(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 132 934
A2

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 84303716.9

(22) Date of filing: 04.06.84

(51) Int. Cl.^{4}: B 61 B 1/00
B 61 B 3/00, B 61 B 13/12
B 61 C 13/04, B 61 D 3/16
B 61 D 49/00, B 61 F 9/00
B 61 F 5/38, B 61 F 13/00

(30) Priority: 12.07.83 US 513009

(43) Date of publication of application:
13.02.85 Bulletin 85/7

(84) Designated Contracting States:
BE CH DE FR GB IT LI LU NL SE

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(54) **Railway system and elements thereof.**

(57) In this railway system substantially each piece of rolling stock, or "car" 14, will be a self-propelled locomotive which can be independently routed from any station location 10 within the system 40 to any other station location 10 within the system. The cars may be in a form similar to current conventional mass transit or freight cars, but in preferred embodiments they will be elevated "carriers" 14 designed to carry self-contained discrete elements which have been designed or modified for ease of connection to and disconnection from such carriers. Such discrete elements will include, but are not limited to, vehicles (such as conventional automobiles 12), crates 220, pallets, similar carriers 14, and so on. System traffic control means for loading and unloading cars, accelerating and decelerating cars, and routing cars will be provided. In preferred embodiments high speed, uninterrupted, universal routing through intersections and in selected directions at switching points will be accomplished without moving switches or moving rails by means of movable switching wheels in conjunction with tracks which will be specially designed to accommodate the cars and their movable switching wheels 90. In preferred embodiments, motive power for the cars will be provided by linear synchronous motors, with the movable magnetic portions 142 of the motors carried by each car and the stationary magnetic portions 152 associated with the track 55 or structure along which the car rides. In preferred embodiments means will be provided to control the location, position, and orientation of the magnetic portion of the motor carried by the car, with respect to the stationary elements associated with the track, regardless of the tilt or angle of the body of the car. In preferred embodiments, means will be provided to continuously transfer electrical energy from stationary lines associated with the tracks to the moving cars, even when the cars are moving at high speeds.

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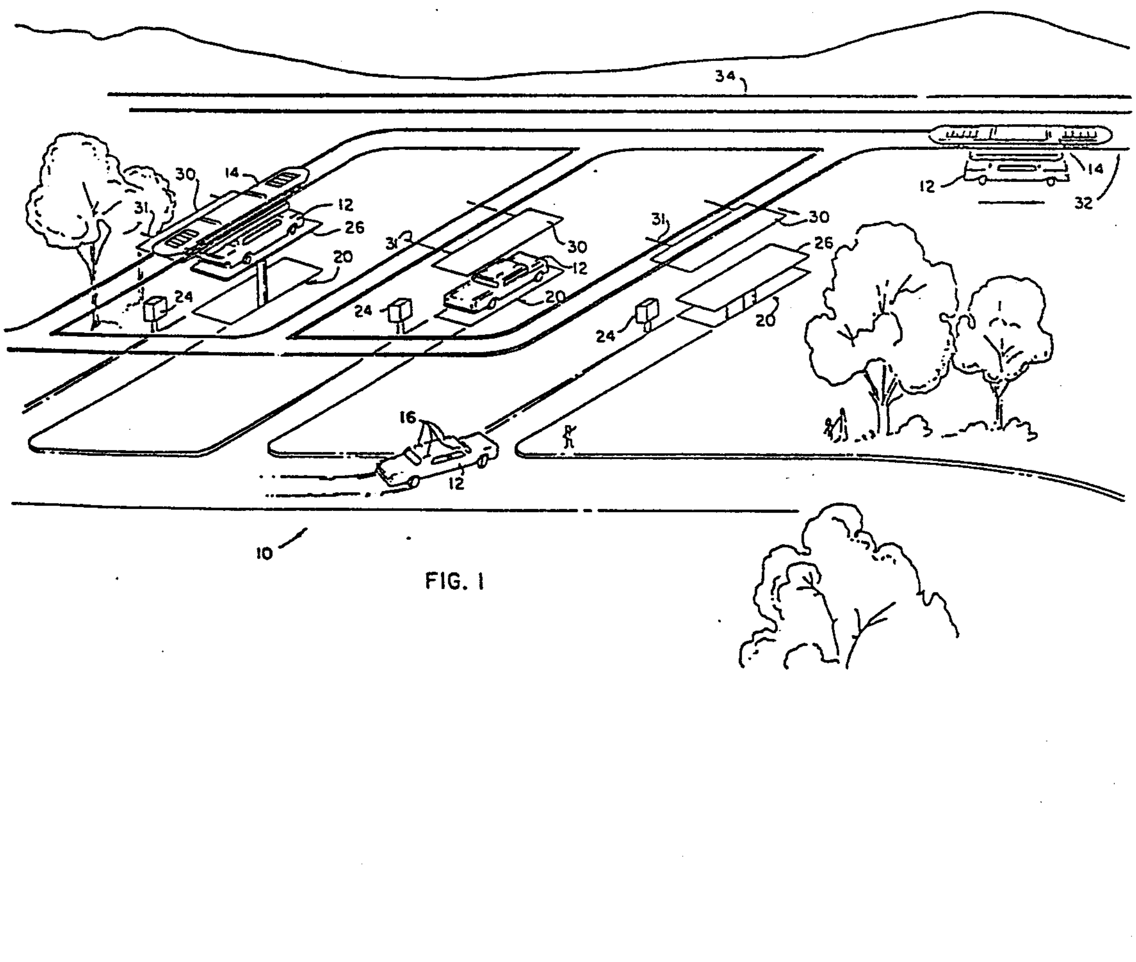

FIG. 1

RAILWAY SYSTEM AND ELEMENTS THEREOF

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a railway system wherein substantially each piece of rolling stock, or "car", will be an independently routed, self-propelled locomotive. More particularly, it relates to such a system in which each such car could be designed for use as a carrier for discrete elements, and also to means for switching, routing, controlling, and providing power to cars in such systems.

2. Description of the Prior Art

Conventional railway systems capable of transporting automobiles are known in the art. The amount of energy needed to transport an automobile a given distance on a railway system is known to be considerably less than that which is required by the same automobile operating over the same distance under its own power. Such automobile transport systems have enjoyed limited success and use for a variety of reasons. As they are currently known, such systems require that passengers follow a rigid railroad time table and route, with a number of automobiles being loaded onto each carrier, a number of carriers being coupled to one another, and thence to a locomotive. Loading and unloading the automobiles on and off of current railroad systems takes such a great amount of time that only long trips are generally considered to be practical. During such trips passengers are separated from their vehicles during transit, traveling in separate passenger cars. Because of these limitations this mode of transport has never been widely accepted, and has been substantially limited to a few corridors where both automobile and railroad traffic are very heavy.

Additionally, the prior art is not known to teach nor suggest any railway system wherein each automobile can travel as a discrete element carried by its own locomotive, is capable of being independently routed and dispatched at any time selected by the traveler, is loaded and unloaded relative to the system quickly and efficiently by the traveler, and carries the driver and any passengers within their own automobile during such journeys.

Prior art railway systems using linear synchronous electric motors as the power source are known. Railway systems capable of carrying discrete elements, such as pallets, containers or truck trailers are also known in the art, as are computerized traffic control systems for individual railway cars. However, no system is known which teaches a system wherein each discrete to-be-carried element, such as an automobile, is equipped with coupling components which permit its rapid attachment to and detachment from its own locomotive carrier car. Additionally, no prior art system is known to teach a system which, because of cars having unique movable switching wheels, in conjunction with their own specially designed tracks, is capable of universal routing of each individual car through switching points without the use of moving switches or rails.

SUMMARY OF THE INVENTION

The present invention teaches and discloses a railway system in which each piece of rolling stock, or "car", will be a locomotive which will be self-propelled by means of its own motor system. The cars may generally be in a form similar to current conventional mass transit or freight cars, but in preferred embodiments they will be elevated "carriers" designed to carry self-contained discrete elements which have been designed or modified for ease of connection to, and disconnection from, the self-propelled carrier. Such discrete elements will include, but will not be limited to, vehicles (such as conventional automobiles), crates, pallets, truck trailers, similar carriers, and so on. In preferred embodiments the power source will be a linear synchronous electric motor, with the moving magnetic elements of the motor being mounted on the cars, while the stationary magnetic elements of the motor will be associated with the track along which the car travels. The system will provide high speeds, high traffic capacities and the ability for each car to negotiate its selected route independently of all other cars. The need for rails or switches at a switching point to be moved from one position to another will be avoided by the use of movable switching wheels carried by each car in conjunction with specially designed stationary rails, with the direction to be taken by each car at each switching point determined by the controlled positioning of those wheels in conjunction with the special stationary rails. The avoidance of the need to switch rails, along with a substantially constant speed of travel for all cars, will permit very close spacing of many cars traveling at high speeds, and will thus impart to the system an extremely high car carrying capacity.

The railway system to which this invention relates will include networks of railed tracks. These networks would preferably be of at least two types: tracks for high-speed traffic, for example covering a large region and/or for long distance travel; and tracks for relatively low-speed traffic, for example, for short distance travel or for travel within a metropolitan area. Different networks will be interconnected at suitable points by means of buffer zones, such as acceleration and deceleration segments, in order to accommodate and adjust the differences in car characteristics, such as speed, between the different networks.

A private automobile, or other vehicle, will be able to use the system, for example, by providing connection means mounted on the vehicle, to which a carrier car in the system of the present invention having mating connection means will be easily connected. With an automobile and railway car so equipped, an automobile driver wishing to travel on the railway system will enter a station located along one of the tracks, and drive to a loading location within that station. There the driver will indicate by means of a selecting device a desired destination. This information will then be relayed to an automatic traffic control system. This control system will then dispatch a carrier car to the site of the automobile, if a carrier is not already there, and the railway car and automobile will be quickly and easily connected to one another by means of a coupling mechanism, one component of which will be on the carrier, and one component of which will be attached to the automobile.

The automatic traffic control system will then survey the pattern of traffic already using the system, and, at the earliest opportunity, will cause the carrier car with its attached automobile load to be accelerated along an acceleration track parallel to a main track of that particular network. This will be done with precise timing so that the railway car will enter the main track smoothly and without interfering with other cars already on the track. Once the car is traveling on the main track, the automatic control system will direct it along the proper course. When the car approaches a switching point, the appropriate position of the switching wheels on the car will be selected so that it will continue towards and reach its selected destination. This switching procedure will also include those switches located within the yard of the destination station, assuring that the car will be brought to a halt at the desired location. There, the railway car will return its automobile load to the roadbed and disconnect from it. The automobile driver and any passengers, who have remained in the automobile throughout the trip, can then immediately resume the journey under the power of their own vehicle.

Once a trip has been begun, if the driver decides to change itinerary, means will be provided to disrupt the scheduled trip, causing the carrier to exit from the system at the next station, at which point the driver may select a new destination.

Using this system a driver will be able to travel from any point on the system to any other point on the system by the most direct route, or enter or leave the system at any station on the system and travel by any route desired. Stops can be made at any station, as the driver wishes, and all travel by the driver will normally take place within the privacy of the driver's own automobile, but without the high amount of energy consumption which individual automobile use now entails.

In preferred embodiments a smooth, quiet ride will be provided by steering the wheels of the car in such a way that they anticipate and follow the curvature of the track precisely. This feature will also reduce the wear on both the car wheels and on the rails.

In addition to transporting private automobiles, the same carrier cars, or other carriers with certain modifications, may also be used to transport other discrete elements, such as public passenger vehicles (buses or passenger cars) or cargo containers, crates, truck trailers, pallets, similar carriers, and so on, which discrete elements will have been designed or modified for ease of connection and disconnection to the carrier car. The use of self-propelled cars in conventional passenger, bus and freight configurations is also contemplated by the present invention.

It will therefore be an object of this invention to provide a railway system in which each piece of rolling stock will be self-propelled and can be independently routed within the system.

Another object will be to provide a railway system comprised of carriers which will couple with and transport discrete elements, such as private automobiles, while the driver remains in the automobile, in such a way that the advantages of high efficiency and low energy consumption of a railed system will be realized, without sacrificing the versatility and convenience of the automobile at the destination location.

Another object will be the provision of to-be-carried elements with coupling components which will be easy to connect to and disconnect from mating coupling components of self-propelled carrier cars in the system.

Yet another object will be to provide, due to the use of a linear synchronous motor as a drive source and cars having movable switching wheels and their own specially designed tracks (which will avoid the need for movable switching tracks), a high capacity railway system.

Still yet another object will be to provide for the use of a computerized traffic control system to facilitate loading and unloading of cars, accelerating and decelerating cars, and switching and routing of cars.

Yet another object will be to provide means for continuously transferring electrical energy from stationary power lines associated with the system track to the cars which will be moving at high speeds.

A further object will be to provide a transportation system which will be faster, safer, less expensive and less subject to disruption than present transportation systems.

These and other objects of the present invention will become apparent to those skilled in the art from the following detailed description, showing the contemplated novel construction, combination, and arrangement of parts as herein described, and more particularly defined by the appended claims, it being understood that such changes in the precise embodiments of the herein disclosed invention are meant to be included as come within the scope of the claims except insofar as precluded by the prior art.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings illustrate complete preferred embodiments of the present invention according to the best mode presently devised for the practical application of the principles thereof, and in which:

FIG. 1 is an aerial illustration of a station having facilities in which a discrete element, such as an automobile, will be connected to an elevated carrier railway car for routing and merging into the railway networks of the present invention;

FIG. 2 is a diagrammatic representation of two types of interconnected rail networks, in two different scales, which will be used by the system of the present invention;

FIG. 3 is a partially cut-away perspective view of one preferred embodiment of a carrier type railway car of the present invention, showing the placement and details of some of the car's interior components;

FIG. 4 is an end view of the car of FIG. 3 with the shell of the car shown in phantom;

FIG. 5 is an enlarged perspective detailed view of one wheel truck of the car of FIG. 3, with the shell, motor and beam removed, showing details of the wheel truck, wheels and switching wheel assembly;

FIG. 6 is an exploded perspective view detailing the means which will be used for connecting a wheel truck to a carrier beam;

FIG. 7 is a schematic side elevational view detailing the relationship between the beams, wheel trucks and wheels of the carrier of FIG. 3;

FIG. 8 is an enlarged, cut-away perspective view of the lower body portion of the carrier of FIG. 3 showing some of the details of its components;

FIG. 9 is a perspective view of the motor section of the car of FIG. 3, in conjunction with tracks and showing the details of a preferred linear synchronous motor system, and including the external stationary portion of the motor shown in phantom;

FIG. 10 is a perspective view, looking upwards, of a suspended section of rails and their housing, which will be used in the practice of the present invention;

FIG. 11 is a perspective diagrammatic representation of the switching rails of the present system at a switching point;

FIG. 12 is a detailed perspective view of one preferred coupling component of the carrier of FIG. 3, shown in position to couple with a coordinate coupling component carried by an automobile; and

FIG. 13 is a perspective diagrammatic representation of a container which has been modified for connection to the carrier of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

As a means for placing the preferred embodiment of the present invention into a meaningful form, attention is first directed to FIG. 1. FIG. 1 shows, by way of illustration, an aerial view of a station, generally 10, having facilities in which a discrete element, such as an automobile 12, will be connected to a carrier railway car 14 for routing and merging into the railway networks, shown in FIG. 2, of the present invention. In such a system, a private automobile 12 will be able to use the system, for example, by providing a plurality of coupling components 16 mounted on its roof, to which components a carrier car 14 in the system of the present invention having mating coupling components 18 (see FIGS. 4, 8 and 12) can be coupled. With an automobile 12 and a railway carrier car 14 so equipped, a driver wishing to travel on the railway network can enter a station 10 located along a segment of track in the network, and drive automobile 12 to a loading location 20 within station 10. There, the driver will indicate, by means of a suitable selecting device 24, a desired destination. Selecting device 24 can be located within automobile 12 for remote selection, or adjacent loading location 20 of station 10, as shown. Destination information will then be relayed to a centrally located automatic traffic control system, not shown. This control system will then dispatch a railway carrier car 14 to the loading location of the automobile, if a carrier car 14 is not already there. Loading location

20 includes platform 26 upon which automobile 12 rests. Platform 26 will be designed to rise, orient and connect automobile 12 with its attendant carrier 14. Orientation will be accomplished by means, for example, of locator lights 28 located in coupling mechanism 16 which is mounted on automobile 12. See FIG. 12 for details as to the location of light 28. Light 28 will provide a collimated light beam which impinges upon photosensitive screen 30, shown located between carrier 14 and automobile 12 to guide automobile 12 into place so that coupling component 16 which is mounted on automobile 12 will be precisely aligned with mating coupling component 18 mounted on carrier 14. Screen 30 will then be withdrawn, in FIG. 1 to the left, on guideways 31 by motive means not shown, and platform 26 will be elevated until coupling between component 16 of automobile 12 and component 18 of carrier 14 takes place. All of this will occur while the driver and any passengers remain in automobile 12.

The automatic traffic control system will then electronically survey the pattern of traffic already using the network and, at the earliest opportunity it will cause railway car 14, with its attached automobile load 12, to accelerate along, and to merge with, an acceleration track 32 parallel to a main line track 34 of a network. This will be done with precise, computer controlled timing so that railway car 14 will enter main track 34 smoothly and without interfering with other cars already traveling on the track. Once railway car 14 is on main track 34, the automatic traffic controller will direct it along the proper route. When it comes to a switching point 36 (as shown in FIG. 11) the appropriate position of the switching wheels on the car, as detailed below, and shown in FIGS. 3 and 5, will be selected so that railway car 14 will continue towards and reach its selected destination. This switching procedure will be similar for those switches located within the yard of the destination station (not shown, but similar to station 10) assuring that railway car 14 and its carried element 12 will be brought to a halt at the desired location within the yard. There, railway car 14 will return its automobile load 12 to a platform, or to the roadbed, and will disconnect from it. The automobile driver, who will have remained in the car, will then use automobile 12 to resume the journey, using the power of the vehicle.

Once a trip has been begun, if the driver shall decide to change itinerary, means will be provided to enable the cancellation of the scheduled trip at any point, with the vehicle exiting from the system at the next station after cancellation. At that station a new destination may be selected, as described above.

The railway system to which this invention relates will preferably include one or more networks of railed tracks. Referring to FIG. 2, two types of network are shown, an interconnected network of tracks 40 for high-speed traffic covering a large region and/or long distances between, for example, metropolitan areas 42, and a separate network of tracks 44 for relatively low-speed and/or short distance traffic, for example, within a metropolitan area 42. These two networks 40 and 44 will be connected at suitable points by means of acceleration and deceleration segments 46 in order to accommodate and adjust for the differences in car speeds between the two networks.

Referring to FIG. 2, the lowermost city 42 is shown at a larger scale than the scale of network 40. Within lowermost city 42 there will be not only passenger stations 10, but also, for example, stations 48 especially designed for loading and unloading freight containers, such as those shown in FIG. 13.

Referring now to FIGS. 3 through 12, the basic and detailed mechanical and electrical components of carrier 14 are shown in detail. The principal structural member of carrier 14 will be upper carrier body 52 having a central body member 54. In this embodiment carrier body 52 will be supported on rails 55 by two six-wheeled trucks 56. Referring to FIG. 5, the load supported by central body member 54 will be transmitted to trucks 56 through sleeve 58 rigidly attached to body member 54 on spherical roller thrust bearings 60 and riding against ball bearings 62. Under normal conditions, thrust bearings 60 will carry the entire weight of upper carrier body 52 and its load on sleeve 58. Ball bearings 62 will be used solely for alignment and to carry transient transverse loads. Both bearings 60 and 62 will be mounted on coupling 64 which in turn will be in contact with truck frame 66 by means of roller bearings 68. This arrangement will permit truck frame 66 to rotate around sleeve 58 relative to body member 54 about both the vertical and the longitudinal axis. This will in turn allow running wheels 70 attached to truck 56 to follow rails 55 around both sharp and/or rapidly changing curves in the tracks. However, the rotation of trucks 56 about the longitudinal axis will be intentionally restricted by means of beam 72 in such a way that each truck 56 will be able to rotate only in the opposite direction, and at the same angle, as its counterpart truck in the same carrier. This restriction will permit wheels 70 to follow a section of track of changing curvature and/or changing transverse tilt while at the same time preventing upper carrier body 52 from rotating about the longitudinal axis of the entire assembly, for example, during strong crosswinds exerting lateral pressure on carrier 14 or due to transversely unbalanced loads in carrier 14, for example due to shifting of weight in carrier 14 or in the load which it will be carrying; or due to emergency stopping of carrier 14 on a banked curve.

As shown schematically in FIG. 7, each upper beam 72 will be mounted to the center of body member 54 by means of roller bearing 74 and to truck frames 66, as shown in FIG. 6, by means of ball pin 76 rotatably secured at each end of beam 72. Ball pin 76 will be seated in separable spherical socket 78 which will have the external shape of a cylinder. Spherical socket 78 will in turn be free to slide forward or back in separable cylindrical cavity 79 in separable mounting arm 80, mounting arm 80 being attached to truck frame 66. This arrangement will also control the vertical orientation of truck frames 56 relative to body member 54. Thus, because of the use of beam 72, the horizontal plane of carrier body 52 will always be identical to the average of the planes of truck frames 56, even though the two trucks may differ from each other in their horizontal planes.

At each side of each truck frame 56.will be a yoke 82, mounted on bearings 84 which will be capable of supporting thrust as well as radial loads, while permitting yokes 82 to rotate about a transverse axis. It will be upon yokes 82 that the running wheels 70 will be mounted, by means of precision bearings 85. The mounting of each yoke 82 on bearings 84 will allow wheels 70 to follow vertical curvature of the track without affecting the stability of the remainder of carrier 14. In preferred embodiments wheels 70 will be made of steel or other long-lasting material. Wheel flanges 86 may be made of a material which will be somewhat softer than the rails so that virtually all wear generated by contact between the wheels 70 and the rails will occur in the wheel flanges, since the wheels can be replaced far more easily and less expensively than rails 55.

Also attached to each truck 56, but operating independently of yokes 82 and supporting running wheels 70 will be switching wheel assembly 88. Each switching wheel assembly 88 will include a pair of transversely opposed switching wheels 90 which will be similar to running wheels 70, except that they will have a wider running surface 92 than wheels 70. Each switching wheel 90 will be mounted by means of precision bearings 85 on brackets 94, which will be connected by two hardened steel shafts 96 supported by ball bushings 98 to enable the entire switching wheel assembly 88 to slide laterally, although, as detailed below, and shown in FIG. 4, they will normally be located in an extreme left or right position. Switching wheels 90 will be mounted in such a way that they will normally ride slightly higher than running wheels 70, but their running surfaces will rest lightly on rails 55, and will therefore be kept rotating substantially at running speed at all times during which carrier 14 is in motion. The lateral separation between switching wheels 90 will be less than the lateral separation between running wheels 70 by an amount slightly greater than the combined width of one rail 55 plus the width of a wheel flange 86. Thus, with switching wheel assembly 88 normally located in an extreme left or in an extreme right position, only one switching wheel 90 will be actually aligned with a rail 55 at a time. However, as noted above, the opposite switching wheel 90 will be kept rotating by virtue of the fact that the greater width of its running surface 92 will keep it in contact with its associated rail, even when it is not in line with that rail.

Lateral right or left movement of switching wheel assembly 88 will be provided by means of solenoids 100 surrounding soft iron cores 102 which will also be attached to each bracket 94. Each solenoid 100 will be powerful enough by itself to shift the entire switching wheel assembly 88 and its associated switching wheels

90, left or right. However, two solenoids 100 will be provided for reliability and safety. The lateral position of switching wheel assembly 88 will determine the direction that carrier 14 takes at each switching location 36, as described in detail hereinafter.

As most clearly shown in FIGS. 4 and 7, attached to the underside of the center of the main carrier body 54 will be a length of narrow vertical webbing, such as the web of I-beam 103, which will provide narrowing of carrier 14. This narrowing will render this connecting portion sufficiently thin to permit it to pass through the slits which will exist in the rails at each switch 36, as detailed below and shown in FIG. 11. Mounted on the lower end of I-beam 103 will be lower carrier body 106. Referring to FIG. 8 for details, at both ends of lower carrier body 106 will be an auxiliary wheel assembly 107, each including a pair of opposed auxiliary wheels 108 which will normally ride on the bottoms of rails 55. Built-in resilience in the design will cause auxiliary wheels 108 to rest lightly against the bottoms of rails 55 to cause them to maintain track speed. The primary function of wheels 108 will be to provide stabilizing support to carrier 14 in case of severe imbalance due to any contingency.

Since wheels 108 will also maintain constant contact with rails 55 at points of changing curvature, wheel assemblies 107 will be housed in rotatable end sections 110 attached to the ends of lower carrier body 106 by means of roller bearings 112. It will also be necessary, in order to prevent simultaneous elevation of both wheels 108 on one side, to connect both auxiliary wheel assemblies 107 with beams 114 on each side of lower carrier body 106 in a manner similar to the manner in which wheel trucks 56 will be connected by beam 72, as described above. Each beam 114 will likewise be mounted on a bearing 116 attached to lower carrier body 106. Since auxiliary wheels 108 will have no flanges which might interfere with or run against the rails, they will not require freedom to rotate about a vertical axis. Thus, auxiliary wheel assemblies 107 will be attached to beams 114 simply by means of self-aligning bearings 118.

In order to avoid interference with rails 55, and also to provide stability at switches, auxiliary wheels 108 will also be capable of the same type of lateral movement as switching wheel assemblies 88. However, the mechanism which will be employed to provide movement to auxiliary wheels 108 will be somewhat different from that which will be employed to provide movement to switching wheel assembly 88. Wheels 108 will be constructed about twice as wide as rails 55, so that only the outer half of each wheel will normally make contact with the rail under normal rolling conditions. As a result, whenever auxiliary wheels 108 are shifted as they approach a switch, one wheel 108 will slide free of its rail, while the opposite wheel on the same axle will maintain its inner half in contact with its rail to provide support and stability to carrier 14. The actual shifting of each set of auxiliary wheels 108 will be performed by means of a pair of solenoids 120 (only one being shown) acting on shaft 122, which shaft also forms the axle for wheels 108. Shaft 122 will ride on three ball bushings 124 (only two being shown) to permit the entire assembly 107 to slide laterally. Shaft 122 will preferably have a varied composition, with enlarged portions 126 (only one being shown) made of soft iron, to act as the solenoid core, while portions 128, in contact with the ball bushings 124 or wheel bearings 130, will be made of hardened steel.

As with switching wheel assembly 88, each solenoid 120 will be capable of shifting shaft 122 and wheels 108 by itself, with two solenoids being provided and used for purposes of safety and reliability. In normal use, the two solenoids 120 on one shaft 122 will oppose each other in order to maintain auxiliary wheel shaft 108 in a centered or neutral position. However, as each switch 36 is approached, both solenoids 120 will act together to shift both auxiliary wheel assemblies 107 in a selected direction. If a single solenoid 120 were to malfunction, it would be overridden, and carrier 14 would continue to perform as required at each switch 36. Between switches, however, if one solenoid were to malfunction then both solenoids 120 on each shaft 122 will be inactivated; with the result that wheels 108 would then be kept in a neutral (centered) position by means of compression springs 132 until the carrier can be retired from service or repaired.

As best shown in FIGS. 4 and 8, at each of the four bottom corners of lower carrier body 106 will be mounted a coupling component 18 which will permit attachment between carrier 14 and the discrete element which it will carry. Each coupling component 18 will be mounted on an extendable cylinder or arm 136 which will permit variation of the width between connectors 18 in accordance with the size of the discrete element to be carried and/or the location of the element's coupling components 16. On each side of lower carrier body 106 will also be an emergency brake 138, which will be attached to body 106 by extendable cylinders 139. Hydraulic, pneumatic, magnetic, or mechanical methods of adjusting the position of cylinders 136 and 140 may be employed.

Component 16 of the connecting mechanism which will be attached to the discrete to-be-carried element will be as simple and as rugged as possible in order to minimize the cost per element and to allow it to survive extensive normal use without damage. It will be attached to the frame of the to-be-carried element with sufficient rigidity and strength so that it will not only support the full weight of the element under all conditions, but so that it can also be attached and released many times without danger of failure.

Connector 18 will also be quick-acting, easily aligned, and dependable even after much use. It will be sturdy and provide a positive lock in case of a power failure, but will still be subject to manual operation in case it fails to release after the vehicle has been delivered to its destination.

Referring now to FIGS. 12 and 13, component 16 of the connecting mechanism which will serve substantially as a handle attached to, for example, automobile 12 or cargo container 220 is most simply a horizontal cylinder or pipe 222 mounted on two vertical posts 224 projecting from the roof of vehicle 12 or container 220. The portions 226 adjacent to the center of cylinder 222 will be reduced somewhat in diameter to serve as a locating means, and to permit positive coupling with component 18, even when there is a small amount of misalignment between the vehicle and the carrier. Attachment between coupling component 18 and coupling component 16 will be made by means of a slotted cylinder 228 which will be rotatably mounted within housing 18. Cylinder 228, when rotated more than 90 degrees, will surround and provide firm support for horizontal cylinder 226 of coupling component 16. Cylinder 228 can be made to rotate by the use of mechanical, electrical, magnetic, hydraulic, or pneumatic means.

In preferred embodiments, four such "handles" 16 will be mounted on the roof of vehicle 12 or container element 220 in a precisely spaced pattern. For existing automobiles, these handles may be rigidly attached to the door posts or other structural members of the body, not shown, by means of connecting channels concealed beneath the top of the automobile, and tailored to the needs of the particular vehicle. Some vehicles may have to be reinforced in order to function as to-be-carried elements in the railway system of the present invention.

Mounted at the top of each handle will be a small light source 28 whose beam is collimated and adjusted to point straight upwards. As discussed above, these light beams will be used to locate the to-be-carried element when it is being loaded onto a carrier 14, of the system, at a freight or passenger station. A photo-sensitive screen 30 above the to-be-carried element will determine the position of each light beam and adjust the orientation of the element to match that of a waiting carrier 14. Lights 28 will be remotely activated by a signal from the station's automatic control system. In this way the driver will be freed from the responsibility of remembering to turn lights 28 on and off.

Centered in one of the four handles 16, in this case, the handle detailed in FIG. 12, will be an electrical connector (not shown) which will provide communication between carrier 14 and the carried element, such as vehicle 12, as well as provide power for other vehicle needs such as heating, battery charging, entertainment, and so on. The opening to this connector will normally be covered by a weatherproof cap 230, held in place by spring-loaded detent 232. When the carrier coupling component 18 is attached to handle 16, cap 230 will automatically rotate to uncover the opening to the electrical connector.

All vehicles or other to-be-carried elements using the system of the present invention will be equipped with the proper connecting components. The only exception to this would be for large cargo containers, and for carriers which will be specifically designed to transport them. In such cases, for example, a sturdier coupler, with its units more widely spaced, will be employed.

Linear Motor System

Referring to FIGS. 3 and 9 for details, each separate segment 140 of the moving motor portions 142 will be mounted on brackets 144 by means of suitable bearings in a manner similar to that described earlier with regard to connecting beams 72 and 114. This will enable the entire unit 142 to flex in keeping with changes in the orientation of the stationary motor portions 152 (see FIGS. 9 and 10), therefore maintaining the proper air gap 154 between the moving 142 and stationary 152 motor portions, even as the carrier travels around corners and through switches. The air gap 154 will also be maintained by means of rubber-tired wheels 156 which will ride on rails 158 mounted on the stationary motor portions 152. Upward pressure on the moving motor portions 142 will be maintained by means of springs or other pressure devices, not shown, mounted below moving motor portions 142. Thrust will be transmitted from moving motor portions 142 to carrier body 54 by means of suitable thrust bearings mounted on support brackets 163.

While a number of alternative means of propulsion could be utilized, the preferred embodiment will employ a linear synchronous motor, preferably with alternating current electromagnets 140 used on the moving carrier 14 and stationary, external permanent magnets 153 carried on the track structure. Such an arrangement will cause an induced thrust between the magnetic motor elements 140 and stationary magnetic motor elements 152 fixed to the track structure. As stationary magnetic motor elements 152 cannot move, the thrust between magnetic motor elements 140 and 152 will cause magnetic motor elements 140 to move. However, as motor elements 140 are affixed to carrier body 54, which is in turn affixed to carrier 14, the entire carrier 14 will be caused to move and will be propelled along the rails at a constant speed which will be synchronous with the frequency of the alternating current which is applied to alternating current magnets 140.

Stationary motor elements 152 will be located the optimum distance above rails 55, as detailed in FIG. 10, so that the proper air gap 154 will be maintained between the moving 140 and stationary 152 magnetic elements. Where the stationary motor elements 152 will utilize permanent magnets 153, as preferred, these will be coupled with soft iron focusing shoes 160, with the linear spacing between these elements being the same as that of the spacing between moving electromagnets 140, on carrier 14. Magnets 153 will be backed by a continuous bed of soft iron 164 which serves to complete the magnetic circuit between adjacent permanent magnets of opposite polarity. The entire stationary permanent magnet assembly will be mounted rigidly to the track support structure 162. Imbedded in focusing shoe assembly 160 will be non-magnetic rails 158 upon which rubber tired wheels 156 mounted on the sides of moving motor units 142 will ride in order to control the air gap 154 between the moving 140 and stationary 152 magnetic units.

In order to prevent foreign objects from interfering with the operation of the motor, continuous shields 170 will be mounted on the track structure between rails 55. A gap 172 will be left in the center of shields 170 in order to permit passage of connecting section 103 of carrier 14. Since both the top and bottom of each rail 55 will be in contact with moving wheel surfaces 70, 90, and 108, rails 55 will be supported from the side by means of support brackets 174.

Other Components

In case of emergency disruptions of traffic, there will likely be a slight difference in the stopping distance of different carriers on the same track. In order to prevent damage to the carriers and to the elements being transported by one carrier ramming another, bumpers 176 will be mounted on spring-loaded or pneumatic arms 178 installed at each end of carrier 14.

On the top of main carrier body 52, near its center and in opposed position to each vehicle connector component 18 suspended from the lower carrier body 106, will be two sets of carrying handles 180 mounted on support members 182. Handles 180 will be substantially identical to those mounted on discrete elements such as private or public vehicles and cargo containers adapted to use the system. Handles 180 will permit the transportation of one carrier 14 by another carrier 14. By this means, disabled carriers will be able to be dispatched to repair shops. Moreover, as many as four carriers can be stacked for routine transfer from one station or region to another with a minimum sacrifice of traffic space or energy.

Access to the carrier's carrying handles 180 will be provided by two sets of spring-loaded doors 184 which will be thrust aside by connectors 18 of a corresponding carrier making vertical contact with them. Clearance without interference will be provided by having doors 184 hinged at their ends and opening at the point where they join.

Both upper shell 186 of upper carrier body 52 and lower shell 188 of lower carrier body 106 will partially cover wheels 70, 90, and 108. Shells 186 and 188 will also provide clearance for all motions of the running wheels 70, as well as for the shifting of switching wheels 90 and auxiliary wheels 108. Clearance (not shown) for the emergency brakes 138, the outer surface of which will form part of the exterior surface when not in use, will also be provided in lower carrier shell 188.

One of the major problems involved in the design of ground transportation systems powered by electricity is that of conveying power from a stationary external source to a rapidly moving vehicle. In the preferred embodiments an electrical connector, not shown in detail, will provide the required contact.

Switching Operations

Referring to FIG. 11, at each switching point 36, switching rails 200 will be installed just inside of each of the two normal rails 55. A variable gap 204 will be formed between switching 200 and normal rails 55, which gap will be adequate to allow the passage of the flanges on each wheel 70 and 90. As shown, each switching rail 200 will be oriented and shaped to parallel the non-adjacent normal rail 55. Each switching rail 200 will therefore deviate from the normal rail 55 adjacent to it as the two normal rails 55 deviate from each other. Each normal rail 55 will eventually provide one of the rails in the two resulting separate sets of tracks.

As carrier 14 approaches each switch 36, its switching wheel assemblies 88 will shift switching wheels 90 into position for either a right or a left turn, the direction of shift being the same as the direction of turn. When the switching wheels on the side of carrier 14 opposite to the chosen direction of turn are placed into contact with the switching rail 200, also on the side opposite to the chosen direction of turn, the support of carrier 14 on that side will then be assumed by switching wheels 90 on that side. This will have the result that the running wheels 70 on that side (the side opposite to the chosen direction of turn) will then be lifted off of normal rails 55 on that side. Carrier 14 will then follow the tracks at the switch in the direction in which switching wheel 90 has not contacted switch rail 200, that is the side on which normal wheels 70 have remained in contact with normal rail 55. Subsequently, a pair of non-parallel new normal rails 206, which will each be parallel to one of the pair of continuing rails 55 will commence. The normal wheels 70 on that side of carrier 14 will contact new rail 206 and reassume the weight of carrier 14, continuing the selected (switched) route of the carrier. The switching rails 200 will end shortly downtrack after new normal rails 206 commence. A gap 208 will be provided in each new normal rail 206 downtrack from switching rails 200 in order to allow the narrow web section 103 of carrier 14 to pass through them. Grooves 210 will be cut into each new rail 206 adjacent to the location where these rails cross one another in order to allow for the passage of the flanges of wheels 70 and 90 of a carrier taking the opposite course which will cross that track.

Anticipatory Steering

Anticipatory steering of carrier 14 around all curves will minimize wear on both the carrier wheels and the rails and will also provide for a smoother ride. Collimated light sources 210 (see FIG. 3) mounted on both sides of both ends of carrier 14 will be directed to shine their light beams parallel to the plane of rails 55, but at an angle to the direction of travel. Photodetecting cells 212 will be adjacent to each light source 210. Beams from lights 210 will be reflected from reflecting strips 214, as shown in FIG. 10, back to photocells 212. The points at which the reflected beams impinge upon photocells 212 will be a function of the curvature of the rail at that point. By analyzing the varying positions of each reflected beam, and comparing these with the orientation of carrier 14 itself, both the curvature of the rails and the change in curvature at any point along the rails can be determined. This information will then be processed by an on board computer (not shown) to provide information to steer the carrier trucks 56 and wheels 70 along tracks 55. Steering will be accomplished by means of servomotor 216 located within sleeve 58 attached to body 54, as shown in FIG. 5. Servomotor 216 will be connected by means of gear 218 to an internal gear 220 rigidly mounted to coupling 64. When activated to steer, servomotor 216 will cause gear 218 to rotate and vary the orientation between sleeve 58 and coupling 64 with the result that truck 56 and its wheels 70 will anticipate and be steered around curved sections of rails.

Upon receiving a "switch ahead" signal, not shown, a pre-programmed sequence of steering maneuvers designed to direct the carrier through the switch will be followed in which the carrier control system will initiate four separate operations:

a. The switching wheels 90 will be shifted toward the chosen direction of travel;

b. The auxiliary wheels 108 on the side opposite the chosen direction of travel will be retracted.

c. The steering control system, discussed above, will be de-activated.

d. Servomotors 216 will steer trucks 56 through a pre-programmed sequence of turns.

Additions And Modifications To The System

Each carrier will also be equipped with a number of components which are not shown in the drawing. Included among these items will be:

a. Batteries or generators to provide emergency power;

b. A computer or other programmed control system;

c. Various monitoring devices needed to assure that all major components are working properly; and

d. Communication lines connecting the carrier with the system and with the vehicle.

Carriers designed for heavier loads will have to be sturdier in construction than carrier 14. They will also be equipped with an additional truck, including running and switching wheels mounted, for example, at the center of the carrier body. As such a center truck assembly will always be oriented in the same direction as the carrier body, it will not be necessary for it to have the mobility and steering capability of trucks 56. However, some provision for both lateral and vertical movement of such a central truck will be made in order for the central truck assembly to support its proper share of the load at banked curves and changing slopes. Additional motor elements will also be provided to supply added power needed for heavier loads. When handling heavier loads the lower carrier body will also be equipped with additional auxiliary wheels and larger or multiple brakes.

Long loads may require more than one carrier for their transport. Such multiple carriers will be equipped with devices permitting their connecting components to pivot relative to the long load which they are carrying. This will be a relatively simple matter if only two carriers are required, but the mechanism will grow more complex with three or more carriers. For such longer loads it will be more sensible to have the load suspended from two specially designed carriers, not shown, each of which will be reticulated and half again as long as carrier 14. Such longer, reticulated carriers will normally only be used in tandem so that each pair will occupy about three consecutive carrier sites on the track, to distribute the load over about the same length of track as would three standard carriers.

Private automobiles may be constructed or adapted to use the system of the present invention. Mechanisms which will be used to connect such private automobiles to a carrier must also be usable for cargo containers, public transit vehicles, and other discrete elements as well.

A number of alternative mechanisms may be employed to couple automobiles and other loads with carriers, including, for example, but not limited to mating screwthreads, clamshell devices, locking pin devices, semi-threaded breechblock mechanisms, and so on. For maximum reliability, that portion of the coupling mechanism which will be attached to the to-be-carried element should be as rugged and as simple as possible. In addition, the mechanism should exhibit reliability in the face of adverse weather conditions, such as rain, snow, ice, or dust. For the sake of styling, the portion of the coupling mechanism attached to an automobile may be incorporated into a rooftop luggage rack, or it could be recessed into the roof of the automobile, either being hidden by cover panels, or equipped with means to elevate it above the rooftop when needed.

It is therefore seen that the present invention will provide a railway system in which each piece of rolling stock will be self-propelled and capable of being independently routed within networks of the system. Additionally, it will provide a railway system comprised of carriers which will couple with and transport discrete elements, such as private automobiles while the driver remains in the automobile, in such a way that the advantages of high efficiency and low energy consumption of a railed system will be realized, without sacrificing the versatility and convenience of an automobile at the destination location. It will also provide to-be-carried elements with coupling components which will be easy to connect to and disconnect from the self-propelled carrier cars in the system. It will provide a high capacity railway system, due to the use of linear synchronous motors as the drive source and the use of cars having movable switching wheels with their own specially designed rails, which will avoid the need for movable switching rails. It will provide for the use of a computerized traffic control system to facilitate loading and unloading of cars, accelerating and decelerating cars, and switching and routing of cars. It will provide means for continuously transferring electrical energy from stationary power lines associated with the systems track to the cars which will be moving at high speeds. When these features are combined they will provide a transportation system which will be faster, safer, less expensive and less subject to disruption than present transportation systems.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that the foregoing and other modifications or changes in form and details may be made therein without departing from the spirit and scope of the invention as claimed, except as precluded by the prior art.

1. A railway car 14, designed for movement on rails 55, including in combination a body member 54 and at least two wheels 70 rotatably connected to said body member 54, said wheels 70 being designed to rest upon and follow a rail network 40 characterized by:

means 18 for connection to and disconnection from a discrete element 12, said connection means 18 being carried by said body member 54, whereby a discrete element 12 can be easily connected to, carried by, and disconnected from said railway car 14.

2. The car 14 of claim 1 characterized by any one or more of the following:

(a) said connecting means 18 carried by said railway body member 54 including a clamp;

(b) said rails 55 being elevated and said connecting means 18 extending below said rails;

(c) said car 14 being self-propelled;

(d) said car including at least one switching wheel 90, said switching wheel 90 having a first, normal position out of driving contact with its associated rail 55 and at least one second switching position in driving contact with a rail 55, whereby a car 14 is directed in a chosen direction at switching points 36 by shifting said switching wheels 90 without the need for moving said rails 55.

3. The car 14 of claim 2, subparagraph (a) characterized in that said clamps are in the shape of a U having a pair of legs defining an open end, and including a locking portion 228 which can be moved to close and open said open end of said U-shaped clamp for connection to and disconnection of said clamp from a to-be-carried discrete element 12.

4. The railway car 14 of claim 2 subparagraph (c) characterized in that said car is capable of being routed independently along a railway network 40.

5. The railway car 14 of claim 4 characterized in that

(a) said routing is computer controlled; and/or

(b) for which motive power is provided by supplying current to a linear electric motor, said linear electric motor including a moving magnetic portion 142 connected to said car and a stationary magnetic portion 152 located for operative interaction with said magnetic portion 142 connected to said car 14, wherein thrust developed between said magnetic portions 142 and 152 results in movement of said car 14 along said rails 55.

6. The system of claim 5 subparagraph (b) characterized by any one or more of the following:

(a) said linear electric motor being synchronous;

(b) means being provided for orienting said magnetic portion 142 connected to said car 14 as the body of said car pivots or tilts, whereby said moving magnetic portion 142 carried by said car 14 remains in operative spaced relation to said stationary magnetic portion 152 of said motor, substantially regardless of the tilt or direction or said car 14;

(c) means for steering at least some of said wheels 70 of a said car so that said steered wheels follow rails 55, whereby wear on the wheels 70 and rails 55, and wheel noise are reduced;

(d) means for routing each car 14 independently by selecting the direction said car will take at each switching point.

7. The system of claim 6 subparagraph (a) characterized by means for controlling the frequency of the alternating current supplied to said electromagnetic portion of said synchronous motor is provided, whereby the speed of said motor and of said car 14 can be controlled.

8. The system of claim 6 subparagraph (c) characterized by means for anticipating the direction and/or curvature of said rails so that said steering means may follow said rails.

9. The system of claim 8 characterized in that said anticipating means includes a light beam which is directed to and reflected from said track, and means for receiving and analyzing said reflected light.

10. A railway system including the car 14 of claim 2 subparagraph (d) wherein said system includes stationary switching rails 206 at switching points 36, said switching rails 206 juxtaposed to the rails 55 upon which said car 14 normally rides, whereby when said switching wheel 90 is placed in its switching position at a switching point 36, said switching wheel 90 makes contact with a switching rail 206, whereby said car 14 turns in a direction opposite to the direction of shift of the switching wheel 90 which is in contact with a switching rail 206.

11. The system of claim 10 characterized in that said body portion includes a second body portion 106 which depends from a first body portion 54; said first body portion 54 being joined to said second body portion 106 by joining means 103, said second body portion 106 extending below said rails 55, said connection means 18 being carried by said second body portion 106.

12. The system of claim 11 characterized in that said switching rails 206 at switching points include a gap 208, whereby said joining means 106 can pass through said gap 208 at said switching point 36.

13. A railway system characterized by, in combination, a railway car 14, a rail network 40, and to-be-carried discrete elements 12, wherein said car 14 includes a in combination a body portion 54 and at

least two wheels 70 rotatably connected to said body portion, said wheels 70 being designed to rest upon and follow said rail network 40, and means 18 for connection to and disconnection from said discrete element 12, said connection means 18 being carried by said body portion 54, and said discrete to-be-carried element 12 includes means 16 for being connected to said connection means, whereby said discrete element 12 can be easily connected to, carried by, and disconnected from said railway car 14.

14. The railway system of claim 13 characterized in that

(a) said discrete to-be-carried element is selected from the group consisting of self-propelled vehicles 12, crates 220, pallets, cargo containers, truck trailers, and similar railway cars 14 and/or

(b) an automatic traffic control system for loading and unloading cars, accelerating and decelerating cars, and routing cars is included in said railway system;

15. The system of claim 14 subparagraph (a) characterized in that said system includes a station 10 for associating said railway cars 14 and said discrete to-be-carried elements 12.

16. The system of claim 15 characterized by any one or more of the following:

(a) said station 10 includes means 30 for orienting said discrete to-be-carried element 12 to a car 14 so that connection between them is facilitated;

(b) said discrete to-be-carried element 12 includes a light source 28 and said station 10 includes a light detector 30, whereby the action of said light detector 30 in determining the location of said light source 28 is utilized to orient said discrete to-be-carried element 12 with a car 14;

(c) a vertically movable platform 26 is used to juxtapose said discrete to-be-carried element 12 with a railway car 14 so that said car 14 and said element 12 can be connected by said connection means 18.

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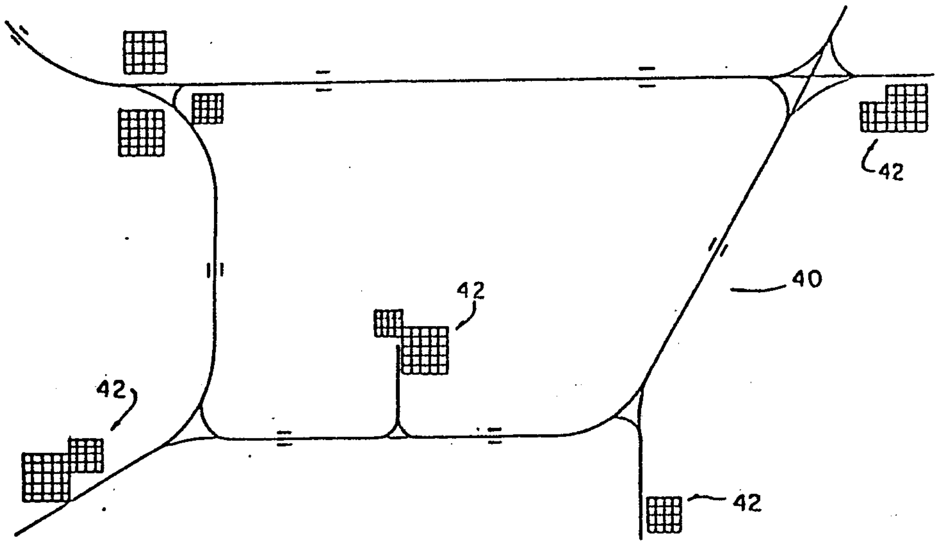
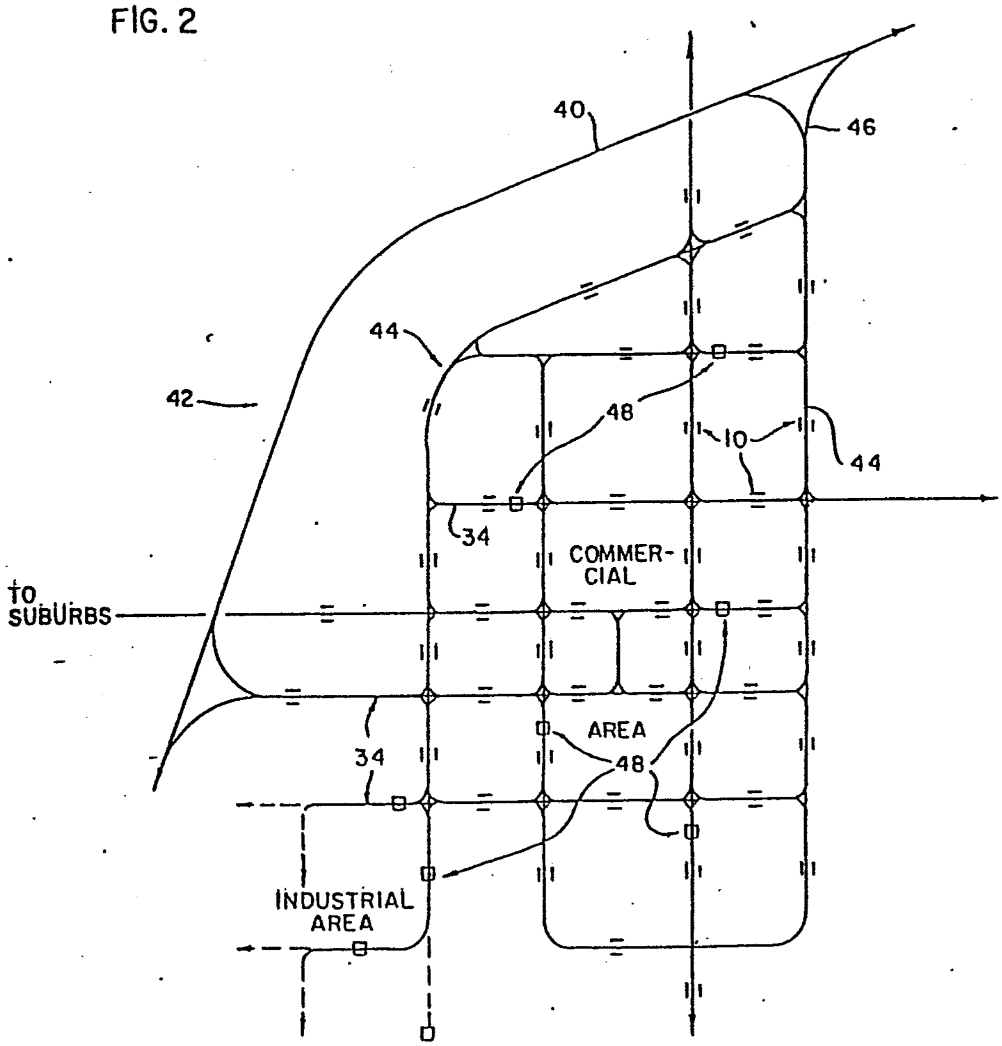


FIG. 2



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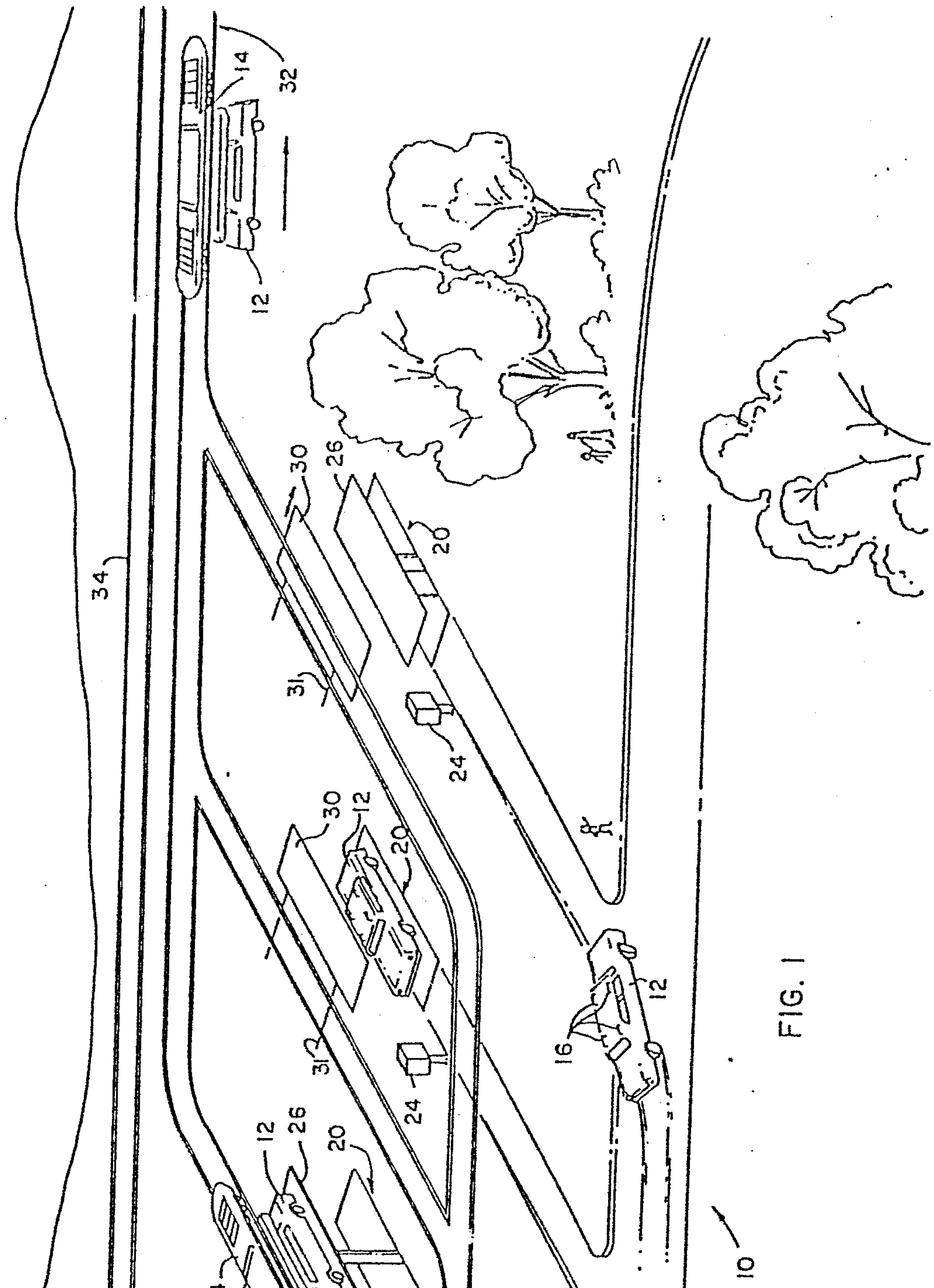

FIG. 1

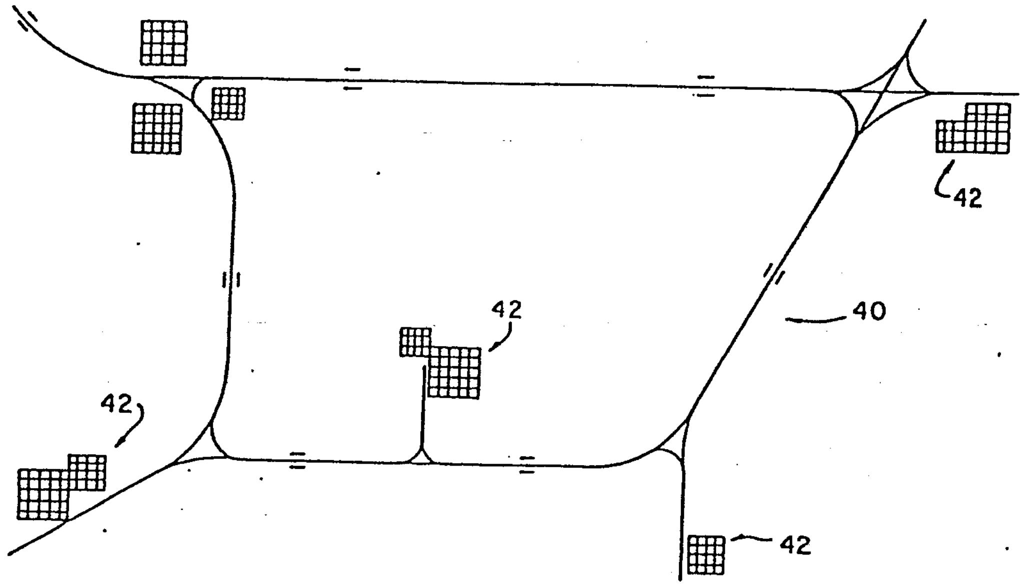
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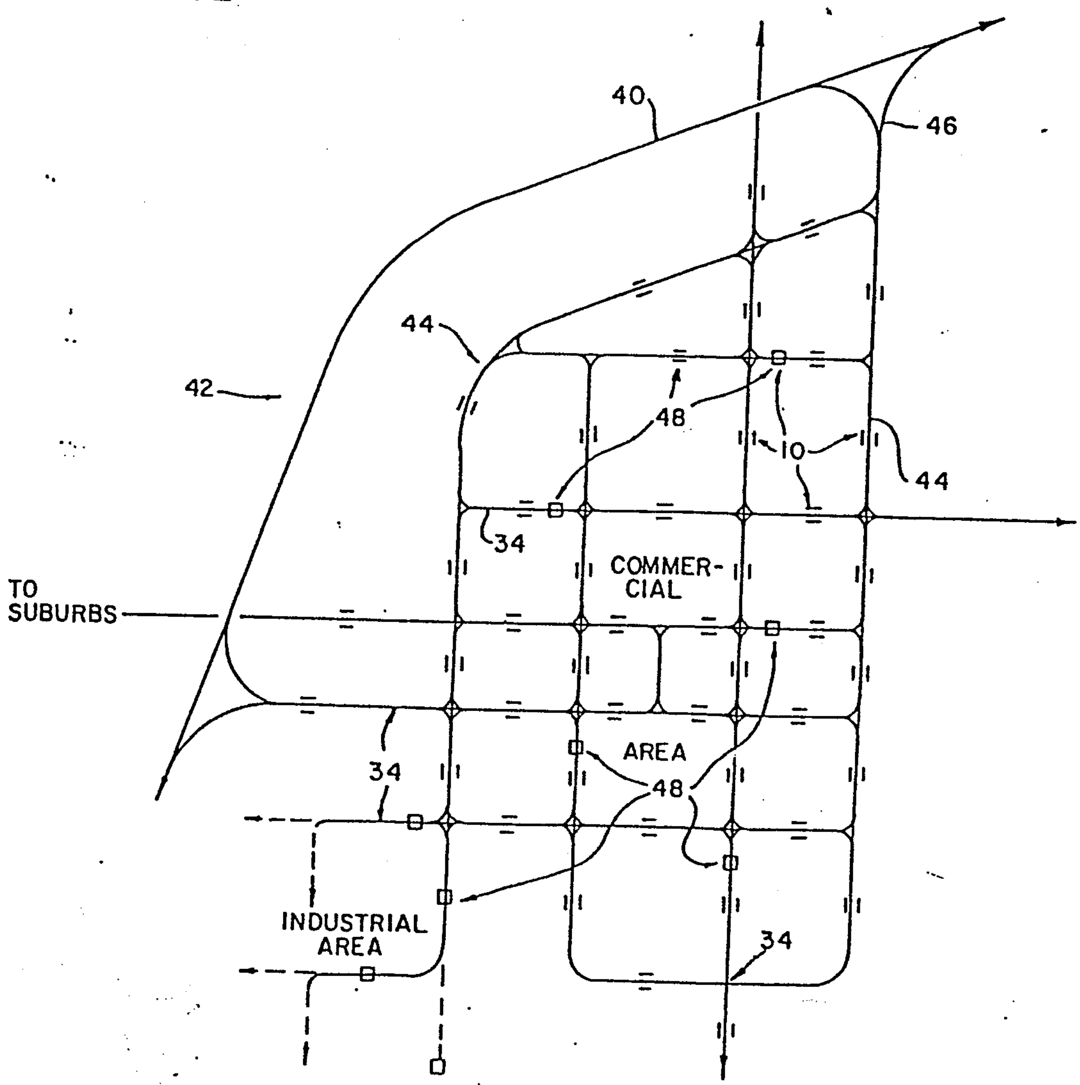
FIG. 2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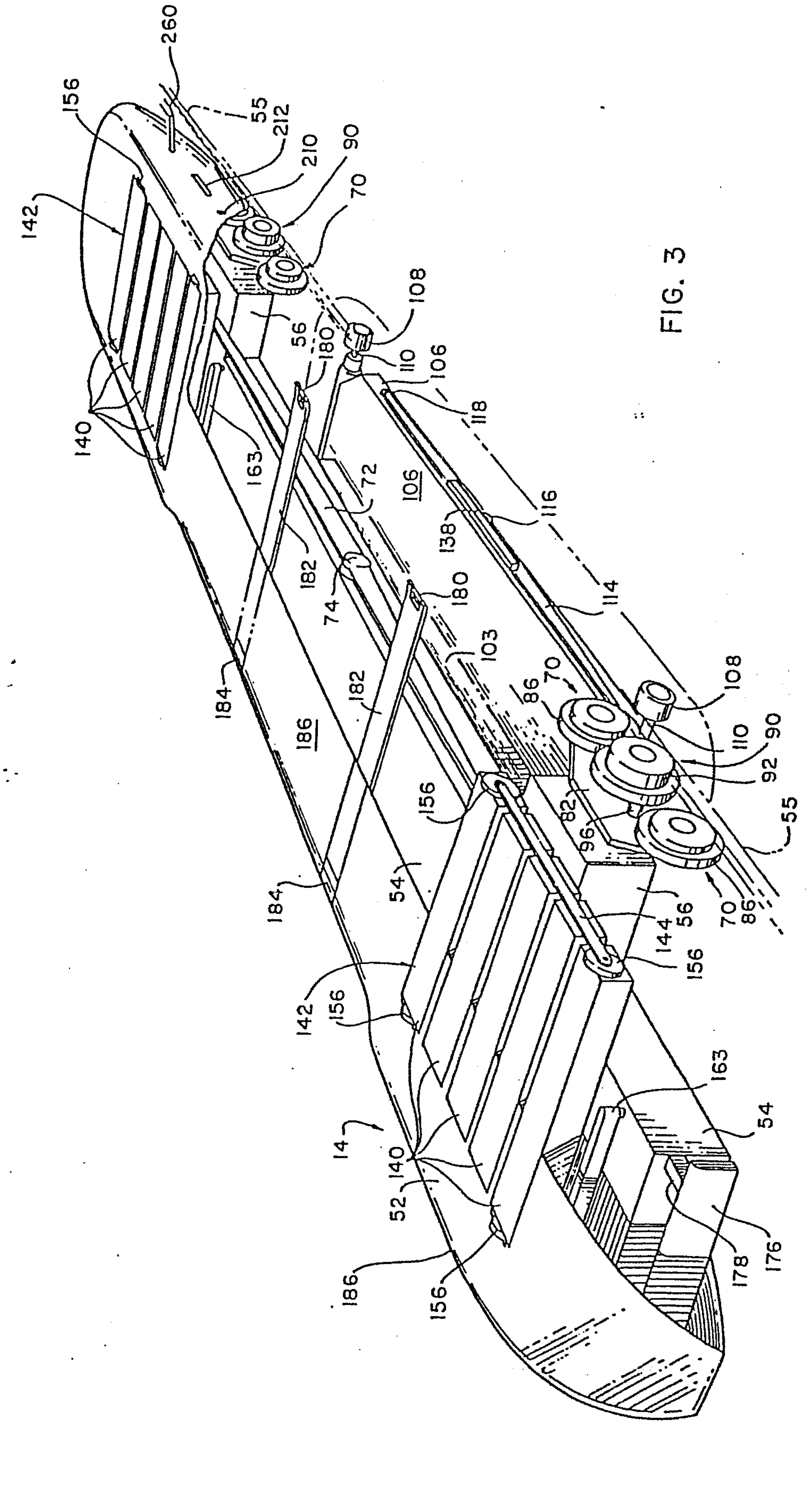
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FIG. 3

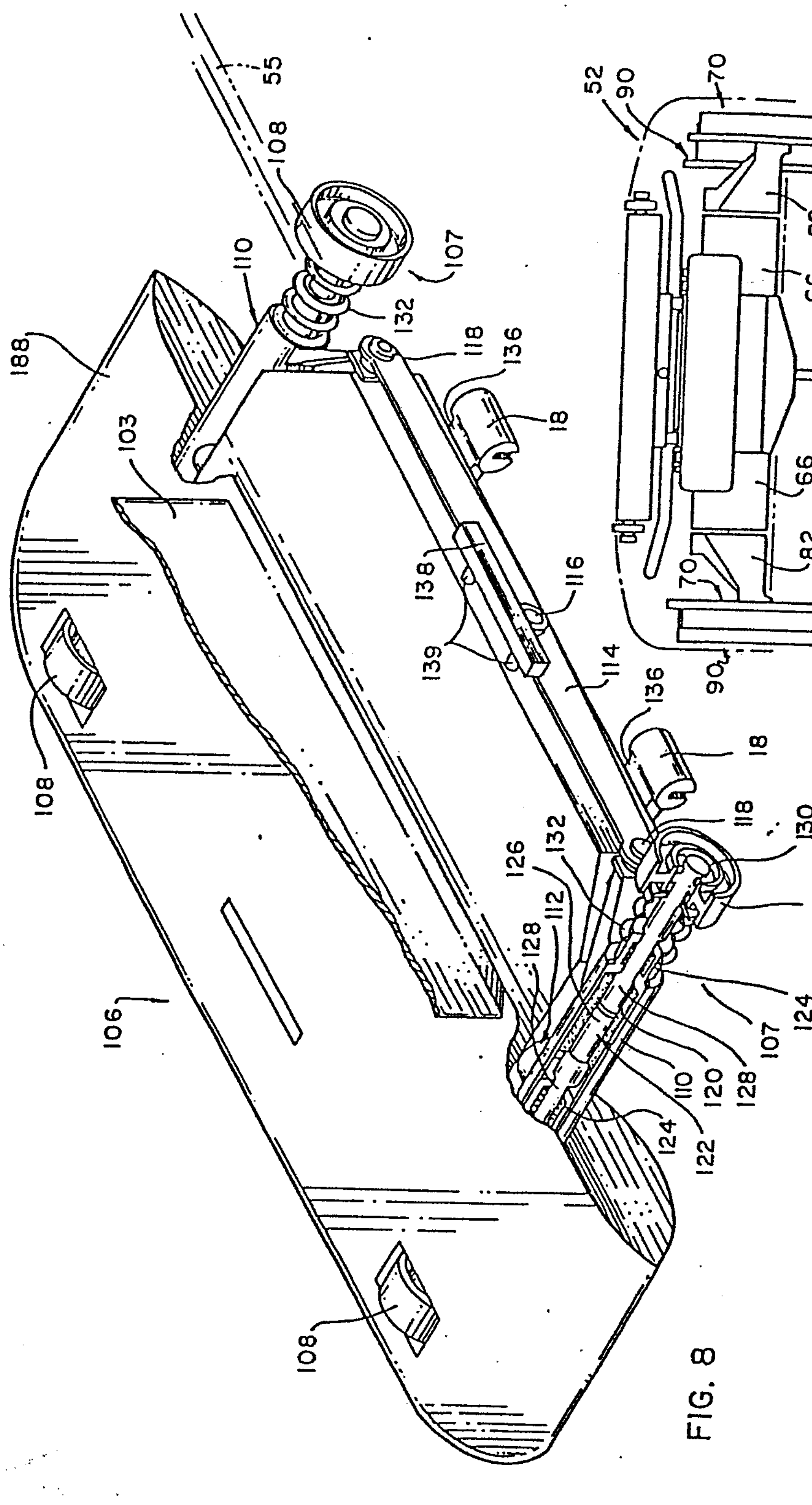
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FIG. 8

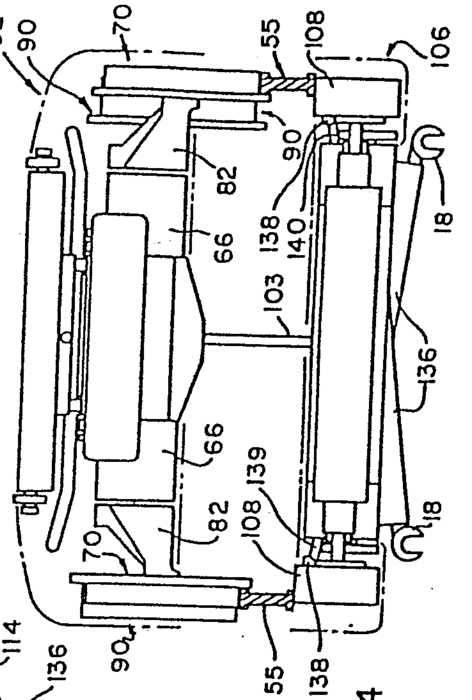
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FIG. 4

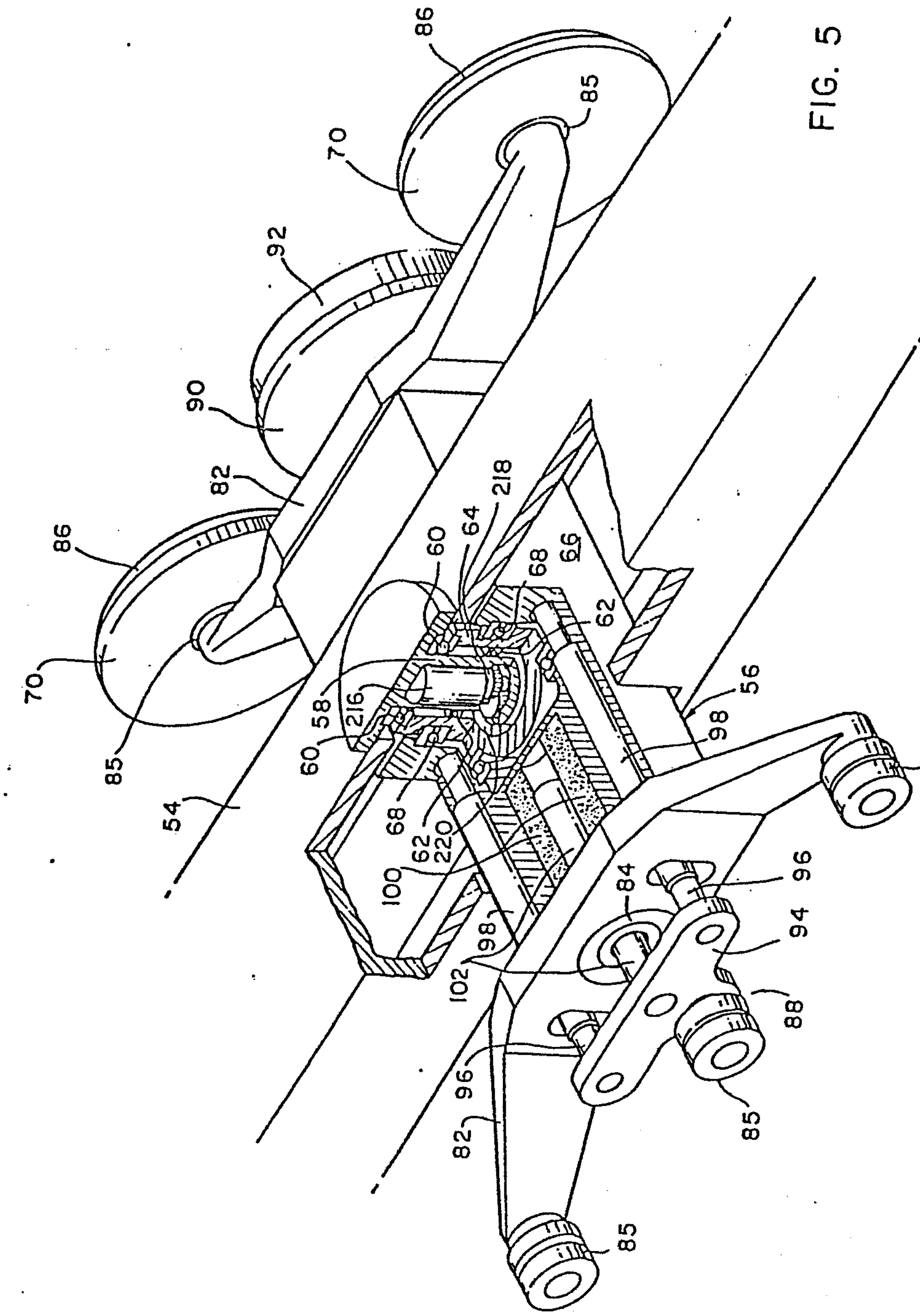
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FIG. 5

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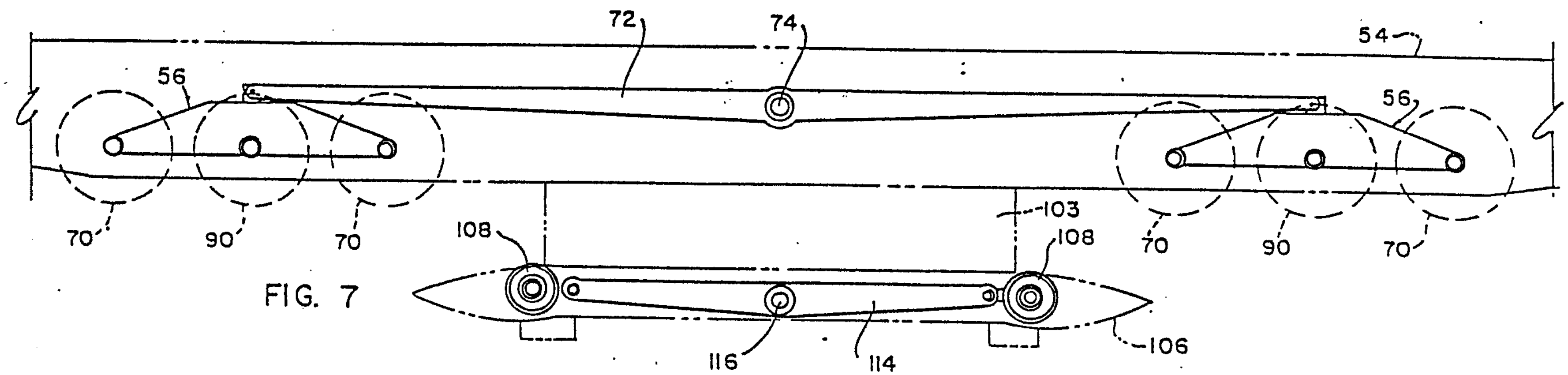

FIG. 7

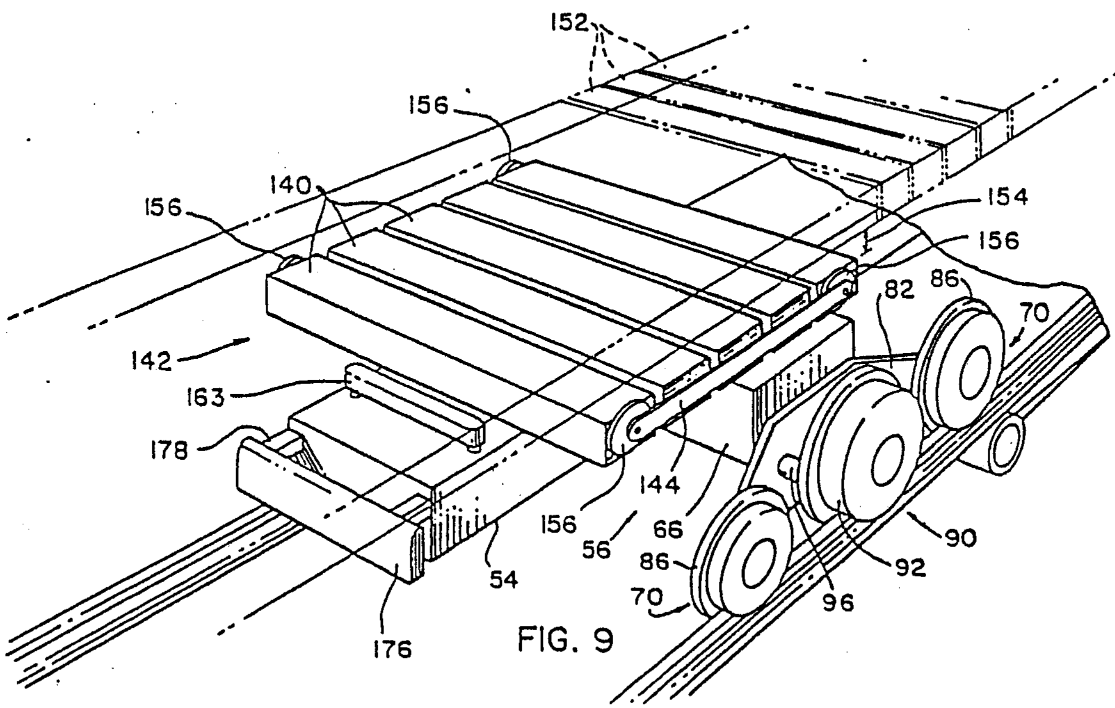

FIG. 9

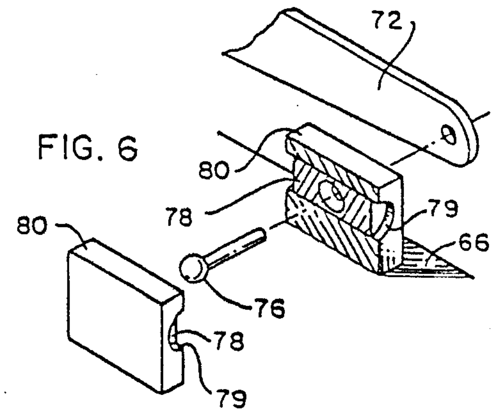

FIG. 6

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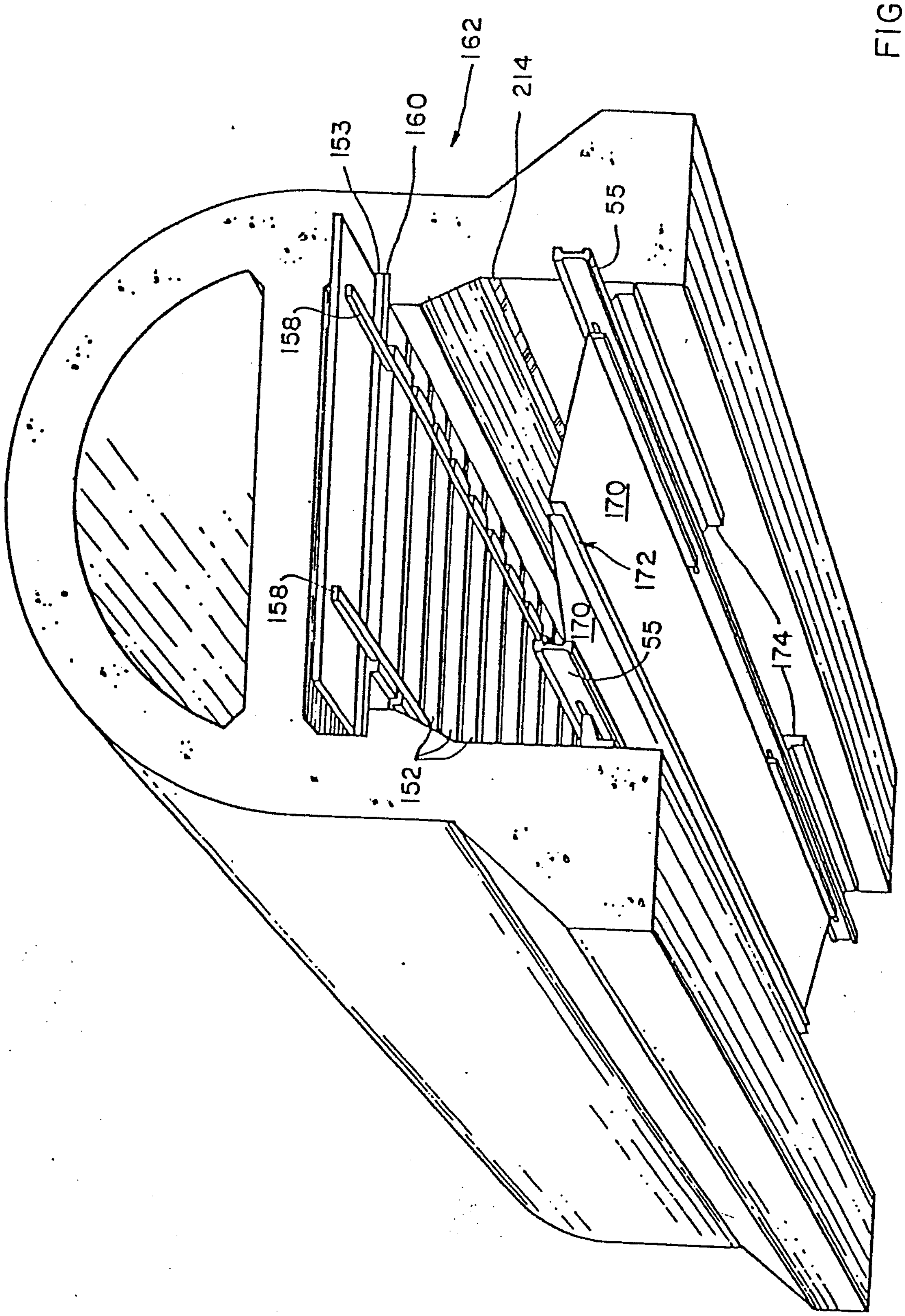

FIG. 10

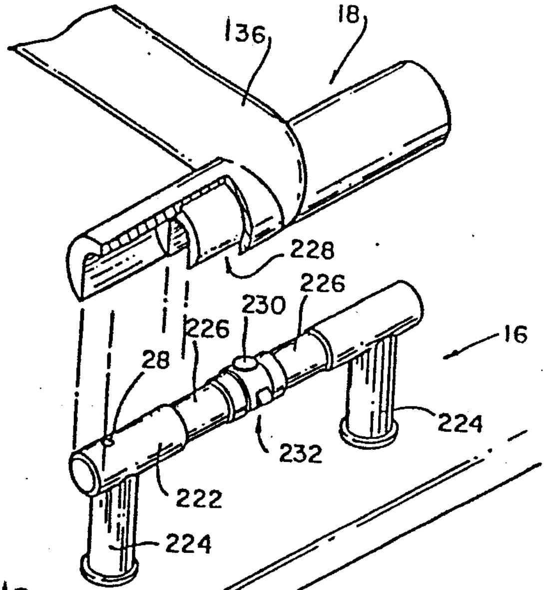

FIG. 12

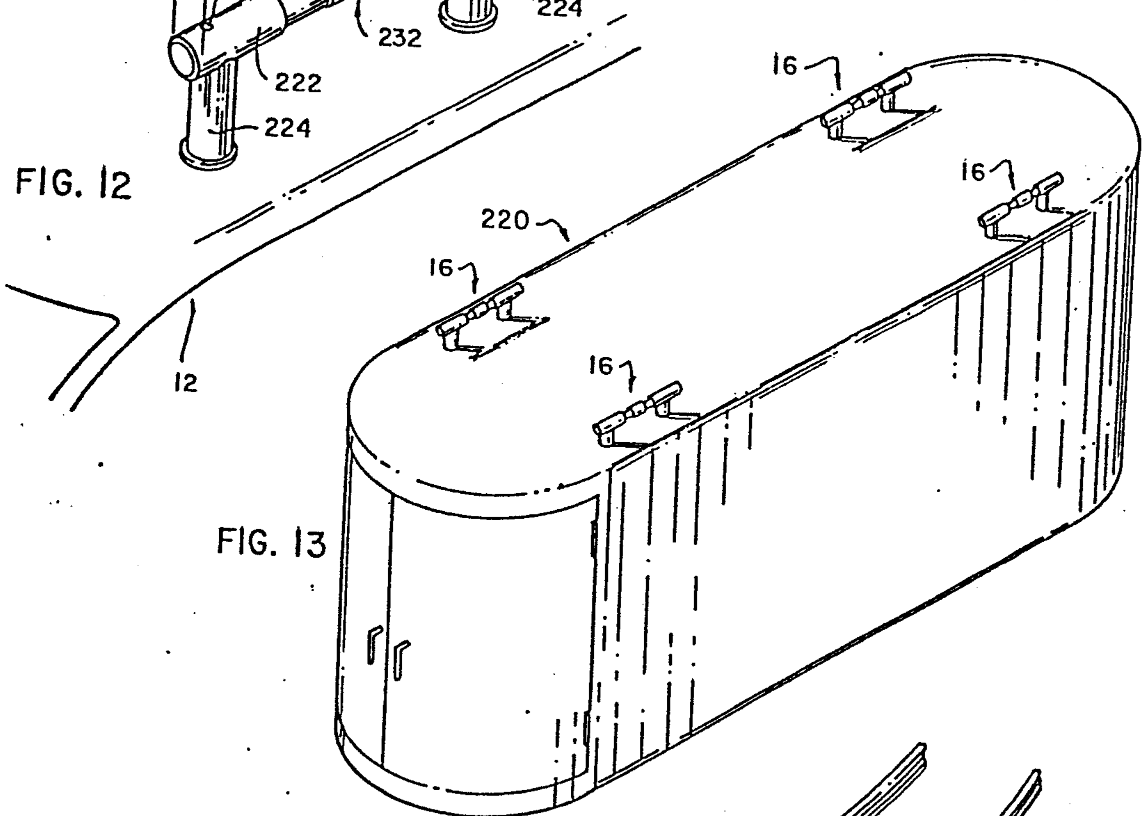

FIG. 13

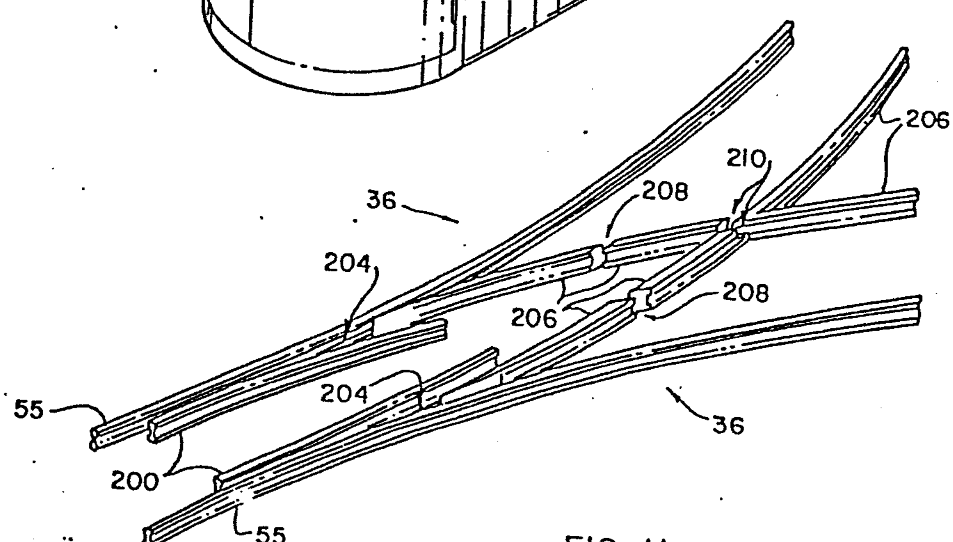

FIG. 11