leave his station for more than a predetermined period of time. This feature is desirable to minimize the possibility of jamming of the dogs by reverse movement of the cars when the operator is not on duty. The invention also provides effective means for completely covering and protecting the piston rods regardless of the amount they are extended from their respective cylinders.

Various other advantages will be apparent.

Having thus described this invention, what is claimed is:

1. Car-moving apparatus comprising a reciprocable fluid-powered unit, a car-engaging and advancing means connected to said unit and adapted to be reciprocated thereby through a predetermined maximum stroke, control means for actuating said fluid-powered unit to produce said stroke, said control means including stroke-selecting means actuated automatically during movement of said car-engaging and advancing means for varying said stroke from its maximum in accordance with variations in cars to be advanced by said car-engaging and advancing means.

2. Car-moving apparatus according to claim 1 in which said fluid-powered unit reciprocates said car-engaging and advancing means through a stroke comprising a car-advancing portion and a retracting portion, said stroke-selecting means being actuated during the retracting portion of the stroke.

3. Car-moving apparatus according to claim 2 in which said stroke-selecting means includes a movable control member engaged by said car-engaging and advancing means during its return stroke.

4. Car-moving apparatus according to claim 3 in which said car-engaging and advancing means comprises a carriage which carries a movable car-engaging dog, means for biasing said dog into car-engaging position so that the car will be engaged during the car-advancing portion of the stroke of the carriage, said dog being yieldable against the action of said biasing means to move out of car-advancing position when it contacts a car during the return stroke of the carriage, said movable control member of the stroke-selecting means being engaged by said dog as it is moved out of car-advancing position.

5. Car moving apparatus according to claim 4 in which said fluid-powered unit is a hydraulic unit, said control means including an electric circuit for controlling said hydraulic unit having switch means engaged and actuated by said movable control member of the stroke-selecting means, and having reversing switch means engaged and actuated as said carriage reaches the extent of its car-advancing stroke.

6. Car-moving apparatus according to claim 4 in which said fluid-powered unit comprises a cylinder and piston unit, said car-engaging and advancing means comprising a dog carriage connected to the piston of said unit, said dog being mounted for vertical swinging movement on said carriage, said movable control member of the stroke-selecting means comprising a vertically movable treadle located along the path of movement of said carriage, a vertically movable, treadle-contact member carried by said carriage and normally biased to a vertical position where it is movable over said treadle with said carriage, without contacting therewith, said dog having cam means for moving said treadle-contact member into engagement with the treadle during the retracting movement of the dog carriage whenever the dog is swung downwardly into its nonadvancing position relative to a car it engages during its retracting movement.

7. Car-moving apparatus according to claim 6 in which said control means includes a reversing control for said cylinder and piston unit engaged by a contact means on the carriage as the cylinder and piston unit reaches the maximum extent of its car-advancing stroke.

8. Car-moving apparatus according to claim 7 in which a hydraulic unit is provided for supplying hydraulic power to said cylinder and piston unit, said control means including an electric circuit for controlling said hydraulic unit, switch means connected in said circuit and engaged and actuated upon vertical movement of said treadle, and said reversing control comprising switch means engaged and actuated by said carriage as it reaches the extent of its car-advancing stroke.

9. Car-moving apparatus according to claim 8 including an overrun switch means connected in said circuit for controlling said hydraulic unit and positioned beyond said reversing switch means relative to the car-advancing movement of the carriage so that it is engaged by said carriage after engagement with said reversing switch means.

10. Car-moving apparatus according to claim 9 located along a trackway on which the cars travel, a pair of said cylinder and piston units being provided with each of the pair being located at opposite sides of the trackway, each of said cylinder and piston units being a single-acting unit, and mechanical means for connecting the piston rods of the units together so that as one retracts the other extends.

11. Car-moving apparatus according to claim 10 in which each of the piston rods is connected to a plurality of dog-carriages disposed at longitudinally spaced intervals relative to the trackway, one of said carriages only carrying said cam means for moving said treadle.

12. Car-moving apparatus according to claim 11 in which the longitudinally spaced dogs of one cylinder and piston unit are staggered longitudinally relative to those of the other unit.

13. Car-moving apparatus according to claim 12 in which said hydraulic unit includes a hydraulic pump driven by an electric motor connected in said circuit, a reversing valve arrangement for controlling supply of hydraulic fluid to said cylinder and piston units, and solenoids connected in said circuits or actuating said valve.

14. Car-moving apparatus according to claim 10 including means for automatically covering each piston rod as it is extended, said means comprising a cover plate disposed over the rod and being connected thereto for movement therewith relative to its respective cylinder, and means for guiding and supporting said cover plate.

15. Car-moving apparatus according to claim 1 in which a plurality of said car-engaging and advancing means are provided and each includes a carriage which carriers a movable car-engaging dog, means for biasing said dog into car-engaging position so that the car will be engaged during the car-advancing portion of the stroke of the carriage, means for overcoming the biasing effect of said last-named means and retract the dog from a car-engaging position to an inoperative position, and additional control means for actuating all of said last-named

means simultaneously to move all of said dogs into an inoperative position.

16. Car-moving apparatus according to claim 15 including timing means for causing said additional control means to function after a predetermined time delay in operation of said first-named control means.

17. Car-moving apparatus according to claim 15 wherein said additional control means includes actuating means coupled with all of said means for overcoming the biasing effect, and having a selectively operable electric motor for effecting operation thereof, and electric circuit means connected with said electric motor and said first-named control means for controlling the operation thereof, said circuit means including switch means for initiating operation of said electric motor in either direction and switch means responsive to the position of all of said dogs and operative to terminate operation of said electric motor when all of said dogs reach either an operative or an inoperative position.

18. Car-moving apparatus according to claim 17 in which said initiating switch means includes electric timing means for causing said switch means to function after a predetermined time delay in operation of said first-named control means.

19. Car-moving apparatus according to claim 15 wherein said additional control means includes first and second cables connected at each end to means for overcoming the biasing effect of respective biasing means, each of said cables being connected to bias overcoming means disposed at opposite sides of said apparatus in longitudinally staggered relationship, means engageable with said first and second cables intermediate their ends permitting relative axial movement of said cables, and actuating means connected with said cable engaging means for effecting displacement of said cables for moving all of said dogs into an inoperative position.

20. Car-moving apparatus according to claim 8 in which said hydraulic unit includes first and second electric solenoids for controlling the direction of operation of said cylinder and piston unit, said solenoids being connected in said electric circuit.

21. Car-moving apparatus according to claim 20 wherein said electric circuit includes normally open switch means which maintains said electric circuit in operation when placed in a closed position for sequential energization of said solenoids in an alternating manner.

22. Car-moving apparatus according to claim 20 wherein said electric circuit includes first and second electrically operated switch means connected in circuit with a respective one of said first and second electric solenoids for selective energization thereof and connected in circuit with each other to prevent simultaneous operation, said first-named switch means being connected in circuit with said electrically operated switch means for automatic selection of the operation thereof in response to position of said dogs, and said reversing control switch means being connected in circuit with said electrically operated switch means.

23. Car-moving apparatus according to claim 22 wherein said electric circuit includes normally closed overrun switch means connected in circuit with said first and second electric solenoids and responsive to displacement of said carriage to a point beyond normal engagement with said reversing control switch means resulting in opening of said overrun switch means for deenergization of said solenoids preventing continued automatic operation of said apparatus.

24. Car-moving apparatus according to claim 22 in which each of said carriage dogs is provided with means operable to retract said dogs to an inoperative position and return said dogs to an operative position and the apparatus includes additional control means connected with said last-named means for operation thereof, said additional control means including a reversible electric motor operatively connected with said last-named means for positioning said dogs in either an operative or inoperative position, and a motor control circuit including electrically operated swtch means connected in circuit with said motor, and switch means responsive to the position of said dogs and operative to terminate operation of said electric motor when said dogs reach the operative or inoperative position, said first-named electric circuit including time responsive switch means connected in circuit with said motor control circuit to initiate operation of said electric motor, said last-named switch means operative to initiate operation of said electric motor after a predetermined time-delay in the operation of both said first and second electrically operated switch means controlling energization of said solenoids.

25. Car-moving apparatus according to claim 24 in which said time responsive switch means is also connected in circuit with said solenoids and is operative to effect a reversal in operation of said apparatus for a relatively short period of time prior to initiation of operation of said electric motor and to prevent energization of said solenoids concurrently with energization of said solenoids concurrently with energization of said electric motor.

References Cited

UNITED STATES PATENTS

2,847,945	8/1958	Merritt	104—162
2,900,922	8/1959	Edmonds	104—162

EUGENE G. BOTZ, *Primary Examiner.*