United States Patent

[11] 3,541,962

[72] Inventor **William H. Avery**
8621 Georgia Ave., Silver Spring, Maryland 20910

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[45] Patented **Nov. 24, 1970**

[54] **URBAN TRANSPORTATION SYSTEM**
20 Claims, 17 Drawing Figs.

[52] **U.S. Cl.** **104/25,** 104/20, 104/94, 104/178, 104/214
[51] **Int. Cl.** **B61k 1/00,** B61b 3/00
[50] **Field of Search** 104/20, 25, 28, 30, 89, 91, 93, 94, 113, 178, 214, 215

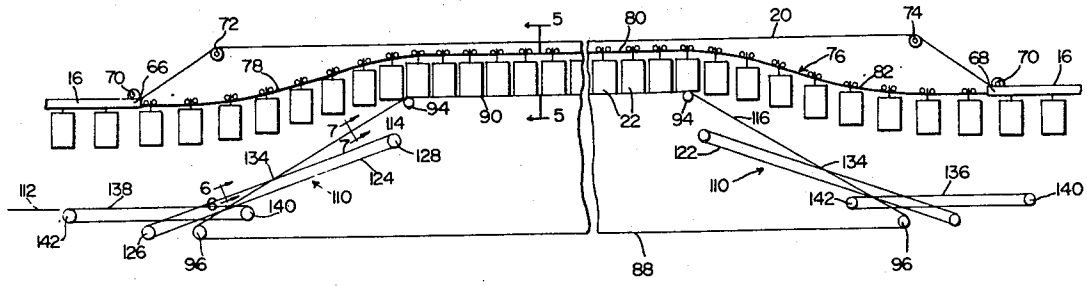
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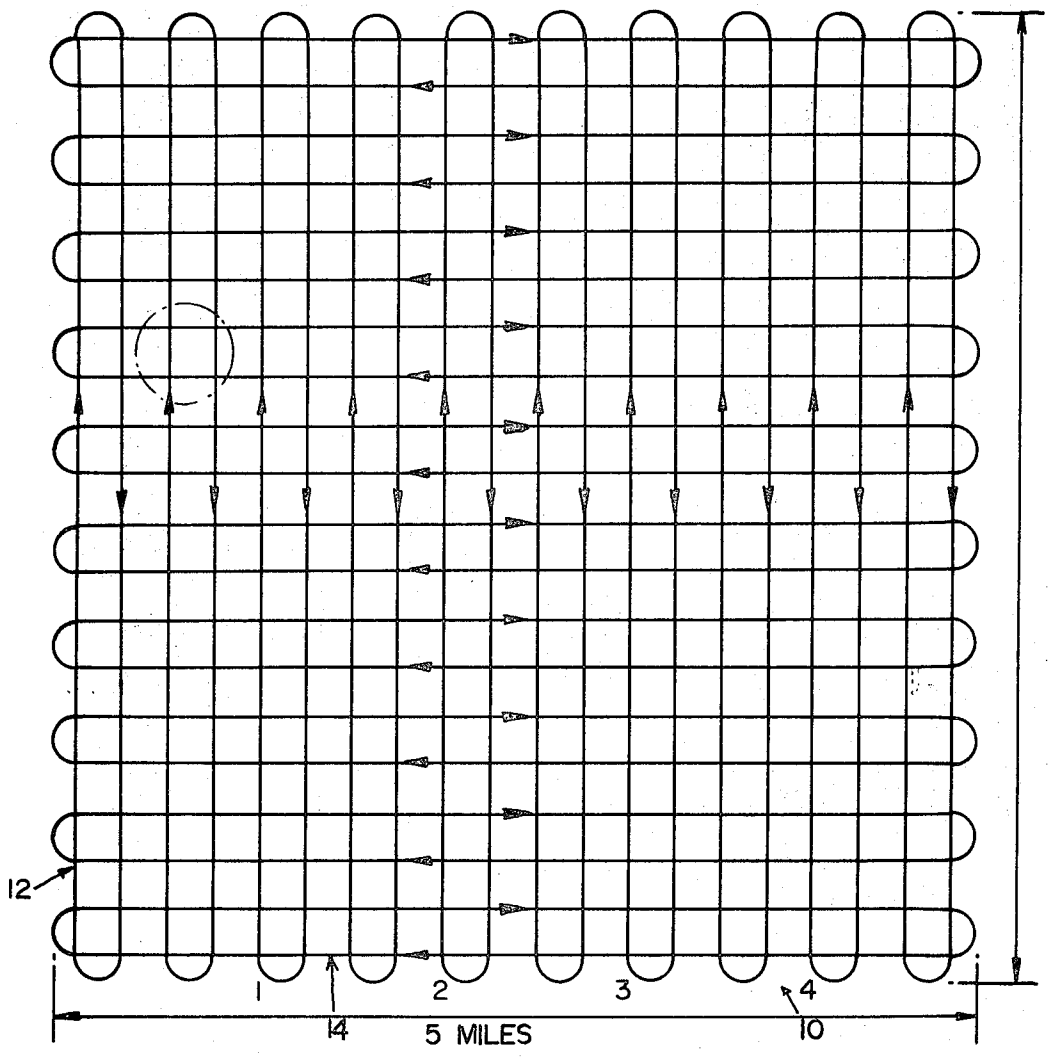
Primary Examiner—Duane A. Reger
Attorney—Stowell & Stowell

ABSTRACT: An urban aerial car transit system for easily accessible, immediately available local transportation which comprises a closely interdigitated series of intersecting north-south and east-west lines of overhead supporting rails and continuously driving cables laid out in separate, parallel loops of minimum block lateral spacement from which small passenger cars are suspended for fixedly spaced-apart movement between aerial stations provided at closely spaced, *e.g.*, 3-block points of intersection between the latitudinally and longitudinally extending lines. Arriving at a station, the cars disengage from the cable and decelerate by gravity up an inclined rail section to arrive in a closely grouped formation on a bottom supporting moving belt carrying boarding and leaving passengers so that the passengers are interfaced with the cars with no relative movement therebetween. Leaving the station, the cars accelerate by gravity down a declined section of the rail to mesh with the cable for rail supported and cable driven orderly spaced full speed movement to the next station. The passengers gain access to and from the moving belt from the lower street level on an inclined conveying surface composed of a series of interleaving end-to-end belts of gradually varying speeds.



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FIG 1.



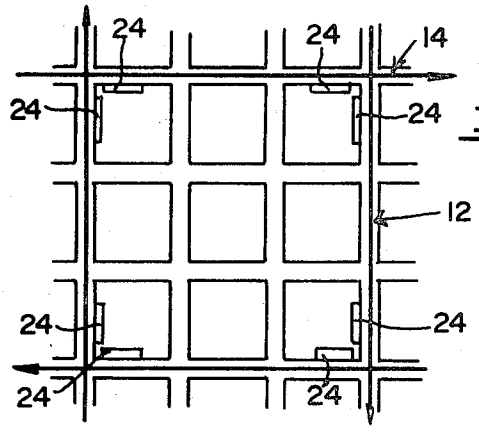


FIG 2.

INVENTOR
WILLIAM H. AVERY

BY Stowell & Stowell

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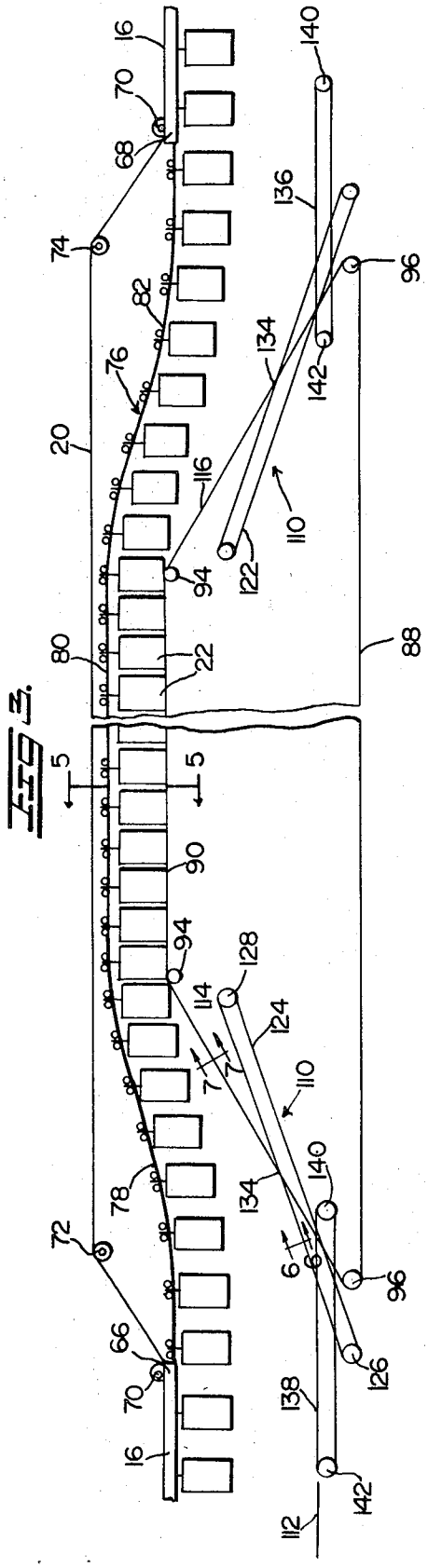


FIG. 3.

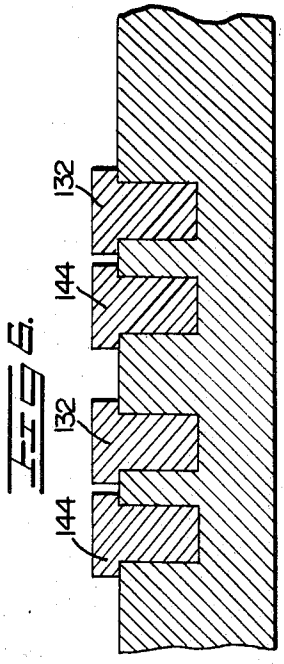


FIG. 5.

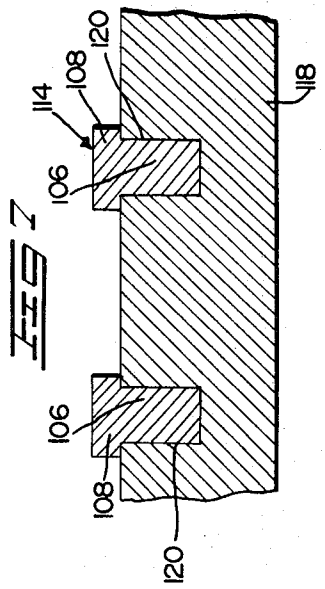


FIG. 7.

INVENTOR
WILLIAM H. AVERY

BY Stauffer & Stauffer

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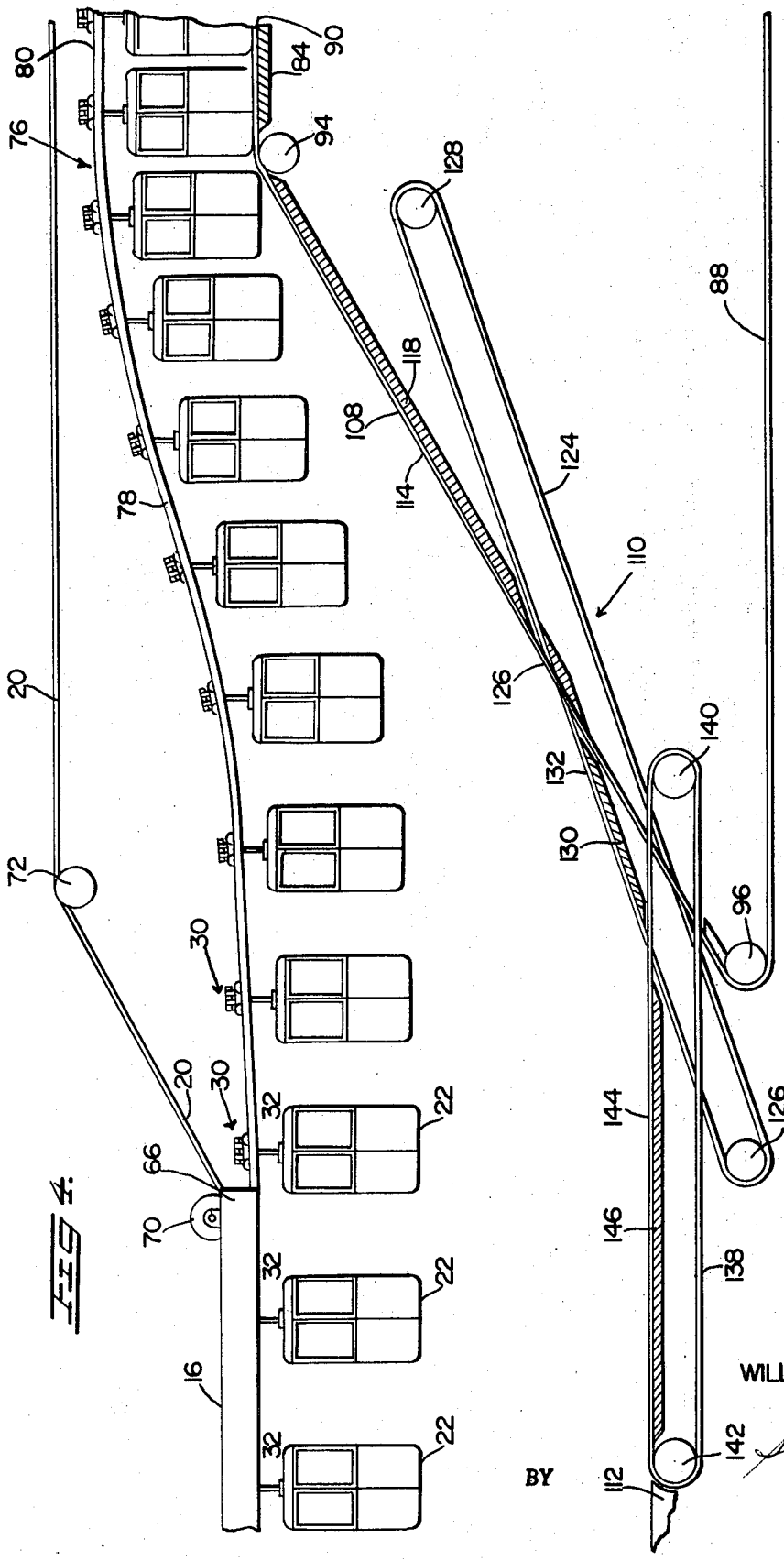


FIG 4.

INVENTOR
WILLIAM H. AVERY

BY Stowell & Stowell
ATTORNEYS

Fig 5.

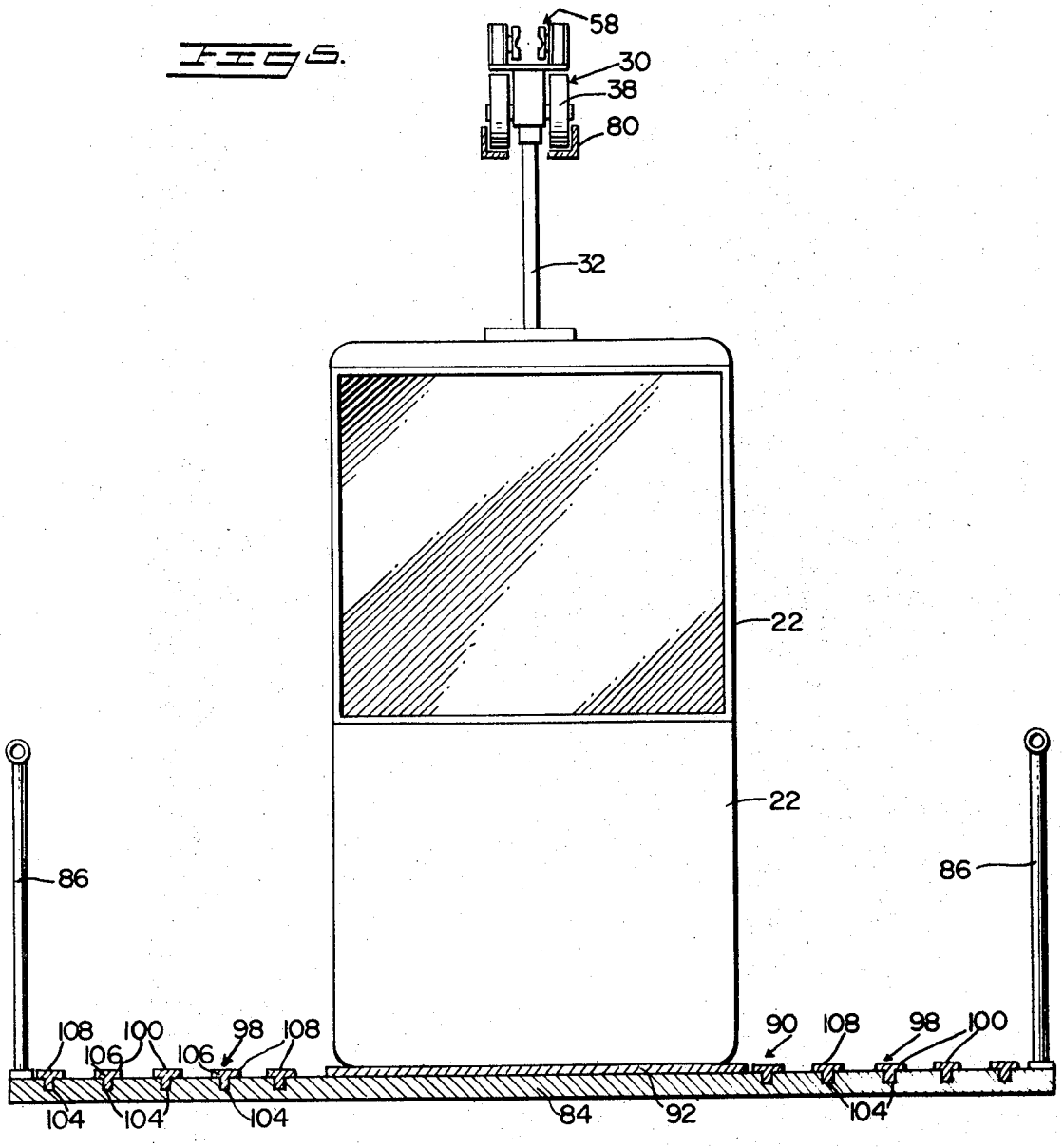
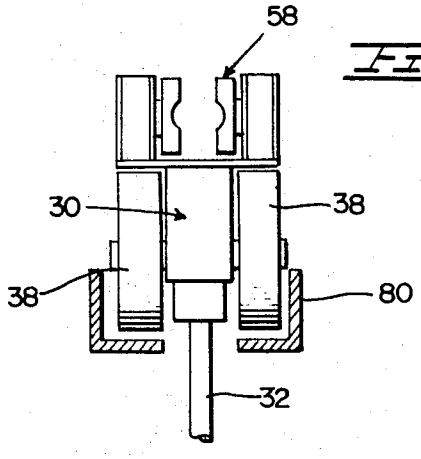


Fig 5a.

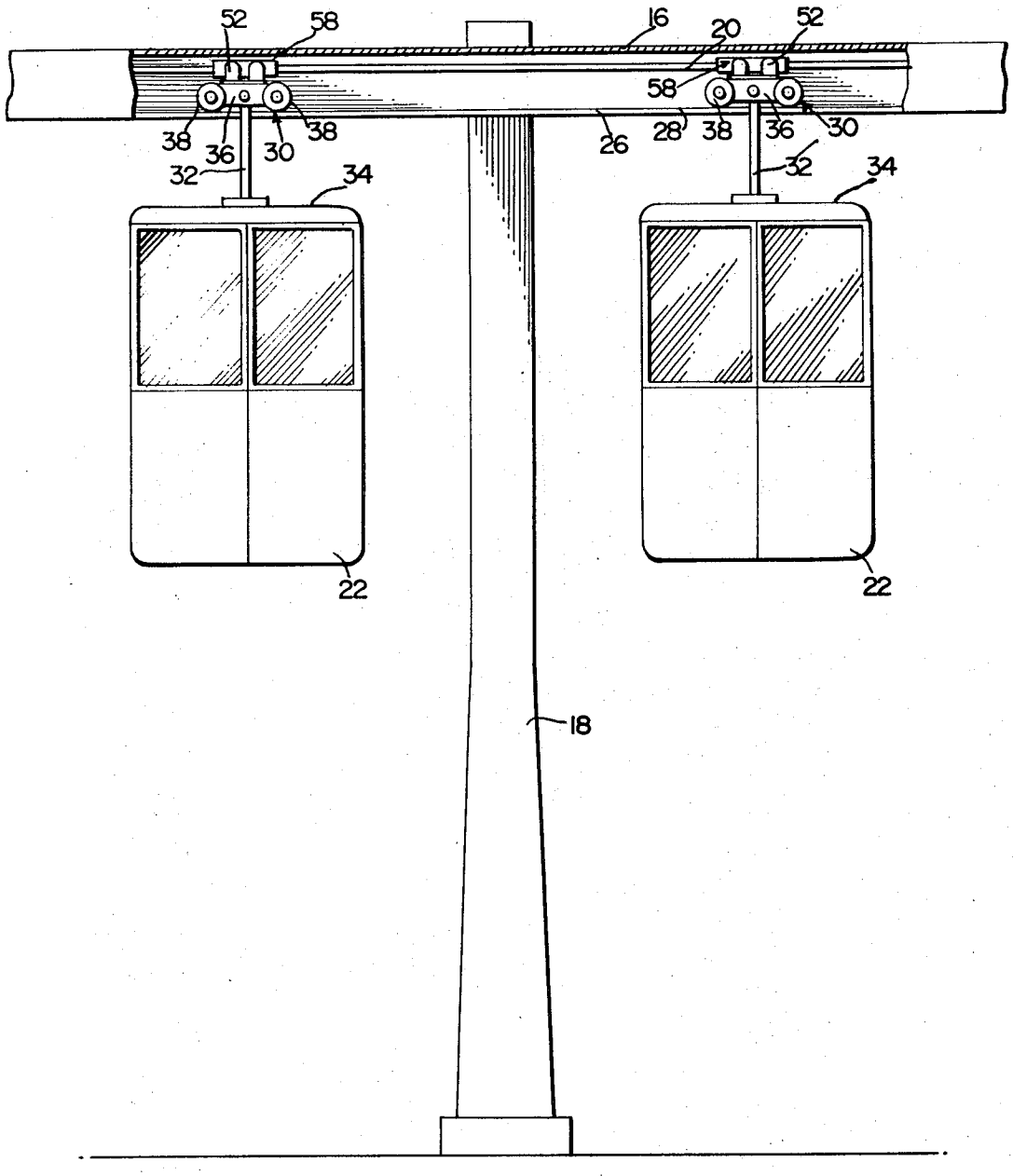


INVENTOR
WILLIAM H. AVERY

BY Stowell & Stowell

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FIG 8.



INVENTOR
WILLIAM H. AVERY

BY Stowell & Stowell

ATTORNEYS

Fig 9.

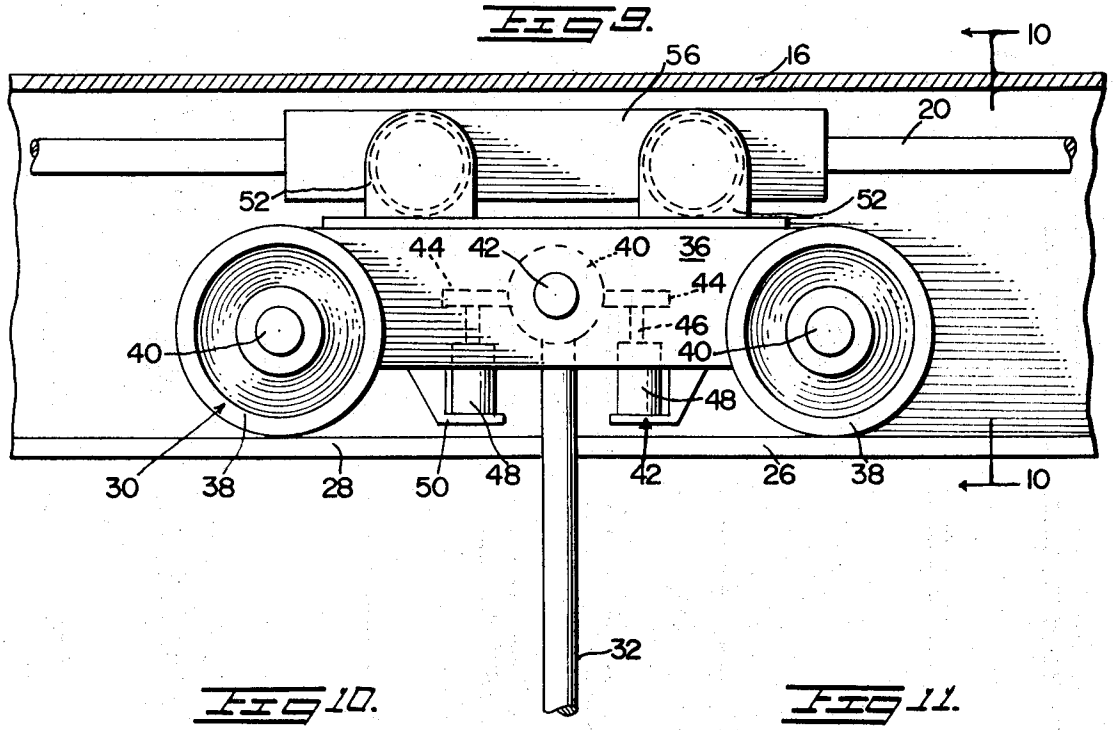


Fig 10.

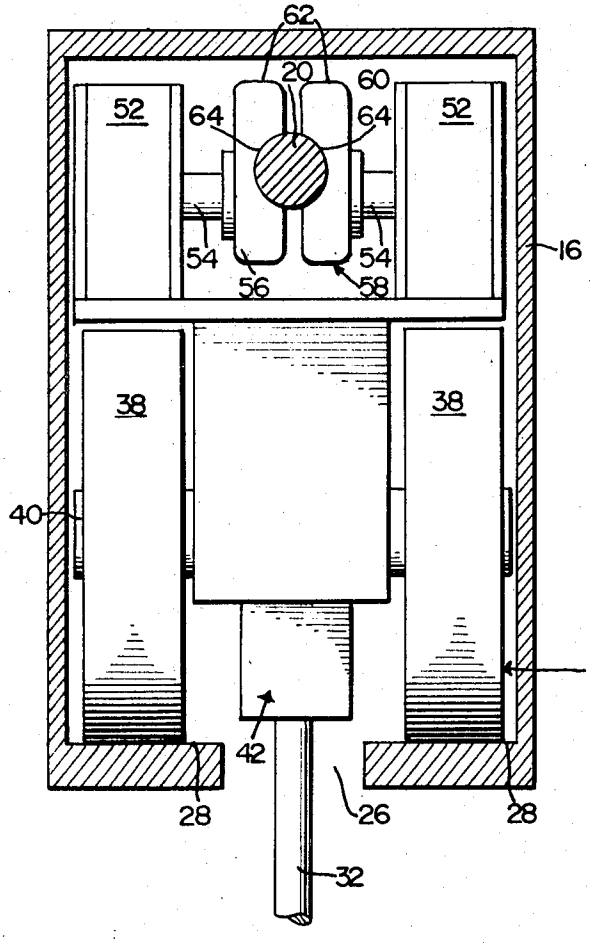
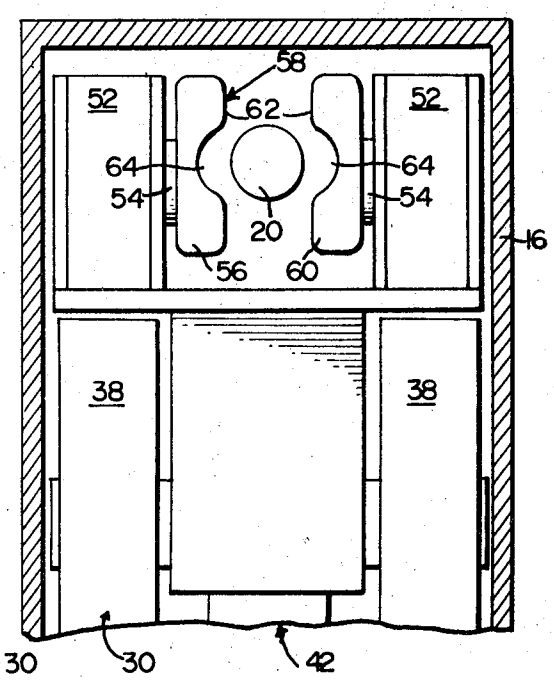


Fig 11.



INVENTOR
WILLIAM H. AVERY

BY Stowell & Stowell

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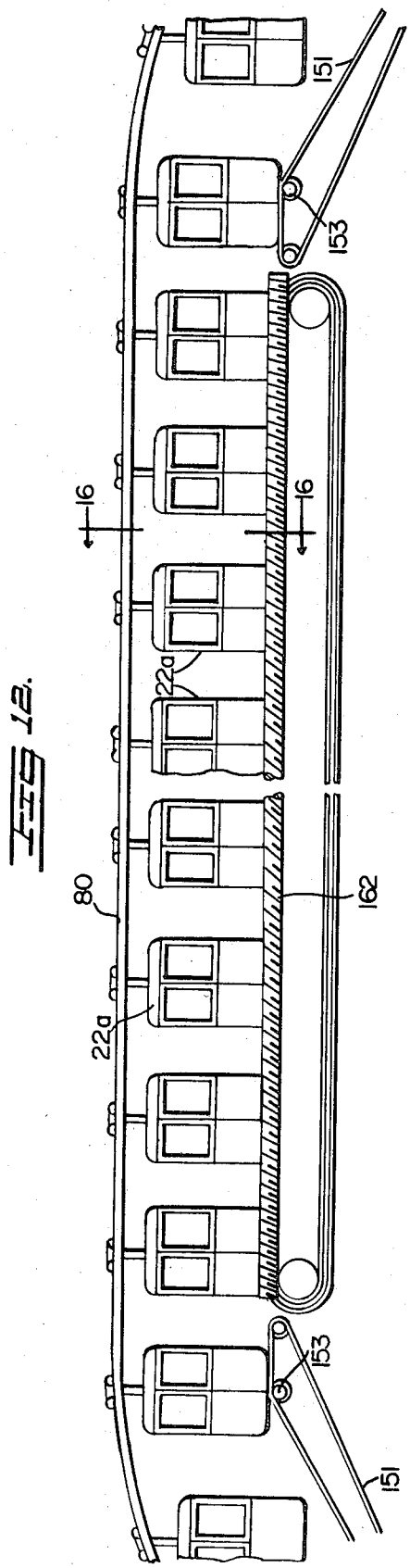


FIG 12.

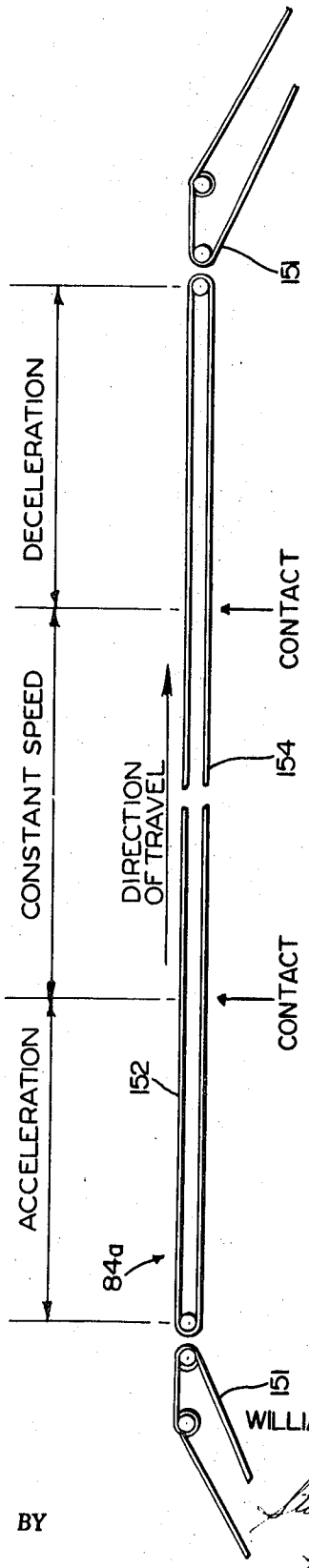


FIG 13.

INVENTOR
WILLIAM H. AVERY

BY Stowell & Stowell
ATTORNEYS

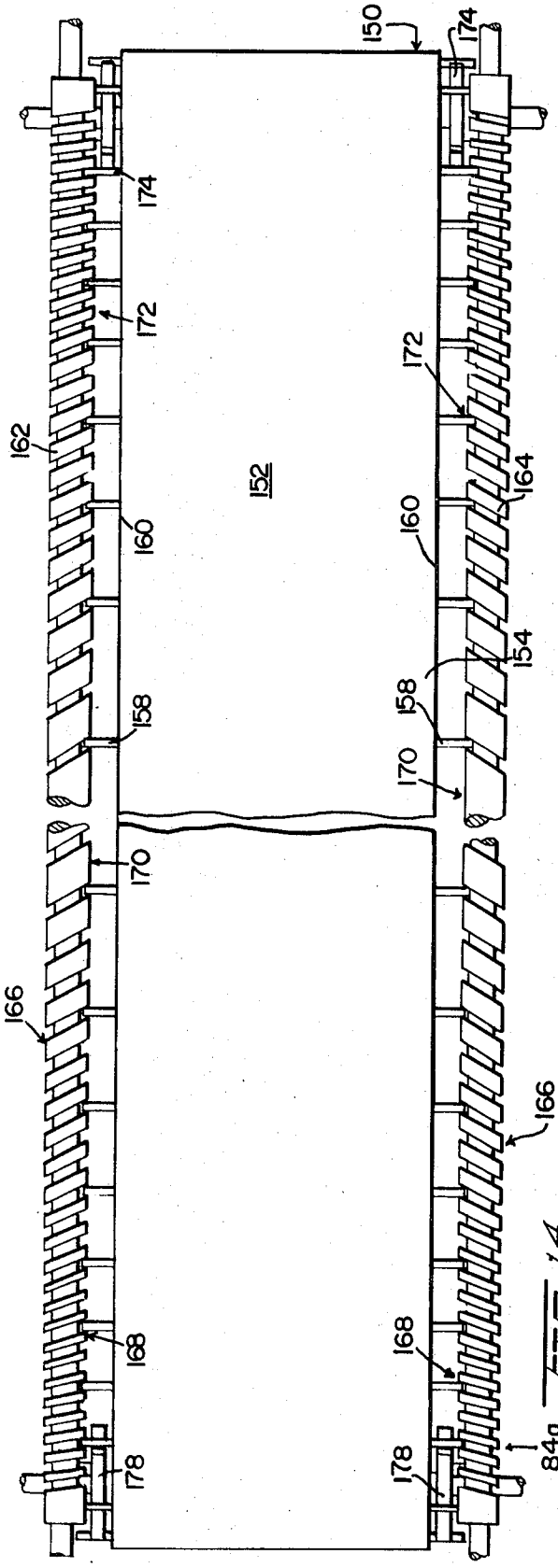


FIG. 14.

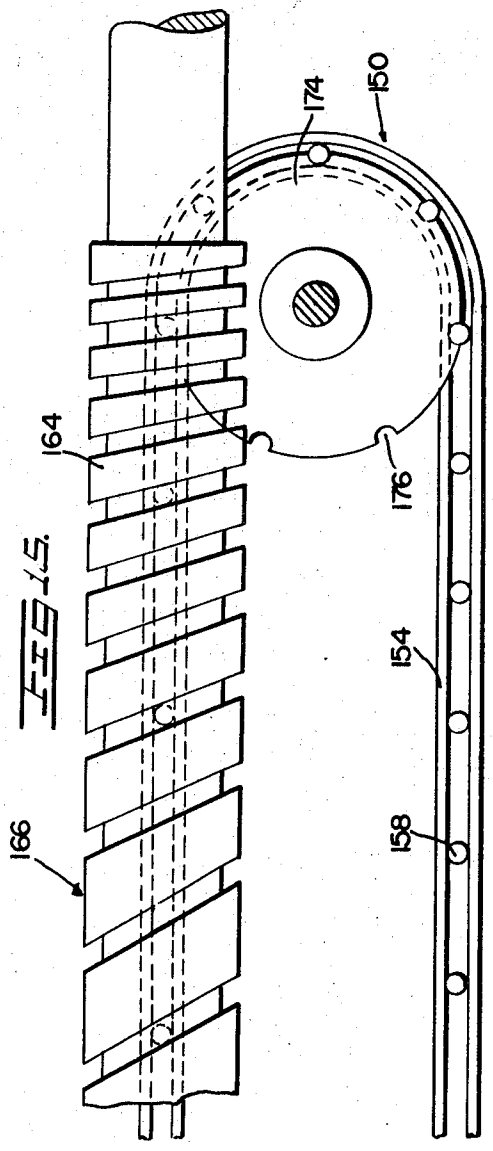


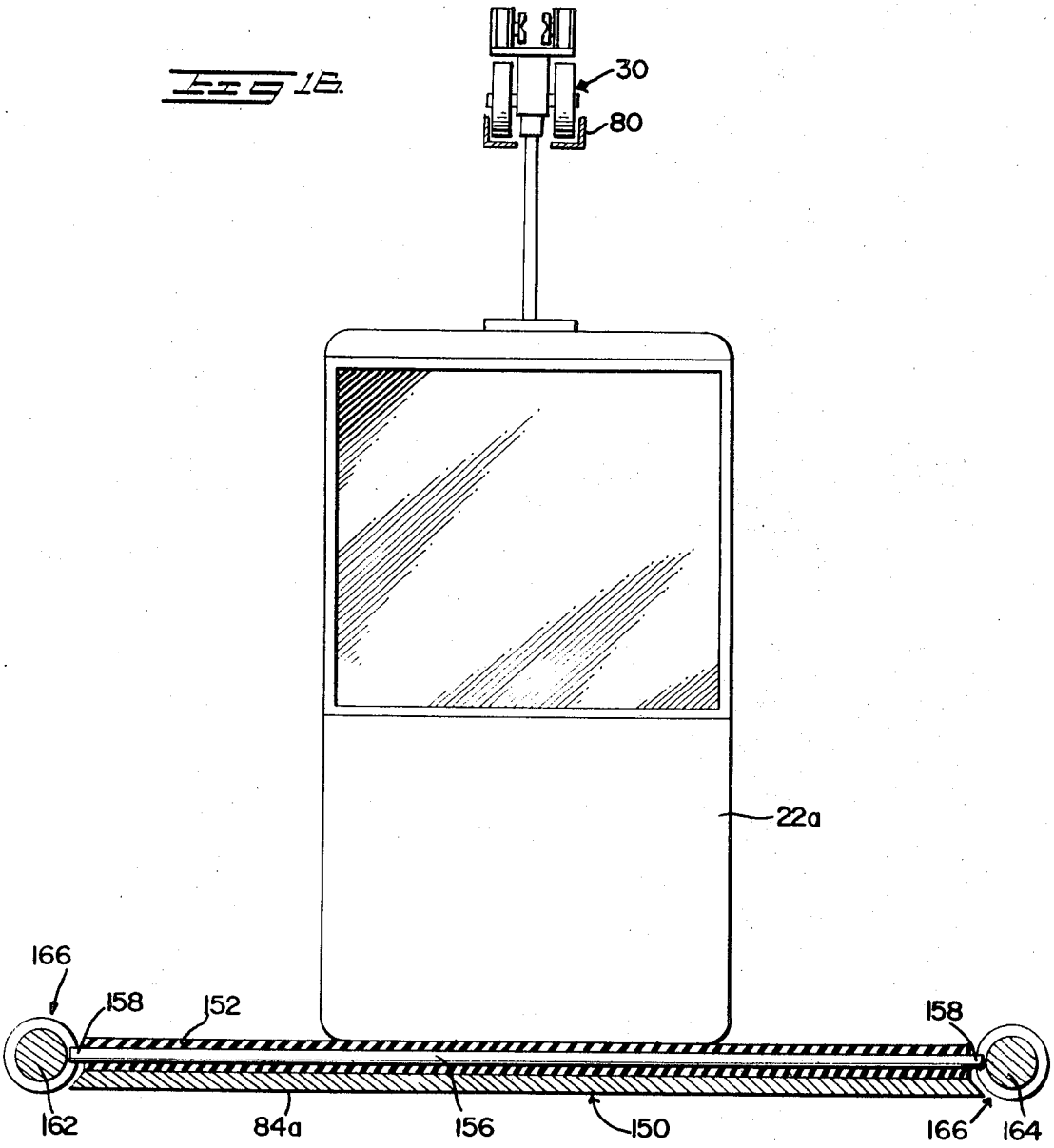
FIG. 15.

INVENTOR
WILLIAM H. AVERY

BY Stowell & Stowell

ATTORNEYS

FIG 18.



INVENTOR
WILLIAM H. AVERY

BY Stowell & Stowell

ATTORNEYS

URBAN TRANSPORTATION SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally appertains to new and novel improvements in the field of urban and interurban transportation and more particularly relates to a new and novel urban transportation system, especially designed for technological, economical and socially acceptable correlation with interurban rapid transit systems in the mass transportation of people into urban areas and movement of people through the urban areas, especially the central business districts thereof. As part of such urban system, the present invention also relates to a new and novel method and apparatus for moving large numbers of people throughout urban areas and particularly for moving large numbers of people relatively short distances in the center of the urban areas.

2. Description of the Prior Art

Much attention and consideration has been given in the past five years to the problem of urban and interurban transportation. Most of the studies and activities, however, have dealt with interurban transit systems and facilities on a separate basis so as to solve only the problem of moving large numbers of people at high speeds and in short time intervals into and from urban areas. In general, there have been two approaches to the suburban commuter problem. One involves personal freedom of travel and lies in the construction of beltways and freeways for the rapid movement of automobiles into and from the urban areas; while the other involves mass transit and lies in the construction of rapid rail systems, either in the nature of surface, overhead or subway rail installations.

With either of the approaches designed for suburban and interurban travel to provide rapid movement over appreciable distances, there still remains the problem of moving the people within the urban areas once they have arrived there. Thus, one of the crucial problems in mass transportation today is that of moving large numbers of people within the urban areas, particularly in the central business districts of cities.

The problems of interurban and urban transportation are so intertwined that an effective and operational solution resides in the installation of two mutually supporting systems: one designed for suburban and interurban travel to provide rapid transit and travel over considerable distances, the other designed for handling local traffic requirements. Such local system should be one that is continuously and easily accessible, of reasonable installation and operational cost, easy to install or relocate, and therefore, capable of having closely spaced access points with no waiting at the boarding and discharging points and with a minimum of attendant pedestrian travel associated therewith or necessitated by the use thereof.

Recent authoritative studies show that the present day transportation situation in average cities in any large industrial country is one involving an almost unbelievable magnitude of traffic flow, a transportation expenditure of over a million dollars a day and a high vehicular and pedestrian accident and death rate. Thus, there are not only factors involving an individual's personal interests, but also important economic, social, and even, health and safety factors involving society as a whole.

Urban transportation, at the present time, mainly centers around personal vehicles, either privately owned automobiles or taxicabs, or around public transportation in the form of buses. A few cities have subways in operation and others are proposing the installation of underground public transportation in the form of subways. The use of private automobiles creates personal problems, such as parking inconveniences, walking distances from parking to office and traffic tieups. Furthermore, the interests of the public, in the instances of impedance and safety of pedestrian traffic, vehicular accidents and air pollution, are jeopardized. This is also true in the case of taxicabs, and further, they are of little value in effecting speedy movement of an individual in the central business districts because of traffic congestion. The use of subways does afford fast mass movement but, the stations are so widely spaced apart and located only at such central points that a considerable walk is required before arriving at a subway station from one place and upon leaving the station before arriving at a destination point.

Thus, personal vehicular travel in our cities has individual and social deficiencies and existing public systems suffer from the problems of a social nature, as far as convenience, health and safety factors are concerned. Furthermore, existing systems suffer from the problem of loss of time waiting for the conveyance at either the terminus or transfer points and all parts of the system cannot be used without a substantial walking distance either to embark thereon or disembark therefrom.

Any new urban transit system to be considered should provide a solution to the problem of dependence on automobiles and should overcome the drawbacks and difficulties associated with presently operating public transportation systems. Such proposed transit system should possess the following characteristics;

1. Convenience so as to eliminate waiting and traveling under crowded conditions and so as to be accessible with, at most, a short walk to and from frequent embarkation and disembarkation points.

2. Short time in transit.

3. Low cost of installation and operation.

4. Technical feasibility so that the system can be made operational at once to meet present and future urgent needs, without waiting for technical breakthroughs.

5. Operation in all types of weather, with the system functioning at normal fashion regardless of winter, summer or rain, fog and the like climatic conditions.

6. Social desirability, so that the system is quiet, does not produce air pollutants, is safe and is aesthetically acceptable.

The best known attempt to solve urban transportation problems is disclosed in the patent to Reid, U.S. Pat. No. 3,315,612, issued Apr. 25, 1967. In such patent, cars are moved through an underground passage by attachment to a high speed cable and, as a car approaches an above ground station, it is slowed down by the influence of gravity and becomes engaged with a slow speed cable that runs alongside the high speed cable. The car is then moved through the station at a slow speed by the slow speed cable so that passengers can enter and leave the slowly moving cars. As the cars leave the station, they become reengaged with the high speed cable, utilizing a downhill gravity travel to effect such hookup. The cars are then moved through the underground installation by the high speed cable to the next station.

This patent is of interest in the field of urban transportation in that it does disclose the use of small passenger cars traveling on a track and driven by high and low speed cables and the influence of gravity on the small passenger cars to effect a changeover from a high speed travel between stations to a slow speed travel of the cars at the stations and then a return to a high speed travel.

However, the patent does not offer any solution to the principal urban problems nor does it disclose a system that possesses the necessary characteristics, as outlined above. Furthermore, the use of high and low speed cables does not solve the problem of interfacing the passengers with the cars so that the cars can be boarded and left in a safe and convenient manner and without any appreciable slowdown of the cars that would cause a waiting period or a loss in travel time. In addition, the patented structure fails to take into account the movement of the passengers into and from boarding positions relative to the slowly moving cars in the station.

In the latter respect, instances of patented teachings of moving sidewalks are known in the art from the following patents: Sinden, U.S. Pat. No. 2,862,603, issued Dec. 2, 1958; Seidman, U.S. Pat. No. 2,936,873, issued May 17, 1960 and Karr, U.S. Pat. No. 3,314,517, issued Apr. 18, 1967.

However, such patents merely disclose structures of a conveyor nature for the purpose of channeling or accelerating pedestrian traffic, as such, or, at best, for moving passengers into and out of transit stations, without any operational or structural relationship between the transit system, insofar as the moving passenger cars are concerned, and the moving sidewalks or pedestrian conveying surfaces. Furthermore, while such patents suggest interesting moving sidewalk structures, they do not offer any solution to the main problems in the field of urban transportation nor do they suggest transit systems that possess the requisite characteristics of a practical and useable system, as outlined in the foregoing.

SUMMARY

The present invention relates to an urban transit system which solves the outlined problems that are now being encountered in the movement of people in cities, particularly in the central business districts, and which possesses the system characteristics that have been previously listed.

Generally stated, the system of the present invention involves the provision of a parallel series of individual endless loop lines arranged in laterally spaced relation and extending north-south and east-west in an intersecting grid arrangement. Each line is composed of a box rail within which a continuously driving cable is disposed. The rails are supported above the sidewalk or curb of existing city streets by strong pylons.

The system includes a series of small cars each with seats for two people and standing room for two additional, which move from station to station supported on the single enclosed rail and pulled by the enclosed cable. As the cars enter a station area they are disengaged from the cable and decelerated by gravity to a speed which matches that of a moving belt on which the cars are supportingly bottomed and which carries boarding and leaving passengers. The cars are moved through the station on the moving belt.

The passengers are interfaced with the cars by means of a system of moving belts providing gradual speed steps which give them the same velocity and place them on the same belt as the cars. Thus, as they approach the station at street level, the availability of a car is signaled and they step on an inclined conveying surface composed of a series of interleaving or continuous belts of gradually varying speeds to arrive at the top of the station at the same time and with the same speed as an incoming car. After the unloading and loading process has been accomplished, the cars leave the moving belt and accelerate by gravity or other means along the rail to mesh with the full speed cable.

The system is placed above the sidewalk in the district served. The system is based on a maximum speed of approximately 20 miles an hour on the cable and 10 miles an hour or less through the station. The cars would be spaced along the cable at varying distances according to traffic demand. At maximum capacity, the car spacing would be 10 feet center to center on the cable with cars bumper to bumper through the station, providing an unending stream of available seats. The onloading passengers are accelerated from 0 to 10 miles an hour in three or more speed steps on the inclined conveying surface, and the unloading passengers are delivered to the sidewalk by a reverse process.

A basic grid system is provided to control the layout and operation of the system. For purpose of disclosure of the concept, the grid is considered as rectangular. A line is placed every 3 blocks (one-fourth mile). The north-south lines are interdigitated such that a north line is available each 6 blocks or one-half mile. A similar system is placed in the east-west direction. With this grid, it is possible to go from any one point in the grid to any other point in the grid with only one transfer. If two stations are provided at each intersection (one each line), a person is never more than 3 blocks from the nearest station. Thus, to go from any point to another, one would be required to walk, in the worst case, 3 blocks on one end of his trip and 2 blocks on the other end.

Such grid has been described for exemplary purposes only. It is based on the assumption of 12 blocks per mile, equally sized and equally spaced, within a metropolitan area. This, of course, might not be the case in an existing city so that a final grid selection would have to be based on actual conditions within a specific city. The choice of a particular grid, however, does allow one to estimate the system and to lay it out for operation to meet the qualifications which have been described.

Thus, as can be appreciated from the foregoing general description, the present invention overcomes the difficulties and drawbacks associated with present modes of urban transportation and possesses all of the delineated features of an ideal mass transit system for modern cities.

Accordingly, the primary objects of the present invention are to provide an urban transit system which can be installed at a low cost with present technology and materials, which can be operated and maintained at a substantially low fare and tax cost, which can be operational at all times of the year and in all types of weather, which will be safe, reliable, quiet and free from air pollutants in operation, which will be convenient for use by everyone with no waiting or walking involved in its usage, which will not require disruption of traffic flow in its installation and operation nor necessitate extensive right of way problems, and which will be aesthetically attractive so as to add to the beautification of cities.

A further important object of the present invention is to provide an urban mass transportation system that will restore the central areas of cities to their former positions of prominence in the business, cultural and social fields by enabling people to move more rapidly and easily throughout a city.

A further important object of the present invention is to provide an urban transit system that can be coordinated with present and contemplated interurban and suburban transit systems so that travel time from home to office by commuters can be reduced to a comfortable minimum and without any appreciable walking at either end.

Brief Description of the Drawings

FIG. **1** is a diagrammatic showing of a basic grid arrangement of the urban transit system of the present invention.

FIG. **2** is an exploded view on a larger scale of a small area of the grid in FIG. 1 and showing in detail the provision of stations at the direction intersection points.

FIG. **3** is a diagrammatic side elevational view of a station in the system.

FIG. **4** is a more detailed view, on a larger scale, of one end of the station, as shown in FIG. **3**.

FIG. **5** is a cross-sectional view, taken substantially on line **5–5** of FIG. **3**, and showing, on a larger scale, the relationship of a car and the supporting and moving belt therefor, and for the passengers at a station, as shown in FIG. **3**.

FIG. *5a* is a detailed view of the upper cable engaging end of the supporting rod for the car, as shown in FIG. **5**.

FIG. **6** is a detailed cross-sectional view, taken on line **6–6** of FIG. **3**, and showing the intermediate speed belt in the series of belts making up the inclined conveying surface between the street level and the car level of the station.

FIG. **7** is a detailed cross-sectional view, taken on line **7–7** of FIG. **3**, and showing the fast speed belt is such series of belts making up the inclined passenger conveying surface.

FIG. **8** is an enlarged side elevational view of the structural supporting arrangement for the overhead cars.

FIG. **9** is a detailed side elevational view of the upper end assembly of a car showing the same in structural relationship with the supporting rail and in driven engagement with the driving cable.

FIG. **10** is a cross-sectional view, taken substantially on line **10–10** of FIG. **9**.

FIG. **11** is a cross-sectional view similar to FIG. **10** but showing the car with its upper end released from the driving cable.

FIG. 12 is a side elevational view, partly diagrammatic, of a modified form of supporting and moving belt for the cars and passengers at a station.

FIG. 13 is a schematic showing of the operation of the belt of FIG. 12.

FIG. 14 is a top plan view of the belt construction shown in FIG. 12.

FIG. 15 is a fragmentary side elevational view, on an enlarged scale, of one end of the belt construction of FIG. 12.

FIG. 16 is a cross-sectional view, taken on line 16–16 of FIG. 12, and showing on a larger scale the relationship of the belt and a car.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now more particularly to the accompanying drawings and initially to FIG. 1, the urban transportation system 10, as shown for exemplary purposes, is composed of a north-south series of individual loop lines 12 and an intersecting east-west series of individual loop lines 14, which service the depicted 5 mile by 5 mile central district of an imaginary urban area.

As shown in greater detail in FIG. 8, each line of the series includes a plurality of elongated box beam rails 16 that are connected so as to provide each line with a supporting structure having as a whole, parallel, lengthwise sections connected at their ends by curved-end sections so that parallel adjoining straight lines form a complete elongated loop. The rails are supported above the ground level, preferably above the sidewalk or curb of existing streets, by attractive columns or pylons 18 which are spaced apart approximately 100 feet and would be of a size comparable to existing poles for street lamps. Of course, the system would operate equally well underground if desired. An endless, continuously driving cable 20 is housed within the rail structure and is driven at a constant uniform speed by any conventional drive arrangement, which is not shown but which will be obvious to those skilled in the power conveyor art. A plurality of small passenger cars 22 are movably supported by the rails and connected to the driving cable, as will be described, and constitute the passenger conveying means associated with each line for moving passengers along each line.

FIGS. 1 and 2 schematically depict a typical grid system which is a layout over an arbitrary 5 mile by 5 mile, north-south and east-west area, so as to provide maximum service for mass movement within and through such an area. As shown, there are ten north-south loop lines 12, with each north line being connected to a south line at each end to provide the continuous north-south laterally adjoining loops. Similarly, each east line is connected at its ends to a west line, so that ten separate, laterally adjoining and spaced east-west loop lines are also provided.

The grid layout is based on the assumption of 12 blocks per mile, equally spaced and equally sized, within the depicted imaginary populated district. As can be realized, from a study of FIG. 1, 200 miles of line are provided.

A line is placed every 3 blocks or one-quarter mile. The north-south lines are interdigitated such that a north line is available each 6 blocks or one-half mile. A similar arrangement is placed in the east-west direction, as can be appreciated. With this grid it is possible to go from any one point in the grid to any other point in the grid with only one transfer. In cases of maximum population density, lines could be more closely spaced if desired, *e.g.*, at 1-block intervals or on both sides of a street. A feature of the system is its ready adaptability to varying traffic requirements. Alternatively, in sparsely populated areas, or for special applications such as airports, a single loop without intersections and with conveniently spaced boarding points might be employed.

FIG. 2 depicts a 3 -by- 3-block module, showing the intersecting north-south and east-west lines in such illustrated section of the overall serviced area. Two stations 24 are provided at each intersection, one station for each line. Thus, it can be understood that a person, within the serviced district shown in FIG. 1, is never more than 3 blocks from the nearest station. Therefore, to go from any given point to another, a person would only be required to walk, in the worst case, 3 blocks at the start of his trip and 2 blocks at his return.

It can be appreciated from a consideration of FIG. 1 that the 5-mile square grid depicted would have 40 lines spaced at 3-block (one-quarter mile) intervals. The 40 lines have a total of 20 loops, 10 north-south and 10 east-west, with 800 stations (two stations at each intersection) and a total of 200 miles of line. Each car is designed to accommodate two seated passengers and, at peak times, two standing passengers. The maximum capacity for the depicted layout of FIG. 1 is approximately 175,000 seated passengers. Each station in the grid is theoretically capable of loading 43,200 people per hour, though it is highly improbable that this maximum requirement would materialize.

The endless cable 20 for each loop line will be powered in a separate and individual manner, so that there will be a separate power distribution and maintenance arrangement for each line. It is estimated that the speed between stations will be 20 miles per hour and, taking into consideration the slowing of the cars at the stations and loading and unloading time, as will be more particularly dealt with in the subsequent description of the constructions and operation of a station 24, the average speed including time in the stations is estimated at over 18 m.p.h. for a station speed of 10 m.p.h.

Attention is now directed to FIGS. 8—11 for a clearer understanding of the structural details of the passenger cars 22, the overhead supporting rail 16 and the driving cable 20. As shown therein, the rail 16 is formed with a longitudinal, centrally disposed slot 26 in its bottom wall with the inner faces of the thusly formed bottom wall flanges providing tracks 28 on which a suspension assembly 30 for the cars 22 travels.

The cars 22, which have side doors (not shown in detail) that automatically open and close during the movement of the cars through a station, are suspended from the suspension assembly by a vertical supporting rod 32 attached at its lower end to the roof 34 of the cars.

The suspension assembly 30 includes a trolley truck 36 movably supported on the tracks 28 by solid rubber wheels 38 which are mounted on lateral stub axles 40 carried by the truck adjacent its ends.

A spring damping mechanism 42 serves to attach the upper end of the suspension rod 32 to the truck 36. As shown more clearly in FIG. 9, the upper end of the rod terminates in a journaling collar 40 that is freely circumposed on a support pin 42 carried transversely by the truck and located intermediate the wheeled ends of the truck. Forwardly and rearwardly projecting lateral wings 44 are fixed to the collar 40 and bear on the upper ends of piston rods 46 which are workingly housed in the damping cylinders 48. The cylinders 48 are vertically seated in fixed manner on supporting plates 50 carried by the truck in a subjacent arrangement and a conventional spring-damping assembly or combined hydraulic-spring assembly (not shown but well known in the art) is operatively housed therein.

The spring-damping mechanism 42 or its functional equivalent is an important part of the car suspension assembly and functions to prevent large pendulum-type oscillations of the cars 22. Such oscillations could result from wind gust loads, intentional attempted "rocking" of the cars by the passengers, and the speed changes that occur during the cars entrance into and departure from the stations 24.

The trucks 36 are provided at their opposite upper sides with upstanding laterally spaced and confronting pairs of ear shaped tubular housings 52 within which shafts 54 are slidably mounted for inward retracted and outward extended movement. The shafts 54 on one side support at their outer ends one jaw 56 of a cable engaging clamp 58 with the complemental jaw 60 of the clamp being carried by the shafts 54 on the other side of the truck.

The cable 20 extends longitudinally within the box beam rail 16 and is disposed centrally thereof just below the closed

top wall of the rail. The cable passes between the mating jaws of the clamp and the jaws engage the continuously moving cable so as to drivingly connect the cable to the suspended cars. In this respect, the confronting faces **62** of the jaws are formed with longitudinally extending, registering arcuate grooves **64** which are adapted to clampingly receive the cable, as shown in FIG. **10**.

A conventional electrical solenoid or electrical valve (not shown) is operatively housed in the housings **52** and actuates, through circuitry and switch means that is well known and not shown for simplication purposes, the clamp mechanism **58**. The solenoid or the like is automatically actuated by a switch arm (not shown) disposed in the path of the suspension assemblies at the approach to and exit from a station. Other means, including mechanical constructions and automatically operating electrical or electromechanical assemblies, may be employed to effect the engagement and disengagement of the clamp **58** with the moving cable **20**.

Attention is now directed to FIGS. **3—7** for an understanding of the structural arrangement of one of the stations **24** with regard to the arrival and departure of the cars **22** and the unloading and loading of passengers with respect to the cars during their passage through the station.

At the station, as shown in FIG. **3**, the box beam rail **16** is interrupted in that at a point **66**, spaced ahead of the station area, the box beam rail terminates while at a point **68**, spaced after the station area, the rail continues on again. The separation points **66** and **68** lie in the same overhead horizontal plane as the rail proper and are positioned fore and aft of the station. At each of the points, guide pulleys **70** are vertically orientated on the terminal ends of the top walls of the rails and the drive cable is guided under the pulleys. Vertically disposed guide pulleys **72** and **74** are positioned above and adjacent to the rail carried pulleys **70** and are coplanarly disposed above the station level with the cable being entrained thereover. Thus, the continuously moving, driving cable **20** is guided in a path over and above the area of the station with the cars **22** being disengaged from the cable at the point **66** and becoming reengaged with the cable at the point **68**.

Between the points **66** and **68**, the rail is in the form of a longitudinally split track **76** which actually constitutes an integral structural and design continuation of the rail tracks **28**. The track **76** is formed in three sections, including an initial incoming deceleration section **78**, a central horizontally disposed and level station section **80** and a final departure or outgoing acceleration section **82**. The upwardly inclined section **78** extends from the point **66** up to the beginning of the raised and level central section **80** while the downwardly inclined section **82** extends from the end of the central section to the point **68**. The upwardly inclined section **78** would be used for gravity deceleration of the cars. If other means were employed for deceleration—brakes, motors—and acceleration—motors, catapults, etc.—Section **78** could be horizontal or downward inclined, and Section **82** horizontal or upward inclined.

Located below the central track section **80** is a horizontally disposed elevated platform **84**, as shown in greater detail in FIG. **5**. The platform is suitably supported in a horizontal plane and is positioned below the center track section **80** a distance from such track section so as to support the cars **22** as they are released, in a manner to be described, from dependence for supported movement upon their suspension assemblies **30**. The platform also constitutes the passenger boarding and unloading area, as will be described. For this reason, the sides of the platform are provided with upstanding moving guard rails **86**, as shown in FIG. **5**.

An endless belt **88** has an upper reach **90** that moves over the upper flat face or surface of the longitudinally extending center portion of the platform in a substantially friction-free manner. The belt has a major center section **92** of a width complemental to the width of the cars **22** so as to receive and movably support the cars which have their bottoms resting on the section **92** of the moving belt, as shown in FIG. **5**. The belt **88** has its flat upper reach **90**, which travels over the platform **84**, guided at both ends of the platform by guide rollers **94** and the belt is entrained over lower rollers **96** which are driven by any suitable means. The belt **88** is driven at a speed so that the upper car supporting and moving reach travels at a convenient boarding and unloading speed. Such speed would be chosen in travel correlation with the car propelling 20 m.p.h. speed of the driving cable **20** to provide fast and efficient movement of the passengers into and from the moving cars, without any consequential time delay in the overall travel of the system.

During the travel of the cars **22** between stations, they are moved at a uniform nominal speed of 20 m.p.h. with a space of approximately 10 feet on the line between the cars. As each of the cars approaches the station point **66**, the clamp **58** for each car is activated by a suitable means under the control of a station attendant or by an automatic release mechanism, such as a cam arrangement, so that the suspension assembly **30** becomes disengaged from the driving cable **20**. The cable released cars are then free to move up the inclined track section **78** which curves upwardly at an angular inclination so as to slow by the influence of gravity the speed of the cars from 20 m.p.h. to 10 m.p.h. The cars then become supportingly bottomed on the moving belt **88** and the cars are lifted, due to the height relationship between the belt reach **90** on the platform **84** and the overhead track section **80**, so that the truck wheels **38** are raised above and moved out of rolling engagement with the track section **80**.

Thus, the kinetic energy of the car is stored in the form of increased potential energy for later recall, except for a slight loss due to friction.

The deceleration rail section **78** is shaped so as to minimize pendulum oscillation of the cars. The spring-clamping mechanism **42** will assist in this and will return the car to its proper orientation by the end of the deceleration period.

The change in speed occurs in approximately 3 seconds, resulting in an average deceleration of 5 feet per second, a significant part of which will be felt as weight change rather than horizontal deceleration. By careful matching of the rail contour, pendulum natural frequency of the cars, and the spring-damper characteristics, it is possible to develop a smooth and unobjectionable speed change of the cars.

After deceleration, support of the cars is transferred from the rolling suspension assembly **30** on the overhead central track **80** to support of the cars by the 10 m.p.h. moving belt **88**. This is the same belt that the unloading and onloading passengers walk on, as will be described, so there is absolute synchronization between cars and passengers. During this period, the car doors are open and passengers exit and enter.

After loading and unloading is accomplished, the car doors close and the suspension assembly engages the declined or accelerating track section **82**. The car accelerates under the influence of gravity and the clamp **58** is actuated to grip onto the moving cable at the point **68** as it reaches the speed of 20 m.p.h. Again, the contour of the rail or track section **82** will be designed to ensure passenger comfort and the change in elevation adjusted to make up for friction losses.

It can be appreciated that the cars **22**, as shown in FIG. **3**, are grouped in a close formation and moving on the supporting section **92** of the belt reach **90** at a speed of 10 m.p.h.

As shown in FIG. **5**, the belt **88** has lateral side sections **98** on each side of the main car supporting section of the belt. Each side section **98** is composed of a series of laterally spaced separate parallel strips **100**. The side sections have upper reaches, as shown in FIG. **5**, which are movably disposed on the upper face of the platform **84** with the strips **100**, that are of T-shape cross-sectional configuration, moving in straight grooves **104** formed in the upper surface of the platform on each side of the center belt section **92**. The strips have their flat body portions **106** slidably fitted with a minimum of friction in the complemental straight walled grooves **104** so that the enlarged heads **108** of the strips slide on the upper face of the platform. The heads **108** on the platform are arranged in the same plane and are coplanar with the center section **92** that supports the cars **22**.

The strips are spaced apart a selected distance in relation to the feet of passengers so that it is not possible for one's foot to become wedged between or caught by the moving belt strips. The stripped side sections **98** support the passengers at a speed of 10 m.p.h. so that there is no relative movement between the moving cars **22** and the passengers, who merely step from the side sections into a car or from a car onto the side sections. Ideally, the passengers enter the cars from one of the side sections and exit from the cars onto the opposite side section.

As shown generally in FIG. **3**, and in more detail in FIGS. **4**, **6** and **7**, an inclined conveying surface means **110** is provided to enable passengers to be moved in a safe and speedy manner from the street level **112** at the station **24** onto the belt sections **98** at the moving car level on the platform **84**.

Such conveying surface means **110** is disposed at both ends of the station, so that it is arranged at the fore-and-aft ends of the platform **84**. The belt **88** forms the last or fast part of the means and has upper front and rearward inclined end portions **114** and **116** which lead up to the platform **84**. Such belt portions **114** and **116** are traveling at 10 m.p.h. and moving with the belt **88** in a clockwise direction. The inclined belt portions **114** and **116** are part of the side stripped sections **98** of the belt **88** and inclined support plates **118** are provided for such portions, as shown in FIG. **7**. The plates **118** are formed with grooves **120** to locate and guide the body portions **106** of the T-shaped strips with the heads **108** thereof moving over the upper surfaces of the plates.

Immediately below the inclined belt portions **114** and **116** are stripped intermediate speed belts **122** and **124** which travel around rollers **126** and **128**, one of which is driven in any suitable way so that the belts **122** and **124** move in a clockwise direction at a speed of 6 2/3 m.p.h. The belts **122** and **124** are supported by grooved support plates **130** with the belt strip and groove arrangement being the same as shown in connection with the plates **118** so that the strips **132** of the belts **122** and **124** are located and guided in their laterally spaced, parallel movement over the plates **130**.

As can be understood from a consideration of FIG. **4**, the strips **132** of the intermediate speed (6 2/3 m.p.h.) belts **122** and **124**, which are disposed at less of an inclined angle to the horizontal street level **112** than the fast speed (10 m.p.h.) belt portions **114** and **116**, interleave with the strips **100** of the belt portions **114** and **116** at changeover zones **134**. This is effected in such a manner that the change in speed goes unnoticed by ascending or descending passengers.

Disposed substantially on the same horizontal plane as the street level **112** and positioned at both ends of the station are slow speed belts **136** and **138** which pass over rollers **140** and **142**, one of which is driven in a conventional manner so that the belts **136** and **138** move at a constant speed of 3 1/3 m.p.h. This is only slightly greater than the normal pedestrian walking speed of 3 m.p.h.

The belts **136** and **138** are also in the form of laterally spaced, parallel strips **144** that are supported in suitable guide grooves in supporting plates **146**. The strips **144** of the belts **136** and **138** interleave with the strips **132** of the intermediate speed belts **122** and **124** on their joined supporting plates in an alternating parallel changeover arrangement, as shown in FIG. **6**.

Thus, it can be appreciated that a passenger walking at a normal rate of speed, for example 2 to 3 m.p.h., can safely step onto the slow speed conveyor **138** and not be aware of the speed increase thereof. From that point on, the passenger is conveyed in a quiet fashion without any discomfort and in complete safety up to the car level. Similarly, a disembarking passenger is safely and comfortably delivered down from the car level to the street level.

A modified form of station arrangement with respect to the supporting and moving belt for the cars **22** at the station and the boarding and unloading passengers is shown in FIGS. **12** and **16**.

As shown in FIG. **12**, passengers are conveyed up to and down from the side portions at the opposing front and rear ends of a belt assembly **150** by fast belts **151** that pass around rollers **153**, with the belts **151** being similar in purpose and function to the belt portions **114** and **116** of the station arrangement shown in FIG. **3**.

The belt assembly **150** includes a platform **84***a* which slidably supports the upper reach **152** of an endless elongatable belt **154**. The belt **154** is formed from elastic or longitudinally stretchable material, as shown, or in the alternative may be formed in sections with accordion like connecting portions between the sections. In any event, the belt is elongatable lengthwise.

As shown more clearly in FIGS. **15** and **16**, the one-piece elastic belt **154** is provided with a series of transversely embedded rods **156** that are spaced in parallel fashion along the length of the belt. The rods have opposite ends **158** which project an equal distance laterally beyond the marginal side edges **160** of the belt, as shown in FIG. **14**. The projecting rod ends **158** constitute laterally extending fingers used in conjunction with oppositely rotating helical drive elements or helixes **162** and **164**, disposed at the level of the upper reach **152**, to move the upper reach **152** so that it has sections moving at differing speeds, as schematically depicted in FIG. **13**, the reach moving in the direction of the arrow.

As shown in FIG. **14**, the helical drive elements are in the form of helical feed screws but may be rods having coils helically wound thereon. Further, other step advancing means with pockets or convolutions of varying spacement and pitch may be employed. The helical drive element **162** on one side of the upper reach **152** of the belt, rotates in a clockwise direction; while the helical drive element **164** on the other side of the upper reach, rotates in an anticlockwise direction.

At one of their ends, the drive elements **162** and **164** are connected to a common drive means (not shown but well known to those in the art), so that the elements rotate at the same rate of speed but in opposite directions.

As shown in FIG. **14**, the varying rates of movement of the upper reach **152** are attained by the spacement, pitch and size of the volutes or coils **166** which provide differing pockets or convolutions in which the fingers **158** ride as the helical elements rotate.

Thus, the closely voluted or coiled and pitched sections or zones **168** will cause the belt reach **152** as it first moves onto the starting end of the platform **84***a* to accelerate. The wider coils in the center zones **170** will produce a constant speed travel of the belt reach over the center section of the platform, while the spacement, pitch and close arrangement of the coils in the ending zones **172** will effect a deceleration of the belt reach.

The overall effect of the differing speed zones of the belt reach **152** will produce a constant movement of 10 m.p.h. for the cars **22***a* supportingly bottomed on the center of the belt reach, as shown in FIG. **16**, and for the passengers standing on the side sections of the belt reach on opposite sides of the cars.

As shown in FIG. **15**, drive sprockets **174** are rotatably disposed at the trailing end of the belt **154** and are formed with circumferentially spaced, peripheral pockets **176** to engage the fingers **158** in timed fashion as they leave the helical drive elements so as to cause the belt to loop back. Similar sprockets **178** are provided at the leading end of the belt.

While in the specific examples hereinabove described, gravity is employed to decelerate passenger compartments arriving at a station and to accelerate the compartments upon leaving a station, it is contemplated that such deceleration and acceleration may be carried out through the use of conventional linear electric motor, hydraulic motor or other means. Through the use of such motors, the passenger compartments may be brought to substantially street level for more convenient passenger embarking and debarking thus reducing the cost of erection of elevated passenger transfer platforms and simplifying passenger acceleration to cab or compartment speeds and deceleration of the passengers to normal walking speeds.

In some areas only a single loop, similar to one of the loop lines 12 or 14 in the grid arrangement of FIG. 1, would be sufficient for rapid transportation purposes. Thus, a single loop line, with or without an intersecting or crossing complemental single loop line, might be adequate to serve as a feeder line to and from other areas in relation to a central or congested area as serviced by an arrangement depicted in FIG. 1. Thus, single loop lines could effectively and efficiently serve as feeder lines to and from interurban transit systems relative to one or more central districts, as depicted in FIG. 1. Furthermore, in relation to two or more adjoining, in the sense of contiguous or spaced apart, congested or central area systems along the outline of FIG. 1, single loop lines could be suitably employed as connecting lines between such systems of FIG. 1.

In addition, a single loop line could be used for conveying passengers to and from a depot or transportation building and the landing ramp of a passenger carrier aircraft or land surface or watercraft passenger carrier.

From the foregoing description taken in conjunction with the accompanying drawings, it can be seen that an urban transportation system and method and apparatus for transporting a large number of people throughout city areas have been provided which possess all of the necessary and desirable features of a technically feasible, economically practical and socially acceptable urban transit system, and have all the characteristics of an ideal urban transit system, as outlined in the beginning of this description.

However, the disclosed urban transportation system admits of many modifications so as to carry out the underlying concept and many changes and structural alterations may be made in the herein disclosed method and apparatus. Furthermore, many structural and environmental changes and conditions, such as those briefly outlined, but not inclusive of such alone, can be carried out in accordance with the present invention so that the invention is not to be considered as limited to what has been shown and specifically described.

I claim:

1. An aboveground transportation system for a given area comprising a first set of one or more aerial lines composed of overhead rails and associated continuously driving cables with passenger cars rollingly suspended from the rails and connected to the cables, said first set of lines extending substantially in a straight line direction throughout the area; a second set of one or more aerial lines composed of overhead rails and associated continuously driving cables with passenger cars rollingly suspended from the rails and connected to the cables, said second set of lines extending substantially at right angles to the first set throughout the area and intersecting the lines of the first set at points on the perimeter of approximately each one-fourth mile square section of the total area serviced; stations provided at such intersection points with one station for each line of each set; moving means operatively associated with each station for movably supporting the cars and passengers and interfacing the passengers and the cars as the cars pass through the station with the cars and the passengers moving at the same rate of speed and without any relative movement between the cars and the passengers; means for disconnecting the cars from the cables in advance of the stations and for reconnecting the cars to the cables aft of the stations so that the cars are free from the cables as they are carried by the moving means; and a passenger conveying surface arrangement of gradually varying speeds connecting the moving means at each station with the street surface level.

2. The system of claim 1 wherein the stations are aerial ones and the moving means is elevated at the stations and the cable moves the cars at a uniform high speed and said moving means moves the cars at a slow speed through the station with the passengers on said moving means and means for disconnecting the cars from the cables as they are engaged by the moving means and for reconnecting the cars with the cables as the cars are released by the moving means.

3. The system of claim 1, wherein said conveying surface arrangement is composed of a series of interleaving conveyors of varying speeds and is disposed in an inclined relationship between the street level and the said moving means.

4. The system of claim 1 wherein each line of each set is an elongated endless loop.

5. The system of claim 4 wherein each line is individually powered.

6. The method of transporting people with an aerial transit arrangement including a ground supported overhead track and associated continuously moving cable and passenger cars rollingly suspended from the track and connected to the cable and embarking and disembarking stations located at spaced points along the extent of the track and cable; said method comprising the steps of moving the cable with the cars attached thereto in a predetermined and set spaced-apart arrangement and suspendingly rolling on the track at an elevated level and at a fast rate of speed between stations; moving the cars at a different level and at a slower rate of speed in a close together arrangement through the stations; moving passengers through the stations at the same rate of speed and at the same level with the cars so that the passengers are in interfacing embarking and disembarking relation with the cars without any relative movement between the passengers and the cars and automatically moving the passengers at gradually varying speeds to and from peripatetic positions on the ground surface at the stations and the level of the cars moving through the stations.

7. In an aerial transportation system including an overhead rail, a continuously driving cable associated with said rail, a plurality of passenger cars, overhead suspension assemblies carrying the cars and rollingly suspending them from the rail and connecting them to the cable; a station construction for the loading and unloading of passengers comprising a horizontally disposed, moving supporting surface interposed in the line of travel of the cars and moving at a slower rate of speed than the cable and having a leading end and a trailing end with respect to such line of travel, means for disconnecting the cars from the cable in advance of the leading end of the moving supporting surface and reconnecting the cars with the cable following the trailing end of said moving supporting surface, means for decelerating the cable drawn speed of the cable disconnected cars so that the car speed matches the speed of the moving surface, means for conveying passengers onto and from said moving conveying surface with the passengers standing on said moving conveying surface in interfacing relation with the cars at the station and without relative movement between the passengers and the cars, and means for accelerating the rate of speed of the cars as they leave the station in the reconnection thereof with the cable.

8. The invention of claim 7 and including means for disengaging the suspension assemblies from the rail to deposit the cars on the moving supporting surface with the cars being supported and conveyed entirely by said surface as they move through the station in the embarking and disembarking of passengers.

9. The invention of claim 8 wherein said moving supporting surface is a conveyor belt having an upper reach provided with a central longitudinal portion for supportingly and movingly receiving the cars and lateral side portions for the passengers.

10. The invention of claim 7 and including means for guiding the cable past the moving supporting surface with the cars disconnected therefrom, said cable guide means including an arrangement of guide pulleys for guiding the cable over the moving supporting surface.

11. The invention of claim 8 wherein the moving supporting surface is elevated and is positioned at a height above the rail, said rail being disconnected fore and aft of the moving supporting surface with the moving supporting surface longitudinally interposed therebetween, said means for decelerating the speed of the cars to match the speed of the moving supporting surface including an upwardly inclined track section extending from one end of the rail, said means for disengaging the suspension assemblies from the rail including a center track section constituting a horizontally disposed continuation of the upwardly inclined track section and disposed at a height relative to the level of the moving supporting surface so that the suspension assemblies of the cars are raised out of engage-

ment therewith and said means for accelerating the rate of speed of the cars as they leave the trailing end of the moving supporting surface including a declined track section constituting a downwardly sloping continuation of the center track section and extending at its lower end from the other end of the rail.

12. The invention of claim 7 wherein said moving supporting surface includes a stationary rigid platform and a conveyor belt having an upper reach moving over the upper surface of said platform.

13. The invention of claim 12 wherein said means for conveying passengers onto said moving supporting surface includes an interleaved series of conveyor belts, one of said belts being an uppermost fast speed belt and being constituted by angularly inclined end portions of the platform conveyor belt at the ends of the platform, another of said belts being an intermediate speed belt arranged at a lesser angle of inclination than said ends of the platform conveyor belt and interleaved therewith and another of said belts being a substantially horizontally disposed belt traveling at a speed only slightly greater than normal pedestrian walking speed and having an end interleaved with the intermediate belt, said last belt being disposed at street level.

14. The invention of claim 13 wherein each of the said belts includes parallel, laterally spaced, separate strips which interleave, rigid underlying supporting surfaces for said belts, said supporting surfaces having guide grooves for the strips and the strips having enlarged head portions overlying the supporting surfaces.

15. The invention of claim 7 wherein said moving supporting surface includes a stationary rigid platform, a conveyor belt encircled around the platform from the leading end to the trailing end and having an upper reach moving over the upper surface of the platform.

16. The invention of claim 15 wherein said upper reach of the belt is elongatable and means for elongating the reach in sections, said last means including lateral fingers projecting from the opposing sides of the belt and oppositely rotating helical drive elements disposed longitudinally alongside the sides and having convolutions with which the fingers are engaged, said convolutions being of varying sizes and pitches in zoned arrangement along the longitudinal axes of the drive elements.

17. The invention of claim 7 wherein said passenger conveying means includes an inclined conveying surface composed of a series of interleaved end to end belts of gradually varying speeds extending from the street level to the moving supporting surface for conveying passengers to and from the moving supporting surface with the uppermost belt in the series moving at the same rate of speed as the moving supporting surface.

18. An aerial transportation construction comprising substantially horizontally disposed overhead hollow rail beams of substantially square cross-sectional configuration, each beam having a top wall, sidewalls and a bottom wall, said bottom wall having a longitudinal approximately centrally disposed slot dividing it into longitudinal rail sections with said rail sections having inner surfaces defining tracks, means for supporting said beams at elevated levels above pedestrian street surfaces, a driving cable movingly and protectively housed within the beams and extending longitudinally thereof and positioned slightly below the top wall of the beams, a relatively small passenger car having a top structure, a supporting rod upstanding from the top structure and extending through the slot in the bottom walls of the beams into the interior of the beams, a trolley truck having wheels rollingly engaging the tracks and movably positioning the trolley truck for travel inside the beams, means suspendingly connecting the supporting rod to the trolley truck so as to prevent oscillatory movement of the passenger car relative to the trolley truck, laterally spaced apart and upstanding and confronting housings on the trolley truck, rods slidably carried by the housings for movement inwardly and outwardly relative to each other transversely of the trolley truck, said rods having outer ends facing the cable, complemental jaws carried by the outer ends of the rods and having confronting clamping faces formed with longitudinally extending concave surfaces for clampingly griping the cable, means mounted in the housings for actuating said rods to move the jaws into and out of griping engagement of the cable and means disposed at selected points, that constitute embarking and disembarking stations, for automatically operating said actuating means.

19. The invention of claim 18 wherein said means connecting the supporting rod to the trolley truck includes supporting plates carried by the truck intermediate the ends thereof and arranged below the truck in longitudinally spaced alignment along the center of the truck, damping cylinders vertically mounted on and upstanding from the supporting plates and having upwardly exteriorly projecting piston rods, a journal pin transversely mounted on the truck adjacent the middle thereof and centrally between the supporting plates, said car supporting rod having an upper end provided with a transverse collar freely circumposed on the journal pin, and said collar having forwardly and rearwardly extending radial wings overlying and restingly engaging the piston rods.

20. An aerial transportation system comprising at least one elongated endless continuously moving driving cable having laterally spaced apart longitudinal driving reaches and looped ends, hollow beams encasing said cable, a plurality of trolley trucks movably mounted within and supported by the beams, cable engaging means carried by the trolley trucks for releasably attaching the trolley trucks to the driving cable in longitudinally spaced-apart relation, means for supporting said beams at an elevated level above a ground surface, a plurality of passenger cars, means for attaching each car to a trolley truck so that the car is suspended from its trolley truck in a manner free from oscillatory movement relative to its trolley truck, at least one ground supported passenger station disposed at a fixed point along the cable and providing an embarking and disembarking structure for passengers, means disposed in advance of and after the station for automatically actuating the cable engaging means of each trolley truck so as to automatically disconnect the trolley trucks from the driving cable in advance of the station and reconnect the trolley trucks to the driving cable aft of the station, moving means operatively disposed at the station and moving in the direction of driving movement of the driving cable, said moving means being disposed at a different level than the driving cable and movably supporting the cable-free cars and supporting embarking and disembarking passengers on either side of the cars so that the cars and the passengers move at the same rate of speed at the station with the passengers in embarking and disembarking interfacing relation with the cars and without any relative movement between the cars and the passengers, said cars being bunched up close together on the moving means, and a passenger conveying surface arrangement of gradually varying speeds for automatically moving passengers from and to peripatetic positions on the ground surface at the station in relation to the moving means.