Dec. 16, 1969 L. D. BARRY 3,484,002

TRANSPORTATION SYSTEM

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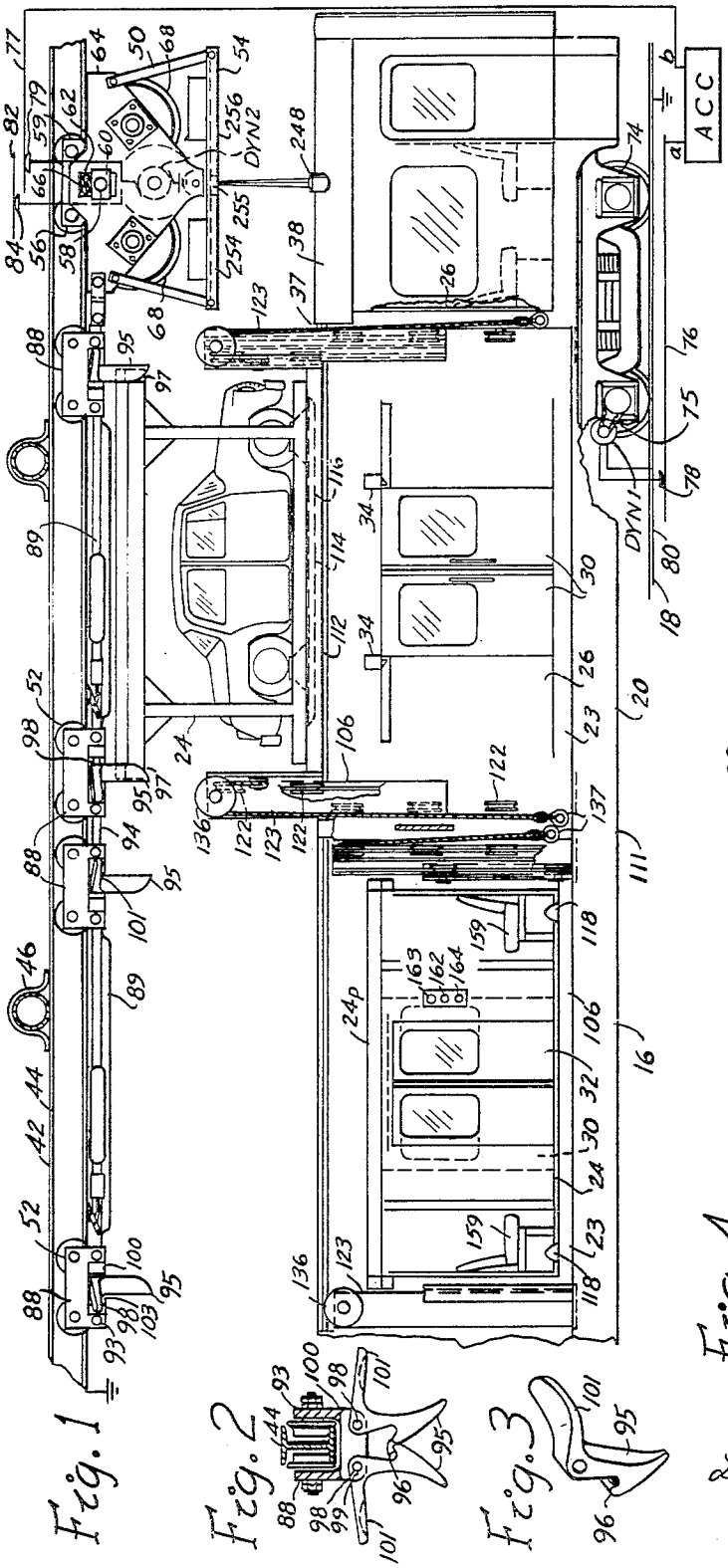


Fig. 1

Fig. 2

Fig. 3

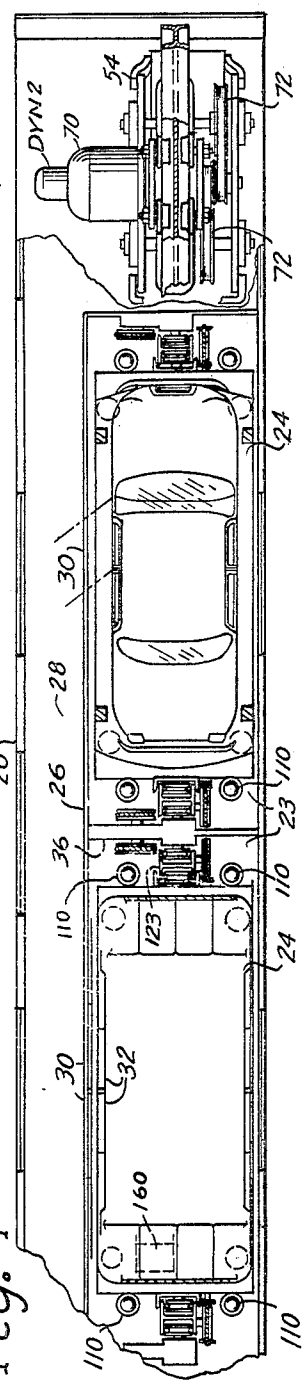


Fig. 4

INVENTOR.

Leonard D. Barry

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TRANSPORTATION SYSTEM

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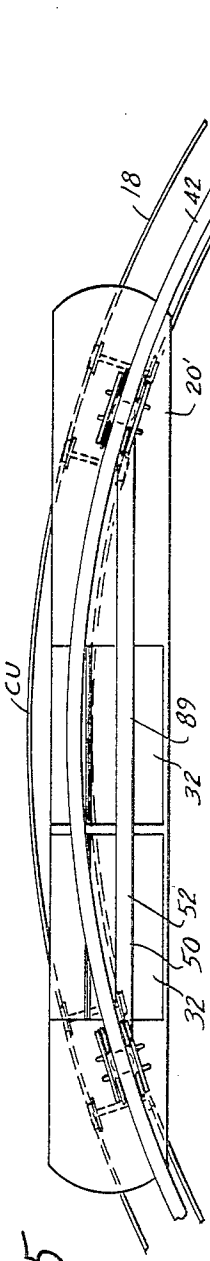


Fig. 5

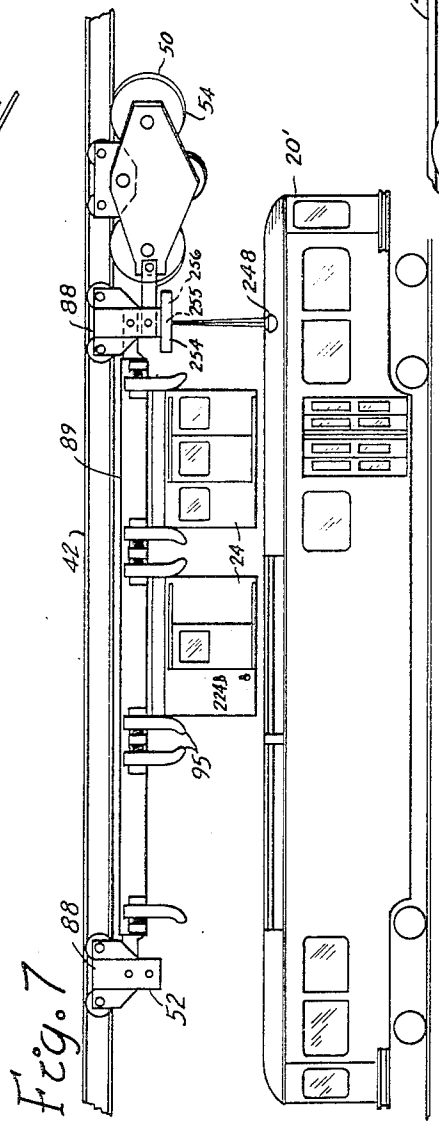


Fig. 7

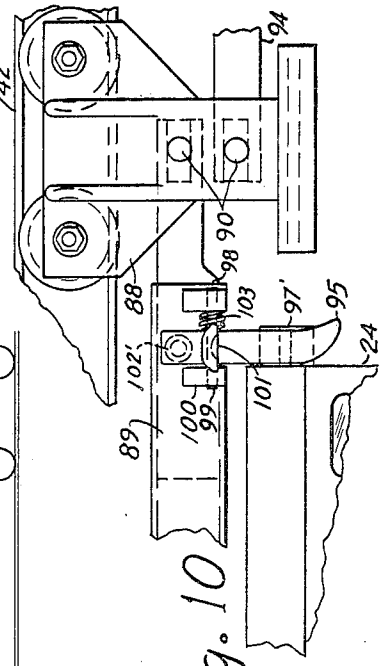


Fig. 10

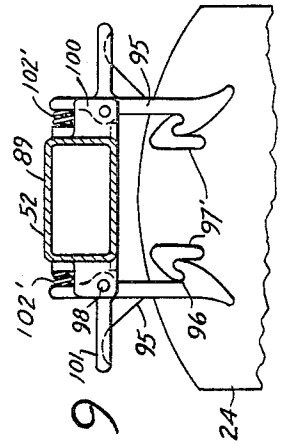


Fig. 9

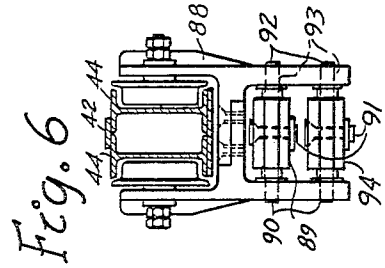


Fig. 6

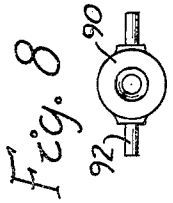


Fig. 8

INVENTOR.

Leonard D. Barry

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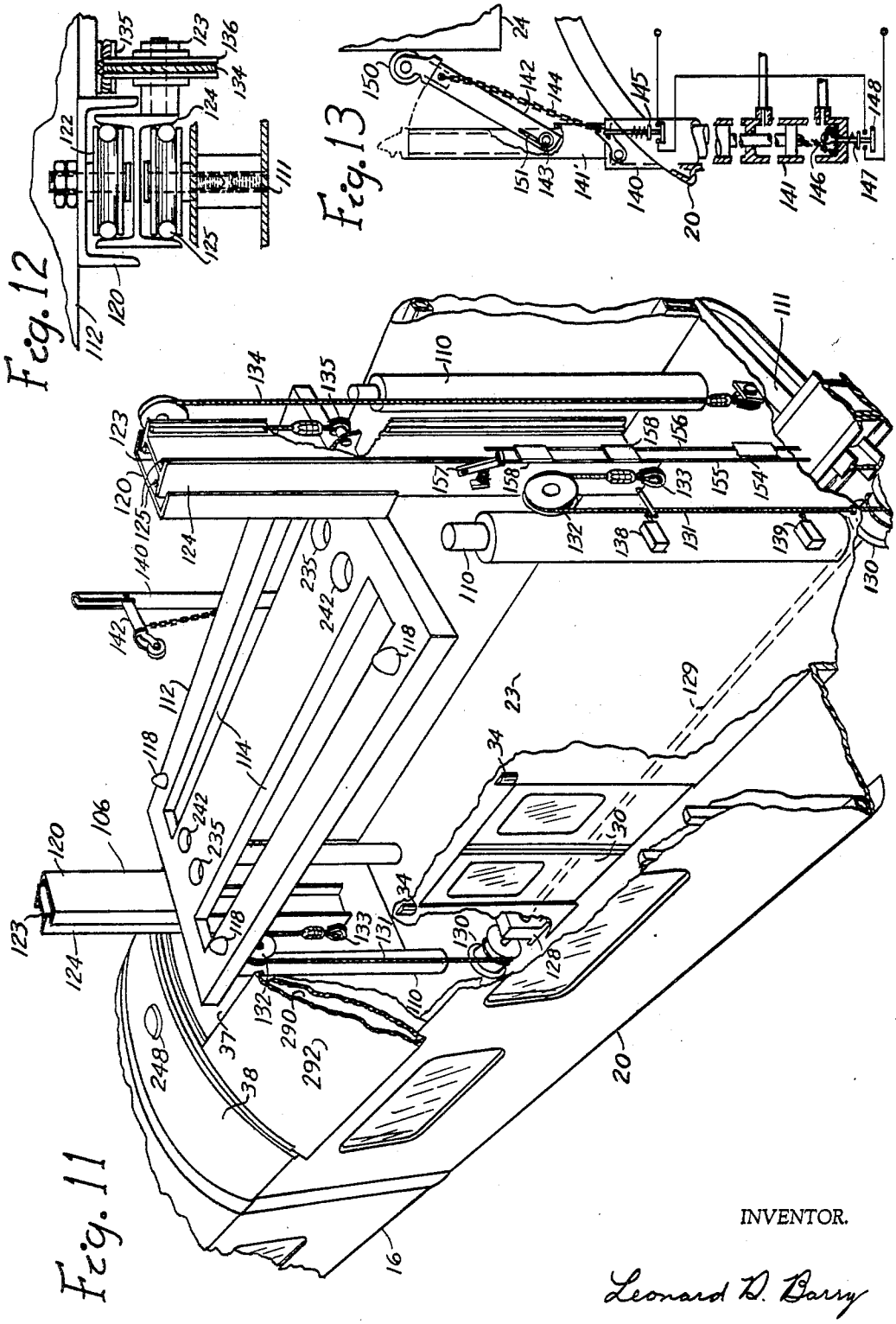


Fig. 11

Fig. 12

Fig. 13

INVENTOR.

Leonard D. Barry

Dec. 16, 1969 L. D. BARRY 3,484,002

TRANSPORTATION SYSTEM

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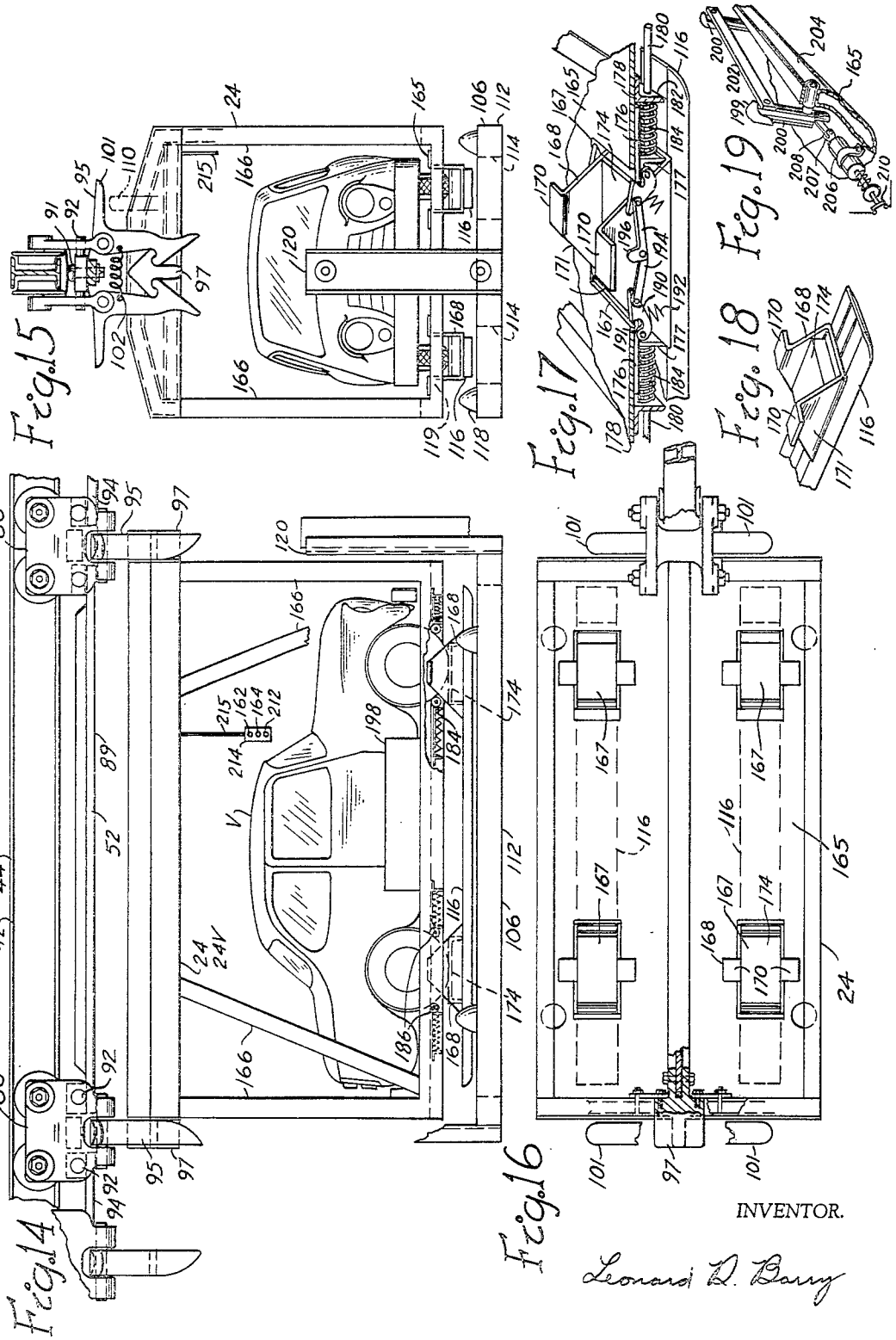


Fig. 14

Fig. 15

Fig. 16

Fig. 17

Fig. 18

Fig. 19

INVENTOR.

Leonard D. Barry

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TRANSPORTATION SYSTEM

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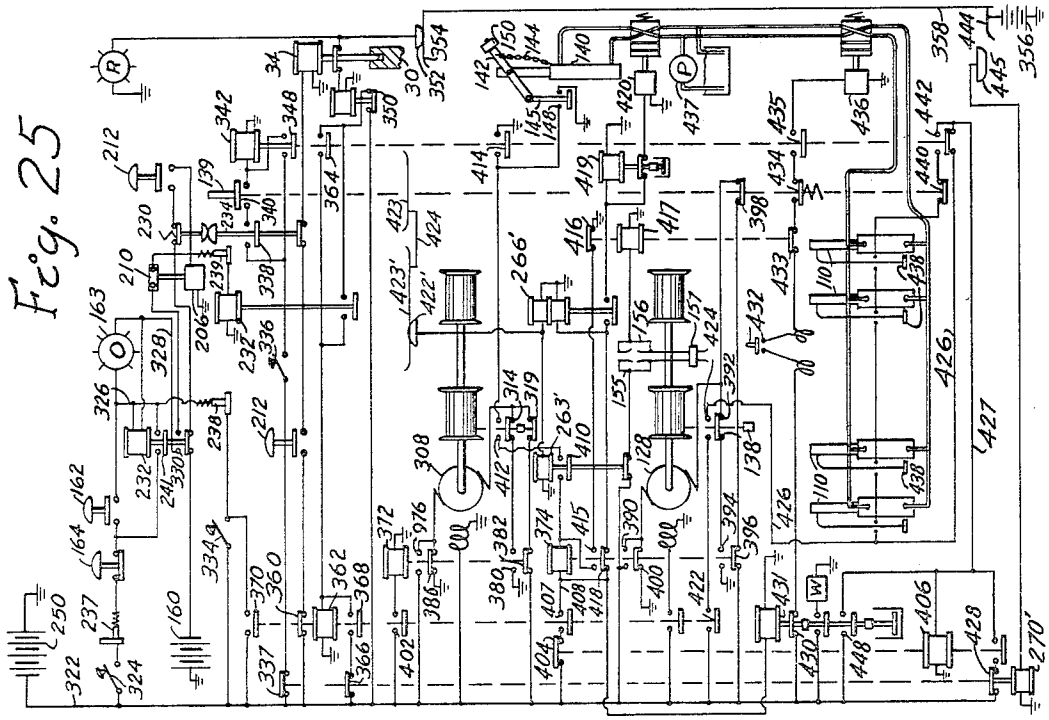


Fig. 25

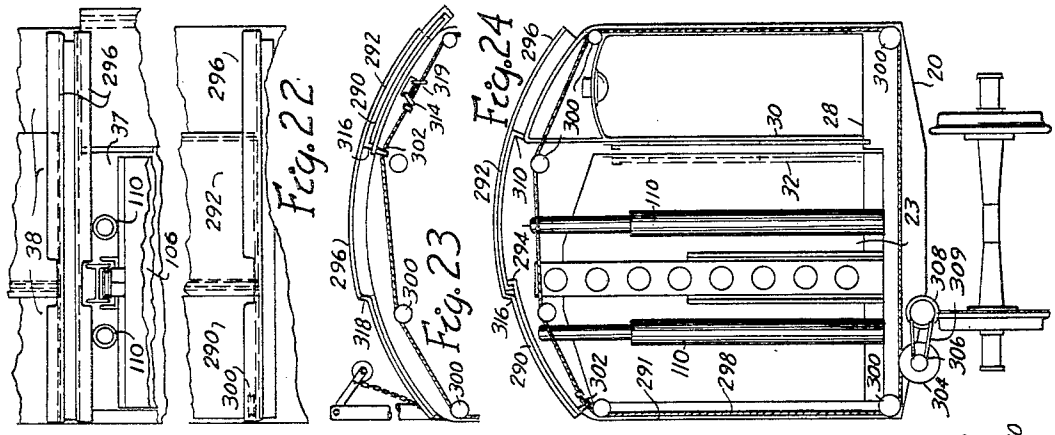


Fig. 22

Fig. 23

Fig. 24

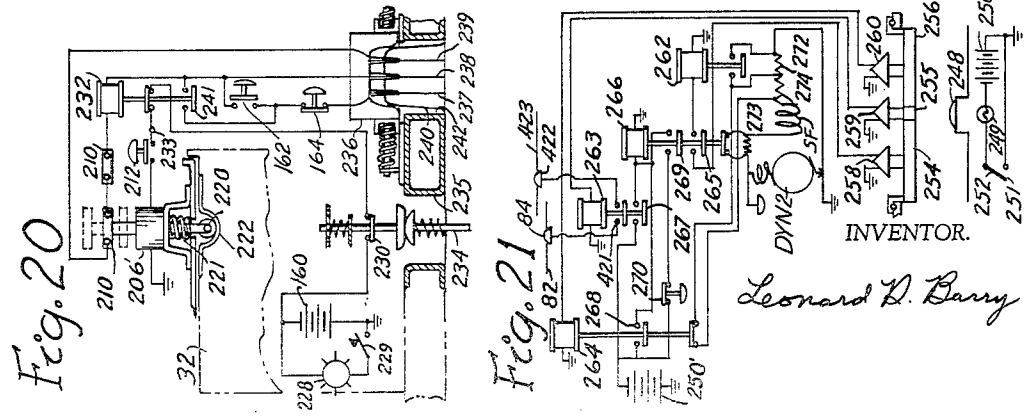


Fig. 20

Fig. 21

INVENTOR.

Leonard D. Barry

Dec. 16, 1969 L. D. BARRY 3,484,002

TRANSPORTATION SYSTEM

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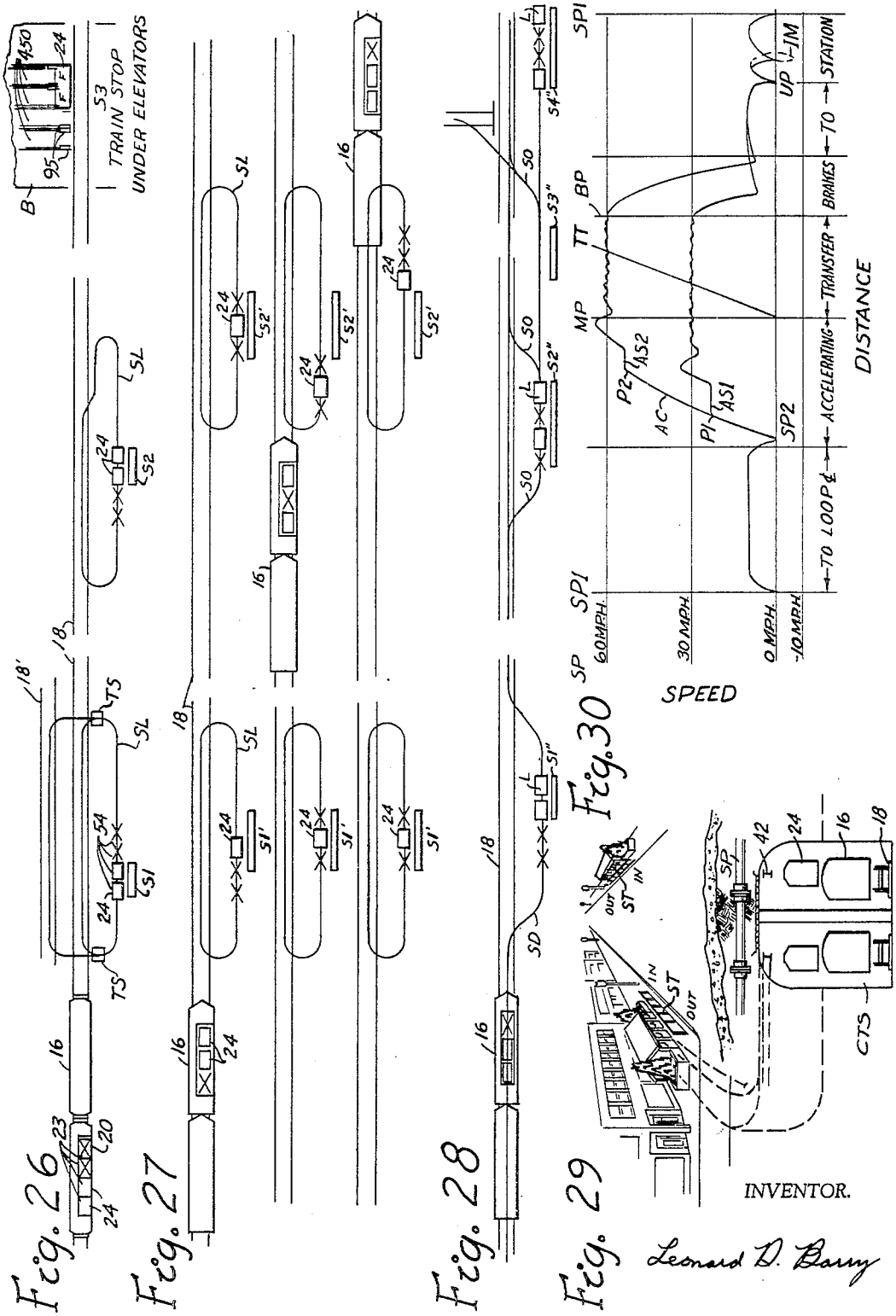


Fig. 26

Fig. 27

Fig. 28

Fig. 30

Fig. 29

INVENTOR.

Leonard D. Barry

Dec. 16, 1969 L. D. BARRY 3,484,002

TRANSPORTATION SYSTEM

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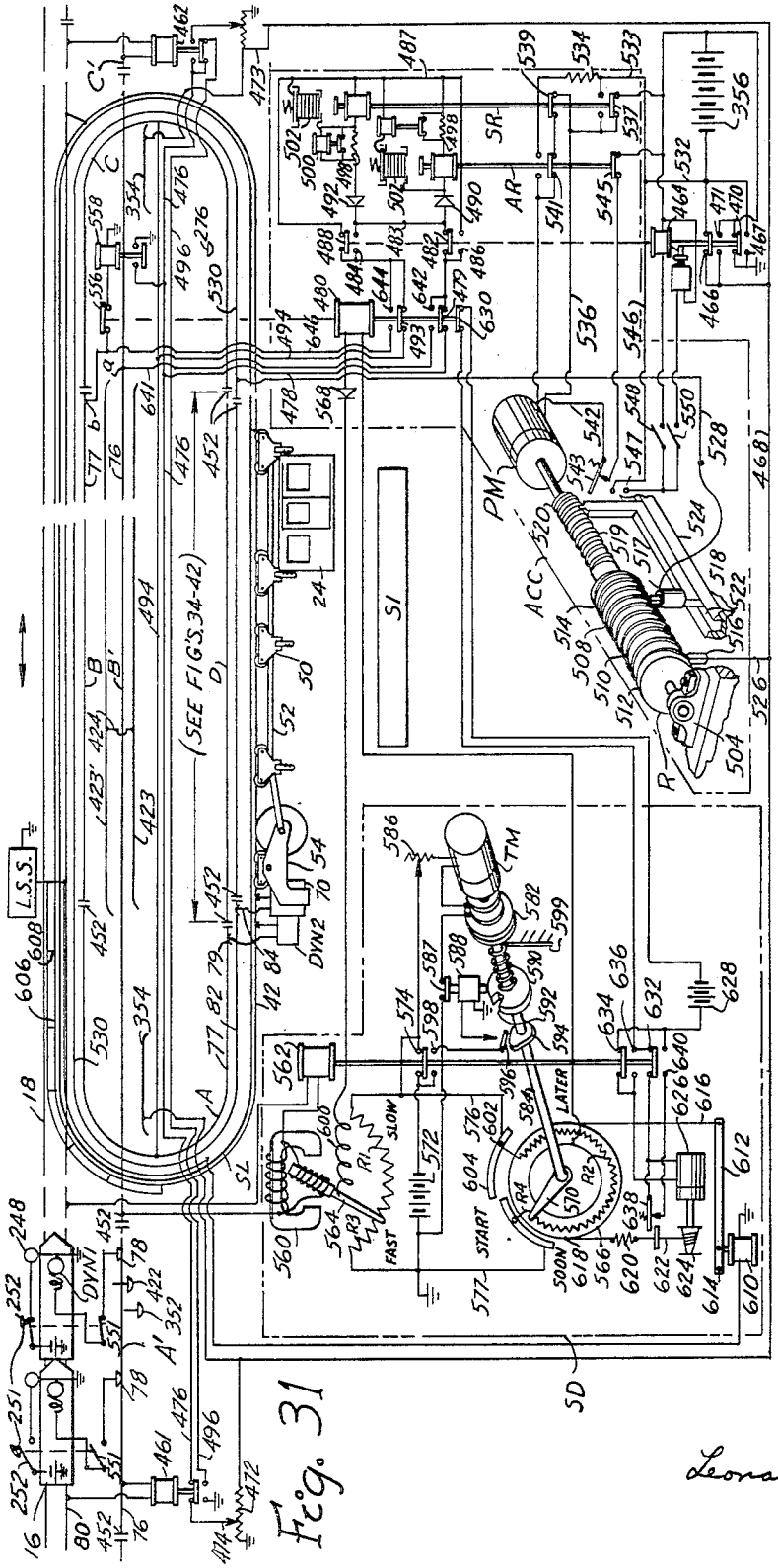


Fig. 31

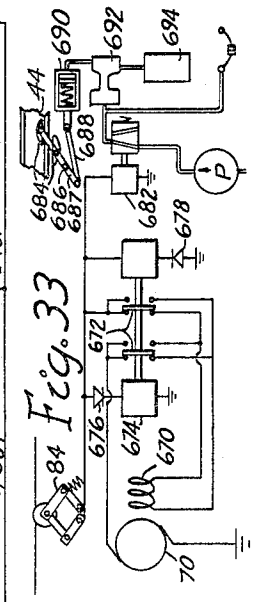


Fig. 33

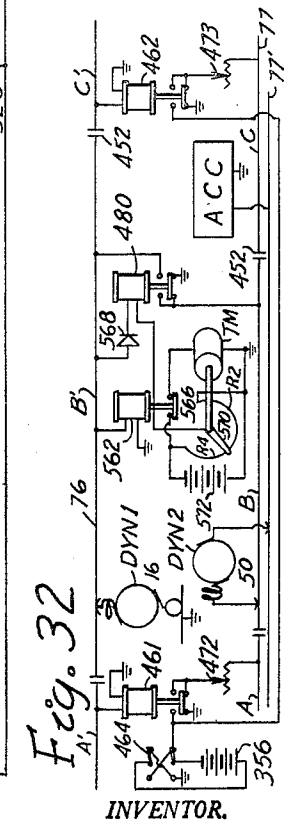


Fig. 32

INVENTOR.

Leonard D. Barry

Dec. 16, 1969 L. D. BARRY 3,484,002

TRANSPORTATION SYSTEM

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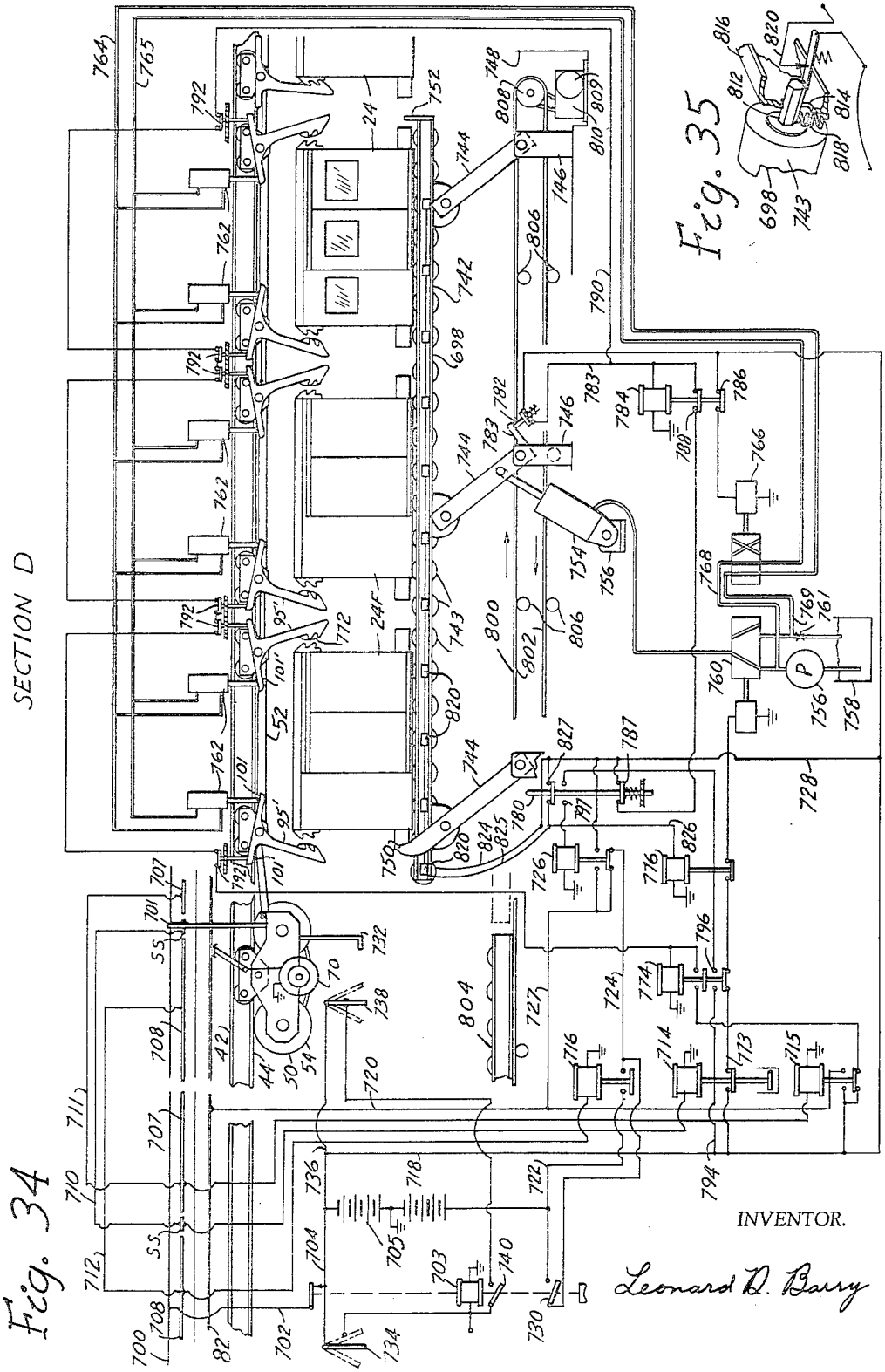


Fig. 34

SECTION D

Fig. 35

INVENTOR.

Leonard D. Barry

Dec. 16, 1969 L. D. BARRY 3,484,002

TRANSPORTATION SYSTEM

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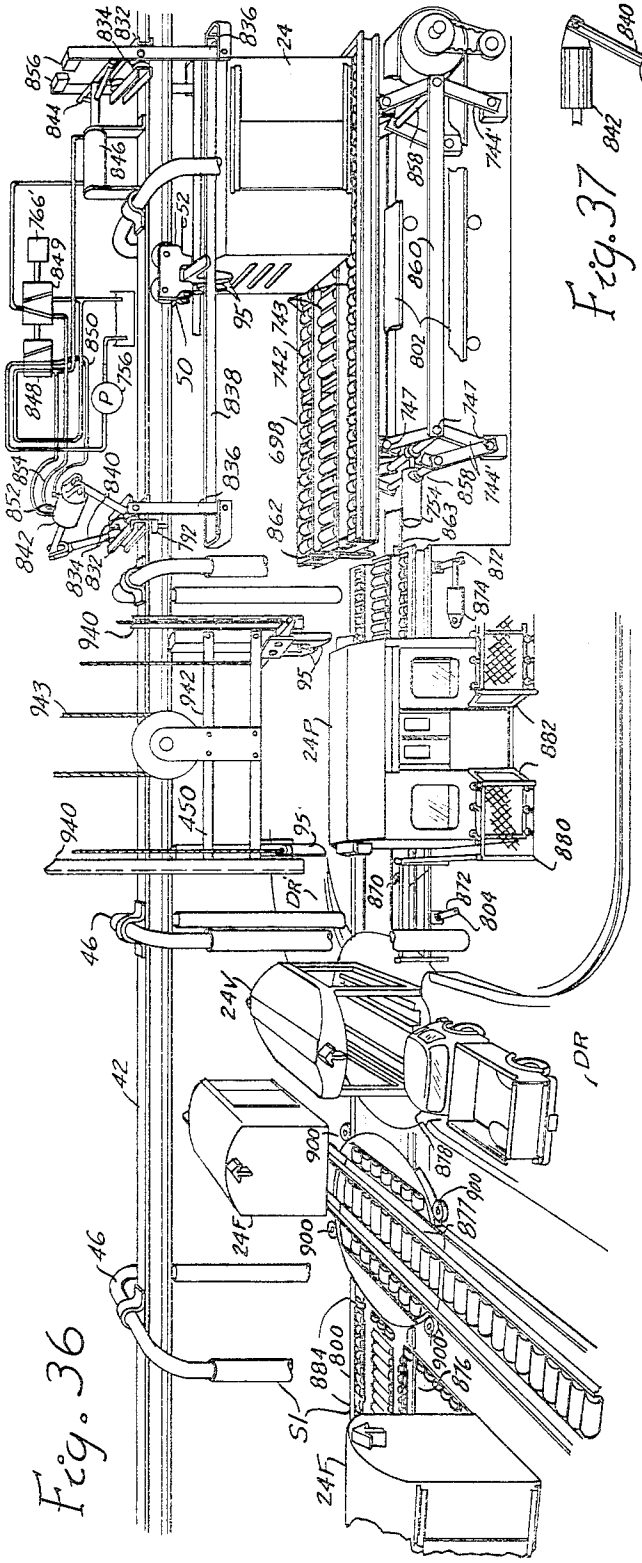


Fig. 36

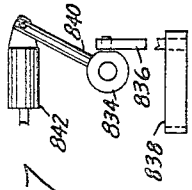


Fig. 37

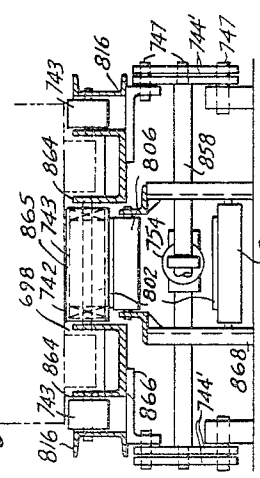


Fig. 40

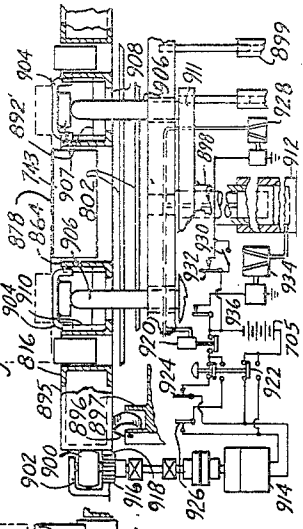


Fig. 39

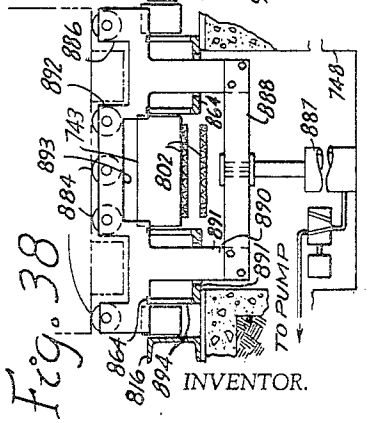


Fig. 38

INVENTOR.

Leonard D. Barry

Dec. 16, 1969 L. D. BARRY 3,484,002

TRANSPORTATION SYSTEM

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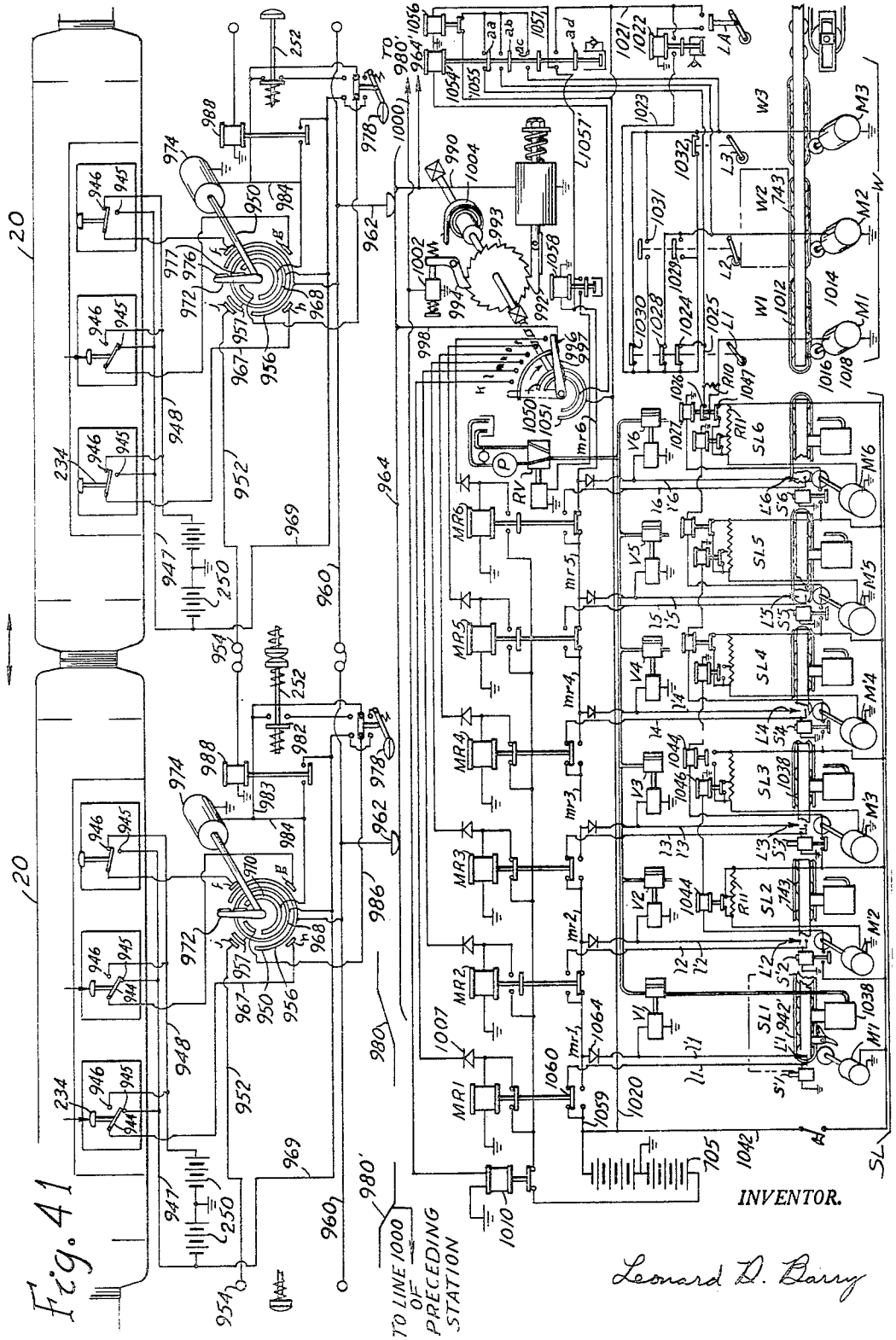


Fig. 41

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TRANSPORTATION SYSTEM

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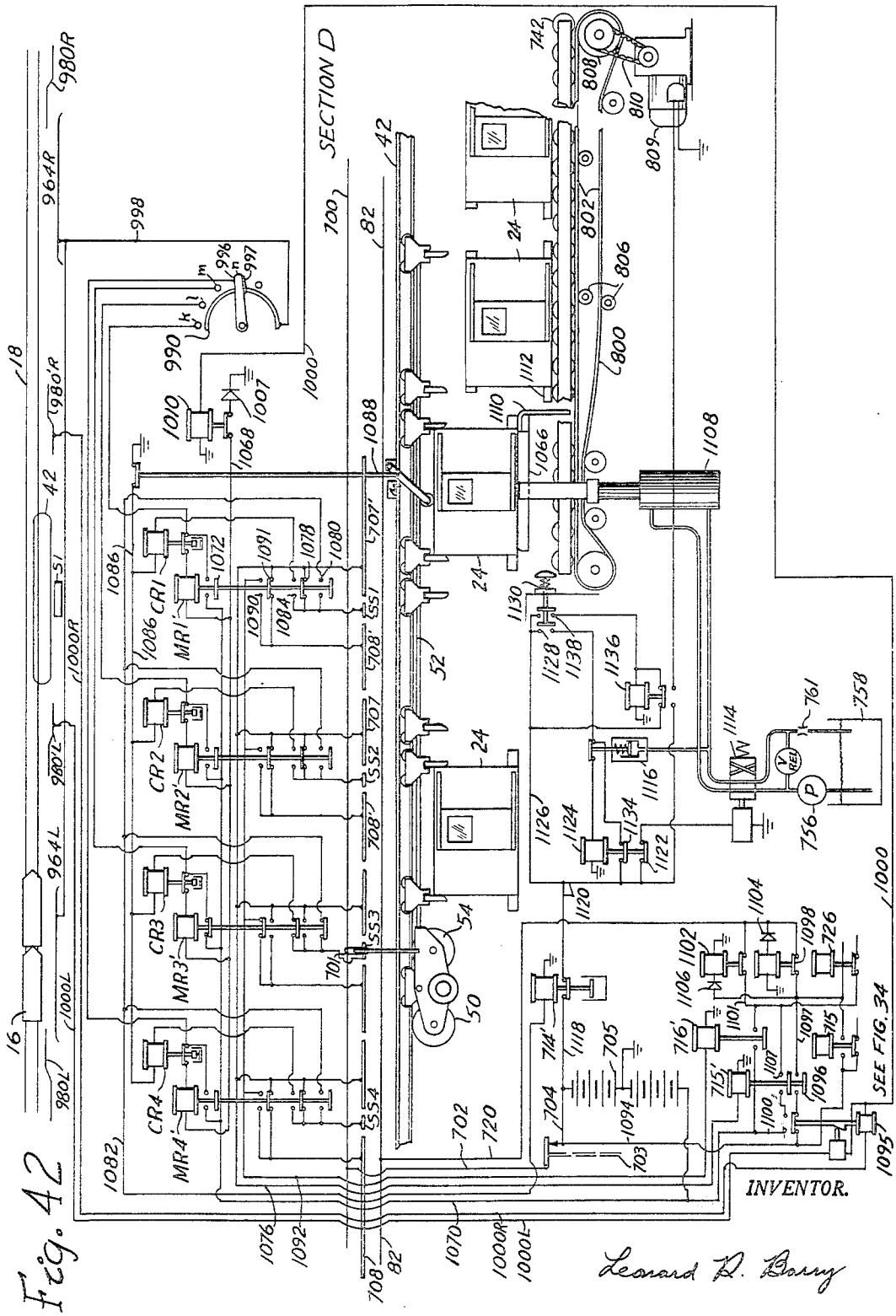


Fig. 42

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TRANSPORTATION SYSTEM

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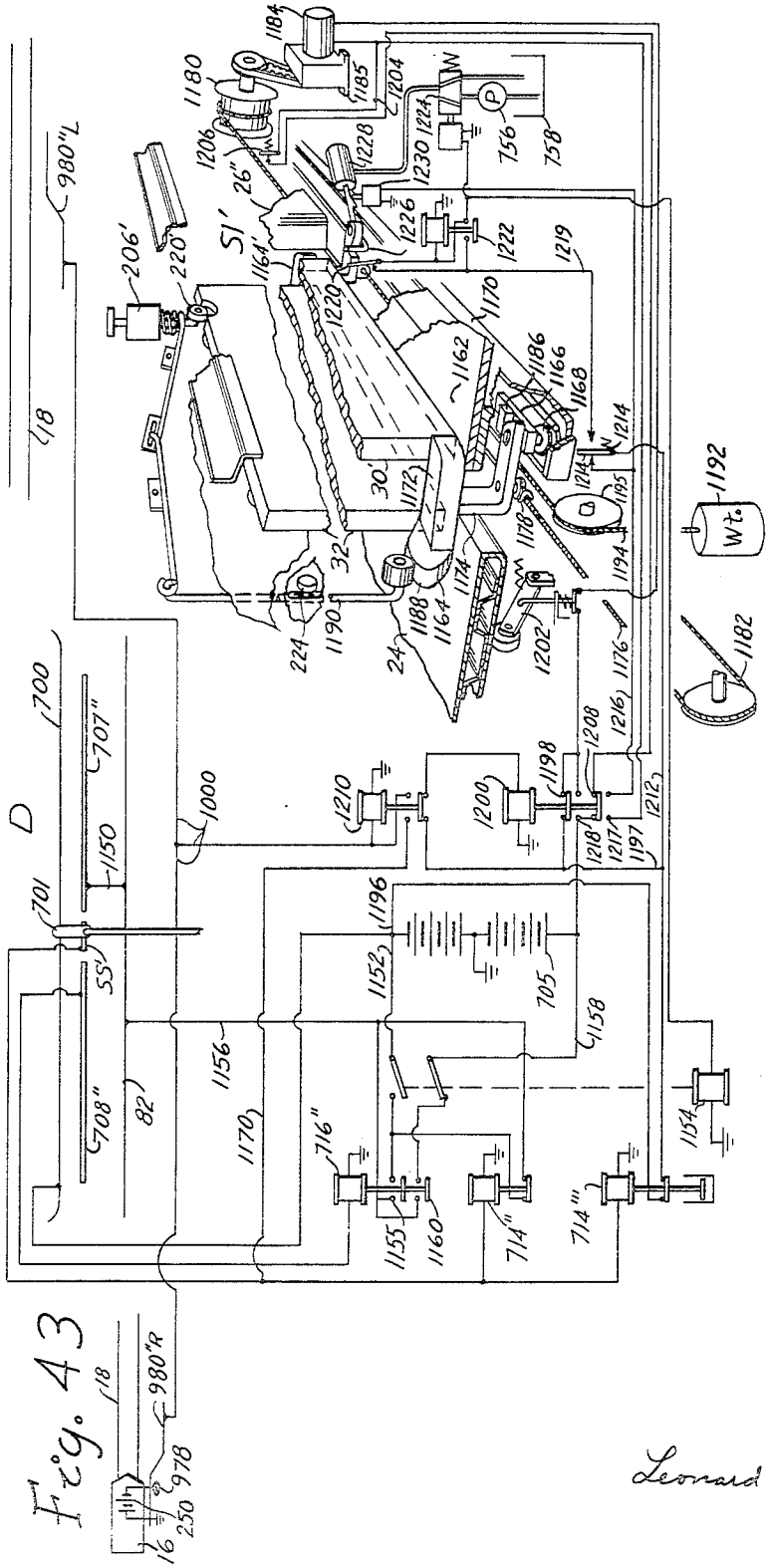


Fig. 43

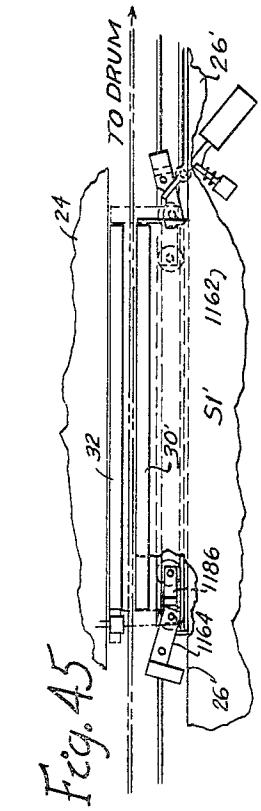


Fig. 45

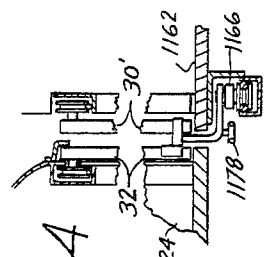


Fig. 44

INVENTOR.

Leonard D. Barry

Dec. 16, 1969 L. D. BARRY 3,484,002

TRANSPORTATION SYSTEM

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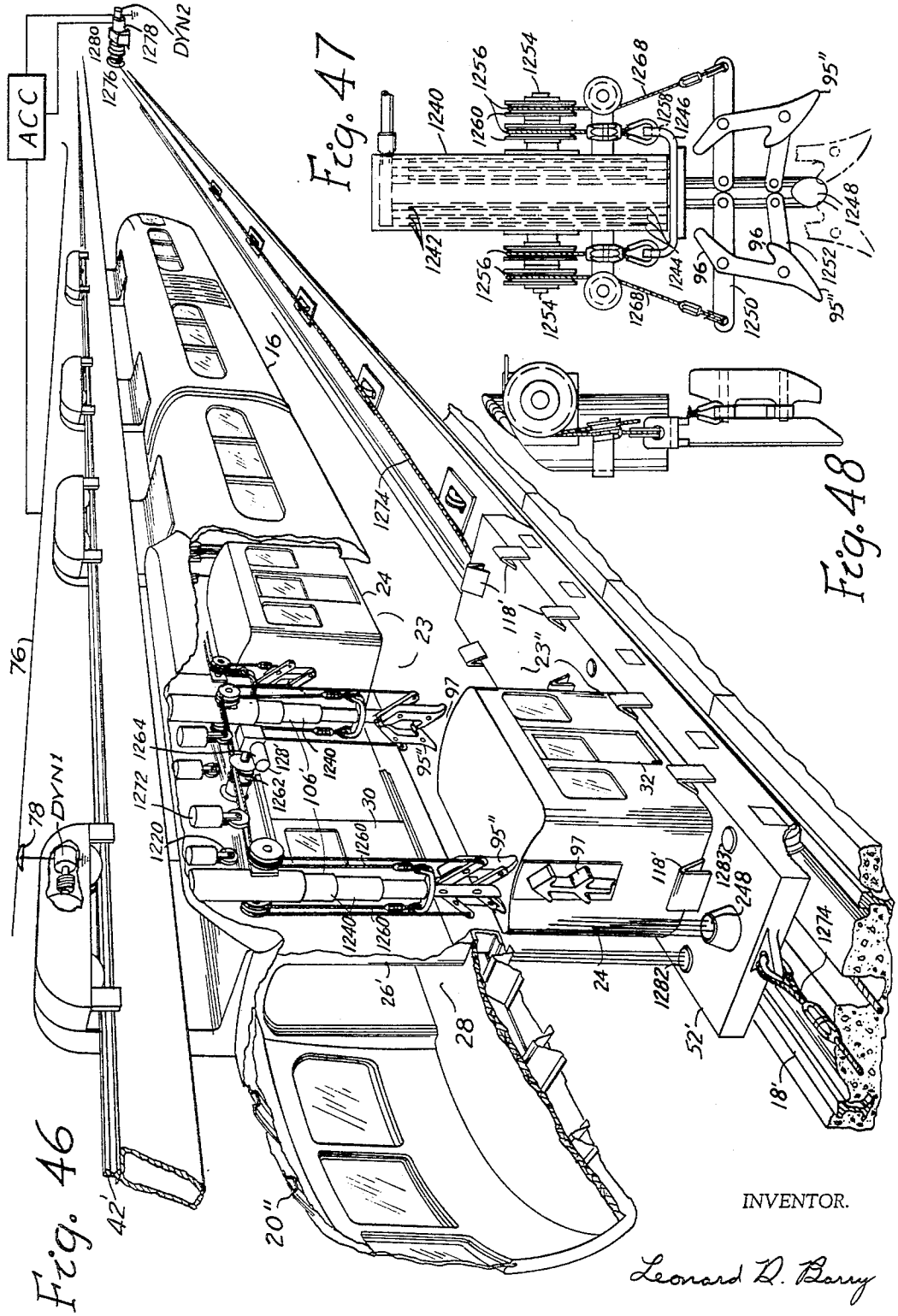


Fig. 46

Fig. 47

Fig. 48

INVENTOR.

Leonard D. Barry

TRANSPORTATION SYSTEM

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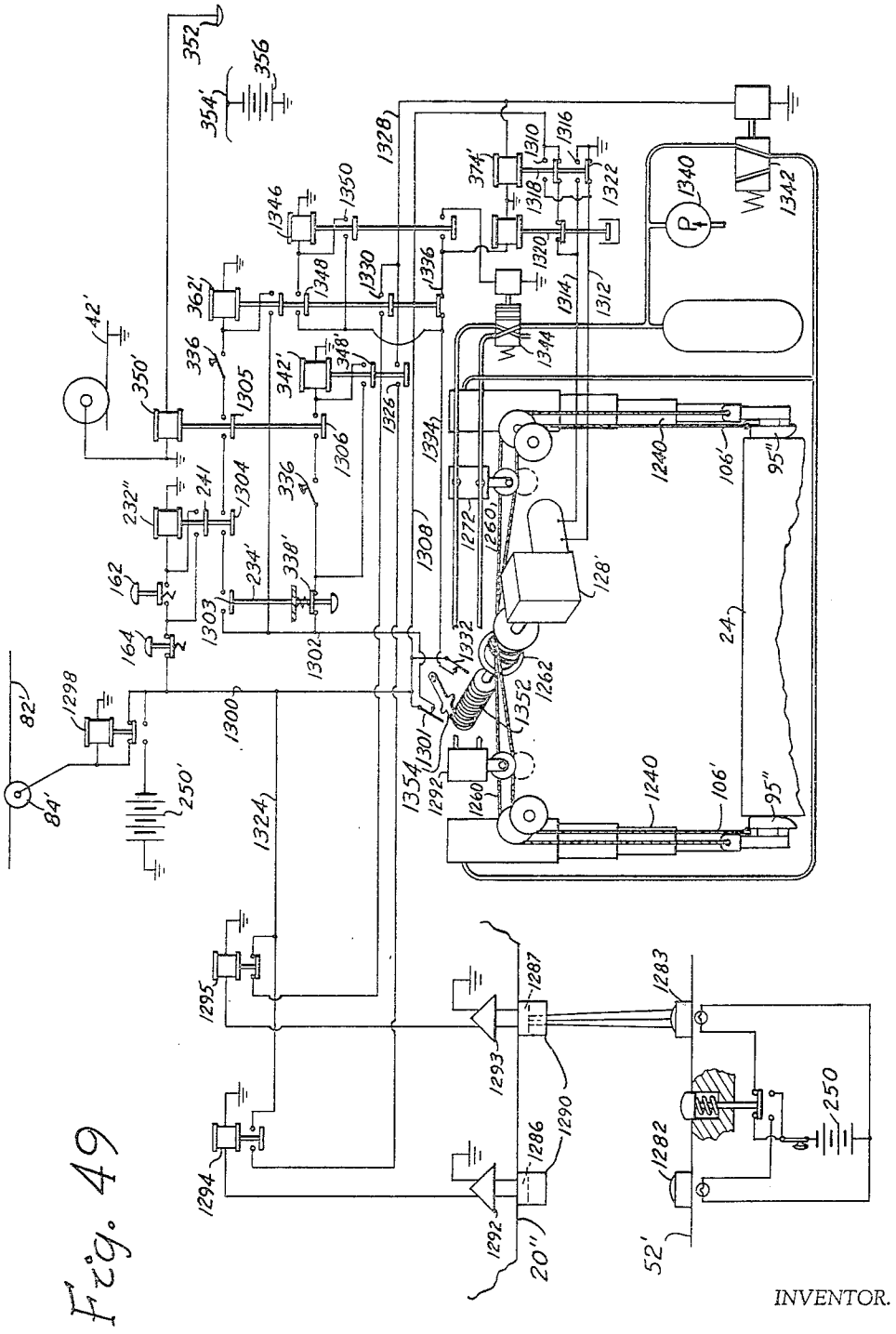


Fig. 49

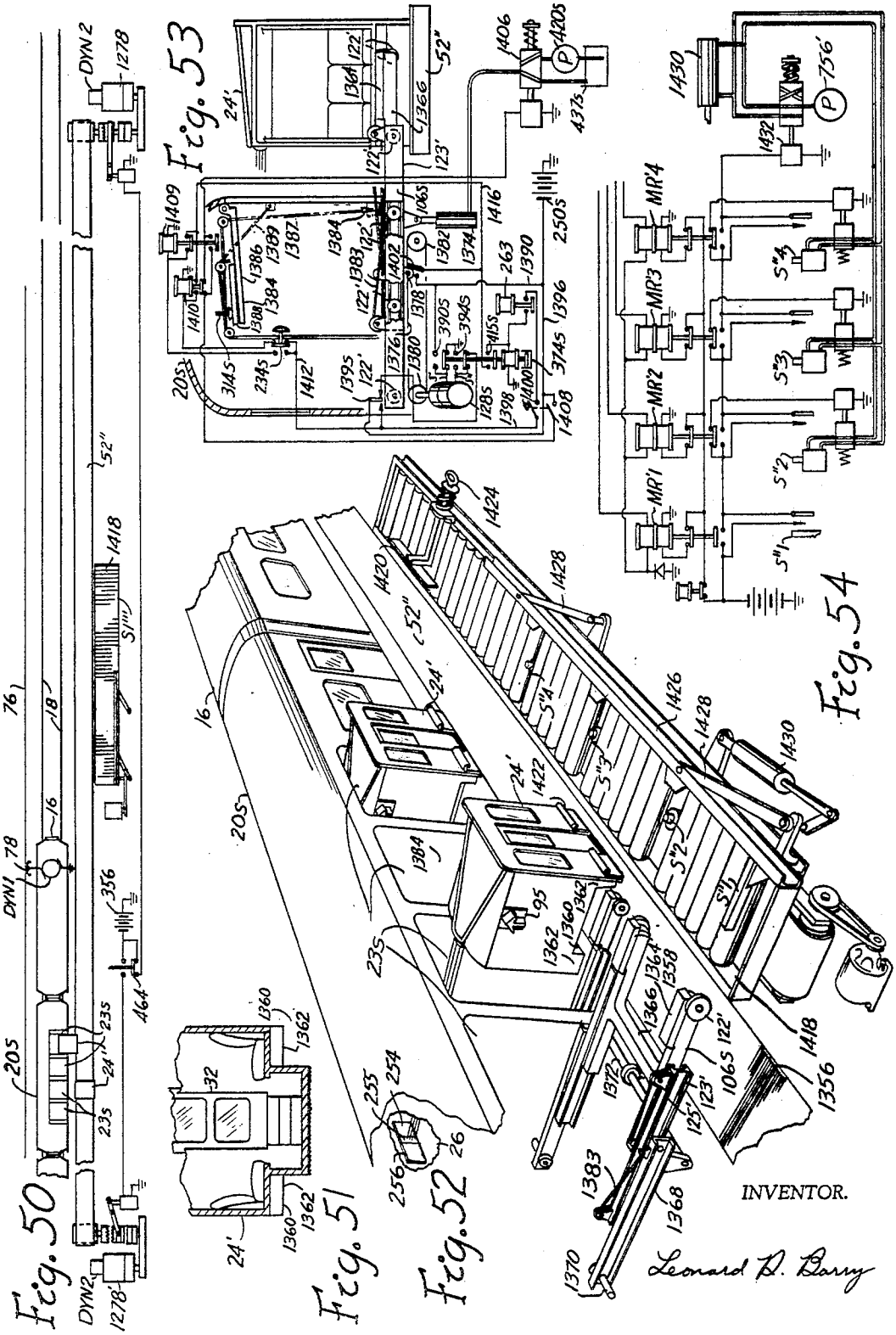
INVENTOR.

Leonard D. Barry

Dec. 16, 1969 L. D. BARRY 3,484,002

TRANSPORTATION SYSTEM

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TRANSPORTATION SYSTEM

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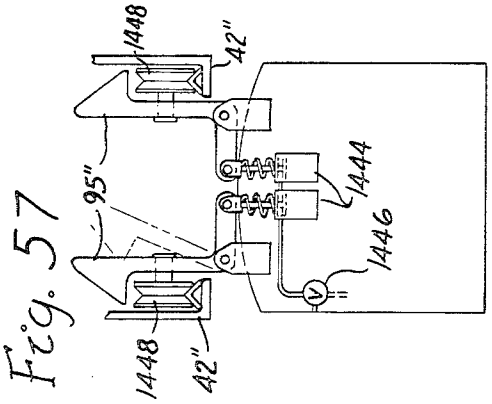


Fig. 57

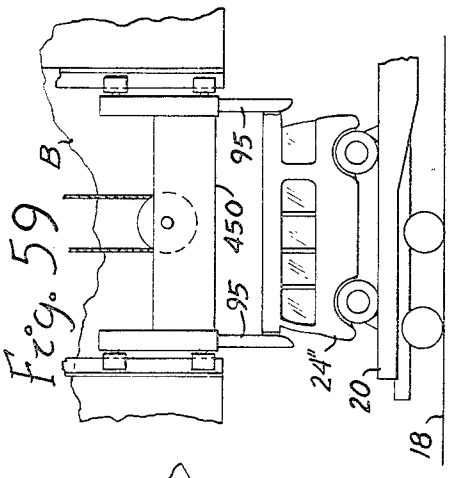


Fig. 59

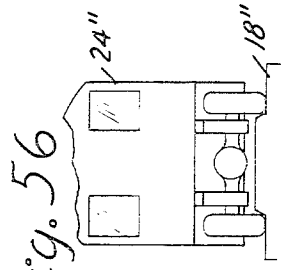


Fig. 56

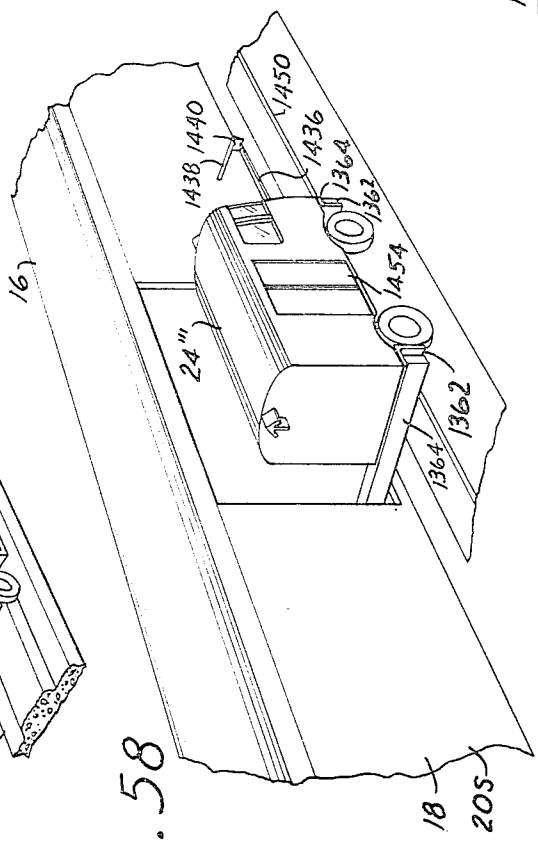


Fig. 58

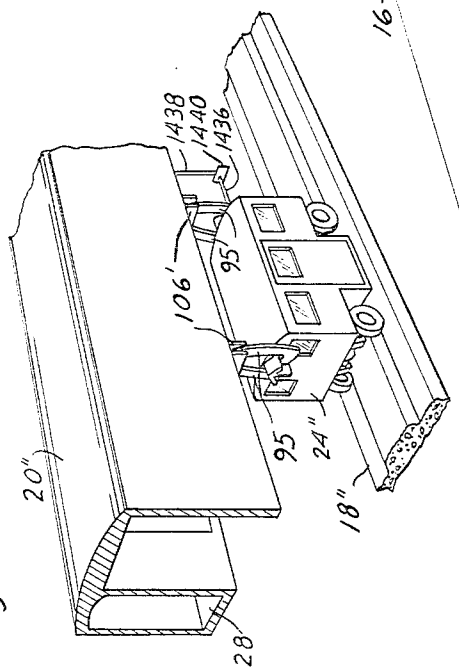


Fig. 55

INVENTOR.

Leonard D. Barry

United States Patent Office 3,484,002
Patented Dec. 16, 1969

3,484,002

TRANSPORTATION SYSTEM

Leonard D. Barry, 19300 Pennington Drive, Detroit, Mich. 48221

Continuation-in-part of application Ser. No. 714,453, Jan. 27, 1958. This application May 16, 1966, Ser. No. 557,333
Int. Cl. B65q 67/02, 67/24; B61k 1/02
U.S. Cl. 214—40 56 Claims

ABSTRACT OF THE DISCLOSURE

This system comprehends the transfer of passengers, goods, etc. in various containers to and from trains safely and is applicable to railroads, rapid transit, subways, monorail, or any guided way which is unobstructed for transfer. The containers are transferred by lifting both ends or all sides at the same time and are completely supported by only one vehicle or way at a time whereby variations in vertical movements between running vehicles or parallel ways do not introduce dangerous rocking of the container while being engaged or transferred. Either vertical or side transfer of the container is provided using the same containers for either if so designed. The stations have a track or way run parallel the railway or way, vehicle means and control to time start and accelerate containers to align with empty berths on the train for transfer and to align containers to be removed with empty spots therefore. Transfer can be selective and automatic when aligned for and subject to safety conditions which can prevent transfer even after alignment therefore. Train to station signaling controls spacing of containers to meet train aligned with empty spots adjacent containers to be transferred. Preferably automatic station vehicles align containers for transfer. Devices such as conveyors for handling the containers at stations unload and reload station vehicles as required to register containers and empty spots for transfer with a train. Special elevators engage and lift the containers in buildings to floors to load and unload as an elevator cage and lower to deposit the containers into train waiting below. Container passenger cars have sliding roof panels to open container berths along one side for transfer, partitions with doors to aisle on other side for passenger movement to and from container in berth, safety door controls therefore, automatic controls for roof, automatic transfer mechanism for each berth on car or optionally on station vehicle. Electronic coupling between parallel running vehicles is provided. Types of containers include vehicle cages with automatic wheel chocks, platforms, tanks, and vehicles. This disclosure covers both geometric and selective transfer of containers.

This is a continuation-in-part of my application filed Jan. 27, 1958, Ser. No. 714,453, now abandoned.

This invention relates to transportation and in particular to a system for transferring passengers or goods from one vehicle to another or from a vehicle to a stopping point.

An object of this invention is to provide fast, practical, and novel means to transfer passengers or goods to and from a vehicle, especially to and from a vehicle traveling at speed.

It is an object to transfer passengers and/or goods between vehicles automatically, gently, and safely to eliminate the need for passengers to walk between vehicles and to facilitate quick loading and unloading of transportation vehicles.

A feature of this invention is the provision of novel passenger transfer containers or cages in cooperation with transfer means to transfer persons and things between vehicles at speed and to load and unload a vehicle while stopped.

According to this invention containers can be transferred, for example, between parallel running vehicles more quickly than can a few passengers walk between vehicles or board or leave a train on foot. As many of my transfer containers as can be provided in a train can be automatically transferred between parallel running trains in less than five seconds, which at 60 miles per hour=.083 miles or 440 feet, whereas it might require five minutes for the same number of passengers to walk between parallel running vehicles which at 60 miles per hour=5 miles (60 times the distance taken by my system).

A further object is to start the station vehicle, herein also called a carrier, a time after the nonstop vehicle or express train has approached to a certain point, the starting time being varied according to the station vehicle's accelerating characteristic and the express train's speed, so as to align with the express for transfer practically as soon as the carrier reaches the speed of the train. This feature substantially eleminiates parallel running of the carrier and train in misalignment at near equal speed, which might otherwise require miles of parallel tracks just to adjust alignment between vehicles. As an example, with a 5 mile per hour speed difference at ⅛ mile separation, the closing time=1½ minutes. 1½ minutes at 60 miles per hour=1½ miles. It is an object to reduce this distance to practically zero.

The acceleration and stopping of the station vehicle to and from 60 miles per hour might take, for example ¼ mile maximum total. Adding to this the .0833 miles in the example given + the maximum length of the carrier train, which, for example, might be five 80-foot cars or .008 miles, gives ⅓ of a mile as the carrier's paralleling track (much cheaper than 5+1½+¼=6¾ miles of paralleling track) and short enough to accommodate without back tracking at least three local stops per mile for urban service up to 60 miles per hour constant train speed. It is therefore an object to reduce the transfer run to a minimum but safe distance for a given maximum transfer speed, thus reducing construction costs and enabling transfer stations to be closely spaced where desired.

Some other and further objects are: to enable an express vehicle to pick up and let off passengers or goods without delay to the express, i.e., to transfer without limiting or governing train speed for transfer; to enable transfer at any train speed or range of speeds designed for; to automatically transfer containers to and from a train at speed or while standing; to provide a more economical system for handling passengers, freight, etc.; to provide an economically practical solution to the problem of enabling through trains to pick up and let off passengers, freight, etc. at local station without stop, to eliminate the need to bump cars or containers together while in use; to provide selective automatic removal of containers from a train or vehicle to permit the occupants of a container, an attendant, or a coded device operated by movement of the vehicle to select containers for removal at each transfer; to provide a container transfer system where the containers can be interchangeably carried on a railroad or monorail train with nonstop interchange therebetween; to provide local service using the containers of this system; to provide elevator service with the containers of this system; to provide a container system on a subway, elevated, or passenger monorail for loading and unloading at street level or at one or more levels above or below the transfer car; to eliminate the need for stairs, ramps, escalators, etc. for patrons at stations; to provide an automatic railway station; to utilize the right-of-way to better advantage; to provide vertical transfer to reduce the width of the

right-of-way required for local and express service and for parallel running transfer and to enable fast transfer without horizontal transfer movements, which might shift the load; to provide a passage on the transfer car to enable passengers to walk through the car and bypass the container area; to separate with a partition the container area from the passenger area to enable the passenger transfer car to carry freight, etc. out of sight; to provide a variety of types of transfer containers for this system; to provide an automatic transfer container to carry a substantially full-size automobile; to provide automatic wheel clamps for the automotive containers; to standardize the containers to be interchangeable; to provide automatic hooks and releasing means for holding containers and releasing them; to provide automatic elevating, lowering, revolving, switching, and conveying devices for these containers; to provide selective loading of containers in a train; to provide means to space containers to simultaneously align empty container compartments or berths on a train or vehicle; to enable simultaneous transfer of all containers to be transferred in a particular interchange; to provide automatic starting, speed control, and alignment of the station vehicle with respect to the express, to provide automatic transfer of this system for either direction of operation along the same transfer run; and to provide means whereby any or all of these objects can be achieved in harmony together.

The automatic transfer container can be any of a variety of types, such as: a passenger cage with or without seats; a passenger compartment, such as a drawing room or sleeping compartment; a portable kitchen for serving meals, easily transferred with personnel from train to train; a portable news stand, notions store, snack bar, supply room, or personnel change units; an auto, small truck, or trailer cage; a bicycle, motorcycle, or scooter cage; a tank, hopper, flat, box, express, mail, baggage, or refrigerator unit, etc. The containers can also supply the train with fuel, water, battery changes, etc.

Three embodiments of this invention are described herein in the following order:

(1) Vertical transfer from top of express vehicle.
(2) Vertical transfer from bottom of express vehicle.
(3) Side transfer from express vehicle.

Types 1 and 2 are preferred respectively for railways and monorail systems and can be used together in the same transfer. Type 3 takes a wider right-of-way than the others and does not permit change of elevation of the containers as easily relative to the train as does vertical transfer. Type 3 can be provided in the same train with 1 or 2. The same containers can be used in all three embodiments if so designed.

Other objects are directed to safety; reduction of manufacturing, installation and maintenance costs; protection from rain, heat, and cold; convenience; etc. and still other objects will either be pointed out hereinafter or should become apparent from consideration of this invention as described with aid of the drawings wherein:

FIGURE 1 is a cut-a-way side elevation of the preferred type of railway transfer car, shown with a passenger container in one of its berths and above which is a portion of a monorail with carrier train having an auto cage on one of its carriers in process of transfer.

FIGURE 2 is a cross sectional view through a monorail I-beam and trolley of a carrier in FIGURE 1.

FIGURE 3 is a perspective view of a carrier hook.

FIGURE 4 is a cut-a-way plan view of the portion of the railway shown in FIGURE 1.

FIGURE 5 is a schematic plan view of a monorail carrier rounding a curve above a transfer car, to illustrate how alignment can be maintained for transfer on curves.

FIGURE 6 is a transverse sectional view through the end of the carrier of FIGURE 5.

FIGURE 7 is a side elevation of the vehicles shown in FIGURE 5.

FIGURE 8 is a top view of monorail carrier's swivel.

FIGURE 9 is a transverse sectional view through a monorail carrier having a wide sill, showing hooks supporting an end of a container.

FIGURE 10 is a side elevation of a portion of the monorail, carrier, and supported container corresponding to the end view FIGURE 9.

FIGURE 11 is a perspective view of a portion of the transfer car showing a berth with its elevator raised.

FIGURE 12 is a top view of a portion of the elevator at the guides on the near end of FIGURE 11.

FIGURE 13 is a sectional view of a portion of the roof and side of the transfer car showing a carrier-loading checking device in raised position engaging a container. The lower portions of the checking device, which are in section, are revolved 90 degrees either way and electrical connections are schematic.

FIGURE 14 is a side elevation of an auto cage with an auto thereon suspended on a monorail carrier and showing portions of a loading elevator moving back down.

FIGURE 15 is an end view of the cage of FIGURE 14 with the elevator platform moving back down.

FIGURE 16 is a plan view of the cage of FIGURE 14 with portions of the carrier.

FIGURE 17 is a perspective view of a tire clamp on the platform of the auto cage with portions of the platform removed.

FIGURE 18 is a perspective view of the tire drop bracket and a portion of the attached runner removed from the auto cage.

FIGURE 19 is a perspective view of a linkage on the auto cage which prevents the opening of an auto door beyond the cage while the cage is being moved to and from its berth.

FIGURE 20 is a diagrammatic view of a cage door latch and circuits on the cage including circuits operated and controlled by the latch.

FIGURE 21 is a diagram of speed control adjustment circuits for aligning two separated driven vehicles.

FIGURE 22 is a plan view of portions of the removable roof on the transfer car of FIGURE 1.

FIGURE 23 is a transeverse sectional view of the transfer car of FIGURE 1.

FIGURE 24 is a transverse sectional view of the transfer car of FIGURE 1 with roof over berth closed.

FIGURE 25 is a circuit diagram of the cage transfer circuits on the transfer car.

FIGURES 26, 27, and 28 are plan views of some transfer system layouts illustrating geometric transfer.

FIGURE 29 is a combination perspective and diagrammatic cross sectional view of a subway system utilizing this invention.

FIGURE 30 is a speed-distance graph of the carrier traveling a loading-unloading station loop.

FIGURE 31 is a diagrammatic view of a portion of a railway with a transfer train thereon approaching a loading loop, together with starting and speed control circuits for the carrier for traffic in either direction.

FIGURE 32 illustrates some variations for the controls of FIGURE 31.

FIGURE 33 is a diagrammatic view of reversing and brake controls on the carrier.

FIGURE 34 is a diagram of an unloading station on the monorail together with electrical circuits for positioning the carrier and removing containers therefrom.

FIGURE 35 is a partly perspective and partly diagrammatic view of a conveyor roller shaft mounted with a limit switch for detecting when the roller carries a load.

FIGURE 36 is a perspective view of a carrier unloading station with portions removed to simplify drawing.

FIGURE 37 is a transversely taken elevation of a portion of the hook opener shown in FIGURE 36.

FIGURES 38, 39, and 40 are transverse sectional views through the conveyor of FIGURE 36 at respectively the right-angle switch, the turntable, and the unload elevator.

FIGURE 41 is a diagram of a transfer train with cir-

cuits for signaling berth loading to a station and a carrier train make-up station with circuits to receive the signals from the train, and container spotting and carrier loading means to make up the carrier train according to the signals received.

FIGURE 42 is a diagram of another carrier make-up station and circuits therefore.

FIGURE 43 is a combination circuit diagram and prespective view of a carrier stop and a container door opening and closing means particularly suited for rapid transit systems at stations where the containers are not removed from the carriers.

FIGURES 44 and 45 are respectively an end elevation and a plan view of the carrier and station doors in the arrangement shown in FIGURE 43.

FIGURE 46 is a cut-a-way perspective view of a two-car monorail train having two transfer berths and in process of reaching for a container on a cable pulled vehicle below.

FIGURE 47 is an assembly view of a portion of a container hoist shown in FIGURE 46.

FIGURE 48 is a side view of the hook mechanism shown in FIGURE 47.

FIGURE 49 is a schematic diagram of the controls for an elevator shown in FIGURE 46.

FIGURE 50 is a plan view of a side-loading container transfer system.

FIGURE 51 is a sectional view lengthwise through a side-loading passenger container.

FIGURE 52 is a perspective view of a side-transfer car in process of transferring containers to and from a paralleling conveyor and showing a selective loading make-up conveyor.

FIGURE 53 is a cross sectional view of the side transfer car engaging a container for loading, together with a schematic diagram of the circuits for operating the loader.

FIGURE 54 is a diagram of circuits for spacing and loading containers on the paralleling conveyor of FIGURE 52.

FIGURE 55 is a perspective view of a section of a suspended carrier transferring a vehicle type container to a parallel running way.

FIGURE 56 is an end view of the container vehicle of FIGURE 55 on the parallel running guide way.

FIGURE 57 is an end view of a container having hooks with wheels latched on an overhead track.

FIGURE 58 is a perspective view of a container which is also a truck being transferred between a train and a parallel running road.

FIGURE 59 is a side elevation of a railway car with transfer bus thereon having end hooks engaging elevator in building.

In each of the several views, like reference characters designate similar parts.

RAILWAY PASSENGER TRANSFER-CONTAINER CAR

Referring to the drawings and in particular to FIGURES 1 and 4, a passenger and/or freight train **16** on track **18** has one or more transfer cars **20** anywhere in its consist but preferably in a group. Each car **20** has one or more container berths **23** each for holding a transfer container or cage **24**. A partition **26** on car **20** separates the passenger, service, or goods areas represented by aisle **28** from the container berth area. Partition **26** has doors **30** therein for access of passengers and personnel to and from containers **24**. The enclosed passenger containers and some freight containers have doors **32** which align with doors **30** when in the berths **23**. Doors **30** are operable, similar to elevator hatchway gates, only while a container with which access is desired is in the berth, and are locked closed by solenoid latch **34** before the cage can be removed. A partition **36** preferably separates adjacent berths **23** on car **20**. The containers are each removable through an opening **37** in the roof **38** of car **20**.

MONORAIL CONTAINER TRAIN

Paralleling track **18** is a monorail track **42**, which comprises one or more parallel rails or I-beams **44** supported over track **18** by means such as inverted tubular U-frames **46**, FIGURE 36. Track **42** is centered over the center of containers **24**, which is off center with respect to the center line of track **18** to provide aisle **28** along one side of car **20**. The containers could be full car width if aisle **28** is not needed, or they could be narrow enough for an aisle on each side of the car, or the monorail vehicle could carry the containers off center as shown in FIGURE 46; in these cases track **42** preferably would be centered over track **18**.

A monorail train **50** for carrying containers **24** is operated on track **42** to align with train **18** and run parallel and aligned therewith for transfer of containers **24**. The form of monorail train first to be described is one or more carriers **52** each capable of supporting one or more containers **24** at a time and each being either self-propelled or preferably pulled by one or more motor trolleys or tractors **54**.

MONORAIL TRACTOR

While presently available monorail tractors could be used with modification and features added, a preferred tractor will be described.

Tractor **54** is supported by trolley **56**, which rides the top of the bottom flanges of I-beams **44**. A pivot shaft **58** runs transverse to trolley **56** and is supported between and extends beyond the trolley's side plates **59**. A grooved bearing block **60** on each end of shaft **58** has grooved sides which ride vertically in a slot **62** in tractor side plates **64**. A compression spring **66** pocketed between the top of slot **62** and block **60** supports each side plate **64** on a block **60**. Two or more rubber tired traction wheels **68** are bearing mounted between plates **64** to engage the under side of I-beams **44** under pressure of springs **66**. Tractor motor **70** is secured to a side plate **64** and connected to drive wheels **68** through speed reduction means such as a toothed belt and pulleys **72**.

SPEED CONTROL

The speed control system for automatically accelerating the carrier to train speed and for controlling the speed of the carrier for maintaining the carrier in alignment with the train is preferably of a type disclosed in my Patent No. 3,037,462, with modification. The types illustrated in my Patent Nos. 3,038,066 and 3,037,461 could also be used instead.

Accordingly dynamos DYN1 and DYN2, each having a shunt field preferably including a permanent magnet to boost residual magnetism or a separately excited field, are driven and excited to provide voltage equally representing the speed of trains **16** and **50** respectively. Dynamo DYN1 is fastened to the frame of truck **74**, which supports an end of car **20**, and is driven at a speed proportional to train speed from an axle of truck **74** by suitable nonslip means, such as the timing belt and pulleys **75**; or, if a traction motor is provided on truck **74**, the dynamo could be mounted thereon and driven from the traction motor's shaft, dynamo DYN2 is secured to the housing of traction motor **70** and driven from a shaft extension of that motor. Dynamo DYN1 is geared and excited to develop a voltage equal to the output voltage of DYN2 whenever trains **18** and **50** are traveling at the same speed and dynamos DYN1 and DYN2 are passing the same current, except that the output voltage of DYN2 is adjustable as described hereinafter with FIGURE 21.

Control line conductors **76** and **77** comprising rail, wire, or bars are insulated from ground in a usual manner and run parallel tracks **18** and **42** respectively so as to be engaged by trolleys or shoes **78** and **79** respectively on trains **16** and **50**. The output terminals of dynamo DYN1 are connected one to a shoe **78** and the other to ground rail **80** of track **18** through the frame, axles and wheels of

truck 74. The output terminals of DYN2 are connected one to a shoe 79 and the other to ground through trolley 56 and track 42 grounded to rail 80.

Whenever control of the station vehicle relative to the train is desired dynamos DYN1 and DYN2 are connected in series opposing in series with automatic controls ACC, forms of which are disclosed in my patent applications Ser. Nos. 538,058 and 564,511 and in this application with reference to FIGURE 31. The order of placing the dynamos and controls relative to ground is unimportant for workability, but is a factor in cost and interchangeability. The ACC is connected across lines 76 and 77 for least cost with point *a* connected to line 76 and point *b* connected to line 77. (See FIGURE 31 for details of ACC.) If instead one terminal of ACC is ground then another control conductor would be needed and both terminals of either dynamo would be connected across parallel control lines as shown in FIGURE 32.

A traction power supply line 82, which could also be the control line 77 as taught in my patent application Ser. No. 538,058, is run parallel track 42 so that shoe 84 on tractor 54 engages it. Traction motor 70 is connected across shoe 84 and ground.

Tractor 54 pulls or pushes the station train according to the direction of the through train. A similar tractor could be added to the opposite end of train 50; or a tractor could be added between each group of three or four carriers, whatever number are provided per transfer car, so that good acceleration can be maintained with a long carrier train, such an arrangement being designed to space the carriers properly over the berths in any desired number of transfer cars within the limit of alignment tolerance, tractors and/or drawbars filling the gap between adjacent berths separated by coupled car ends. Train lines (not shown) connect all traction motors of train 50 only to the shoe 84 of one tractor. One dynamo DYN2 is connected per carrier train to conductor 77, and this vehicle is selected to be the same tractor which has shoe 84 connecting the traction motor or motors 70.

CARRIER AND HOOKS

Some of the many possible embodiments of the station or local carrier 52 are shown in several FIGURES including 1, 2, 5–10, 14, and 15. Each carrier 52 has one or more supporting trolleys 88 at each end of a frame or sill 89. Each end of sill 89 is pivotally secured for horizontal turning to a swivel 90 (FIGURES 6 and 8) by pin 91. Each swivel 90 has trunnions 92 integral therewith and engaged in holes 93 in opposite depending sides of the two-piece H-shaped frame of a trolley 88. Draw bars 94, which connect the carrier to another or to a tractor, are similarly pivotally secured to trolleys 88 either beyond the end of or above or below the swivel for the sill. Sill 89 can be long enough for one or more containers 24. Hooks 95, having one or more teeth 96 arranged to hook under hooks 97 on each end of each container 24, are pivotally mounted by pin 98 engaging holes 99 in lugs 100 on either sill 89 (FIGURES 7, 9, and 10) or, if the carrier is one container long, on trolleys 88 (FIGURES 1 and 2) with holes 99 horizontally elongated to allow for turning of loaded carriers; or the hooks 95 can be mounted on and elevator on the carrier as shown in FIGURE 46; or upside down on container 24.

Hooks 95 are preferably arranged in pairs mounted to swing in a transverse plane with teeth 96 facing the other hook of the pair. Hooks 95 each have a lever arm 101 preferably extending horizontally away from the toothed face of the hook near the top thereof and by which the hook is opened. The weight of arms 101 force teeth of opposite hooks 95 toward each other to engage hook 97. Also a tension spring 102 (FIGURE 15) can connect adjacent facing hooks 95 to force them together or a compression spring 102' (FIGURE 9) can serve the same purpose. The teeth of hooks 95 and 97 vertically interlock, so that sidewise forces on the container will not push the hooks apart. The facing faces of hooks 95 sweep away from each other to engage hook 97. The container straddling side of each hook is tapered at the bottom and swept endward to point away from the container supported thereby to axially shift the hook on its pin 98 to yield when engaging a container imperfectly aligned. A compression spring 103 (FIGURE 10) is preferably added about pin 98 to urge hook 95 tight against the end of the container to reduce longitudinal slippage of the container on the hooks and to increase the longitudinal tolerance in aligning containers. Hooks 97 are preferably arrow shaped in a plane transverse to the container and point up. Each hook 95 engages under a side projection of hook 97 and supports the cage so that if tilted down on a side the hooks 95 on the heavy side support the cage to restore equilibrium. To further reduce rocking, opposite hooks 95 can be spaced apart each to engage a hook 97' (FIGURE 9) on each side of each end of the containers.

Carriers shown in FIGURES 1, 2, 14, and 15 are designed for transfer along straight or slightly curved transfer runs, but can round curves at the ends of the transfer run.

The carrier shown in FIGURES 5 and 7 is designed for transfer on sharp curves as well as straight runs. This carrier has the center distance between its sill swivels equal to that between the trucks which support the transfer cars with which transfer on curves is to be made. FIGURE 5 shows how the carrier's sill will remain centered over berths 23 on transfer car 20' as it rounds a sharp curve CU on track 18. If transfer is made to one or more berths between truck swivels of a transfer car, track 42 can be located radially further inward relative to track 18 on a curve so that a carrier centered over these berths with a shorter swivel base than the transfer car can align for transfer on curve CU. The container on the right hand end of the carrier in FIGURE 7 is a local which is not transferred.

ELEVATOR ON RAILWAY CAR

Referring to FIGURES 1, 4, and 11, each container berth on car 20 has a transfer elevator or mechanism 106 for lifting a container to engage or disengage hooks 95 on a carrier above. If the monorail carriers are all provided with elevators (see FIGURE 46) the elevators on car 20 can be omitted. The lifting of a cage by elevator 106 while the monorail carrier is properly located relative to the cage automatically hooks the cage to the carrier above by the closing, by gravity or spring pressure, of the teeth of hooks 95 under the teeth of hooks 97. To remove the cage from the carrier the cage is lifted by elevator 106 from hooks 95; then levers 101 are raised to spread apart the hooks 90 on the carrier; and the elevator with the container thereon is lowered while hooks 95 are spread to clear hooks 97. Lever arms 101 can be lifted as shown by rams which are shown as hydraulic rams 110 raised through an opening in the roof of car 20 at the proper time. Cylinders 110 are secured to the frame 111 of car 20 but optionally could be shorter and supported on the elevator. The under sides of levers 101 are preferably concaved to receive rams 110.

The preferred form of elevator 106 for car 20, FIGURES 11 and 12, has a platform 112 which has recesses or holes 114 to relieve skids 116 on the auto cage from engaging the plaftorm and conical locators 118, which engage holes 119 in containers 24, to locate and hold the containers from slippage while riding on the train or from slipping off the elevator while being transferred to or from the train. At each end of platform 112 is secured a guide channel 120 to which is rotatably secured two or more guide wheels 122. Each channel 120 is guided by an intermediate guide 123 comprising an I-beam 124 having a rod 125 welded along the inside of each leg. Wheels 122 are grooved to ride and guide on both rods 125 along the inside of a trough of I-beam 124. Grooved wheels 122

also are rotatably secured to the frame of car 20 to ride in the opposite channel of each I-beam 124 from that which guides the platform.

The elevator is raised and lowered by cables driven by gearmotor 128 whose output shaft 129 drives two drums 130 each under and at an end of the berth. Preferably a worm gear reduction holds the elevator from too fast a descent and an electric brake (not shown) holds the elevator at extended position. Each drum 130 has a cable 131 secured and wrapped thereon and extending up over a pulley 132 rotatably secured to the cars' frame and down to an anchor 133 on the bottom of beam 124 at the same end of the berth. Two cables 134 anchored on pin 135 at each end of platform 112 are wrapped each over a pulley 136 on the I-beam at the end of the berth where anchored and run down and anchored at 137 to the car's frame 111 whereby the platform is raised at twice the speed of the intermediate guides. The whole elevator lowers below roof level with the top of the platform at or below floor level and extends so that the platform reaches the required height above roof level. Limit switches 138 and 139 respectively control upper and lower limits of elevator travel, FIGURE 11.

CARRIER LOADING CHECK

Before an elevator 106 which has a container is extended to a carrier aligned for transfer, the carrier above the container must be empty. To insure that it is; transfer can be arranged geometrically, as hereinafter explained with FIGURES 26–28; selectively, as explained with FIGURES 41 and 42; and/or checked by any of various means such as loading checker 140 shown in FIGURE 13.

A checker 140 (see FIGURE 13) is supplied for each berth 23 and comprises a double acting cylinder 141 vertically supported in the outer wall of car 20 at the berth for which the check is to be made. The rod end 141' of cylinder 141 extends up and is integral with tube 141', guided in an upward extension of the wall of cylinder 141 to a point above the roof of car 20. A tubular arm 142, pivotally supported on pin 143 at its lower end, is arranged to be pulled out against a container 24 on the carrier above car 20 by a chain 144 anchored to the upper end of arm 142 at one end and to a limit switch 145 at the other. A chain 146 connects the head end of the piston of cylinder 141 to a rod 147 which extends through the bottom of cylinder 141 to operate limit switch 148. When the head end of cylinder 141 is pressured the piston flies up; arm 142 is pulled out by chain 144 against a container if on a carrier above; and chain 144 being taut prevents the further rise of cylinder 141', which is held down at point 143 by arm 142, chain 146 having sufficient slack so as not then to operate limit switch 148. But when there is no container present the piston can continue to rise as arm 142 is pulled further out by chain 144 toward horizontal position wherein arm 142 engages the bottom of a slot therefore in tube 141'. At this extension, limit switch 148 is pulled closed by chain 146 completing a portion of a circuit through contacts of limit switches 145 and 148 in series. A caster 150, secured in the upward end of tube 142, has a rubber tire which engages any container encountered by arm 142. Arm 142 is returned through the slot in tube 141' to vertical position within tube 141 preferably by spiral spring 151 wrapped on pin 143 and secured one end to arm 142 and the other to tube 141'. FIGURE 11 shows arm 142 fully extended. Circuits for operating and using this device will be described with FIGURE 25.

CONECTIONS MADE BY ELEVATOR FOR RETURN IN CASE OF MISALIGNMENT

The elevator or transfer mechanism is retracted if misalignment occurs while the elevator is extending, except that if the mechanism has extended nearly to the point of latching or unlatching the process is completed before lowering to insure that all hooks have opportunity to latch if any one might. For this purpose an insulating strip 154, FIGURE 11, is secured to the frame of car 20 adjacent and parallel to the guides at one end of each elevator 106. Two parallel conductive bars 155 and 156 are secured to strip 154 so as to be insulated from each other and from ground. A contact finger 157 is insulated from and supported on the intermediate guide 124 to engage both said strips to electrically connect them at points wherefrom it is safe to lower the elevator 106. One or both strips 155 and 156 have an insulated section 158 on which finger 157 rides at points of extension of the mechanism at which the hooks hook. Sections of the bars are electrically connected beyond contact of finger 157. A circuit completed across bars 155 and 156 will be utilized in the circuits described with FIGURE 25.

PASSENGER AND FREIGHT CAGES

The typical closed passenger cage or compartment is represented by containers 24P in FIGURES 1 and 36, containers 24' in FIGURE 52, as examples. These cages can be partitioned, fitted, and furnished as desired for their particular service. Container 24P, FIGURE 1, has its side removed to show end seats 159, which the first passengers to arrive can take. Later passengers, which have less time to wait, can stand. The end seats provide a space thereunder for batteries 160 (FIGURE 4), electrical connections, and locators 118, and the like.

The container is removed from car 20 at the next transfer station upon pressing stop button 162, FIGURE 1, as will hereinafter be described with aid of FIGURE 25. Light 163 indicates that button 162 has been pressed and button 164 enables cancellation until an approach point is reached. These buttons are shown located within container 24P but might be located in a control box on the transfer car for access only by the conductor or can be arranged for automatic operation by any suitable means.

Typical box-type freight or express containers 24F are shown in FIGURES 34 and 36, which, except for windows, seats, etc., are similar to passenger containers 24P, which could serve for freight, express, etc., if needed.

VEHICLE CAGES

The preferred vehicle cage 24V (FIGURE 14) comprises an open frame 166 with hooks 97 at its upper ends and supporting a platform 165 connected to the upper portion by rectangular tubing along the sides. The cage of FIGURES 14, 15, and 16 is designed to carry one small auto, truck or four-wheeled trailer, while that of FIGURE 1, being longer and wider takes a six-foot wide auto. Longer cages could carry a plurality of autos.

Platform 165 has openings 167 each for and substantially centered under each wheel of the vehicle V to be carried. Each hole 167 has a U-shaped wheel supporting bracket 168 (FIGURES 17 and 18) having two lips 170 each arranged to engage the platform along the side of hole 167 and trapezoidal side portions 171, which widen to the bottom, which is preferably beyond the length of hole 167. The two brackets 168 on each side of the cage are connected by a skid 116. Skids 116 can be made up from channel or square tubing as shown with uprounded ends. Brackets 168 have a floor piece 174 welded to the sides to support the wheel of a vehicle at floor level when the cage is resting on the skids. When the cage is picked up, the skids with brackets 168 remain down until the platform engages lips 170, thus forming a depression for holding each wheel of the vehicle.

AUTOMATIC TIRE CLAMP

The vehicle V is preferably clamped in place. Two plates 176 are provided to clamp each pneumatic tire of the vehicle. Each plate 176 has secured thereon an angle iron 177 faced one leg down and the other toward a hole 167. Angles 178 are secured leg down to the underside of the floor of the platform as part of the transverse fram-

ing of the platform on each side of each hole **167** at a distance from the hole about equal to half the length of the hole. One or more rods **180** are secured to the depending leg of each angle **177** and extend therefrom through a hole **182** in the depending leg of the angle **178** on the same side of the hole **167**. Each rod **180** has a compression spring **184** thereabout pocketed between depending legs of angles **177** and **178** on the same side of each hole thus forcing plates **176** on opposite sides of each hole **167** toward each other. Plates **176** at each hole **167** are held apart by bracket **168** and are forced wide apart by the tapered edges of bracket **168** as the cage is rested on runners **116**. Thus plates **176** clamp the tires in brackets **168** as the cage is lifted and unclamps them when rested on runners **116**.

TIRE CLAMP LATCH

The tire may be clamped before bracket **168** settles on lips **170** picking the wheel up off bracket **168** or scraping the tread of the tire as the tire settles in the deepening pocket. This can be remedied by equipping each plate **176** with a roller **186**, pivotally mounted along the edge of the plate which engages the tire (FIGURE 14), but this will permit the wheels of the vehicle to roll to ends of holes **167** if the vehicle's brakes do not hold sufficiently or are not applied.

As a preferred alternative, plates **176** can be latched open until the pocket is fully formed and then released to engage the wheel. For this purpose latches **190** are pivoted at **191** at the frame of platform **165**. Latches **190** are offset, so that the latch can engage the tire engaging edge of plate **176** through opening **167** while pivot **191** is outwardly both laterally and longitudinally from hole **167**, so that pivot **191** is substantially horizontally aligned with the point of latching. Springs **192** hold the latches up. Linkage **194** pivotally connects the latches on the same side of hole **167** together. One link of linkage **194** has a projection **196** which engages lip **170** to release the latches as the runners are about to lift. The latches are reset as the runners are forced toward the bottom of the cage as the cage is set down on the runners, the tapered edges of brackets **168** forcing plates **176** of each hole **167** apart until latches **190** hook over the edges of these plates.

CLOSED DOOR CHECK FOR AUTO CAGE

Both sides of the auto cage **24V** are equipped with a barrier to prevent the opening of an auto door beyond the edge of the cage except while the cage is in a berth or at a station stop, or the auto can be driven on and off a cage without provision at the station to open the auto's door. If the cage is inserted in the berth with the same side always toward aisle **48**, the cage is provided with a removable barrier on that side and either a fixed barrier such as a high side **198** or a removable barrier **199** on the other side. If the cage is inserted with either side of the aisle, both sides of the cage have a removable barrier.

A typical removable barrier **199**, FIGURE 19, is provided by two bars **200** pivotally linked together at their tops by bar **202** and pivotally secured as a parallelogram linkage to the inside of the side sill **204** of platform **165**. A spring returned solenoid **206**, secured to platform **162**, has an end of its plunger **207** pivotally linked by linkage **208** to a bar **200** to raise bars **200** by force of the solenoid's spring and to lower the bars when the solenoid is energized. Contacts **210** on the solenoid are closed when bars **200** are lifted, indicating that there is no door extending past bar **202**. Bars **200** are long enough to extend above the bottom edge of all vehicle doors to be carried and are preferably rubber covered to prevent scratching of the auto if engaged therewith.

Solenoid **206** is controlled by switch button **212** preferably suspended in box **214** by electrical cable **215** from the upper portion of the cage to be conveniently reached through the driver's window. Box **214** also contains a cage removal button **162** and a cancel button **164**. Power to buttons **162**, **164**, and **212** is on only while the cage is in a berth or at a station. Optionally a train attendant could control solenoid **206** and the removal of the cage from the train.

DOOR LATCHES AND CIRCUITS FOR PASSENGER AND SOME FREIGHT CAGES

Each door **32**, FIGURE 20, of a passenger or freight cage is latched closed before the cage can be removed from a berth and preferably cannot be opened during transfer or at any other time unsafe for passage therethrough. For this purpose a solenoid latch relay **206'**, which is similar in purpose to solenoid **206** on the vehicle cage, is secured for vertical movement to the frame of the cage above each door **32**, which is of the sliding type. The lower end of the solenoid's plunger carries wheel **220** forced down by gravity or by spring **221** and arranged to roll on the top edge of door **32** and to drop into pocket **222** therein to latch the door closed. Contacts **210** on solenoid **206'** are closed only when door **32** is latched closed, to close the same circuit closed by the auto cage to enable removal of the cage.

Doors **32** could be opened by power connected to the cage while on car **20** or at a station to operate solenoid **206** or **206'**. Doors **32** can also be opened by an outside latch **224** for lifting solenoid **206'**, FIGURES 7 and 43. As shown in FIGURE 20, battery **160**, across which lamp **228** in series with switch **229** is connected for lighting the cage, energizes solenoid **206** or **206'** through a circuit from one terminal of battery **160**, container positioning switch **230** closed when the container rests in its berth or at a station, back contacts of relay **232**, in series to point **233**, and the coil of each solenoid **206** or **206'** on the container in series with a latch switch, button **212**, across point **253** and the other terminal of battery **160**. Switch **230** is closed by the head of a push switch **234** secured to the floor of berth **23** and extending through hole **235** in the elevator platform. Switch **230** is also closed when the container is set down from the carrier or by means for pressing switch **230** or a switch in parallel therewith at each station. Or the latch can be lifted and door opened by the controls shown in FIGURE 43.

The portion of the container removal circuit on the vehicle cage or passenger cage comprises a plug **236** having prongs or contacts **237**, **238**, and **239** arranged to engage receptical **240** in berth **23**, from prong **237** in series cancel button **164**, front contacts **241** of relay **232** in parallel with removal button **162**, to prong **238**, and from prong **238**, coil of relay **232**, contacts **210** in series to prong **239**. All cages to and from which persons do not pass have prong **237** and/or **238** electrically connected to **239**. Plug **236** is preferably spring centered and mounted on the bottom of each container to engage receptical **240**, which is elevated from the floor of berth **23** and extends through hole **242** in the platform of elevator **106**. If the container is apt to be reversely positioned in the berth, the container has two plugs **236** wired in parallel and positioned so that either can engage receptical **240**.

ALIGNMENT CIRCUITS

Alignment of a carrier train for transfer with an express train can be accomplished in a number of ways. The preferred arrangement is to locate the upper vehicle on a light beam directed upward from the lower vehicle to photo cells on the bottom of the upper vehicle. By this arrangement the photoelectric cells are naturally shielded from extraneous light.

Accordingly train **16** has lamp **248** on the roof of transfer car **20** preferably centered with respect to the monorail. Lamp **248** has one or more bulbs **249** connected across battery **250** in series with switch **252**. Switch **252** is closed on the controlling or leading transfer car with which transfer is to be made at a particular transfer station. The carrier's speed is controlled to equal the train's speed less, say, 5 miles per hour for reasons ex-

plained with FIGURE 31. The monorail train is equipped with photo cells 254, 255, and 256 on its bottom arranged to be engaged by light from lamp 248 in succession as the transfer car passes thereunder. The output current of each cell 254, 255, and 256 is preferably amplified by amplifiers 258, 259, and 260 respectively to operate relays 262, 263, and 264 connected across the outputs of amplifiers 258, 259, and 260 respectively. The coil of relay 262 is connected through front contacts 265 of relay 266. Relay 266 is energized by a circuit from the positive of battery 250', front contacts 267 and 268 of respectively relays 263 and 264 in parallel, coil of relay 266 in series to the ground terminal of battery 250'. Relay 266 is held by a circuit connected in series with front contacts 269 of relay 266 and back contacts of reset lift switch 270 across battery 250'. Three resistors 272, 273, and 274 are in series with the shunt or separately excited field SF of dynamo DYN2. Resistor 272 is shorted through front contacts of relay 262, resistor 273 through back contacts of relay 266, and resistor 274 through back contacts of relay 264. Lift switch 270 is closed beyond the transfer run by engagement with lift ramp 276, FIGURE 31.

When train 16 approaches the carrier train, the initial condition is that relays 262, 263, 264 and 266 are de-energized and relay 266 shorts resistor 273 increasing the output voltage of dynamo DYN2 to balance the voltage of dynamo DYN1 on train 16 at a speed slightly less than the train's speed; for example, five miles per hour less. As the express passes the carrier, light from lamp 248 first hits cell 254 but cannot energize relay 262, because front contacts of relay 266 are open. The light next hits cell 255, which, if it dwells on long enough, closes relay 263, which closes relay 266. Relay 266 holds closed upon closing, which enables light on cell 254 to control relay 262 and which adds resistor 273 in series with field SF of dynamo DYN2 reducing the output voltage of dynamo DYN2 to balance the speed difference between trains 16 and 50 to zero. If the light hits cell 256, which it probably would, the indication is that the carrier is not traveling fast enough; whereupon, relay 264 closes, adding resistance 274 in series with field SF of dynamo DYN2, decreasing its voltage to cause a current in a particular direction which is utilized to control the voltage on the tractor's traction supply conductor 82 to increase the speed of all traction motors in the carrier train by, for example, five miles per hour above the speed of train 16, if time were allowed to reach this speed difference. Cell 256 is long enough for the carrier to gain speed over the express. Then light from lamp 248 drops back to cell 255 and leaves cell 256, dropping relay 264, shorting resistance 274 to balance to approximately zero speed difference with respect to train 16. If then light from lamp 248 engages cell 254 to close relay 262, resistor 272 is shorted to increase the output voltage of dynamo DYN2 to reduce the speed of train 50. By this arrangement the speed of train 50 is continuously changing, if need be, to maintain alignment of cell 255 on lamp 248, without any control of the speed of train 16.

Cell 255 should be short lengthwise the train; for example, it might be one inch long. If hooks 95 have an alignment tolerance of 6 inches fore and aft, speed correction must take place before light from lamp 248 moves, say 5½ inches, onto either cell 254 or 256 while elevator 106 rises. The rise of elevator 106 is delayed after relay 266 closes to equate the speeds of the two trains. The values of resistors 272 and 274 can be increased to provide quicker speed correction according to the operation of the automatic controls ACC, FIGURE 31. Lamp 248 focuses light within the length of cell 255.

REMOVABLE ROOF

Each berth 23 on car 20 has a removable roof shown in FIGURES 11, 22, 23, and 24 and comprising panel 290 covering from the side wall 291 of car 20 to approximately ⅓ of the roof arc and panel 292 covering above the inward upturned edge 294 of panel 290 to the roofing over aisle 28, about ⅓ of the roof. The panels are held to the roof of the car by grooves 296 along each end edge of the panels.

A wire rope 298 at each end of each berth is guided over pulleys 300 in an endless loop run through the wall framing and under the roof and floor of car 20. Pulleys 300 are supported on the car's frame. Each rope 298 is secured by a cleat 302 to the under side of roof panel 290 just inward of groove 296 at opposite end edges. Each rope is tractioned about a drum 304 which is secured with drum 304 for the rope on the opposite end of the berth to shaft 306 bearinged to the car frame and driven by motor 308 through speed reduction 309 mounted under the floor of car 20.

To open the roof panels above berth 23, ropes 298 fastened to each end of the panel 290 are driven by motor 308 to pull the panel to the right, FIGURE 24. The upturned edge 294 of panel 290 engages the down-turned edge 300 of panel 292 and carries panel 292 to the right side of car 20 as shown in FIGURE 23. Limit switch 314 then shuts off motor 308. When the cables 298 are pulled in reverse, the edge 294 engages down-turned edge 316 on panel 292 and pulls panel 292 back to stop 318 as panel 290 covers over the side wall of the car and limit switch 319 shuts off motor 308. The upper portion of FIGURE 22 shows the roof panels carried to the right exposing elevator 106 and rams 110, and the lower portion of FIGURE 22 shows the roof panels covering the berth.

TRANSFER CIRCUITS

The transfer circuits, FIGURE 25, located on transfer car 20, control container transfer to and from one berth in the car. Car 20 would have three of these circuits for the three berths shown. Operating power is supplied by a dependable source, such as battery 250. Stop button 162, pressed to remove a container at the next transfer station, connects power to the coil of relay 232 on the container and relay 232' on the car preferably in series by a circuit from the positive of battery 250, line 322, switch 324, container removal contacts 237, normally closed contacts of cancel button 164, normally open contacts of stop button 162, line 326, coil of relay 232, line 328, front contacts 330 of relay 232, all latch contacts 210 in series, removal contacts 239, coil of relay 232' to ground of battery 250. Lamp 163 is connected across the coil of relay 232 or 232' to indicate that selection of the next stop has been made. Button 162 is bypassed by front contacts 241 of relay 232 to hold relays 232 and 232'. By passing current to the coil of relay 232' through front contacts of relay 232, back contacts of relay 232 are assured to be open to prevent the energizing of solenoid 206 while relay 232' is energized.

Switch 334 is connected from line 322 to removal contacts 238 whereby a train attendant or any other means can bypass buttons 162 and 164 to select removal of the container. Switch 324 is opened by the attendant to prevent unscheduled removal of a cage as might occur if children which are left alone therein press button 162.

Provision is made to raise elevator 106 when empty to transfer a container thereto from a carrier. A switch 336, whereby an attendant can select to have the elevator raise if empty at each transfer station entered with the elevator empty and switch 336 closed, connects a circuit across battery 250 from line 322, back contacts 337 of relay 270', operator's switch 336, contacts 338 of switch 234 opened when a container is bottomed in the berth, contacts 340 of limit switch 139 closed by the elevator when at the bottom of the berth, coil of relay 342, all in series to ground. Relay 342 is held by connection through its front contacts 348 across contacts 338 and 340. Switch 336 permits a train attendant to select the containers on the carrier train which are to be transferred to his train, permitting the carrier train to carry containers for more than one main train at a time or for local service without

being transferred to an empty berth when aligned therewith unless so selected by the operator.

An approach relay 350 is closed on car 20 when shoe 352 engages rail 354 by a circuit from one terminal of trackway battery 356, lead 358, rail 354 insulated from ground, shoe 352 on train 16, back contacts of all solenoid latches 34 which are similar to solenoids 206' and which contacts are closed when doors 30 for the berth are latched closed, coil of relay 350, all in series to the other terminal of battery 356 by ground return rail. The circuit for operating latch 34 is from line 322, back contacts 360 of transfer relay 362, contacts of latch button 212', contacts of limit switch 234 closed when a container is in the berth, coil of solenoid 34, all in series to ground. Approach relay 350 connects a circuit from line 322, front contacts of relay 350, front contacts of relay 232' in parallel with front contacts 364 of relay 342, coil of relay 362, in series to ground. The hold circuit for transfer relay 362 is connected across battery 250 in series with back contacts 366 of reset relay 270' and front contacts 368 and coil of relay 362. Relay 362 is therefore energized whenever rail 354 is engaged by shoe 352 and doors 30 are closed and either relay 232' or 342 is energized indicating transfer is desired.

When transfer relay 362 has lifted, back contacts 360 on relay 362 open to prevent doors 30 from being unlatched, and front contacts 370 on relay 362 connect line 322 to contact 238 to hold relay 232 energized to prevent opening of doors 32. The energizing of relay 362, which depends on doors 30 being latched and if a container 24 is present depend also on doors 32 being latched, thus prevents doors 30 and 32 from being unlatched after shoe 352 engages rail 354 while awaiting transfer. Contacts 230 open before back contacts of relay 232 close after contacts 238 open when a container in withdrawn to prevent anyone unlatching solenoid 206 during transfer between a berth and a station stop.

The roof removal motor 308 and the elevator motor 128 have their fields connected across battery 250 and their armatures connected reversibly across battery 250 by reversing relays 372 and 374 respectively. The positive of battery 250 is connected through front contacts 376 of relay 372, armature of motor 308, limit switch 314 arranged to open when roof panels 290 and 292 are fully opened, front contacts 380 of relay 372 to ground of battery 250, and from the positive of battery 250, back contacts 382 of relay 372, limit switch 319 arranged to open when the roof is fully closed, armature of motor 308, back contacts 386 of relay 372 to ground. The positive of battery 250 is connected through front contacts 390 of relay 374, armature of motor 128, contacts 392 of limit switch 138 arranged to open when the elevator reaches full extension, front contacts 394 of relay 374, in series to ground, and from the positive of battery 250, back contacts 396 of relay 374, contacts 398 of limit switch 139 arranged to open when the elevator bottoms in its berth, armature of motor 128, back contacts 400 of relay 374, in series to ground.

The coil of relay 372 is connected across battery 250 through front contacts 402 of relay 362 to initiate opening of the roof panels when relay 362 closes. The coil of relay 374 is connected from the positive of battery 250 through back contacts 404 of relay 406, front contacts 407 of relay 362, line 408, coil of relay 374, front contacts 410 of alignment relay 263', contacts 412 of limit switch 314 arranged to be closed when the roof is full opened, front contacts 414 of relay 342 in parallel with contacts 145 and 148 in series on the optional carrier loading checking device 140 closed if there is no container on the carrier above in series to ground. The hold circuit for relay 374 is connected from line 407, coil and front contacts 415 of relay 374, back contacts 416 of relay 417, in series to ground. Contacts 416 are opened to drop relay 374 to return the elevator in case misalignment of the vehicles occurs during transfer. Relay 417 is energized by a circuit including from line 322; back contacts of relay 263' or optionally back contacts of relay 266' according to the alignment tolerance of hooks 95 and the length of cells 254, 255, and 256; bar 156; coil of relay 417; all in series to ground.

A circuit for operating the optional container loading check device 140 is connected from line 322, back contacts 404 and front contacts 407, line 408, back contacts 418 of relay 374, front contacts of alignment relay 266', back contacts of time delay relay 419, and coil of solenoid valve 420, all in series to ground. The coil of relay 419 is connected in parallel across its contacts and the coil of valve 420.

When alignment of the carrier above the berth occurs, alignment relay 263 on tractor 54 closes and transmits a signal to close relays 263' and 266' on train 16 by a circuit from power line 82 (FIGURE 21), shoe 84, front contacts 421 on relay 263, shoe 422 engaging conductor 423 connected by lead 424 to rail 423' (FIGURE 25), shoe 422' engaging rail 423', coils of relays 263' in parallel with pull-in coil of relay 266' in series to ground. The hold coil of relay 266' is connected from line 408 through back contacts 418 to ground. The closing of relay 266' energizes solenoid valve 420 to pressure cylinder 141 to raise its arm 142. Arm 142 is pulled out by chain 144 after reaching a height to engage a container with wheel 150. If no container is present arm 142 extends horizontally and closes contacts 145 and 148; see FIGURE 13. Time delay relay 419 opens the circuit of solenoid valve 420 to return the cylinder after sufficient time is allowed to make this check. This check is optional according to the method used to load the carriers as will be explained with FIGURES 26–28, 41, and 42 all of which provide carrier loading which does not require this check.

If a container is to be removed from the berth, the closing of contacts 145 and 148 on checking device 140 starts the elevator, otherwise with relay 362 energized the energizing of relay 263' starts the elevator. In either case relay 374 is energized. The closing of the contacts of the checking device 140 with contacts 410 and 412 closed energizes relay 374, which opens the circuit of solenoid valve 420 to return the checking device before the elevator or a container thereon engages arm 142. Time delay relay 419 opens its contacts to return the checking device if the device does not close its contacts in the brief time limit. Relay 419 can be omitted, since valve 420 will be de-energized when relay 362 is later dropped; but it is not preferred to leave the checking device extended against a container that long.

The elevator rises until a container thereon would be lifted slightly above the height at which hooks 95 and 97 latch, whereat limit switch 138 opens stopping the elevator, which is held by brake or worm drive. Then if a container was raised to load to a carrier or the like, relay 374 is dropped to return the elevator by the closing of a circuit from line 322, front contacts 422 of relay 362, contacts 424 of limit switch 138 closed when the elevator reaches its upper limit of travel, line 426, back contacts of relay 342, line 427, coil of relay 406, all in series to ground. The hold circuit for relay 406 is connected across battery 250 in series with its front contacts and back contacts 428 of reset relay 270'. Relay 406 opens back contacts 404 to drop relay 374, which returns the elevator by reversely driving motor 128 until contacts 398 are opened when the elevator bottoms.

If a container is to be brought into the berth, alignment relay 263' initiates operation of elevator 106 by energizing relay 374, which opens contacts 418 before valve 420 operates. When the elevator has raised to a height to pick up a container on the carrier, cylinders 110 are raised by a circuit from the positive of battery 250, line 322, back contacts 430 of time limit relay 431, contacts 432 closed by a container on the elevator, back contacts 433 of relay 417, contacts 434 of elevator bottom limit switch 139 opened when the elevator bottoms, front con-

tacts 435 of relay 342, coil of solenoid valve 436, in series to ground. The energizing of valve 436 connects fluid pressure from pump 437 to the head ends of the four cylinders 110 in parallel. When cylinders 110 are extended, they open hooks 95 and close a series check circuit to check that all four cylinders 110 are raised. This check circuit includes from line 426, four contacts 438 closed in series each by a cylinder 110 when fully extended, contacts 440 of limit switch 139 opened when the elevator bottoms, front contacts 442 of relay 342, line 427, coil of relay 406, all in series to ground, whereby contacts 404 are opened to drop relay 374 to lower elevator 106. Cylinders 110 remain extended until the elevator bottoms, opening contact 440, de-energizing valve 436, which is spring returned to exhaust cylinders 110.

The coil of relay 406 also is connected across battery 250 in series with front contacts 448 of time limit relay 431 which are closed after its contacts 430 open. The opening of contacts 430 returns cylinders 110, and the closing of contacts 448 energizes relay 406, opening contacts 404, dropping relay 374 to return the elevator after cylinders 110 are returned. Thus if the transfer is delayed, as would occur if a contact 438, for example, does not close, time limit relay 431 first returns cylinders 110 (if raised) to latch hooks 95 and 97 and then lowers elevator 106 before the end of the transfer run is reached. The coil of relay 431 is connected from line 408 to ground to start timing when relay 362 closes and stop when elevator reverse relay 374 is de-energized. If relay 431 is energized long enough to return the elevator, front contacts of relay 431 connect a warning device across battery 250 to indicate need for repair.

TRACK LAYOUTS

Where stations are far apart as in railroad operations, the course or track 42 for the station vehicle 50 can be in the form of a station loop SL (FIGURES 26 and 27). The station vehicles carry the containers to and from the express vehicles or trains 16 and return to the station on the portion of loop SL removed from the course or track 18 on which train 16 runs. The station track 42 can be extended to a local run of several stops, a branch run, connect with more than one track for express vehicles by adding switches TS (FIGURE 26) to divide the loop SL to run parallel over tracks 18, 18', etc. The express is a vehicle which is saved from making a stop by transfer to and from a station vehicle. The station vehicle is a vehicle which provides transfer to and from an express and makes a station stop. An express and a station vehicle can be the same vehicle depending on the configuration of their tracks and operation.

Transfer car 20 in train 16 is stopped with berths 23 aligned under elevators 450 in building B, FIGURE 26. Elevators 450 have hooks 95 which engage containers 24 to remove them from the train and take them to various floors in the building to let off and take on passengers and return to another train waiting below. Elevator 450, which can also carry freight and other containers 24, will be further described with FIGURE 36.

In urban rapid transit the monorail would parallel the railway (FIGURE 28) with departures SD or switchouts SO to one or more stations or railway lines.

To provide station-to-station service where more than one station is on a carrier run, the carrier train can haul one or more local cages L, FIGURE 28, which are not transferred to and from trains.

The carrier train 50 being suited for operation on steep grades enables the carriers to bring subway or railway passengers from deep or elevated roads to street level. FIGURE 29 shows a container transfer subway CTS built below sewers SP and other obstacles which are expensive to reroute and thereby to reduce costs and have convenient street-level sidewalk loading and unloading stations ST.

GEOMETRIC TRANSFER

To insure that there will be an empty berth 23 in the train for each container to be loaded, the containers at successive stations can be loaded on the carrier train in a geometric pattern which will complement the pattern on the train, so that empty carriers align full berths on the train where transfer therebetween is to be provided.

Referring to FIGURE 26 as an example of geometric transfer, train 16 has its first two container berths 23 empty, designated X, and its next two berths each have a container 24. The train 16 is approaching station S1 which has first two full carriers and then two empty carriers X arranged to respectively align with the empty and full berths of train 16. The next station S2 has first two empty and then two full carriers, etc. With this arrangement two container units 24 are inserted in the train and the other two units are removed at each station.

Referring to FIGURE 27 as another example of geometric transfer, the progression of a transfer train with three container berths is followed past two successive stations S1' and S2' by a series of three pictures of the same area taken in succession with considerable elapsed time between each. At each station one container unit 24 is added to the train and the unit which was added at the second station preceding is removed. With this arrangement a container stays with the train to the second station after it was added. By increasing the number of berths in the train per number of containers removed and added at each station, the containers could stay with the train as long as desired for unloading and reloading them for their next local run. FIGURE 28 shows the same geometric transfer as FIGURE 27.

Geometric transfer is considered suitable only for some passenger, express, and mail service and accordingly selective transfer, to be described with FIGURES 41 and 42, is provided for freight, vehicles private passenger cages, or any transfer container which is to be sent from one transfer station to any other.

SPEED-DISTANCE CURVE FOR STATION VEHICLE

The speed-distance graph, FIGURE 30, for the vehicle 50 on the station loop of FIGURE 31 has distance around the loop or along a run between stations plotted as abscissa and speed of the station vehicle plotted as ordinate. The graph, as well as the track loop, will be described as applied to monorail train 50, but it should be understood that the circuits and graph can be applied to any suitable vehicle and that the loop would be broken at the station and unwrapped for a straight transfer run between stations.

On the graph the station vehicle is started from point SP1, where it is completely made up (i.e. the containers are arranged as required for the approaching railway train). When train 16 enters section or block A', FIGURE 31, the monorail starts and travels to and around the end loop section A and waits at point SP2 for train 16 to enter section B'. When train 16 enters section B' a starting delay timer SD, FIGURE 31, starts timing and delays the starting of the carrier train inversely according to the speed of train 16 and preferably also according to factors which vary the accelerating rate of the carrier, such as load, temperature, line voltage, etc. so that when the carrier reaches express speed, it is in alignment with the express train irrespective of the speed of the express within limits established.

If the carrier starts early it must run slower than the train to align. If it starts late it must run faster than the express to align and will take more distance to align than if slower than the train by the same speed difference. If the carrier could align cell 255 with lamp 248, FIGURE 21, as soon as it can be accelerated to train speed that would be ideal; but, since this is difficult to consistently maintain, the carrier is preferably brought up to a slightly lower speed ahead of alignment to establish

which vehicle is ahead. This initial misalignment, which might be a few feet maximum, is preferably kept as small as practical and is closed as quickly as practical by a sufficiently large speed difference.

Accordingly when the carrier train is started from point SP2 it follows acceleration curve AC to a speed, say 5 miles per hour, less than train speed, which for train speeds of 30 and 60 miles per hour as examples would be points P1 and P2 respectively. The carrier maintains this aligning speed, represented by lines AS1 and AS2 respectively for 30 and 60 mile an hour trains, until lamp **248** aligns cells **255** and **256**, FIGURE 21; whereupon the speed difference is balanced out, the aligning speed following a transient curve to reach train speed, and then transfer can take place. Alignment should be reached by line MP.

The time required for transfer of containers to and from a train is substantially constant and requires a distance varying with speed, line TT. Line TT intersects with zero speed at line MP. Where line TT intersects the line of highest train speed allowable the distance needed for transfer is established. To this distance is added a safety factor represented by the additional time before timer **431** functions and time allowed for the elevators to be returned by timer **431**, thus taking distance to line BP. In the space between the intersection of line TT with highest train speed and line BP, which are points along the right-of-way, the carrier could swing up or away from the train to clear the train before the carrier slows down even if the elevators remain extended.

When point BP is reached train-carrier speed control ceases, and brakes are applied automatically to the carrier as train **16** continues at uninterrupted speed. After the monorail carrier reaches a low speed for rounding the curve at the end of the loop, this speed is maintained until an unloading point UP is reached at the station. Points UP and SP1 would coincide on a one-stop loop with geometric transfer, but where the monorail trains are selectively made up reversible indexing movements IM take place between points UP and SP1.

SPEED CONTROL CONTINUED

The preferred circuitry for starting, stopping, and speed control for a station vehicle for transfer at speed with tain **16** in either direction is described with aid of FIGURE 31, wherein train **16** is shown approaching station loop SL on track **18** for transfer with station train **50** waiting at station S1. Section B′ of control line **76** parallels track **18** where speed control between trains **16** and **50** is desired. Section B′ extends to the point in each direction at which speed control should be established to accelerate the slowest accelerating station train to align with the fastest express with which transfer is intended.

Control line **77**, which parallels track **42** around station loop SL, is divided by insulators **452** into sections A, B, C, and D. Section D is the station section (FIGURES 34, 36, 41, 42, and 43), A the run from or to the station around the left-hand loop, B the accelerating and transfer section, and C the run to and from the station around the right-hand loop. Sections A and C are mirror images of each other except as modified by curves, grades, and station location. Either or both sections A and C can be eliminated for a straight run between stations.

The polarity of dynamo DYN1 is selected to be positive when car **20** travels from left to right with shoe **78** engaging control line **76** and is negative when movement of car **20** is reversed. If car **20** is turned around shoe **78** will not engage line **76**. The polarity of dynamo DYN2 is, therefore, arranged to be positive when the carrier train makes a clockwise run and negative for a counterclockwise run on the loop shown.

A voltage representing the speed and direction which the station train is to travel in sections A and C is placed on these sections in any of the number of possible ways upon the approach of train **16** to station S1. The arrangement for this which is shown provides sections A′ and C′ of control line **76** on respectively the left and right side of section B′ with the coils of relays **461** and **462** connected from sections A′ and C′ respectively to ground, return rail **80** of track **18**, to be energized from dynamo DYN1 or other source, to connect battery **356** through reversing switch contacts of a latching relay **464** to sections A and C, to apply a positive polarity for clockwise movement of train **50** and negative for counterclockwise movement. Sections A′ and C′ are of sufficient length to enable the station vehicle to move from the beginning of section A or C respectively to the beginning of section B while an energized shoe **78** is in respectively sections A′ or C′. The positive of battery **356** is connected through front contacts **466** and back contacts **467** of relay **464** to line **468**, and the negative of battery **356** is connected through front contacts **470** and back contacts **471** of relay **464** to ground. Line **468** is connected to rheostatic resistors **472** and **473** in parallel to ground. Finger **474** on rheostat **472** is connected through front contacts of relay **461** to lines **476** and **478**, back contacts **479** of relay **480**, front contacts **482** by line **483** to back contacts **484** in parallel with back contacts **486** by line **487** to front contacts **488** all of relay **464** and rectifier **490** in series with the coil of accelerating relay AR both in parallel with rectifier **492** and the coil of decelerating relay SR in series and connected across lines **483** and **487**, back contacts **493** of relay **480**, line **494** to line **77** in sections A and C. Rectifier **490** is arranged to pass current when either dynamo DYN1 or sections A or C supply current to dynamo DYN2. Rectifier **492** is arranged to pass current when dynamo DYN2 is generating with front contacts of relay **464** closed for traffic from left to right or back contacts for traffic from right to left. Line **496** connects line **476** through back contacts of relays **462** and **461** in series to ground. Voltage dividing rheostats **472** and **473** enable adjustable selection of the desired speeds for the tractor train in sections A and C respectively.

Relays AR and SR are sensitive to operate on a low voltage difference between dynamos DYN1 and DYN2. Dynamos DYN1 and DYN2 have series fields which oppose the main field to limit the maximum current to relays AR and SR and permit a much higher current between dynamos DYN1 and DYN2 at low speed differences than would be permitted if current was proportional to speed difference. Each relay AR and SR is further protected from high currents by a resistor **498** in series with the coil thereof. Resistors **498** are each bypassed through back contacts of a relay **500** whose coil is connected across the coil of the relay AR or SR being protected preferably in series with contacts **502** closed by the relay AR or SR which the relay **500** is connected across. Contacts **502** are preferably a carbon pile closed and pressured by the relay across which the pile is connected. Relays AR and SR can be biased by a current or permanent magnet to be sensitive yet rugged. Relays **461** and **462** can be similarly protected.

A pilot gearmotor PM, controlled by relays AR and SR, controls acceleration and braking of station train **50** when in sections A, B, and C. Motor PM drives rheostat R secured on the output shaft **504** of motor PM. Rheostat R preferably comprises a cylinder **508** having a helical-grooved insulating periphery with a resistance fin **510**, wrapped on edge to fit in the groove, connected to slip ring **512** at one end, and having a nonconducting segment **514** at the other end. Spring loaded brushes **516** and **517** ride on ring **512** and fin **510** respectively. Brush **517**, supported on a follower **518**, is made to follow fin **510** as it turns preferably by a finger **519** on the follower engaged with screw **520** on the shaft of motor PM. Screw **520** has the same pitch as fin **510**. Follower **518** is supported in a groove **522** axially parallel shaft **504** in a supporting base **524**.

The traction power supply circuit for train **50** in sections A and C is completed from the positive or negative

of battery 356 respectively through front contacts 466 and back contacts 467 of reverse relay 464 to line 468; line 526; brush 516; ring 512; fin 510; brush 517; line 528; section 530 of traction conductor 82 which extends through sections A, B, and C; shoe 84; all traction motors 70 on train 50; to ground return to back contacts 471 and front contacts 470 of relay 464 to respectively the minus or plus of battery 356. Brush 517 rides off the conducting portion of fin 510 onto segment 514 opening this circuit in the off position of rheostat R. Brakes on the station vehicle are automatically applied when this circuit is opened (described with FIGURE 33). The positive traction voltages on line 82 cause clockwise movement and the negative counterclockwise movement of train 50 as explained hereinafter with FIGURE 33.

The armature of pilot motor PM, which preferably has a permanent magnet field, is connected in a circuit from the positive of battery 356, line 532, line 533, resistor 534, front contacts of relay AR, armature of pilot motor PM, line 536, back contacts 537 of relay SR to the negative of battery 356 to turn the rheostat to accelerate train 50. Relay AR drops to stop the pilot motor by shorting its armature from line 536, back contacts 539 and 541 of relays SR and AR respectively in series to the other side of the armature. When relay SR lifts, a circuit is completed from the positive of battery 356, line 532, line 533, front contacts of relay SR, line 536, armature of motor PM, line 542, limit switch 543 closed in all but off position, back contacts 545 of relay AR in series to the negative of battery 356 to turn the rheostat to decelerate and stop train 50. The pilot motor returns the rheostat to off faster than it accelerates the train according to the value of resistor 534.

The pull-in coil of traction polarity-reversing latching relay 464 is energized by a circuit from the positive of battery 356, line 532, line 546, limit switch 547 closed by rheostat R in off position, switch 548, pull-in coil of relay 464 to the negative of battery 356. The circuit for unlatching relay 464 is from the positive of battery 356, line 532, line 546, limit switch 547, switch 550, unlatching coil of relay 464 to the negative of battery 356. The direction in which train 50 is to operate is selected by closing switch 448 or 450 by means such as an operator at a remote location or by the approach of train 16 from a certain direction, or by a clock or train counter according to train schedule. Limit switch 547 prevents the reversal of traction polarity in all but off position of rheostat R.

Train 16 is made ready for a transfer at station S1 before entering section A' or C' by closing switch 252 to light lamp 248 on the leading transfer car for the next transfer, which can be anywhere in train 16. Some transfer cars need not have a lamp 248 or dynamo DYN1 if located in a train with relation to a car which does. Each transfer car which has a lamp 248 has shoe 78 equally spaced in relation to the lamp lengthwise the train and preferably on the same car. This shoe is connected to dynamo DYN1 through switch contacts 551 mechanically linked to close with switch 252, which lights the lamp 248. The shoe 78 connected to a dynamo DYN1 establishes when the lead transfer car enters each section for starting the station train at the proper time independent of the number of cars in the express ahead of the lead transfer car.

Before a train enters section A' or C' with sections B' and C' or B' and A' respectively clear relays 461 and 462 are down grounding any dynamo DYN2 in sections A and C through relay SR to stop the tractor train which enters section A or C after being loaded. This circuit for a tractor entering section A clockwise is from dynamo DYN2, shoe 79, section A of line 77, line 494, back contacts 493 of relay 480, front contacts 488 of relay 464, line 487, coil of relay SR, rectifier 492, line 483, front contacts 482 of relay 464, back contacts 479 of relay 480, line 478, line 476, line 496, back contacts of relays 462 and 461, all in series by grounded return to DYN2. This circuit for counterclockwise movement of the tractor is the same except the tractor enters section C with reverse polarity developed by DYN2 and, relay 464 being dropped, the circuit from contacts 493 to 479 is changed to back contacts 484 of relay 464, rectifier 492, coil of relay SR, line 487, back contacts 485 of relay 464 to contacts 479. In either case the energizing of relay SR returns pilot motor PM to off position wherein brush 517 rides to open the power circuit to all tractors in sections A, B, and C.

When a shoe 78 connects dynamo DYN1 to section A' a circuit is completed from ground, armature and opposing field of dynamo DYN1, contacts 551, shoe 78, section A' of line 76, coil of relay 461 to ground. Relay 461 is thereby energized at all but lowest train speeds. Relays 461 and 462 might optionally be operated from a power supply connected by train 16 in sections A' and C' respectively.

The energizing of relay 461 closes, through DYN2 of the lead tractor 54 which has entered section A, an accelerating circuit from the positive of battery 356, front contacts 466 of relay 464, line 468, front contacts of relay 461, line 476, line 478, back contacts 479 of relay 480, front contacts 482 of relay 464, rectifier 490, coil of relay AR, line 487, front contacts 488 of relay 464, back contacts 493 of relay 480, line 494, section A, shoe 79, armature and opposing field of dynamo DYN2, ground return, front contacts 471 of relay 464 to the nagative of battery 356. Relay AR thereupon lifts, connecting motor PM across battery 356, turning rheostat R from off to gradually reduce series resistance to traction motors 70 of tractors 50 until the voltage of dynamo DYN2, increasing with speed, approximately balances the voltage supplied to line 77 by voltage divider 472. Whereupon relay AR drops, shorting pilot motor PM to stop abruptly at the speed setting of rheostat R. Tractor 50 travels around the end loop at this speed whether moving up or down grade until its shoe 79 enters section B, which is connected through back contacts of relay 480 and the coil of relay 558 in series to ground, energizing relay 558, which connects line 476 to ground through its front contacts, completing a circuit from ground, dynamo DYN2, shoe 79 now positive, section B of line 77, line 494, back contacts 493 of relay 480, front contacts 488 of relay 464, coil of relay SR, rectifier 492, line 483, front contacts 482 of relay 464, back contacts 479 of relay 480, line 478, line 476, front contacts of relay 558 to ground, energizing relay SR to stop train 50.

STARTING RELAY TIMER

When shoe 78 energizes section B' dynamo DYN1 is connected across the coils of relays 560 and 562, which are connected in series across line 76 section B' and ground rail 80. Relay 560 is a rheostatic relay having a D'Arsenval or other type of electromagnetic movement for moving contact finger 564 clockwise from the right-hand end of its rheostat to a point representing the current through its coil or coils. Since the voltage developed by dynamo DYN1 represents the speed of train 16, being preferably proportional thereto at zero current, the position of rheostat 560 when train 16 engages section B' represents the speed of train 16. A Wheatstone bridge is formed by paralleling rheostat 560 with rheostat 566, connecting the coil of relay 480 in series with rectifier 568 across slide fingers 564 and 570 on respectively rheostats 560 and 566, and connecting a direct current supply, such as battery 572, in series with front contacts 574 of relay 562 across the end terminals of rheostats 560 and 566. The right-hand terminals of rheostats 560 and 566 are respectively labeled SLOW and LATER and are connected by lead 576, and their left-hand terminals are respectively labeled FAST and SOON and are connected by lead 577. Rheostats 560 and 566 are divided by their fin-

gers respectively into variable resistances R1 and R2 on their right sides and R3 and R4 on their lefts.

Contact finger 570 of rheostat 566 is driven by timing motor TM through gear reduction therein and a magnetic clutch 582 connecting the output shaft of motor TM to shaft 584 on which finger 570 is secured. Motor TM has counter clockwise rotation to rotate finger 570 from SOON to LATER. Motor TM is connected in series with clutch 582, rheostat 586 for adjusting the speed of motor TM, and contacts 587 on latch 588 across lines 576 and 577. Latch 588 rides on cam 590, secured on shaft 584; until the end of travel for shaft 584 when finger 570 approaches the LATER terminal; whereupon latch 588 drops into notch 592 in cam 590, opening contacts 587.

Cam 594, secured on shaft 584, operates contacts 596 which connect a circuit from the positive of battery 572, back contacts 598 of relay 562, contacts 596 of cam 594 closed at the end of travel in LATER position, lifting coil of latch 588, all in series to the negative of battery 572. A torsion spring 599, one end being secured to shaft 584 and the other to mounting means for shaft 584, restores contact finger 570 to START at the SOON end of travel when relay 562 drops, closing contacts 596, lifting latch 588. Cam 594 opens its contacts as spring 599 returns contact finger 570 to START.

The energizing of section B' by the presence therein of train 16 at speed lifts relay 562 and moves relay 560 from rest point in SLOW position, increasing R1 and reducing R3 against tension of spring 600, to a position representating the speed of train 16. The lifting of relay 562 energizes clutch 582 and starts timer motor TM turning counterclockwise, reducing R2 and increasing R4. Rectifier 568 is connected to block current until finger 570 increases R4 past the point of bridge balance (R1/R3=R2/R4). The time required for finger 570 to pass this point is longer the slower the train 16 and preferably inversely logarithmic (base 10Q) to train speed, being least for fastest train speed. The speed of motor TM is adjusted and the taper of potentiometers 560 and 566 selected so that the tractor train reaches a particular speed relative to train 16 as light from lamp 248 reaches cell 255.

For closer control of the meeting of trains 16 and 50, rheostat 566 is adjusted by the weight of train 50. Rheostat 566 has its end terminals connected by brushes 602 to segments 604 and is mounted to be rotated on its axis to a position representing the effect of the weight of train 50 on its acceleration. Train 50, waiting for train 16 to enter section B', rests on scales 606, preferably comprising a plurality of differential transformers 608 each mounted in a proving ring supporting the scales section of track 42. Each transformer 608 is connected to a supply LSS in a usual manner and has its output connected to energize solenoid 610 proportional to the weight of train 50 on the proving rings. Solenoid 610 operates lever 612 pivoted at 614 and arranged to rotate rheostat 566 clockwise by pulling down on a flexible band or wire 616. Wire 616 extends around a circumference on rheostat 566 and is secured thereto at point 618. Spring 620 applies a torque on rheostat 566 to balance the force exerted by solenoid 610 to position rheostat 566 to start the station train earlier the heavier it is.

Less weight correction is need the slower train 16. Accordingly the pull of solenoid 610 or spring 620 is adjusted with time. In the arrangement shown one end of spring 620 is secured on the end of wire 616 opposite to the pull of lever 612, and the other end is secured to an end of wire 622 whose other end is wrapped and secured on drum 624 secured on the shaft of gearmotor 626. The gearmotor's shaft is held from turning except as driven. Drum 624 is preferably grooved and tapered so that when turned at constant speed it wraps wire 622 thereon logarithmically slower with time or as desired to offset the curvature of the acceleration curve for train 50. Motor 626, which has a permanent magnet field, is connected from the positive of battery 628 or other source, back contacts 630 of relay 480, front contacts 632 of relay 562, armature of motor 626, front contacts 634 of relay 562 to the negative of battery 628 all in series to turn drum 624 to wind wire 622 thereon as desired to make this correction when relay 562 lifts until relay 480 lifts, stopping motor 626 until relay 562 drops as shoe 78 leaves section B'. Motor 626 is then returned through a circuit from the positive of battery 628, back contacts 630 of relay 480 and 636 of relay 562, armature of motor 626, limit switch 638 opened in starting position of drum 624, back contacts 640 of relay 562, to the negative of battery 628. Other adjustments can be made by varying the speeds of motors PM, TM, and 626.

SPEED CONTROL CONTINUED

When finger 570 becomes more positive than finger 564, rectifier 568 passes a current and relay 480 lifts, closing an accelerating circuit for a clockwise run of tractor 54, from dynamo DYN1, shoe 78, section B' of line 76, line 641, front contacts 642 of relay 480, front contacts 482 of relay 464, rectifier 490, coil of relay AR, line 487, front contacts 488 of relay 464, front contacts 644 of relay 480, line 646, section B of line 77, shoe 79, dynamo DYN2 to ground to the other side of DYN1 all in series. The lifting of relay AR accelerates the station train until dynamo DYN1 and DYN2 are substantially developing the same voltage. Relays 560 and 562 remain energized, since they are in parallel with dynamos DYN1 and DYN2; but relay AR or SR which is in series drops. The coils of relays 560 and 562 have high resistance relative to the series circuit between DYN1 and DYN2.

When relay 266 (FIGURE 21) lifts its reduces the output of DYN2 and relay AR again lifts to drive motor PM to supply a higher voltage on traction line 82 to accelerate tractor 54 to train speed. Relays 262 and 264 adjust the output of DYN2 to maintain alignment of trains 16 and 50 for transfer as relays AR and SR are operated respectively when relays 264 and 262 operate to adjust the setting of brush 517 to accelerate or decelerate train 50. If the output of dynamo DYN2 exceeds that of DYN1 a decelerating circuit is closed which is the same as the accelerating circuit last described except the current being in reverse is blocked at rectifier 490 but passed by rectifier 492. The accelerating and decelerating circuits for counterclockwise movement of tractor 54 is the same except the tractor enters section B from the opposite end with reverse polarity developed by DYN1 and DYN2 and accordingly rectifiers 490 and 492 are reversed by dropping relay 464, so that relays AR and SR function similarly for either direction of traffic. If relay 464 is set wrong for the direction of train 16, train 50 will not be accelerated, a safe condition.

This speed control circuit is maintained until train 16 or 50 passes insulators 452 into respectively sections C' and C or for the reverse traffic into sections A' and A. Upon passing insulators 452 at the end of section B the monorail is slowed to say 15 miles per hour (by the voltage on line 77 in the section following B) to round the end of loop SL and return to station S1 after the transfer. Various voltages can be applied to additional sections of conductor 77 to vary speed along the monorail, so that time is not wasted with slow speed or straight runs.

VARIATIONS OF THE SPEED CONTROL AND STARTING DELAY TIMER

Some of the many possible variations and simplifications are illustrated in FIGURE 32 wherein two control lines for train 50 simplify circuitry but increase cost; a less accurate starting timer is provided; and transfer is provided for traffic from right to left only.

The circuit controlled by the timer is from dynamo DYN1, control line 76 section B', rectifier 568 arranged to pass current from dynamo DYN1 when developing a positive voltage, coil of relay 480, finger 570 of rheostat 560, resistance R2, ground return to DYN1 all in series. Battery 572, now having a higher voltage than the maximum developed by DYN1, is connected positive to the terminal of resistance R4 and negative to ground. Finger 570 is turned from the positive of battery 582 to ground by motor TM, again driven through front contacts of relay 562, whose coil is connected across section B' of line 76 and ground to start the timer when shoe 78 enters section B'. The voltage of battery 572 blocks current of dynamo DYN1 from relay 480 until finger 570 has turned to a lesser voltage than the output of DYN1 thus closing relay 480 after a time interval inversely proportional to the speed of train 16.

The speed control ACC is now connected on the ground side, and comprises in blocks B and B' from dynamo DYN1, line 76, front contacts of relay 480, line 77, dynamo DYN2, line 77', and automatic controls ACC which in this circuit include coils of relays AR and SR and rectifiers 490 and 492 connected as shown in FIGURE 31. Battery 356 is now connected separately to blocks A and C respectively through front contacts of relays 461 and 462.

REVERSING CIRCUIT ON STATION TRAIN

Traction motor 70 on tractor 54 is reversible to reverse movement if the tractor passes a stop point at the station as well as for transfer in the reverse direction. While another traction power line could be strung around the monorail loop to feed the field of motor 70 separately from its armature, it is preferred to keep down the number of contact conductors. Accordingly the reversing circuit of FIGURE 33 is provided.

The series field 670 of traction motor 70 is reversibly connected through reversing contacts 672 on a differential relay 674. Relay 674 has one coil connected from trolley 84 to ground through rectifier 676 and the opposite coil connected from trolley 84 to ground through rectifier 678 reversed from rectifier 676. Relay 674 shifts according to the polarity of the traction power to maintain the polarity of the series field constant when the armature current reverses, thereby reversing motor action.

BRAKES

Usual types of brakes can be applied to the monorail such as air brakes controlled by solenoid valve 682. Preferably each carrier and tractor has one or more sets of three brake shoes 684 mounted on one or more levers 686 pivoted on pin 687 to the vehicle and connected by linkage 688 to the rod end of cylinder 690 to press one shoe 684 against the under side of I-beam 44 and the others down on each lower flange of the I-beam. The braking includes the standard control and shift pistons 692 and auxiliary supply tank 694.

TRANSFER STATION

When train 50 arrives at station S1 after transfer, it is stopped on a dead section of line 82, and then its containers 24 are either opened and unloaded and reloaded for the next transfer run, or the carriers of train 50 are uncoupled and switched by switch and tractor means, such as provided in industrial monorails; or, as preferred for general service, containers 24 are unloaded from the carriers, and the station train is made up later by reloading containers 24 thereon for the next transfer run. The unloading of the freight and auto containers from the carriers frees the carrier train for fuller use, eliminates the need to switch carriers for parking containers or for carrier train make up, enables convenient loading and unloading of auto cages and permits delivery and pickup of freight containers by other conveyances. Accordingly the general purpose transfer stations to be described with FIGURES 34–42 are of the carrier unloading type.

CARRIER POSITIONING STOPS AND UNLOAD ELEVATOR

Train 50 upon entering section D from either direction is stopped in proper relation to elevator 698 (FIGURE 34) to unload a number of containers 24 from their carriers 52. Along the monorail section D a control power supply line 700 is strung on insulators for contact by shoe 701 on the controlling tractor 54 in train 50. Line 700 is connected by line 702, back contacts of relay 703, and line 704 all in series to the positive of battery 705. Stop or locating segments SS are located at points along the monorail where the lead tractor is to stop. Forward segments 707 and reversible segments 708 are run in line for a distance equal to about half the distance between stops on respectively the right and left of each stopping point SS. Segments SS, 707, and 708 are positioned to be engaged by shoe 701, connected together as shoe 701 passes between them, and otherwise connected individually by shoe 701 to the positive of battery 705. Segments SS are connected together by lead 710, segments 707 by lead 711, and segments 708 by lead 712. The coils of relays 714, 715, and 716 are respectively connected from segments SS, 707, and 708 to ground. Forward relay 715 connects the positive of battery 705 via line 718, front contacts of relay 715, line 720 in series to traction conductor 82. Reverse relay 716 connects the negative of battery 705 via line 722, front contacts of relay 716, line 724, back contacts of polarity reversing relay 726, line 727, line 720, in series to conductor 82 of section D. Front contacts of relay 726 close a circuit from the positive of battery 705, line 718, line 728, front contacts of relay 726, line 727, line 720, to line 82 of section D. Relay 726 is energized when it is desired to move the tractor to the next stopping point or section.

Elevator 698 is located at the end of section D usually entered by train 50, which is here shown on the right. When train 50 enters section D from the left the front contacts of relay 716 are bypassed by front contacts 730 on relay 703 closed by finger 732 on tractor 54 pushing swing switch 734 to the right, closing a circuit from the positive of battery 705, swing switch 734, coil of relay 703, to ground of battery 705. The holding circuit for relay 703 is connected from the positive of battery 705, line 736, spring centered swing switch 738 closed in center position, front contacts 740 and coil of relay 703 to ground of battery 705. When the lead tractor enters segment 707 at the right-hand end of station S1 while moving to the right finger 732 opens switch 738 dropping relay 703. Then train 50 is brought to the first stop SS from the right as if the train had entered station S1 from the right.

Elevator 698 is positioned under a number of container positions or berths when train 50 is stopped with shoe 701 on an unloading stop SS. Elevator 698 has a roller conveyor platform 742 having rollers 743 of large enough diameter to extend above the top and bottom of platform 742 supported on equal and parallel lift arms 744, pivotally secured on pins 745 to platform 742 and to supporting brackets 746 secured to the floor of pit 748 which houses elevator 698. Either or both of the forward arms 744 have an extension 750 which prevents the containers from rolling off the front end of the conveyor when the elevator is lifted. Stop 752 runs across the back of conveyor 742 to prevent containers from rolling off the back. A hydraulic lift cylinder 754 is clevis mounted to bracket 756 secured in pit 748. The rod of cylinder 754 is pivotally secured to an arm 744 to lift the elevator.

Pump 756 forces fluid from tank 758 through two-way spring-returned solenoid valve 760 in the energized position shown to the head end of cylinder 754. When valve 760 is de-energized cylinder 754 exhausts through valve 760 to orifice 761, to tank 758.

Double-acting cylinders 762 supported from the monorail I-beam or supporting framing are positioned to open hooks 95' when elevator 698 lifts the containers 24 from these hooks as shown. Cylinders 762 have their rod ends connected to line 764 and their head ends connected to line 765. Lines 764 and 765 are connected through four-way two-position spring-returned solenoid valve 766 to lines 768 and 769 respectively in the energized position of valve 766 shown and to lines 769 and 768 when valve 766 is de-energized. Lines 768 and 769 are connected respectively to the outlet port of pump 756 and tank 758, so that cylinders 760 lift hooks 95' which are over elevator 98 when valve 766 is energized.

Hooks 95' differ from hooks 95 in that they rotate on pivot 98' parallel the line of travel of the carriers and are shown in FIGURE 34 to better illustrate the opening of the hooks. Each hook 95' has one or more teeth for engaging teeth on hook 97' and have webb 772 which intermeshes with a central vertical slot in hooks 97' to prevent sidewise slip. Hooks 95' are not preferred, since lengthwise train shocks might unlock the containers. See FIGURE 36 for the uncoupling of hooks 95 at the unload elevator.

Relay 714 connects the positive of battery 705 via line 718, front contacts of relay 714, back contacts on stick relay 774, front contacts of relay 776 (optional), coil of solenoid valve 760 to ground of battery 705. Relay 714 has a closing time delay checking that the tractor 54 is practically stopped before closing to energize valve 760 to raise elevator 698.

When the elevator is lifted to a height at which all containers 24 on the hooks thereabove would be lifted off these hooks, limit switch 782 engaged by finger 783 on an arm 744 closes its contacts closing a circuit from the positive of battery 705, line 718, contacts of limit switch 782, line 783, coil of relay 784, all in series to ground of battery 705. Relay 784 closes a circuit from the positive of battery 705, line 718, front contacts 786 of relay 784, coil of valve 766, all in series to ground, operating valve 766 to the position shown, lifting the hooks 95' which are above elevator 698. Relay 784 then closes its holding circuit from the positive of battery 705, line 718, line 728, contacts 787 on limit switch 780 closed when the elevator is lifted above its bottom position, front contacts 788 and coil of relay 784, all in series to ground of battery 705. Limit switches 792, supported on structure along I-beam 44 and each located to be engaged by an arm 101' on each hook 95' positioned above elevator 698, control the lowering of the elevator by a circuit from 783, line 790, contacts of all limit switches 792 closed in series when all the hooks are sufficiently lifted to clear the containers, coil of relay 774, all in series to ground of battery 705. Relay 774 closes its holding circuit from the positive of battery 705, line 718, back contacts of relay 715, front contacts and coil of relay 774, all in series to ground. When relay 774 lifts it de-energizes valve 760 to exhaust cylinder 754 through orifice 761, lowering elevator 698. Then, when the elevator bottoms, a circuit is closed from the positive of battery 705, line 718, line 794, front contacts 796 of relay 774, contacts 797 on limit switch 780 closed when the elevator bottoms, coil of relay 726, all in series to ground.

OPERATION OF CARRIER POSITIONER AND UNLOAD ELEVATOR

When the lead tractor 54 enters section D from the right contact shoe 701 connects line 700 with the segment 707 on the right, energizing relay 715, which connects the positive of battery 705 to line 82 to supply power to motor 70. The voltage supplied by battery 705 to motor 70 is high enough to move the trolley train slowly to spot SS. If spot SS is passed, shoe 701 connects the positive of battery 705 to energize relay 716, which connects the negative of battery 705 to line 82, relay 715 having dropped to break the positive connection of battery 705 to line 82. The traction motors connected by train line to section D thereby reverse and come to rest with shoe 701 on spot SS. Whereupon relay 714 is energized, reversing solenoid valve 760, extending lift cylinder 754 to the end of travel in which position finger 783 closes limit switch 782, energizing relay 784, which reverses solenoid valve 766, extending cylinders 762, releasing the three containers shown from the carriers to elevator 698 and closing limit switches 792, energizing relay 774. When relay 774 lifts, valve 760 reverses, lowering the elevator under its own weight; or a double acting cylinder could be used with orifice 761 to lower the elevator of a desired speed. When the elevator is fully lowered, contacts 787 of limit switch 780 open, dropping relay 748 to retract cylinders 762. Then limit switch 780 closes contacts 797, energizing relay 726, which thereupon connects the positive of battery 705 to line 82, moving train 50 forward off spot SS, dropping relay 714. Relay 726 continues to connect the positive of battery 705 to line 82 until shoe 701 passes section 708 and engages the next segment 707, lifting relay 715, which opens the holding circuit for relay 774, which is thereby dropped, dropping relay 726. Since relay 715 now connects the positive of battery 705 to line 82, train 50 continues to move forward and then similarly locates on the next spot SS, repeating the unloading process for the next three carriers. When the containers on these are lowered the tractor train again moves forward either to other unload stops or to the loading elevator stops. A short section 707 is located at the exit end (left) of the last section 708 to open relay 774 to drop relay 726.

UNLOAD ELEVATOR AND STATION CONVEYOR

Elevator 798 is lowered to a belt-under-roller conveyor 800, which has a belt 802 running in the direction shown by arrows to move the containers from the elevator to the left as soon as they are lowered. The containers are thus transferred to a roller section 804 similarly driven by belt 802. Belt 802 is supported on rollers 806, and its drive pulley 808 is driven by motor 809 through speed reduction drive 810.

The containers are preferably removed from elevator 698 at a faster speed than train 50 is then moving, whereby the lift of elevator 698 need only allow containers 24 to clear tractor 54.

CHECK THAT ELEVATOR IS UNLOADED

All or a number of the rollers 743 on elevator 698 can have each end of their axles 812 mounted as shown in FIGURE 35. Each end of the axle 812 shown is mounted in a slot 814 in a lengthwise frame member of platform 742, such as channel 816, and is held toward the top of slot 814 by compression spring 818 imposed between the shaft and channel in a usual manner. A limit switch 820 is located to close when the roller 743 is up in this slot and opened when the roller is depressed by a load. Limit switches 820 on elevator 698 are connected in a circuit from the positive of battery 705, line 718, line 728, flexible load 824, contacts of limit switches 820 in series located to detect a container on platform 742, flexible lead 825, line 826, coil of relay 776, in series to ground of battery 705. With this arrangement elevator 698 cannot be lifted until after relay 776 is lifted, indicating that all containers are removed from the platform of elevator 698. Upper contacts 827 of limit switch 780 are connected across limit switches 820 to permit elevator 698 to continue to lift after engaging containers which are on carriers 52.

LIFTER FOR HOOKS

If carriers 52 have the preferred hook 95 these hooks are preferably lifted to release containers 24 to elevator 698 by a hook lifter such as next described with reference to FIGURES 36 and 37. Two sets of two channels 832

are positioned transversely to and secured on the top of I-beam 44. Between the channels 832 of each set are pivotally mounted two hubs 834, equally spaced from, on each side of, and arranged to rotate in a plane transverse to I-beam 44. Each hub 834 has an arm 836 pivotally mounted thereto for rotation in a plane parallel the axis of that hub. A bar 838 on each side of I-beam 44 is pivotally supported to the two arms 836 on the same side of I-beam 44 to be horizontal while moved up or down on arms 836 to lift or drop hooks 95 together. Bars 838 are run parallel under side extending levers 101. Bars 836 have their ends bent outward to and pivotally secured on the two arms 836 on the same side of track 42 to enable parallelogram movement of arms 836. The opposite hubs 834 each have an arm or rod 840 radially extending therefrom and secured thereto. Cylinder 842 is clevis mounted at opposite ends to opposite rods 840 near the outer ends thereof. Cylinder 842 and rods 840 are arranged to swing bars 838 inward and outward relative to I-beam 44. Cylinder 842 extends to spread rods 840 to push bars 838 in under levers 101, and then arms 836 are ready to operate in preferably a vertical plane. The opposite set of arms 836 from cylinder 842 extend above hubs 834 to be engaged by a transverse bar 844 secured to the rod of cylinder 846, foot mounted to I-beam 44.

The hydraulic (or air) circuit for cylinders 842 and 846 is controlled by solenoid valve 766' which comprises a four-way two-position valve 848 and a two-way two-position valve 849 with their spools secured on the same shaft operated by a spring-returned solenoid operated by the same circuit as and in place of valve 766 of FIGURE 35. In the energized position of solenoid valve 766' shown, pressure from pump 756 is connected through valve 848 to line 850 to the head end of cylinder 842, which spreads rods 840 to swing bars 838 under levers 101. Cylinder 842 has a port 852 near its rod end uncovered by its piston. Port 852 is connected by line 854 through valve 849 to the head end of cylinder 846, which then rotates arms 836 clockwise and raises bars 838 to open hooks 95 while the elevator lowers. The rod ends of cylinders 842 and 846 are connected together and exhaust through valve 848. When valve 766' reverses, the head ends of cylinders 842 and 846 exhaust, and the rod ends are pressured to swing bars 838 down, outward, and up and holds them free from interference with tractor train 50 as it moves thereunder. Arms 836 have counter weights 856 if needed to hold them free from interference with train 50 as it moves if pressure on cylinders 842 and 846 is off. The arms 836 opposite those engaged by bar 844 each engage a limit switch 792 to close it when hooks 95 above elevator 698 on that side of I-beam 44 are open.

FURTHER DETAILS OF UNLOAD ELEVATOR

A preferred yet somewhat more complex form of elevator 698 is shown in FIGURES 36 and 40 wherein platform 742 is supported on jointed legs 744' of equal length between pivots 745 to eliminate horizontal movement of the platform. Rods 858 connect the center joints of legs 744' on opposite sides of the platform. At one end of the platform there are two sets of legs 744' arranged to fold away from each other at their center joints, the rod 858 of one set pivotally supporting lift cylinder 754' whose rod end is secured on the rod 858 of the other set at the same end of the platform so that cylinder 754' controls the spreading of the center joints of these legs to raise and lower the hoist. The center joints of the legs which bend in the same direction are connected by bar 860 also pivoted on pins 745.

Optional to extensions 750, FIGURE 34, a spring raised lever 862, FIGURE 36, can be provided to prevent the containers from rolling off the front of platform 752 while lifted. Lever 862 is forced down when engaged with projection 863 extending to the right from the bottom of the cross plate on the right-hand end of roller section 804.

Platform 742 has a central longitudinal row of rollers 743 with their axles transversely positioned. Along each side of this row runs a channel 864 turned web down, supporting the shaft ends of these rollers in pockets or holes along the inner legs of these channels, and providing a relief for runners 116 on the auto cages 24V. Channels 864 are spaced and secured together by channels or flats 865 clearing the top and bottom planes of and between the rollers. A row of wheels or rollers 743 are provided on each side of the center row, one end of the shaft of each of these rollers being supported in an outer channel 816 and the other end in the outer leg of a channel 864. Along the bottom on each side of platform 742 angle brackets 866, each having a down turned leg to which a leg 744' is pivoted, connect the outer channels 816 with the inner channels 864 on the same side. Belt 802, supported on rollers 806 in conveyor frame 868, engages the central row of rollers 743 when the platform is lowered thereto.

STATION CONVEYOR

When containers 24 are conveyed off platform 742 they run on sections of roller conveyor 800, similar in cross section to platform 742, and are stopped by setting a stop 870 in their path. When a container hits a stop, belt 802 slides past rollers 743 on which the container rests. Rollers 743 and belt 802 can be disengaged by mounting the sections of conveyor 800 on parallel arms 872 to be lifted slightly by cylinder 874. The containers can be taken off conveyor 800 by right-angle takeoff 876, turntable 877, unloading turntable 878, or by any other suitable means.

CONTAINER PARKING

The passenger cage 24P shown in FIGURE 36 is shown as having been pulled off conveyor 800 at right angles and parked for unloading and loading where it will not interfere with removal of other containers from the monorail. A fence 880 borders this parking area so patrons cannot walk onto conveyor 800. The near door 32 of the passenger cage shown and gates 882 are preferably opened by an attendant, but all passenger doors 32 are also preferably arranged to be opened from within by usual emergency means. Freight containers 24F also are shown as having been taken off conveyor 800 at right angles for unloading, storage, pick-up by another vehicle, or to move on a conveyor to a desired location.

RIGHT-ANGLE CONVEYOR TAKEOFF

The right-angle takeoff 876, shown in FIGURES 36 and 38, has two rows of short horizontal rollers 884 supported each between a set of two plates 886. A lift cylinder 887, secured in pit 748, has secured to its rod a frame 888, which supports plates 886. Plates 886 have depending arms 890 which extend through holes 891 in the web of channels 864 and are fastened to frame 888. Both sets of plates 886 are arranged at right angles to channels 816 and 864 and spaced to support opposite ends of a container 24. Each set of plates 886 with their rollers 884 is arranged to recess below the top plane of and between rollers 743 and to be lifted by cylinder 887 to support a container 24 on rollers 884 to enable the container to be easily removed from conveyor 800. Plates 886 each have notches 892 to permit a cage with runners 116 to pass on rollers 743 and a notch 893 which straddles belt 802 when plates 886 are lowered. The legs of channels 864 have slots 894 the width of and spaced for each set of plates 886, to vertically guide and recess these plates. The return side of belt 802 is passed between arms 890 above frame 888.

VEHICLE CAGE TURNTABLE

Auto cages 24V preferably are either run off conveyor 800 on the right-angle takeoff or loaded and reloaded even more quickly on one or more unloading turntables 878 on conveyor 800, FIGURE 36. An auto truck AT is shown on ramp DR about to be driven on a cage 24V turned on

turntable 878 to be at right angles to conveyor 800 for end loading and unloading of cage 24V. Vehicles unloading on turntable 878 are driven off the opposite end onto drive DR'.

A section through turntable 878, FIGURE 39, shows the turntable formed of a channel rim 895 turned legs in and secured to and transversed by lengths of channels 816 and 864 similarly spaced and supporting rollers 743 as on the straight sections of conveyor 800. Rim 895 has notches 892' for the runners 116 to pass on and off the turntable and is supported except at belt 802 on a ring of rollers 896 supported on frame 897. Frame 897 is mounted on a cylinder 898 for lifting the turntable above belt 802 for turning. Frame 897 is held from turning by a vertical guide 899. The turntable is guided by four rollers 900 equally spaced about the rim and each supported by a C-shaped bracket 902.

To release the tire clamps (i.e., open plates 176, FIGURE 17, and lift brackets 168 to floor level) on cages 24V, two channels 904 the length of and one in each channel 864 on the turntable and turned legs down are arranged to be lifted on four or more arms or rods 906. Pads 907 secured near the ends on the under side of channels 904 are engaged by rods 906 through holes 908 in channels 864 aligned when the turntable is in position for loading and unloading as shown in FIGURE 36. Vertical guide bars 910, secured to channel 864 at each end of channels 904, prevent channels 904 from slipping out of place lengthwise. Rods 906 are secured on frame 911, which is vertically moved by cylinder 912. Cylinders 898 and 912 are combined as inner and outer cylinders respectively, fluid to the inner cylinder being fed through a hose to a port through its rod. When the outer cylinder is down channels 904 are low enough in channels 864 to permit skids 116 to pass over channels 904.

Turntable 878 can be turned manually or driven by gearmotor 914 whose vertical output shaft drives spur gear 916 engaging gear rack 918 secured on the rim of the turntable. Power for motor 914 is connected from the positive of battery 705, contacts of pressure switch 920 closed when the turntable is lifted, top front contacts of reverse switch 922, limit switch 924 opened when the table is transverse to conveyor 800, armature of motor 914, low front contacts of switch 922, all in series to ground of battery 705. When the turntable is to be returned switch 922 is reversed closing a circuit from the positive of battery 705, the same contacts of pressure switch 920, upper back contacts of switch 922, limit switch 926 opened when the turntable aligns with conveyor 800, armature of motor 914, bottom back contacts of switch 922, all in series to ground of battery 705.

The inner cylinder 898 is controlled by a spring-returned solenoid valve 928 closed to pressure cylinder 898 by a circuit from the positive of battery 705, switch 930 in parallel with limit switch 932 opened only when the table is aligned with conveyor 800, coil of valve 928, in series to ground of battery 705. The outer cylinder 912 is controlled by a spring-returned solenoid valve 934 closed to pressure cylinder 912 by a circuit from the positive of battery 705, limit switch 936 closed only when the table is 90 degrees revolved from conveyor 800, coil of valve 934, in series to ground of battery 705. The gearing of motor 914 locks the table in position when stopped.

Turntable 877 is similar to table 878 except, since it is not used to unload vehicle cages, the outer cylinder 912, channels 904, and arms 906 are omitted.

ELEVATOR IN BUILDING

Above the passenger container is a container elevator 450 for transporting passenger or freight containers 24 to various floors of a building. The elevator has vertical guide tracks 940 between which carriage 942 is guided. Carriage 942 is hoisted by cable 943 in a usual manner and has hooks 95 which are opened by ropes fastened to arms 101 and operated similarly as described hereinafter for hooks 95'' shown in FIGURES 46–48.

SELECTIVE TRANSFER

Referring to FIGURE 41, when train 16, represented by two coupled transfer cars 20, approaches a transfer station or run it signals ahead which container berths are empty, so that the station train can be made up to have containers only in the berths which align empty berths on train 16. Cars 20, which can be traveling in either direction, each have three container berths 23 arranged to signal to station S1 in order from the right-hand end of train 16 beginning at the first transfer car from the right which is to be used in the transfer for station S1 to the transfer car at the other end of the series of coupled transfer cars to be used in the transfer for station S1.

Limit switches 234, which detect the presence of a container in each berth 23, have a single-pole double-throw contact 944 alternately engaging a normally open contact 945, closed when the berth has a container, and a normally closed contact 946, closed when the berth is empty. In each transfer car, contacts 945 are connected by line 947 to the positive of battery 250, and contacts 946 are connected by line 948 to the negative of battery 250, which has a grounded center tap.

A rotary selector switch 950 on each transfer car has four rings of contact segments. The outer ring comprises contacts *f*, *g*, *h*, and *j* arranged in clockwise order. Contacts *f*, *g*, and *h*, one for each container berth, are connected to contacts 944 of successive container berths starting from the right-hand end of the car. Contact *j* is connected by line 952 to a train-line coupling switch 954 at the left-hand end of car 20. The second ring comprises an annular segment 956, which extends past all but both contact *j* and off position selected to be at the top just ahead of contact *f*, and a segment 957, which extends past segment *f* but not the stopping position. Segment 956 is connected to train line 960 and to a contact shoe 962 which engages conductor rail 964 along the right-of-way. The third ring 968 is solid and connected to the positive of battery 250 by line 969. Segment 957 is connected to ring 968. The fourth and inner ring has an annular segment 970 extending past contacts *f*, *g*, and *h* and a segment 971 radially in line with contact *j*. Selector switch 950 has a contact arm 972 secured on the output shaft of gearmotor 974 and driven clockwise over the segments and contacts of switch 950. Arm 972 has a brush 976 connecting the first and second rings and a brush 977 insulated from 976 and connecting the second and third rings together.

Starting from the off position of arm 972, motor 974 on the first transfer car to be used from the right-hand end of the train is first driven by a circuit from the positive of battery 250, line 969, normally open contacts on shoe switch 978 closed when shoe 978 is lifted by ramp 980, contacts 982 linked to close with switch 252, line 983, motor 974, all in series to ground of battery 250. Rail 980 is long enough for motor 974 to engage brush 977 with segment 970, closing a circuit from the positive of battery 250, line 969, ring 968, brush 977, segment 970, line 984, line 983, motor 974, all in series to ground of battery 250, which continues to drive motor 974 after shoe 978 leaves ramp 980. To prevent motor 974 from turning hand 972 more than one revolution upon approach to a station, brush 977 runs onto segment 971 and leaves segment 970, opening the circuit of motor 974 until ramp 980 is cleared. The circuit for driving motor 974 through the remainder of the revolution is from battery 250, line 969, ring 968, brush 977, segment 971, line 986, normally closed center contacts of switch shoe 978 closed when the shoe is free of ramp 980, line 983, motor 974, all in series to ground. Shoe 978 is supported as a lever on a spring in center position and can be lifted or lowered to engage a total of three contacts each in a different position.

When arm 972 revolves, brush 976 connects contacts *f*, *g*, and *h* in succession to shoe 962 placing a positive or negative charge on shoe 962 for each of these contacts according to whether successive berths 23 of that car have a container 24 or are empty. When brush 976 connects segments *j* and 967, a circuit is closed to start motor 974 in the next car 20 to the left. This circuit is from the positive of battery 250, line 969, ring 968, segment 967, brush 976, segment j, line 952, train line coupler 954 to the next transfer car 20 to the left, coil of relay 988, all in series to ground of battery 250. Front contacts of relay 988 are connected in parallel with contacts 978 and 982 across lines 969 and 984 to close the starting circuit for motor 974 in the next transfer car 20 if coupled on the left to initiate the signaling of that car's container loading, which thereafter starts the motor 974 in the next following transfer car, etc. to the end of the series of coupled transfer cars 20.

At station S1 a rotary stepping switch 990 connects conductor 964 in a polarized circuit to successive memory relays MR1–6 on successive pulses to close each of these memory relays if their pulse is negative. Switch 990 is ratchet operated by a spring-operated solenoid-returned pawl 992 engaging ratchet wheel 993 secured on the shaft of switch 990. The solenoid for pawl 992 is connected across conductor 964 and ground return to batteries 250 and when energized pushes pawl 992 to catch the next tooth as holding pawl 994 holds the ratchet wheel from turning. The spring for operating pawl 992 turns wheel 993 one tooth each time the solenoid is de-energized. Brush 996 on arm 997 is connected by line 998 to conductor 964 and makes contact with contacts *k*, *l*, *m*, *n*, *o*, *p*, etc. separately in succession as ratchet wheel 993 is turned from tooth to tooth.

When arm 997 has been pulsed around to the contact representing the last container berth in the series it remains in this position until shoe 978 is depressed by a rail 980 or 980' according to whether train 16 is traveling from left to right or right to left respectively and after the carrier train has had time to be made up. Rail 980' is located beyond station S1 in advance of the next rail 980 (as shown in FIGURE 41 for the station preceding S1 and in FIGURE 42). Rail 980 depresses shoe 978 when traveling from right to left only and rail 980' vice versa for two directional operation. When shoe 978 is depressed it completes a circuit from battery 250 on a car 20, line 969, bottom contacts of switch shoe 978, rail 980' (or 980) in advance, line 1000, solenoid 1002 arranged to disengage holding pawl 994 from ratchet wheel 993, all in series to ground return for batteries 250. Upon completion of this circuit solenoid 1002 lifts pawl 994 from wheel 993 and coil spring 1004, arranged to apply a counterclockwise torque on the switches shaft, returns arm 997 to its starting position against stop 1006.

Memory relays MR1–6 each have a pull-in circuit from the negative of battery 250, line 948, contacts 946 and 944 closed together by a container 24, contact *f*, *g*, or *h* according to which berth the container is in, brush 976, segment 956, train line 960, shoe 962, rail 964, line 998, brush 996, contacts *k*, *l*, *m*, *n*, *o*, or *p*, according to the number of berths from the right-hand end of the car 20 which has contacts 982 closed, a rectifier 1007 arranged to pass current from the negative of battery 250 in series with the coil of a relay MR1, 2, 3, 4, 5, or 6 according respectively to the contact *k*, *l*, *m*, *n*, *o*, or *p* which brush 996 is on, all in series to ground of battery 250. Memory relays MR1–6 each close a holding circuit from the negative of battery 705 having a voltage equal to the negative voltage of battery 250, back contacts of clearing relay 1010, front contacts 111 and coil of each relay MR1–6 in parallel, to ground of battery 705. The coil of clearing relay 1010 is connected from rails 980' to ground to operate in parallel with solenoid 1002. Relay 1010 drops relays MR1–6 when a shoe 978 is pulled down by the rail 980' connected to relay 1010 when traveling from left to right. For trains from either direction, see the arrangement shown in FIGURE 42. The relays MR1–6 which receive the negative pulses transmitted by train 16 are energized and held to store this information of the sequence of berth loading for making up the monorail train. Though this information can be displayed by relays MR1–6 for an operator to make up train 50 it is preferred to automatically and quickly make up train 50.

AUTOMATIC METHODS FOR LOADING CONTAINERS ON THE MONORAIL

The fastest method for loading train 50 is the spacing of the containers 24 along a conveyor under each carrier 52 to be loaded and the lifting of all the containers to be loaded up to hook on the waiting carrier train as soon as the containers are located and while the carrier train remains at one stop. An example of this method is shown in FIGURE 41 where a waiting section W and a spacing and lift section SL follow in sequence at the end of and in line with conveyor 800.

WAITING SECTION

The embodiment of the waiting section shown in FIGURE 41 comprises a sectional belt conveyor 1012 having a frame 1014 supporting rollers 743 similarly as along conveyor 800. Conveyor 1012 is powered in runs or sections W1, W2, and W3 or more if desired, each in length equal to a container 24 plus clearance and each driven by a belt 1016 over the central row of rollers 743. The number of sections provided equals the number of containers which are to be lined up for loading. These sections prevent containers from bumping each other. Gearmotors M1, M2, and M3 drive conveyors W1, W2, and W3 respectively each by a drum 1018 secured to turn with the output shaft of their gearmotor, each drum being engaged to traction the belt 1016 on the return side of the conveyor which it drives.

Motors M1, M2, and M3 are controlled by limit switches L1, L2, and L3. The circuits for bringing the containers onto the waiting section are as follows: for motor M1, from the positive of battery 705, line 1020, line 1021, front contacts of relay 1022, line 1023, normally closed contacts 1024 of limit switch L1, line 1025, resistor R10 bypassed by back contacts of relay 1027, motor M1, in series to ground; for motor M2 the same except from line 1023 normally closed contacts 1028 of limit switch L1 in parallel with back contacts 1029 of limit switch L2, motor M2, in series to ground; and for motor M3, the same to line 1023 and from there back contacts 1030 of limit switch L1, 1031 of L2, and 1032 of L3 all in parallel, motor M3, in series to ground. The coil of relay 1022 is connected to line 1021 through normally open contacts of limit switch LA closed by a container approaching the waiting section. Relay 1022 has a vacuum cylinder and check valve arranged to exhaust in closing and draw a vacuum when de-energized to hold closed until the container which closed limit switch LA has had time to be positioned on conveyor W1. Limit switches L1, L2, and L3 are located to be opened by containers 24 respectively on conveyors W1, W2, and W3 to locate the container thereon if the advance waiting conveyors are full. Magnetic brakes can be used to stop motors M1, M2, and M3 if desired.

When a container 24 enters W3 with W1 and W2 empty motors M1-3 are operated until limit switch L1 opens stopping motor M1 with the container located on W1. When the next container enters W3 with W2 empty, motors M2 and M3 operate until L2 opens stopping that container on W2. When a third container enters W3 with W1 and W2 full it is stopped on W3 when switch L3 is opened.

SPACING AND LIFT SECTION

The embodiment of the spacing and lift section shown in FIGURE 41 comprises conveyor and elevator or lift sections SL1, SL2, SL3, SL4, SL5, and SL6 for positioning

and lifting up to six containers at a time each one one of these sections. the center distance between conveyors SL1 and SL2 etc. coincides with the center distance between the berths which the lift sections are to load. Sections SL1–6 each have a platform 742' supporting three rows of rollers 743 similarly as along conveyor 800. Each platform 742' is secured to the rod of a hydraulic cylinder 1036 to lift a container to a carrier on the monorail. Each section SL1–6 has a belt 1038 wrapped around its central row of rollers 743 tractioned by a drum 1040 engaging belt 1038 under the platform when the platform is lowered. The drums 1040 of sections SL1, SL2, SL3, SL4, SL5, and SL6 are driven respectively by gearmotors M'1, M'2, M'3, M'4, M'5, and M'6 connected in parallel across line 1042 to the positive of battery 705 and ground, motors M'2, M'3, M'4, M'5, and M'6 each having in series therewith a speed reducing resistor R11. Resistors R11 each are bridged by back contacts of a relay 1046. A portion of each resistor R11 except that for motor M'2 is tapped and partially bridged by back contacts of a relay 1048.

Stops S'1, S'2, S'3, S'4, S'5, and S'6 are respectively secured to the platform of elevators SL1, SL2, SL3, SL4, SL5, and SL6. These stops are solenoid operated to lift above rollers 743 on the far end of each platform and to recess by gravity or spring pressure below the tops of rollers 743 when de-energized. A toothed pawl 1043 (only one being shown) is pivotally secured to each platform 742' and rides on belt 1038 to prevent reverse travel, so that a container will not roll off the near end of the elevator.

Stops S'2–5 each connect a circuit from the positive of battery 705, line 1042, front contacts on a stop S'2–5, the coil of the relay 1044 which inserts resistance R11 in series with motor M2–5 respectively in series (or parallel) with the relay 1046 for shorting a portion of the resistance R11 in series with motor M'3–6 respectively, to ground. Stop S' connects a circuit from line 1042, front contacts on stop S'6, coil of relay 1027, to ground. Relay 1027 has back contacts 1047 in parallel with the resistance R11 which is in series with motor M'6. Thus the motor which drives the conveyor of the section which has a lifted stop has a resistance R11 in series therewith, and the motor of the preceding section has a portion of a resistance R11 in series therewith to slow a container in steps before engaging a stop. This permits faster loading of the lift sections than if all motors were driven slow enough to suddenly stop a container. Motors M'2 and M'1 drive their conveyors at successively slower speeds than M'3 with its resistance R11 shortened.

Brush 1048 on the arm of rotary switch 990 connects two concentric annular segments or rings 1050 on and beyond contact *p*, closing a circuit from the positive of battery 705, line 1020, ring 1050, brush 1048, ring 1051, coil of timing relay 1054 to ground of battery 705. Relay 1054 closes contacts *aa*, *ab*, *ac*, and *ad* in timed succession. Contacts *aa* close a circuit from the positive of battery 705, line 1020, line 1055, back contacts of relay 1056, contacts *aa*, line 1025, resistor R10 in parallel with contacts 1026, motor M1, to ground, starting the first waiting container onto the spacing and lift section. After the container has had time to travel from conveyor W1 to SL1 and the next stop set, contacts *ab* close a circuit from line 1055, back contacts of relay 1056, contacts *ab*, motor M2, to ground, starting the next container. After this container has had time to travel to SL2 and the next stop set, contacts *ac* close, connecting motor M3 across battery 705 to move the third waiting container onto the spacing and loading section. Contacts *ad* close after a time delay sufficient for spacing maximum number of containers for which this station is designed to load on one carrier train, which might be one to the number of lift sections (six). A circuit is closed from line 1020, contacts *ad*, line 1057, coil of relay 1056 to ground, and from line 1057, line 1057', coil of relay 1058 to ground, and from line 1057', front contacts of relay 1058, coil of valve RV to ground. The lifting of relay 1056 stops motors M1–3 from sending containers onto the spacing and lift section but permits the loading of the waiting section for the next train. Relay 1058 has a dashpot to delay its closing sufficient to permit the last container to leave the waiting section to be loaded on a carrier before closing its front contacts reversing valve RV to lower the elevators which have lifted. Contacts *aa*, *ab*, *ac*, and *ad* remain closed after closing until solenoid 1002 is enregized returning arm 996.

The coil of relay 1058 is also connected across battery 705 in series with back contacts on relays MR1–6. This circuit is from the positive of battery 705, line 1059, back contacts of relay MR1, line *mr*1, back contacts of MR2, line *mr*2, back contacts of MR3, line *mr*3, etc. to line *mr*6, coil of relay 1058 to ground. Limit switches L1–6 are respectively connected in series with front contacts 1060 of relays MR1–6 across back contacts of relays MR1–6 respectively to form what I call a progressive circuit, for closing circuits in sequence according to the container loading specified by the memory relays and the progress indicated by the limit switches, and for energizing relay 1058 when the spacing of the containers for loading is complete. Limit switches L'1, L'2, L'3, L'4, L'5, and L'6 are preferably similar to switch 820, FIGURE 35, and mounted on the platform of elevators SL1, SL2, SL3, SL4, SL5, and SL6 respectively to be closed when a container approaches stopping position on that elevator.

Pump 756 supplies fluid from tank 758 to lift sections SL1, SL2, SL3, SL4, SL5, and SL6 through piping from the outlet of pump 756, solenoid reverse valve RV, line 1062 to solenoid shutoff valves V1, V2, V3, V4, V5, and V6 respectively to the head end of the cylinder 1036 for the section SL1, SL2, SL3, SL4, SL5, or SL6. Valve RV is also energized from line *m*16, front contacts of relay 1058, solenoid of valve RV to ground. The circuit for valve V1 is from the positive of battery 705, line 1059, front contacts 1060 of relay MR1, lead 11, limit switch L1, lead 1'1, coil of valve V1 to ground. The circuit for valve V2 is from line *mr*1, front contacts 1060 of relay MR2, lead 12, limit switch L2, lead 1'2, coil of valve V2 to ground. Likewise valves V3–V6 are connected from the line between back contacts of the memory relay for the loading section which is controlled by that valve and the preceeding memory relay, front contacts of the memory relay for the section controlled by that valve, the limit switch for that section, the coil of the valve of that section, in series to ground. Rectifiers 1064 are connected across lines 11 and *mr*1, 12 and *mr*2, 13 and *mr*3, etc. to pass current from limit switches L1, L2, L3, etc. to lines *mr*1, *mr*2, *mr*3, etc. and block current on line *mr*1 from valve V1, on line *mr*2 from valve V2, on line *mr*3 from valve V3, etc. The solenoids of stops S'1–S'6 are connected respectively from line 11–16 to ground. Flexible leads connect stops S'1–S'6 and limit switches L1–L6 to and from the elevator platforms in preference to sliding contacts.

OPERATION—FROM WAITING SECTION TO CARRIERS

With memory relays MR1–MR6 de-energized, valve RV and relay 1058 are energized respectively connecting valves F1–6 to tank and dropping timing relay 1054, preventing containers 24 from passing the waiting section. When train 16 engages shoe 962 with rail 964, completing the signal circuit which selectively lifts memory relays MR1–6 according if the train's berth represneted by each is empty. Valve RV and relay 1058 are de-energized and respectively reverse and drop. The first memory relay lifted sets its stop. Valve RV when de-energized connects pressure from pump 756 to valves V1–V6. Relay 1058 when de-energized starts timer 1054 as soon as brush 1048 connects rings 1050 and 1051 after the complete signal is received from train 16 by

the memory relays. Relay 1054 closes contacts as connecting motor M1 across the positive side of battery 705, starting the first waiting container moving on to the loading section. Motors M1–6, being running, drive the container to the set stop. When the container closes the limit switch of the lift whereon the stop is set the circuit is closed to the solenoid shutoff valve controlling the cylinder to raise the container to the waiting carrier. The stop remains lifted on the rising platform to prevent the container from over shooting the conveyor section as it is lifted. The limit switch remains closed by the weight of the container on the lifted elevator, closing a circuit through the rectifier 1064 from this section to the front contacts 1060 of the next memory relay lifted, setting the stop for the next container, which is now about to be started as timer 1054 closes contacts *ab* to connect motor M2 across the positive side of battery 705. This process continues either until a container is positioned for each empty berth represented on the spacing and lift section, energizing relay 1058 through line *mr6*, or until contacts *ad* close, energizing relay 1058 through line 1057'. When relay 1058 closes its front contacts after delay to permit all containers which have passed the waiting section to be lifted, valve RV is energized, exhausting cylinders 1038, returning the elevators. After the carrier train is made up and as train 16 progresses, shoe 978 is depressed by rail 980' (or 980), resetting selector switch 990, dropping relays 1054 and 1056 and lifting clearing relay 1010 for a short interval to drop the memory relays, which thereupon de-energize valves V1–V6 and energize relay 1058 and valve RV, ready for making up the next train.

VARIATION OF WAITING, SPACING, AND LIFT SECTION

A slower but less expensive selective loading system for the carrier train is shown in FIGURE 42. With this loader the carrier train is loaded by one elevator 1056 one container at a time and is indexed to position the next carrier berth to be loaded over the elevator.

Rotary switch 990 is again provided to connect successive loading signals from train 16 to successive memory relays MR1–MR4 etc. The "empty" signals are received from train 16 on rail 964L from traffic from the left and on rail 964R for traffic from the right and are connected each to a segment *k, l, m,* or *n* etc. by brush 997 similar as in FIGURE 41. Rails 964L and 964R are respectively on the left and right and far enough in advance of station S1 for train make-up to be completed before train 16 reaches rail 980L when traveling from the left or rail 980'R when traveling from the right. Rails 980L and 980R are placed just in advance of rails 964L and 964R respectively.

Segments *k, l, m,* and *n,* are connected respectively each through the coil of memory relay MR1', MR2', MR3', or MR4' each in series with back contacts on clearing relay CR1, CR2, CR3 or CR4 respectively, line 1068, back contacts of clearing relay 1010, rectifier 1007' in series to ground of battery 250. Reactifier 1007' is arranged to pass current to ground. The holding circuit for each memory relay MR1'–MR4' is from the negative of battery 705, line 1017, front contacts 1072 of each memory relay MR1'–MR4' in parallel and each in series with back contacts of relay CR1–CR4 respectively and the coil of relay MR1'–MR4' respectively, line 1068, back contacts of clearing relay 1010, rectifier 1007', in series to ground.

Memory relays MR1'–MR4' control respectively carrier positioning stops SS1–SS4 which are similar to stops SS for the unload station and each located to be connected by shoe 701 on tractor 54 to line 700 when successive carrier train berths align with elevator 1066 for loading. Stopping spots SS1–SS4 each have a forward segment 707' on the right and a reverse segment 708' on the left similar to respectively segments 707 and 708 for stops SS and similarly arranged for contact with shoe 701. Forward segments 707' are connected by line 1076 to the coil of relay 715' to ground. Stopping spots SS1, SS2, SS3, and SS4 are connected each through back contacts 1078 of relays MR1', MR2', MR3', and MR4' respectively to line 1076; each through front contacts 1080 of relays MR1', MR2', MR3', and MR4' respectively, line 1082, coil of relay 714', in series to ground; and each through front contacts 1084 of relays MR1', MR2', MR3', and MR4' to the coil of relay CR1, CR2, CR3, and CR4 respectively, to line 1086, normally open contacts of limit switch 1088 closed when a container is lifted to loading height on elevator 1066, in series to ground. Reversing segments 708' each adjacent a stop SS1, SS2, SS3, and SS4 are connected through front contacts 1090 of the relay MR1'–MR4' for that stop adjacent which they are located, line 1092, the coil of relay 716', in series to ground. Reversing segments 708' are also each connected through back contacts 1091 of the relay MR1'–MR4' for that stop where located to line 1076.

Relay 715' closes a circuit from the positive of battery 705, line 704, line 1094, back contacts of latching relay 1095, front contacts 1096 of relay 715', line 1097, back contacts of relay 1098, line 720 to line 82 in section D, to supply traction power to motors 70 for slow forward movement of train 50. Relay 716' closes a circuit from the negative of battery 705, line 1100, front contacts of relay 716', line 1101, back contacts of relay 1002, line 720 to line 82 in section D, to supply traction power to motors 70 for slow reverse movement. The coil of relay 1098 in series with rectifier 1104 is connected across line 720 and ground, rectifier 1104 being arranged to pass current from ground to line 720. The coil of relay 1102 in series with rectifier 1106 is connected across line 1097 and ground, rectifier 1106 being arranged to pass current from line 1097 to ground. The positive polarity controlled by relays 715 and 726, FIGURE 34, is connected to line 1097 and the negative to line 1101 instead of directly to line 720 as in FIGURE 34. Relays 1098 and 1102 then prevent the connecting of two different polarities on the traction line 82 in section D at the same time.

Front contents on latching relay 1095 close a circuit from the negative of battery 705, line 1100, front contacts of relay 1095, front contacts 1107 of relay 715', line 1101, back contacts of relay 1002, line 720 to line 82 section D, for running train 50 into section C when the train with which transfer is to be provided is approaching from the right. Ramp rail 980'R is connected by line 1000L to the latching coil of relay 1095, line 1000, the coil of relay 1010, all in series to ground, to latch relay 1095 up when a carrier train is made-up for a train from the right. Ramp rail 980'R is connected by line 1000R to the unlatching coil of relay 1095, to line 1000, to check that relay 1095 is down for a carrier train made-up for a train from the left.

Elevator 1066 is in line with and at the left-hand end of belt-under-roller conveyor 800. Elevator 1066 is constructed similarly to the right-angle takeoff, FIGURE 38, except arms 890 and cylinder 887 are longer to give the desired vertical travel; rollers 884 are omitted; and the lift cylinder 1108 for elevator 1066 is optionally selected to be double acting. Elevator 1066 has a depending skirt 1110 secured on the entrance end of its platform to prevent bumper 1112 or any portion of a container 24 from going under the elevator.

The head end of cylinder 1108 is connected through spring-returned solenoid reversing valve 1114 to the output port of pump 756 when solenoid valve 1114 is energized and to tank 758 when de-energized. The rod end of cylinder 1108 is connected through valve 1114 to the pump or tank reversely from the head end. A pressure switch 1116 connected to the head end of cylinder 1108 opens its contacts when pressure exceeds a predetermined amount.

Valve 1114 is operated by a circuit from the positive of battery 705, line 1118, front contacts of time delay relay 714', line 1120, front contacts 1122 of relay 1124, coil of valve 1114, all in series to ground. The circuit for lifting relay 1124 is from line 1120, line 1126, normally open contacts 1128 of buffer and limit switch 1130 closed when bumped by a container carried by belt 802 onto elevator 1066, normally closed contacts of pressure switch 1116, coil of relay 1124, all in series to ground. Relay 1124 closes a holding circuit from line 1120, front contacts 1134 of relay 1124, contacts of pressure switch 1116, coil of relay 1124, all in series to ground.

Conveyor 800 is operated by a circuit from the positive of battery 705, line 1118, front contacts of relay 714', line 1120, back contacts of relay 1136, motor 809, to ground. Relay 1136 is energized by a circuit from line 1120, line 1126, normally open contacts 1138 of limit switch 1130 closed when a container bumps the buffer, coil of relay 1136, in series to ground. Relay 1136 closes a holding circuit from line 1126, front contacts and coil of relay 1136 to ground.

OPERATION OF ONE-AT-A-TIME SELECTIVE LOADER

When shoe 701 on the empty carrier train from the unload station engages the first segment 707' from the right a circuit is completed from the positive of battery 705, line 704, back contacts of relay 703, line 702, line 700, shoe 701, segment 707', line 1076, coil of relay 715', to ground closing relay 715', which connects a positive voltage on line 82 in section D to drive motors 70 to bring shoe 701' onto contact SS1. If memory relay MR1 is lifted (which it was to load the first container 24 in FIGURE 42) when shoe 701 leaves segment 707' relay 715' is dropped, stopping the carrier train; but if segment 708' is engaged by shoe 701 relay 716 is lifted, reversing the carriers until shoe 701 rests on stop SS1. Then, after a delay to check that shoe 701 is stopped, relay 714' closes the circuit which starts conveyor 800. Conveyor 800 rolls a container 24 onto elevator 1066, bumping it against buffer 1130 which closes contacts 1128 and 1138, lifting stick relays 1124 and 1136, stopping conveyor 800, energizing valve 1114, which reverses, connecting pump 756 to pressure the head end of cylinder 1108, raising the hoist. The rod of cylinder 1108 is fully extended when the container is fully lifted. Then cylinder 1108 builds up higher pressure opening contacts of pressure switch 1116, dropping relay 1124, which reverses valve 1114, lowering cylinder 1108, the fluid from the head end flowing through orifice 761, which controls the lowering speed. Meanwhile the roof of the container lifted engaged limit switch 1088 as the hoist was lifted, connecting conductor 1086 to ground, closing a circuit from the positive of battery 705, line 704, back contacts of relay 703, line 702, line 700, shoe 701, segment SS1, front contacts 1084 of relay MR1', coil of relay CR1, contacts of limit switch 1088, all in series to ground. After a time interval permitting the elevator to return far enough for hooks 95 to hold the container and for the container to clear the hoist, relay CR1 opens, dropping relay MR1', which drops relay 714', which drops relay 1136. The dropping of relay MR1' energizes relay 715', which connects power to line 82 to drive the tractor train forward from SS1 to the next stop whose memomy relay is lifted, which in this example is stop SS3, whereat this cycle is repeated to load the next container on the third carrier as shown in FIGURE 42. The process continues until a container is supplied for each memory relay lifted or until train 16 reaches rail 980'L if traveling from left to right or rail 980'R if traveling from right to left, which depresses shoe 978 when traveling from either direction, placing a positive voltage on line 1000L or 1000R respectively, releasing or latching relay 1095 respectively, and lifting relay 1010, which opens its back contacts to drop all the memory relays and relay 714', relay 714 thereupon connecting respectively a positive or negative potential on line 82 to move the carrier train into section A or C to await a train 16 from the left or right respectively. Thus train 50, even if not completely made up when train 16 engages rail 980'L or 980'R, is run to the section A or C to await further progress of train 16.

FURTHER VARIATIONS FOR LOADING ELEVATOR

Elevator 1088 can be made long enough for holding two or more containers 24 and have stops such as S'1–6 placed along its platform, so that a few containers 24 can be positioned and lifted at the same time to one or more waiting carriers, and then the carrier train indexed for another group of containers, thus reducing the number of elevators from that shown in FIGURE 41 and improving the speed of operation over FIGURE 42.

STOPS FOR PASSENGER LOADING AND UNLOADING

As an example of a stop for permitting travelers to board and leave the carrier train, reference is made to FIGURE 43. If the containers 24 are to be accurately stopped to align with station doors or gates 30' as here shown the stop preferably has a forward segment 707'' and a reversing segment 708'' on opposite sides of a short stopping segment SS'. If an accurate stop is not needed segment SS' could be long enough to assure a stop without segments 707'' and 708''.

Line 700 is connected by shoe 701 to segments 707'', SS', and 708'' in succession as the carrier train passes. Line 700 is connected to the positive of battery 705. Section 707'' is connected to traction supply line 82 in section D by conductor 1150. Line 82 of section D is also energized through the following connections: from the positive of battery 705, line 1152, front contacts of relay 1154, front contacts 1155 of relay 716'' in parallel with front contacts of relay 714'', line 1156, in series to line 82 of section D; and from the negative of battery 705, line 1158, back contacts of relay 1154, front contacts 1160 of relay 716'', line 1156, in series to line 82 of section D. The coils of relays 714'' and 716'' are connected across ground and respectively segments SS' and 708''. This stop stops train 50 similarly as stops SS or SS1–4. The position of relay 1154 determines if train 50 is to be stopped on stop SS' and controls the starting of the train which stops on stop SS'.

AUTOMATIC STOP AND DOOR OPERATOR

Referring to FIGURES 43–45, when the carrier train is brought to rest with its shoe 701 on stop SS', at station S1', doors 32 of container 24 are superposed on doors 30' which are in partition 26' supported along the edge of station platform 1162. Partition 26' and doors 30' are provided as a safety feature. Only doors 30' which are adjacent a stopped container are opened.

A dog 1164 for opening adjacent doors 30' and 32 is pivotally mounted on bar 1166 to which two grooved rollers 1168 are rotatably secured to roll in channel track 1170 extending under the floor of platform 1162 along door 30' and to the right thereof a little more than the door's length further. Dog 1164 has a push block 1172 for engaging doors 30' and 32, a depending L-shaped bracket 1174 secured thereto between and so as to extend below doors 30' and 32 over to the shaft for a roller 1168 on track 1170. Dog 1164 is pulled by an endless rope 1176 secured to pulley 1178 pivotally fastened to the bottom of bracket 1174 remote from bar 1166. Rope 1176 is wrapped about drum 1180 for traction and returned about take-up pulley 1182. Drum 1180 is reversibly driven by motor 1184 preferably through a worm drive 1185. Rope 1176 rotates dog 1164 away from door 30' and against the platform when pulled to the left, and when pulled to the right rotates the dog to engage the side edges of doors 30' and 32 near the bottom and pushes the doors open. Bar 1166 has a stop block 1186

secured to its top side to be engaged by bracket **1174** to prevent rotation beyond extended position when pulled by cable **1176** to the right. Dog **1164** has a cam **1188** which when passed under latch linkage **1190** on a container **24** lifts latch **206'** as the doors are engaged by the dog to be pushed open. Latch wheel **220**, which rides on door **32**, holds the latch linkage lifted until the door is closed. Dog **1164** as pulled by cable **1176** carries the doors past full open position to clear the passage. A dog **1164'** the mirror image of dog **1164** (except that cam **1188** is omitted) also rides in track **1170** at the opposite end of the doors **30'** and **32** from dog **1164**. Dog **1164'** is pushed along by the opening of the doors and lifts a weight **1192** supported on rope **1194** which runs up and over sheave **1195** to the bottom of the bracket **1174** of dog **1164'** to which rope **1194** is secured remote from bar **1166**. Cables **1176** and **1194** are below platform level.

The circuit for opening doors **30'** and **32** is from the positive of battery **705**, line **1196**, front contacts of time delay relay **714'''**, line **1197**, front contacts **1198** of reversing relay **1200**, limit switch **1202** closed when a container is opposite the door **30'**, armature of motor **1184**, which has a permanent magnet field, line **1204**, limit switch **1206** opened when the doors **30'** and **32** are fully open, front contacts **1208** of relay **1200**, in series to the negative of battery **705**. Relay **714'''**, whose coil is in parallel with that of relay **714''**, closes after a delay sufficient to insure that train **50** is stopped. Relay **1200** is energized by a circuit from the positive of battery **705**, line **1196**, front contacts of relay **714'''**, line **1197**, back contacts of a stop timing or terminating relay **1210**, coil of relay **1200**, in series to ground. If train **50** makes a stop at more than one station between transfers, relay **1210** would be a timing relay to determine the stay at all but the last station before transfer and have its coil connected across segment SS' and ground. At the last or only station before transfer, relay **1210** as shown is energized upon approach of train **16** by a circuit from the positive of battery **250**, shoe **978**, rail **980"R** or **980"L**, line **1000**, coil of relay **1210**, in series to ground. Relay **1210** closes a holding circuit from segment SS', line **1170** front contacts and coil of relay **1210** to ground, the positive voltages of batteries **250** and **705** being equal; if not equal a separate holding coil is used.

The circuit for closing the doors and returning dog **1164** is from the positive of battery **705**, line **1196**, front contacts of relay **714'''**, line **1212**, contacts of limit switch **1214** opened when dog **1164** is returned and revolved out of the way from train **50**, line **1216**, back contacts **1217** of relay **1200**, armature of motor **1184**, limit switch **1202**, back contacts **1218** of relay **1200**, in series to the negative of battery **705**. When limit switch **1214** is engaged by dog **1164** it stops motor **1184** and closes a circuit from the positive of battery **705**, line **1196**, front contacts of relay **714'''**, line **1212**, contacts of limit switch **1214** closed when dog **1164** is retracted, line **1219**, limit switch **1220** closed when dog **1164'** returns to the left-hand end of travel indicating that the doors have closed, coils of relays **1222** and **1154** and of valve **1224** all in parallel, in series to ground. Relay **1222** closes a holding circuit from line **1219**, front contacts and coil of relay **1222** to ground. Dog **1164'** is revolved for clearance with train **50** by a hook **1226** on the rod of cylinder **1228**. Hook **1226** engages the door side of dog **1164'** when the doors are closed. Valve **1224** when energized connects pressure from pump **756** to the rod end of cylinder **1228**, which pulls dog **1164'** out of the way for clearance with train **50**. Solenoid latch **1230** then locks the dog in position by spring action. Valve **1224** exhausts cylinder **1228** to tank **758** when de-energized. Solenoid **1230** is connected from line **1216** to ground to release dog **1164'** to revolve against doors **30'** and **32** when dog **1164** moves away from limit switch **1214**.

OPERATION OF AUTOMATIC STOP AND DOOR OPENER

When train **50** stops with shoe **701** on segment SS', relay **714'''** is lifted after a time delay, lifting relay **1200**, driving motor **1184** to pull rope **1176** to the right swinging dog **1164** away from limit switch **1214**, which closes the circuit to unlatch dog **1164'** to swing against the doors. Dog **1164** then lifts latch **206'** and opens doors **30'** and **32** by further pull of rope **1176**. The doors push dog **1164'** along with them as they open and engage limit switch **1220**, stopping motor **1184** when fully opened.

When it is time to close the doors relay **1210** picks up, dropping relay **1200**, reversely driving motor **1184**, returning dog **1164** until limit switch **1214** disconnects line **1216**, stopping the motor, and connects line **1219**. The doors are closed by weight **1192** on dog **1164'** and can be held open by anyone in the passage. When the doors close, limit switch **1212** is closed, reversing valve **1224** to pressure cylinder **1228** and withdraw and latch dog **1164'**, and lifting relay **1222** to connect power to line **82** to run train **50** to the next stopping point.

A VARIATION FOR MONORAIL

The monorail can be the main line transfer vehicle as shown in FIGURE 46. Two-car monorail train **16'** on track **42'** has a transfer car **20''** which has two container berths **23''** separated from the passenger area and aisle **28** by partitioning **26'**, having access doors **30** to each berth. Doors **30** are provided with elevator hatchway-type locks, since berths **23''** have no bottom. An elevator **106'** is provided in each berth **23''** to extend down to pick up a container **24** aligned below to bring it into the berth and hold it in transit.

Elevator **106'** preferably comprises two sets of downward extending vertical telescoping sets of cylinders **1240**, the outer cylinder **1240** of each set being secured to the frame of car **20'** one at one end of a berth **23'** and the other at the other end of the berth. Each set of cylinders, as shown by FIGURES 47 and 48 in raised position, has three, more, or less movable telescoping cylinders **1240** each with an outer flange **1242** at the top to engage an inner flange **1244** on the next outer cylinder at full extension, to hold the cylinders from slipping apart when extended. A lift bracket **1246** and a coupling bar **1248** are secured to the lower end of the inner cylinder. Each coupling bar **1248** has two facing hooks **95''** each pivotally secured on the sides of arms **1250** and **1252** facing the berth each arm being pivotally secured on the side of bar **1248** facing the berth. Hook **95''** has one or more teeth **96** to engage hooks **97** on containers **24**. Optionally bar **1248** can support other hook arrangements such as shown in FIGURES 9 and 15. Bar **1248** extends through a hole in bracket **1246** into the bottom end of the inner tube of cylinders **1240** and is secured thereto air tight to form the end of the inner cylinder and holds bracket **1246** against the bottom of the inner tube by a flange against the bottom of bracket **1246**. The two sets of cylinders of each berth **23''** are positioned to extend down each end of a container **24** to hook and lift it.

Each outer cylinder **1240** has two stub shafts **1254** secured thereto on a common horizontal axis transverse to car **20'**. Each shaft **1254** supports two independently rotatable sheaves **1256**. Lift brackets **1246** each have two diametrically opposite arms transversely positioned with upturned ends each having a hole **1258** through which the end of a flexible wire rope **1260** is secured. Each of the four ropes **1260** for each elevator **106'** are run up to and over the pulley **1256** directly above the eye to which they are fastened and run horizontally inward and secured to and wrapped on drum **1262**. Drum **1262** is secured on shaft **1264** rotatably mounted on the frame of car **20'** and driven and held by preferably a worm-drive gearmotor **128'** whose output shaft is **1264**. The four cables **1260** support both sets of hooks **95''** at equal level, and both

cables for each set of cylinders 1250 equally share a balanced load.

Each hook 95'' has a lift rope 1268 secured to an extension on the upper parallel arm 1250 for that hook. Ropes 1268 are similarly run each up to and over the sheave above and over to drum 1262 on which they are secured and wrapped. A pulley 1270 rides on each rope 1268. Pulleys 1270 are each secured on the rod of a cylinder 1272 which is secured to the frame of car 20'. Cylinders 1272 are arranged to extend or retract simultaneously. When they are extended they shorten ropes 1268 relative to ropes 1260 to open hooks 95''.

A container 24 is shown riding on a special flat car 52' but can be considered riding in a berth 23 in train 16, FIGURE 1, or on a conveyor or other vehicle. Alignment means 118'' guide the containers into place and hold them. Flat car 52' on track 18' parallel and monorail track 42' can be driven in either direction by any suitable means such as cable 1274 the ends of which are fastened each to an opposite end of car 52'. Cable 1274 is wrapped on a traction drum 1276 at each end of the trackway 18'. Drums 1276 are each driven by a gearmotor 1278 through a clutch 1280 to enable one drum to run free while the other is driving. The speed of motor 1278 is controlled by a brake and by the circuit shown for motor 70, FIGURE 31.

Referring to FIGURES 46 and 49, in addition to the alignment lamp 248 secured to the platform of car 52' to direct light on cell 255, FIGURE 21, when car 52' is in alignment with car 20' for transfer, two lamps 1282 and 1283 are provided on respectively the right and left-hand side of car 52' at the near end of berth 23''' and so as not to be obstructed by a container in or above the berth. The lamps 1282 and 1283 indicate whether or not the adjacent berth 23''' has a container. A limit switch 1284 located on the platform of car 52' to be engaged by a container 24 in the berth adjacent which the lamps 1282 and 1283 are located closes a circuit from one terminal of battery 250, line 1286, upper contacts of limit switch 1284 closed when the berth 23''' is empty, lamp 1283, in series to the other side of battery 250 and closes a circuit from one terminal of battery 250, bottom contacts of limit switch 1284 closed by a container, lamp 1282 to the other side of battery 250. 52' can be a stationary receiver, train 16' stopping on SS.

When cars 20' and 52' are in alignment for transfer, lamp 1282 or 1283 directs a beam to respectively photo cell 1285 or 1287 according to whether the berth on car 52' has a container or not. Current provided by photo cell 1286 or 1287, mounted on the bottom of monorail car 20' and each shielded from extraneous light by tubular shields 1290, is preferably first amplified by amplifiers 1292 and 1293 and then connected to energize respectively relay 1294 or 1295.

Referring to FIGURE 49 for the control circuit for an elevator 106', relay 1298 has its coil connected from trolley or shoe 84' to ground, track 42'. Front contacts of relay 1298 connect power to line 1300 and back contacts connect battery 250' across line 1300 and ground. A circuit is closed from line 1300 through normally closed contacts of button 164, normally open contacts of button 162 in parallel with front contacts 241 of relay 232'', coil of relay 232'', in series to ground. The circuit for collecting conditions for removing a container from berth 23'' is from line 1300, limit switch 1301 opened when cylinders 1240 are sufficiently extended, line 1302, contacts 1303 of limit switch 234' closed when a container is in place in the berth and front contacts 1304 and 1305 of respectively relays 232'' and 350' and switch 336 all in parallel with front contacts 366' of relay 362', coil of relay 362' in series to ground. The circuit for collecting conditions for picking up a container is from line 1300, limit switch 1301, line 1302, contacts 338' of limit switch 234' opened when a container is positioned in berth 23', operator's switch 336 and front contacts 1306 of relay 350' both in parallel with front contacts 348' of relay 342', coil of relay 342', in series to ground. The circuit for driving gearmotor 128' to unreel ropes 1260 to control the lowering of the elevator is from line 1300, line 1308, front contacts 1310 of motor reversing relay 374', line 1312, armature of motor 128', line 1314, front contacts 1316 of relay 374', all in series to ground. The circuit for driving gearmotor 128' to reel cables on drum 1262 to raise elevator 106' is from line 1300, line 1308, back contacts 1318 of relay 374', front contacts of relay 1320, line 1314, armature of motor 128', line 1312, back contacts 1322 of relay 374', all in series to ground. Reversing relay 374' is energized by a circuit completed from line 1300, line 1324, front contacts of relay 1294, front contacts 1326 of relay 342', line 1328, coil of relay 374', all in series to ground, or by a circuit completed from line 1300, line 1324, front contacts of relay 1295, front contacts 1330 of relay 362', line 1328, coil of relay 374', all in series to ground. Relay 1320 is energized by a circuit completed from line 1300, limit switch 1332 opened at the upper limit of travel of elevator 106', line 1334, back contacts of relay 362', line 1336, coil of relay 1320, all in series to ground.

The head ends of cylinders 1240 for each berth 23' are connected to the outlet of air compressor 1340 or exhaust according as valve 1342 for that berth is respectively energized or de-energized. Air forced into cylinders 1240 extend the cylinders when ropes 1260 are unreeled and gives added rigidity to the sets of cylinders when extending. Pump 1340 supplies air pressure to four-way spring-returned solenoid valve 1344 which reversely connects this pressure to either the head or rod ends of cylinders 1272, connected in parallel, according as valve 1344 is energized or de-energized respectively to open or close hooks 95''. The coil of valve 1342 is connected in parallel with the coil of relay 374' so as to pressure cylinders 1240 when the ropes are unreeled. The coil of valve 1344 is connected in series with front contacts of relay 1346 across the coil of relay 1320. Relay 1346 is energized by a circuit including from line 1334, front contacts 1348 and 1350 of respectively relays 362' and 1346 in parallel, coil of relay 1346, in series to ground.

Gearmotor 128' turns a threaded cylinder 1352 on which a rider 1354 rides to engage and open limit switches 1301 and 1332 at respectively the lower and upper limits for the elevator.

OPERATION OF MONORAIL ELEVATOR

Information that a container is to be removed at the next transfer is stored by relay 232''. Then with switch 336 closed when shoe 352 engages rail 354', relay 350' is lifted, lifting relay 362'. When car 52' comes into alignment with car 20' with an empty berth under the container to be removed from car 20', relay 1295 is lifted, lifting relay 374', lowering the elevator and pressuring cylinders 1240. As soon as the elevator starts to lower, limit switch 1332 closes, picking up relays 1320 and 1346. When the elevator is fully lowered, i.e. when limit switch 1301 is opened, hooks 95'' have latched over hooks 97. The opening of switch 1301 drops relay 362', which closes contacts 1336 to energize valve 1344 and relay 1320 and which opens contacts 1330 to drop relay 374' and de-energizes valve 1342 to exhaust cylinders 1240. Valve 1344 first connects pressure to cylinders 1272, lifting hooks 95''. Then relay 1320, which has a closing delay, closes, reversely driving motor 128' to reel ropes 1260 and 1268 on drum 1262, lifting the empty elevator until limit switch 1332 is opened, dropping relay 1320 and de-energizing valve 1344 to exhaust cylinders 1240 to drop the hooks 95'' to latching position.

If it is desired to pick up a container at the next station, the berth must be empty, i.e. contacts 338' closed, and switch 336 closed. Then when shoe 352 engages rail 354', lifting relay 350', relay 342' is lifted. When a lighted lamp 1282, indicating a full berth 23''', is aligned with cell 1286, relay 1294 is lifted, energizing relay 374' and

valve 1342 to drive motor 128' to unreel ropes 1260 and 1268 and respectively pressure cylinders 1240. When the elevator starts down, limit switch 1332 closes, lifting relay 1320. Relay 1346 does not lift, because contacts 1348 have remained open, since contacts 1303 are open on an empty berth. When the elevator extends to where limit switch 1301 opens, hooks 95" have latched over hooks 97 on the container. The opening of switch 1301 de-energizes valve 1342, exhausting cylinders 1240, and drops relay 374', completing a circuit through front contacts of relay 1320 to reversely drive motor 128' to raise the elevator.

VARIATION FOR SIDE TRANSFER

Referring to FIGURES 50–54 for an embodiment of the side transferring form of this invention, train 16 or 16' includes one or more side transfer cars 20*s*, having one or more side transfer berths 23*s* each for holding a transfer container 24' for side transfer. Containers 24' are suited for use with cars 20, 20', and 20*s*. Parallel running vehicle 52", herein shown as a belt-over-roller conveyor, runs parallel track 18, on which is train 16, and transports containers 24' to align for transfer with train 16. The belt of conveyor 52" preferably has saw-toothed grooves 1356 which interfit with transverse grooves 1357 on the bottom of container 24'. Conveyor 52" is driven from either end by motors 1278' through speed reduction, electric brake and clutch means arranged in a usual manner. Vehicle 52" can be controlled by means such as shown in FIGURES 21, 31, 46, and 50.

An extendible and lifting transfer mechanism or elevator, rack 106*s*, in each berth 23*s* has arms 1358 which it engages into recesses 1360 at each end of container 24' under seats 159' therein. Rack 106*s* holds the container in the berth, lifts it slightly when removing it, then lowers it to vehicle 52" and returns. Rack 106*s* also extends from the side of car 20*s* into recesses 1360 of a container 24' aligned therewith, lifts the container from vehicle 52" and draws it into its berth. Containers 24' have depending end pieces 1362 each side of each recess 1360. Arms 1358 each have a raised portion, preferably a spring mounted vertically guided table 1364, which fits into the recess 1360 between end portions 1362 to support each end of a container 24' and which insures that the container will not slide from arms 1358.

Rack 106*s* comprises a horizontally positioned H-frame 1366, the legs of which have outboard rollers 122' which roll on an intermediate guide 123', one parallel each leg of the H-frame outward therefrom. Guides 123' are preferably made up from an I-beam and have a track 125' on each channel for rollers 122'. Guides 123' are also supported on rollers 122' rotatably secured to lift channels 1368 pivoted on the same axis to the frame of car 20*s* at point 1370 and connected by bar 1372 below the H-frame and guides 123'. A lift cylinder 1374, trunnion mounted to the frame of car 20*s*, supports bar 1372 to lift channels 1368, guides 123', rack 106*s*, and any container thereon. Each guide 125' is extended and retracted by a cable 1376 both ends of which are connected to a depending lug 1378 on the guide 125'. Cable 1376 runs transversely on car 20*s* about traction drum 1380 on the far side from loading and about takeup pulley 1382 on the transfer side. Drum 1380 is reversibly driven by gearmotor 128*s* to whose output shaft drum 1380 is secured for turning. The H-frame is operated by a cable 1383 in the form of a loop passed over a pulley on each end of an intermediate guide 125' and is anchored to the H-frame and to channel 1368 on opposite runs.

The outer side of each berth 23*s* is covered by a folding door 1384 to aid in streamlining the car, reduce heat transfer, and prevent rain and snow from entering the car. Door 1384 preferably has a lower portion or door 1385 and an upper door 1386, FIGURE 53. The lower door 1385 is hinged along its top edge to swing in and up against the upper door when pulled by rope 1387 secured to the top of spring latch 1388 secured to the inside of the lower door to latch door 1384 in closed position to the frame of car 20*s*. The upper door 1386 is hinged along its top edge to swing in and up to the top of the berth when pulled by rope 1389 secured to the inside middle of door 1386. Ropes 1387 and 1389 are run up over pulleys supported to the structure of car 20*s* above the berth and are operated by hand, motor 308 of FIGURE 25, or other means.

Referring to FIGURE 53, motor 128*s* is driven from battery 250*s* to extend rack 106*s* when empty by a circuit from the positive of battery 250*s*, line 1390, front contacts 390*s* of reversing relay 374*s*, line *s'*, armature of motor 128*s*, line *s"*, front contacts 394*s* of relay 374*s*, in series to ground of battery 250*s*. Relay 374*s* is energized by a circuit from the positive of battery 250*s*, line 1396, left-hand contacts of limit switch 139*s* closed when rack 106*s* is fully retracted into car 20*s*, line 1398, operator's switch 1400, front contacts of relay 263, coil of relay 374*s*, in series to ground. Relay 374*s* closes a holding circuit from the positive of battery 250*s*, line 1390, limit switch 1402 opened when rack 106*s* is fully extended, front contacts 415*s* and coil of relay 374*s*, in series to ground. The lifting of relay 374*s* drives motor 128*s* to extend rack 106*s*. Relay 263 is energized by the alignment cell 255 as shown in FIGURE 21.

The head end of cylinder 1374 is connected through solenoid valve 1406 to the outlet of pump 420*s* or tank 437*s* according respectively to whether valve 1406 is energized or not. The circuit for valve 1406 is from the positive of battery 250*s*, contacts 1408 which are linked to close with switch 1400, front contacts of relay 1409 in parallel with back contacts of relays 1409 and 1410, coil of valve 1406, in series to ground. Relay 1409 is energized by a circuit from the positive of battery 250*s*, line 1396, left-hand contacts of limit switch 139*s*, line 1412, left-hand contacts of limit switch 234*s* closed when a container is positioned in the berth, the coil of relay 1409, in series to ground, and is held by a circuit from the positive of battery 250*s*, line 1390, limit switch 1402, line 1416, front contacts 1717 and coil of relay 1409, in series to ground. Relay 1410 is energized by a circuit including from line 1412, right-hand contacts of limit switch 234*s* opened when a container is positioned in the berth, coil of relay 1410, in series to ground, and is held by connection from line 1416 through its front contacts and coil in series to ground.

Parallel a portion of and adjacent conveyor 52" is a spacing conveyor 1418. Conveyor 1418 is a roller conveyor onto which the containers are pulled by pull-over bar 1420, which can be hand operated. Bar 1420 engages under hooks 1422 on a container 24' and is pulled to the opposite side of conveyor 1418 by handle 1424. Stops S"1, S"2, S"3, and S"4 are spaced along conveyor 1418 to equal spacing of berths 23*s* in train 16. Succeeding stops S"2–S"4 to be lifted are lifted as preceeding stops are engaged by a container. Which stops are to be lifted is controlled by memory relay MR'1–4 similarly controlled as those shown in FIGURE 41, the description of which is considered to be sufficient for understanding that portion of FIGURE 54 which is a repetition of the spacing circuits with minor variations.

A push-over bar 1426, pivotally mounted on parallel arms 1428 to the frame of conveyor 1418, is arranged to push the containers back onto conveyor 52" after spacing to simultaneously align empty berths 23*s* on car 20*s* and to be positioned on coveyor 52" so that conveyor 52" can be timed to start to align the containers with empty berths at speed in the least distance. Cylinder 1430, clevis mounted to the frame of conveyor 1418 has its rod and lever linked to operate arms 1428 to push bar 1426 to conveyor 52" and return to the position shown. Actually, bar 1426 would be pushed straight to belt of conveyor 52" by double jointing arms 1428 similarly as arms 744' for elevator 698, FIGURE 36.

FIGURE 54 shows how stops S"1–S"4, which are hydraulically operated, are withdrawn by operation of valve **1432** after the spacing. The coil of valve **1430** is connected across the wire connected through back contacts of the highest memory relay and ground to energize solenoid valve **1430** after the spacing to retract the lift stops and then pressure cylinder **1430** to push bar **1426** to transfer the containers back to conveyor **52"**, whereon they are run to the end and await the next transfer train. When train **16** approaches the point where shoe **78** engages rail **76** in section A', FIGURE 31, conveyor **52"** is reversed and driven to align containers **24'** for transfer at speed with train **16** by the circuits preferably as shown in FIGURE 31, which are now used to control gearmotor **1278** instead of motor **70**.

The side doors **1384** of the empty berths **23***s* on train **16** which are to be used in the next transfer and of the berths **23***s* having containers to be removed to conveyor **52"** are opened by an operator if transfer at the next station S1"' is desired. When a container **24'** is aligned at speed with a berth **23***s* whose door is open, lamp **248***s*, mounted on the side of container **24'** facing berths **23***s*, is directed to cell **255***s* mounted on petition **26**, causing relay **263** to lift, left-hand contacts of limit switch **139***s* being closed, closing the circuit which lifts relay **394***s* to drive motor **128***s* to extend rack **106***s*. When rack **106***s* was returned empty, closing left-hand contacts of limit switch **139***s* and right-hand contacts of **234***s*, relay **1410** was lifted closing its holding circuit through limit switch **1402** and its front contacts. Cylinder **1374**, being now connected to tank **437***s*, rests rack **106***s* at a level to extend arms **1358** under seats **159** of container **24'**. When the rack is fully extended limit switch **1402** is opened by lug **1378**, dropping relay **1410** to energize the coil of valve **1406**, to pressure cylinder **1374**, to left the container. The opening of limit switch **1402** also de-energizes relay **374***s*, which has a dashpot to drop slowly. When relay **374***s* closes its back contacts, after the container is lifted, motor **128***s* is driven to retract rack **106***s*, bringing the container into car **20'**, opening right-hand contacts of limit switch **139***s* to stop motor **128***s* when the container is fully within car **20***s* and closing left-hand contacts of limit switches **139***s* and **234***s*, picking up relay **1409** to maintain cylinder **1374** pressured while power is on. The rack is held in by the worm drive of motor **128***s* or any other means.

When one container is aligned to be loaded onto train **16** the containers to be removed can be transferred. Accordingly relays **263** are connected in parallel on car **20***s*, each in series with the limit switch **314***s* closed when the door **1384** for that berth is fully opened and all in parallel across the outputs of the amplifiers for photo cells **255** (this circuit is not shown). Relays **263** for the full berths having doors **1384** open are then lifted, lifting relay **374***s* for each of these berths, driving motor **128***s* to extend rack **106***s*. Relay **1409** remains energized, maintaining valve **1406** in position to pressure cylinder **1374** holding arms **1358** up as the container is removed. Relay **1410** remains de-energized, since limit switch **139***s* opens its left-hand contacts before limit switch **234***s* closes its right-hand contacts preventing the closing of the pull-in circuit for relay **1410**. When rack **106***s* is fully extended, limit switch **1402** is opened, dropping relay **1409**, which de-energizes valve **1406**, exhausting cylinder **1374** to lower the container onto carrier **52"**. When relay **374***s* closes its back contacts after time delay to allow the container to be lowered, motor **128***s* is reversely driven to return rack **106***s*, which is supported on the outer wheels **122'** of H-frame **1366** which roll on the belt of conveyor **52"** as tables **1364** clear the bottoms of the projections **1360** which face train **16**. When rack **106***s* is retracted into train **16** the right-hand contacts of limit switch **139***s* are opened, stopping motor **128***s*. The rack is now ready to extend when a container **24'** is aligned therewith.

By way of further variations it should be noted that the containers could have wheels on which they are propelled on a parallel way to align with the transfer car. They could be self-propelled, pulled or pushed at the proper speed; but are preferably as shown herein. Various means can be devised to engage the containers to transfer them into the transfer car. The carriers can be coupled in various ways to the transfer car to maintain them at train speed during transfer.

ADDITIONAL DISCLOSURE FIGURES 55–59

A suspended carrier **20"** is shown in FIGURE 55 engaging a vehicle type container **24"** on a concrete guideway **18"**, shown in section in FIGURE 56. Vehicle **24"** can be an automobile, bus, truck, or a container mounted on wheels. It can be pushed along by a conveyor, engaged and pushed by the train (by an arm extended therefrom) or driven to train speed as by an operator to align for transfer using a rod **1436** extendible out the front of the container vehicle to meet a rod **1438** extended down from the carrier. A limit switch **1440** on rod **1438** is closed by rod **1436** to control the extension of the elevator **106'** for picking up the vehicle **24"**. Vehicle **24"** can be set off on a flat pavement or on a guideway **18"**.

Referring to FIGURE 57, the container or vehicle **24** can have hooks **95"** for latching on a carrier, elevator, or (as shown) guideway above to suspend it. The hooks **95"** are shown in normal position and can be swung inward at the top by action of cylinders **1444** only when the container is lifted off rails **42"** by elevating means under the container. Cylinders **1444** are controlled by valve **1446** either manually or when the container is selected for transfer but will not open the hooks until positioned above rails **42"**. The hooks have wheels **1448** on which the container sides on rails **42"** and can be taken off at any point or left on selectively according to the position of valve **1446** and the relative position of the container with respect to rails **42"** as controlled by elevator means such as elevator **106** of FIGURE 1.

Referring to FIGURE 58 where a container transfer truck **24"'** has both hooks **97** at the ends for engaging with hooks **95"** of FIGURE 46 and bottom tabs and recesses **1362** for engaging with arms **1364** of the elevator of FIGURE 52 with which it is shown being picked up off a roadway which has a line **1450** painted along on which the vehicle's operator can steer to position for transfer. The road with steering line **1450** for automatic or manual steering can for the guideway for vertical or side type transfer. FIGURE 59 shows a transfer bus from the side, with both hooks **97** and tabs **1362**.

Goods or mail from trucks **24"'** can be sorted to other trucks **24"'** in the train in route using aisle **28** along the container berths and side loading doors **1454** in the trucks. When the motor vehicle is set off from the train the operator on the motor vehicle releases the clutch for the touchdown and brakes the vehicle or drives off.

I claim as my invention:

1. A container transfer system including in combination a first and a second parallel running transfer vehicle, at least one transfer container, at least one rigidly guided extendible and retractable lift transfer device on said first vehicle including substantially rigidly guided means for supporting and holding said container and extendible to engage for vertically lifting said container from said second vehicle and retractable to move said container to said first vehicle and for returning said container to said second vehicle, receiving means on said second vehicle for receiving and supporting said container as passed thereto by said transfer device, said transfer device being selectively operable to extend to engage and lift said container from said second vehicle and retract to bring it onto said first vehicle, means for controlling the speed of one said vehicle to substantially align said vehicles at substantially equal speed, means for maintaining alignment of said vehicles for transfer of said container, means for rendering said transfer device operable when said vehicles are substantially aligned for transfer of said container.

2. In a system as in claim 1, a plurality of discrete locations on each said vehicle wherein said container can be placed, said locations being arranged in each said vehicle to register with the locations in the other said vehicle, said means for controlling the speed serving to align said locations of said vehicles to register.

3. In a system as in claim 2, at least one station, said container and said second vehicle being thereat, means at said station for placing said container in any of said locations on said second vehicle, means on said first vehicle for signaling ahead to said station the arrangement of containers in said locations on said first vehicle, means at said station to receive and store said signals so that they can be used for placing said container in a said location on said second vehicle to align with an empty said location in said first vehicle when said locations on said first and second vehicles are brought into register.

4. In a system as in claim 1, said last mentioned means including a lamp on one of said vehicles directed substantially at right angles to the length of the other said vehicle, a photoelectric cell on said last mentioned vehicle positioned to align with the lamp to receive light therefrom only when said vehicles are aligned for transfer, a circuit completed by said cell by receiving light from said lamp for controlling said transfer device to transfer said container.

5. A system as in claim 1, a railway track, a suspended-vehicle overhead track above and parallel to said railway track, said vehicles each having a rigid frame, a swivel truck supporting each end of each frame, one said vehicle being supported thereby from said overhead track and the other on said railway track, the axis of swivel of these trucks being substantially equally spaced on each said vehicle, said transfer device and said receiving means being similarly spaced lengthwise the vehicles between said trucks on their respective vehicles to align for transfer when said trucks on said vehicles are aligned, for maintaining alignment for transfer on curved track.

6. A transfer system comprising in combination, a track, a first vehicle thereon, a guideway paralleling a length of said track, a transfer vehicle on said guideway, means for moving said transfer vehicle at the speed of said first vehicle along said guideway, and for aligning said transfer vehicle for transfer to said first vehicle, said first vehicle having elevator means for picking up all corners of said transfer vehicle substantially level while operating at speed and means for carrying said transfer vehicle on said first vehicle, and means for rendering said elevator means operable to transfer said transfer vehicle to said first vehicle only when substantially aligned for transfer.

7. In combination, two parallel running vehicle, each on a parallel running way, one above the other, a transfer container, the said vehicle above being a carrier for said container, the said vehicle below being a holder for said container, a vertically guided elevator on a said vehicle for transferring said container from and to the other said vehicle, means for aligning said vehicles for transfer of said container, hooks for suspending said container to the said vehicle which is above, unlatching means for opening said hooks to release said container when said elevator is extended and said container is supported on the said vehicle which is below, said elevator being sufficiently rigid for guiding said container vertically during transfer to substantially maintain alignment for engaging said hooks while said vehicles operate at speed, and means for controlling said elevator to operate when aligned for transfer.

8. In a combination as in claim 7, said elevator being telescoping, secured to the said vehicle which is above, and having said hooks pivotally secured thereto; said container being arranged to open the hooks on said elevator and hook thereto.

9. In a combination as in claim 7, said hooks being pivotally secured on said container, means on said vehicle which is above for opening and coupling with said hooks.

10. A system for loading and unloading a train nonstop which comprises in combination, a railway track, a railway train thereon having a plurality of container berths therein, an overhead track, a container carrier train on said overhead track and having a plurality of container berths spaced apart to longitudinally register with said berths on said railway train, said tracks being parallelly spaced for a distance so as to transversely align said berths on said carrier train with said berths on said railway train when these berths are longitudinally aligned in said distance, a transfer container, hook means on said carrier train to hold said container in any said berth on said carrier train, means to longitudinally and transversely hold said container in any said berth on said railway train, a transfer elevator in each said berth on the train for lifting said container to and from said carrier, a station having elevator means for lifting and lowering said container from said carrier to a level to clear the carrier and any container thereon, means for opening said hooks when said container is supported on said elevator to be lowered, means on said railway train and at said station to respectively send and receive signals designating the sequence of loading of said berths on said railway train, means utilizing said signals to selectively load said container on said car rier train in a said berth thereon which in sequence registers with an empty berth on said railway train, means to start and accelerate said carrier train in a direction and at a time to substantially align said berths thereof at speed with said berths on said railway train, means to adjust the speed of said carrier train to bring said berths into alignment for transfer, means to maintain alignment for transfer, means to control each said transfer elevator to transfer said container to the said berth when aligned, means to selectively remove a said container on said railway train to an empty said berth on said carrier when aligned thereabove, means to decelerate and stop said carrier after sufficient time for this transfer, whereby said container can be transferred to or from the train without stopping said railroad train.

11. In a system as in claim 10, timer means for controlling each said transfer elevator to retract is not returned from transfer upon termination of a time limit for transfer so that said elevators are assured to be retracted before the end of said distance is reached.

12. A closed container car having at least one container berth for receiving a transfer container, an opening in said car for transfer of the container to and from the car, an aisle connecting ends of the car past said berth, a partition separating said berth from said aisle, a human passage in said partition to said berth, door means closing said passage, means for transferring the container to and from said car, and means for locking said door means closed before transfer is permitted and while said berth is empty.

13. A transfer system comprising in combination, at least one transfer container, a track, a vehicle for carrying said container on said track, station means along said track for moving said container for loading and unloading said vehicle while moving, transfer lift means having parallel arms which extend parallel for transferring said container with parallel and substantially level movement between said station means and said vehicle when aligned for transfer.

14. A stretch of railway track, a railway transfer car having a body supported at each end on a swivel truck on said track, a stretch of monorail track supported above said railway track, a transfer container carrier on said monorail track, said carrier having a frame and a truck supporting each end of the frame of said carrier on swivel axes which are spaced substantially equal to the distance between the swivel axes of the said trucks of said transfer car, means for engaging and holding a plurality of transfer containers on said carrier, hoist means having rigidly guided extending and retracting means on a said vehicle for

vertically transferring the containers to and from said carrier and said car, said tracks being relatively located whereby said supporting means are transversely aligned with said berths on either curved or straight portions of said stretch of track when said transfer car and said carrier are aligned lengthwise.

15. In a system as in claim **13**, said container being an auto cage, which comprises a platform, upright side members secured to and extending up from the edges of said platform to straddle an auto when driven on said platform, wheel locks on said platform for locking the wheels of an auto thereto, and means secured to the upper end of each said upright member for engaging with a hook to suspend said container.

16. In a system as in claim **13**, said container being an auto cage comprising a platform and wheel chocks thereon.

17. In a cage as in claim **16**, said wheel chocks comprising troughs placed in openings through said platform to align with the wheel of the vehicle to be carried, flanges on the top of the troughs to engage the top of the platform when the cage is lifted to form a depression under wheels of the vehicle by the lifting of the cage.

18. On a vehicle cage as in claim **16**, linkage means pivotally secured along the side of the platform to swing up to prevent opening beyond the edge of the cage of a side door of a vehicle to be carried on the cage, means for holding said linkage lifted, and means for releasing said linkage to lower to enable the door to be opened when the cage is safe for passage on said vehicle.

19. In a system as in claim **16**, each said wheel chock comprising an open end trough having trapezoidal sides with the long base at the bottom to be inserted through an opening in the platform of the cage, lips on the outer sides of said trough for supporting the trough in the opening, members arranged to move endwise said trough on the tapered edge thereof to be wedged open thereby as said trough moves up relative thereto, a latch for hooking open each said member when said members are separated by the relative lifting of the trough, a linkage connecting said latches, said linkage having a portion positioned to be engaged by said trough to release said latches when said trough lowers relative to said members, resilient means for forcing said members toward each other to clamp a wheel therebetween, and means on which to rest the trough to release a wheel held therein when at a station.

20. In a transportation system, in combination, two parallel running vehicles, transfer containers, berths on said vehicles each for holding a said container, said berths being aligned on one said vehicle each with one on the other said vehicle, a transfer mechanism in a said berth on one said vehicle for transferring a said container from that berth to the berth on the other said vehicle which is aligned therewith, said containers being placed in berths on a said vehicle to align empty said berths on the other said vehicle there being at least one container in a berth of each said vehicle a said container being in the berth having said mechanism, means for controlling said mechanism to transfer said container to the adjacent said berth during alignment.

21. In a transportation system, a first, second, and third vehicle at least three container spaces on each spaced to register with each other, a first transfer wherein said first and second vehicles are parallelly run a first and second container in said first vehicle, a third container on said second vehicle opposite the vacant said space on said first vehicle, means on said first vehicle for transferring said first and third containers to the opposite said space on the adjacent vehicle, a second transfer wherein said third vehicle is substituted for said second vehicle, a fourth container on said third vehicle aligned with the space emptied on said first vehicle by the said removal of said first container, means for transferring said second and fourth containers on said first and third vehicles to opposite vehicles, means for controlling said last means to transfer during alignment, each said vehicle maintaining the same number of containers after as before each of the alignments.

22. A passenger monorail train, a passenger transfer container, a container berth in said train for holding said container, an elevator and automatic hook means for engaging, picking up, and for lowering and disengaging said container, whereby passengers are transferred to and from said train in containers saving delay from passenger movements of loading and unloading.

23. In a container transfer system a carrier unloading station comprising a monorail carrier track, a container carrier train thereon having a plurality of container berths, an unload elevator under said track, at least one unload stop arranged to stop said carrier train with a whole number of container berths over said elevator, means for controlling said elevator to lift when the carrier train is so stopped, hooks on said carrier train for holding containers, means controlled by the movement of said elevator to open said hooks when containers held by said hooks are lifted by said elevator, a conveyor drive, said elevator having a conveyor platform which when lowered engages said drive to move said containers off said elevator.

24. In a system as in claim **23**, conveying means at the end of said elevator platform for moving containers from said elevator to handling points and wherefrom reloaded containers are moved by said conveying means to an end thereof, a waiting section at that end of said conveying means, a conveyor and elevator section following said waiting section for spacing and reloading said containers on a carrier train for the next transfer run.

25. In a container transfer system, means including a platform for transferring automotive vehicles between a railway car and a station, a railway car for said platform, a way for moving said platform at said station, lift means for selectively removing said platform from said car to said way as the train passes, and automatic wheel chocks controlled to open when said platform is spotted for loading and unloading at the station.

26. A suspended vehicle way, a hoisting vehicle thereon having a hoist, reversible drive means connected to said hoist to selectively lift or lower said hoist, a container, supporting and positioning means for said container, means for vertically aligning said hoist and container, means partly on said hoist and partly on said container for engaging said hoist and container together when said hoist is lowered to engage said container, a first and a second photoelectric cell on said hoisting vehicle, means including lamp means below said vehicle for directing a light to said first or second photoelectric cell according respectively to the presence or absence of a container on said supporting means when positioned to align with said hoist, switch means for detecting whether a container is on said hoist, said switch means being connected to render said first cell effective to control the lowering of said hoist when said hoist is empty and connected to render said second cell effective to control the lowering of said hoist when a container is held in said vehicle at said hoist.

27. An overhead vehicle way, a container, a hoisting vehicle on said way having a hoist for lifting said container up thereto, reversible drive means connected to said hoist to lift and lower said hoist, a lower vehicle below said hoisting vehicle having a berth for holding said container, means for vertically aligning said hoist and berth, means partly on said hoist and partly on said container to engage said hoist and container for lifting said container after said hoist is lowered to said container, a first and a second photoelectric cell spaced transversely apart on the bottom of said hoisting vehicle, first detecting means for detecting the presence of a container on said berth, lamp means on said lower vehicle connected

to said detecting means to be controlled thereby to direct a light to align with said first cell only when said berth has a container and is aligned with said hoist and to direct light to align only with said second cell when said berth is empty and aligned with said hoist, second detecting means for detecting the presence of a container on said hoist associated with said second cell and said drive to lower said hoist when said container is thereon and said berth is empty and aligned with said hoist and associated with said first cell and said drive to lower said hoist when said container is positioned on said berth and said hoist is aligned and empty.

28. In a combination as in claim 27, said lamp means comprising a first and a second electric lamp spaced to shine up respectively to said first and second cell when said hoist and berth are aligned, switch means in series with said first lamp to be closed when desired to have the container in that berth transferred from the lower vehicle, and limit switch means in series with said second lamp opened by a container in said berth.

29. In combination, a vehicle, a transfer container, first means for positioning said container for transfer, second means on said vehicle to hold said container at a discrete spot thereon, third means for operating said vehicle, fourth means for controlling said third means to align said first and second means, a transfer device for transferring said container between said first and second means, and alignment and loading checking means for controlling said transfer device to transfer said container to said vehicle when said container is positioned on said first means and said second means is empty.

30. In a combination as in claim 7, said hooks having an up-turned tooth at the bottom of its front face, an upper swivel pivot having an axis parallel to the tooth, a lever arm substantially radiating from the axis of said pivot for opening the hook, the front face of said tooth being curved down and toward the back until it reaches a point substantially at or beyond the back of the portion of the hook which connects said pivot and the tooth for guiding the hook into engagement.

31. A hook as in claim 30, one side of the hook from the bottom of the tooth down being swept down under the hook toward the other side for aligning a container to hook.

32. A hook as in laim 31, means pivotally supporting said hook on said pivot with considerable axial play, resilient means biasing said hook to axially move in the direction of said side.

33. A transportation system comprising in combination, a first track, a second track paralleling said first track for a distance, a first and a second vehicle on respectively said first and second track, means to operate each said vehicle, lift means on a said vehicle for transferring a container to or from the other said vehicle, said first vehicle approaching said second vehicle waiting on the near end of said distance, a timer for timing an interval inversely proportional to the speed of said first vehicle and for starting said second vehicle, means to start said timer when said first vehicle is substantially a fixed distance from said second vehicle such that when said second vehicle is accelerated to a speed approximately that of said first vehicle said first and second vehicles are substantially aligned for transfer, and means for maintaining alignment of said vehicles at speed for a portion of said distance for transfer of containers between said vehicles, and means actuating said lift means to start transfer only during the early portion of this alignment.

34. In a system as in claim 33, said vehicles being trains.

35. In a system as in claim 33, a speed control sytem for accelerating the second said vehicle to a definite speed less than that of said first vehicle slightly ahead of alignment for transfer.

36. In a system as in claim 35, said speed control system including photo-electric means comprising a lamp on one vehicle sending light at substantially right angles to the line of movement; a first, a second, and a third photoelectric cell arranged in succession in the direction of travel on a said vehicle, a first circuit controlled by said first cell to decrease the speed of said second vehicle when said light engages said first cell, switch means in said circuit to open said circuit to prevent said first cell from reducing speed, a second circuit controlled by said second cell, said second circuit having relay means to control said switch to close by action of said light on said second cell, contacts on said relay means to increase the speed of said second vehicle to substantially that of said first vehicle, a third circuit controlled by said third cell to increase the speed of said second vehicle above said first vehicle to restore alignment of said light on said second cell.

37. In a system as in claim 33, said timer comprising, a generator driven and excited to develop a voltage representing the speed of said first vehicle, a way point having a relay energized by the approach of said first vehicle thereto, a rheostat having end terminals and a moving contactor, means for supplying a voltage across end terminals of said rheostat, a second relay, the output of said generator being connected one terminal to the terminal of said rheostat of the same polarity and the other terminal in series with the coil of said second relay and a rectifier to said contactor, biasing and stop means to position said contactor near the other said terminal in starting position, means for driving said contactor from this point toward the opposite terminal according to the time lapsed from the closing of said relay first mentioned, said contactor being turned by said last mentioned means to a point on said rheostat whereat movement of said second relay takes place to start said second vehicle to accelerate to meet with said first vehicle for transfer at various speeds, and means for opening the circuit of said first relay to restore said contacts to starting position for the next vehicles.

38. A transportation system comprising in combination, a suspended vehicle way, a container carrier thereon having a plurality of container berths, an elevator in each said berth for lifting and lowering a container and carrying it therein, hook means on each said elevator for engaging and disengaging a container automatically when set down, at least one station along said way at which a container is set down and another is picked up therefrom into said carrier.

39. In a system as in claim 38, said carrier having an enclosed body for passengers, an aisle along one side of said berths, a partition separating the aisle from the berths, doors in said partitions to register with doors in the containers, means for controlling said doors to be opened only when a constainer is in said berth, whereby people board and leave the suspended vehicle.

40. In a system as in claim 39, said container being an automotive vehicle.

41. A container transfer system comprising in combination, a self propelled vehicle having at least one berth for carrying a transfer container, a transfer container therefor, means separate from the vehicle for conveying said container parallel said vehicle for a distance, means for starting and controlling the speed of said means for aligning said container with said berth during travel along said distance, selectively operable means for transferring or not said container to said berth only while aligned lengthwise therewith.

42. A container transfer system comprising, a track, a vehicle thereon having at least one berth for carrying a transfer container, a transfer container therein, suspended railway means for receiving said container and running parallel said track for a distance thereabove, lift means for transferring said container to said suspended railway means directly above said berth, and selective means for controlling said lift means for control whether transfer is to be made when aligned therefor.

43. A system as in claim 42, said selective means being on said container.

44. A transportation system comprising in combination, a vehicle way, vehicle means thereon, transfer containers for automatic transfer to and from said vehicle means, a plurality of transfer runs along said way, self operating transfer carrier means for operating on said runs, a station for each run and including means for facilitating loading and unloading of said containers, means for lifting said containers to and from said vehicle means and said carrier means, means for signaling ahead the approach of said vehicle means to each said station, said containers being arranged on said carrier means at said stations for transfer into empty spots on said vehicle means, means for starting and accelerating at a substantially fixed rate said carrier means after said vehicle means approaches to a given point, means for delaying said last means for a time inversely proportional to the speed of said vehicle to align for transfer therewith when accelerated substantially to the speed of said vehicle means, means for maintaining alignment of said vehicle means and said carrier means for transfer of said containers, and means for controlling said transfer means to transfer said containers to and from said carrier means during alignment within the transfer run.

45. A container transfer system comprising at least one railway container car, at least one transfer container therefor, automatic means for conveying said container and for aligning with said car for transfer of said container, automatic lift means for transferring said container between said vehicle and said means for conveying, said lift means including hook means for supporting and automatically hooking said container, means for detecting substantially steady alignment of the container with an empty spot for controlling said lift means to operate.

46. A container transfer system comprising in combination; vehicle means for transporting a plurality of containers, a plurality of containers therefor, station means for conveying said containers and for aligning said containers with said first vehicle adjacent empty spots thereon, lift means for automatically engaging and transferring said containers between said means for conveying said vehicle means, means for detecting a container for transfer in substantially steady alignment with an empty spot for rendering said lift means operative to transfer the container, and means for signaling which containers are to be transferred.

47. A container transfer system comprising at least one railway container car, at least one transfer container therefor, a suspended trackway over said car, a container carrier on said trackway, a lift on said carrier operable to lower and then lift and including automatic hook means for latching onto and lifting said container for transfer to and from said car, means for aligning said carrier with said car for transfer of said container therebetween, and means for selectively controlling said lift to lower when aligned for transfer.

48. In a system as in claim 47, means for signaling that the spot on the car is empty for controlling said lift to lower said container.

49. In a system as in claim 47, means for signaling that a container is on the car to be removed for rendering said lift operable only when empty to pick up said container.

50. A transit system having vehicle means having spaces for transfer containers, at least one stopping place for at least one transfer container by which said vehicle means runs non-stop, containers conveniently located for loading at said stopping place, at least one transfer container on said vehicle means and at least one transfer container at said stop and at least one empty spot for a said container on said vehicle means, means for moving said containers from said stop parallel said vehicle means, means for aligning each of said containers so moved with an empty container space on said vehicle means, lift means for transferring each said container when so aligned with said vehicle means into the said space aligned therewith and for removing any of other said containers selected on said vehicle to be put off onto said means for moving, and means for controlling each said lifting means to operate when aligning a container for transfer, means for gradually decelerating to a stop the containers transferred to said means for moving.

51. A transportation system comprising in combination, a vehicle way, transfer containers, vehicle means on said way having discrete spots lengthwise thereof for carrying said containers, a plurality of stations along said way for receiving and sending said containers, said stations including conveying means for moving said containers adjacent and parallel said way for a distance with clearance from said vehicle means on said way, parallelly extending and retracting transfer means for transferring said containers in substantially a straight line relatively between said conveying means and said vehicle means and so as to clear containers on said conveying means and on said vehicle means, and means for controlling said transfer means to transfer only during alignment of a container with an empty spot.

52. In a system as in claim 51, said containers being spaced on said conveying means ahead of the vehicle to simultaneously align each with an empty spot on said vehicle means.

53. In a system as in claim 51, said station comprising means for spacing said containers on said conveying means each to align an empty spot on said vehicle means and for providing empty spots on said conveying means to align with containers to be removed from said vehicle means to said station.

54. In a system as in claim 51, said conveying means comprising a suspended vehicle way extending above said vehicle way over said vehicle means, and carrier means thereon having means for suspending containers therefrom.

55. A transportation system having in combination, a railway train, at least one container transfer car therein, a transfer container on said car, and a rigidly guided transfer mechanism above said car which operates to transfer said container in substantially a straight line for lifting said container vertically off from said car, and means for rendering said mechanism operable when aligned with said container for transfer, a building for persons, said transfer mechanism being the elevator in the building, said container being a cage of the elevator, and means on said elevator for automatically engaging and disengaging said container when setting on said car.

56. In a system as in claim 55 said elevator being a passenger elevator, said cage being a passenger container.

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ROBERT G. SHERIDAN, Primary Examiner

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