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[54] **PNEUMATIC-ELECTRIC TRANSIT SYSTEMS**

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[21] Appl. No.: **241,109**

[52] U.S. Cl. .... **104/147 R,** 104/93, 104/139, 104/106, 105/26, 104/167, 104/140

[51] Int. Cl. **B61b 13/00**

[58] Field of Search .... 104/89, 93, 94, 106, 107, 104/108, 109, 138, 138 G, 139, 140, 147 R, 148, 165, 167, 155; 105/26, 148

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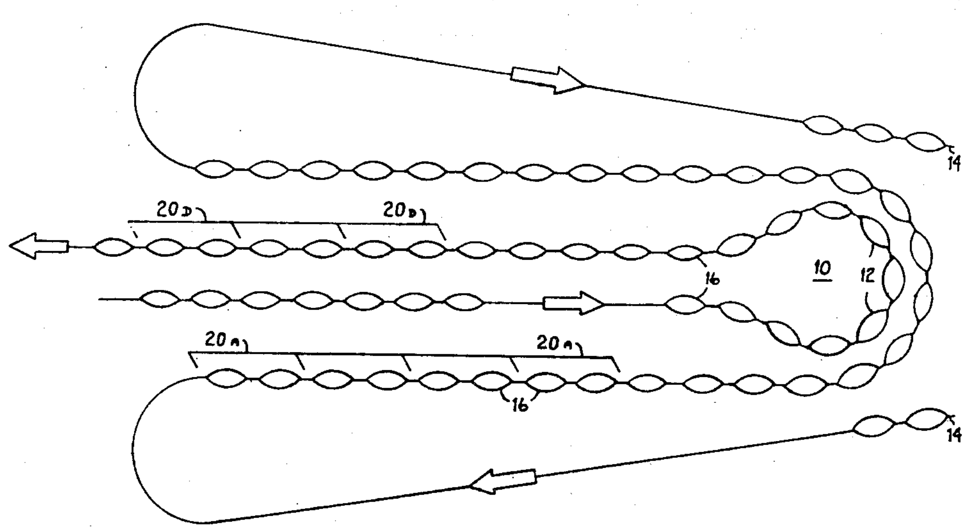
Primary Examiner—M. Henson Wood, Jr.
Assistant Examiner—D. W. Keen
Attorney, Agent, or Firm—James T. Barr

[57] **ABSTRACT**

A pneumatic-electrical transit system employing a series of closed loop tracks for carrying passengers and/or freight without the necessity for switching or intersection of vehicles as well as providing maximum safety, comfort and convenience. The electrical drive consists of individual motors for each vehicle which provide the motive power for helical traction wheels carried within a pneumatic tube.

13 Claims, 16 Drawing Figures



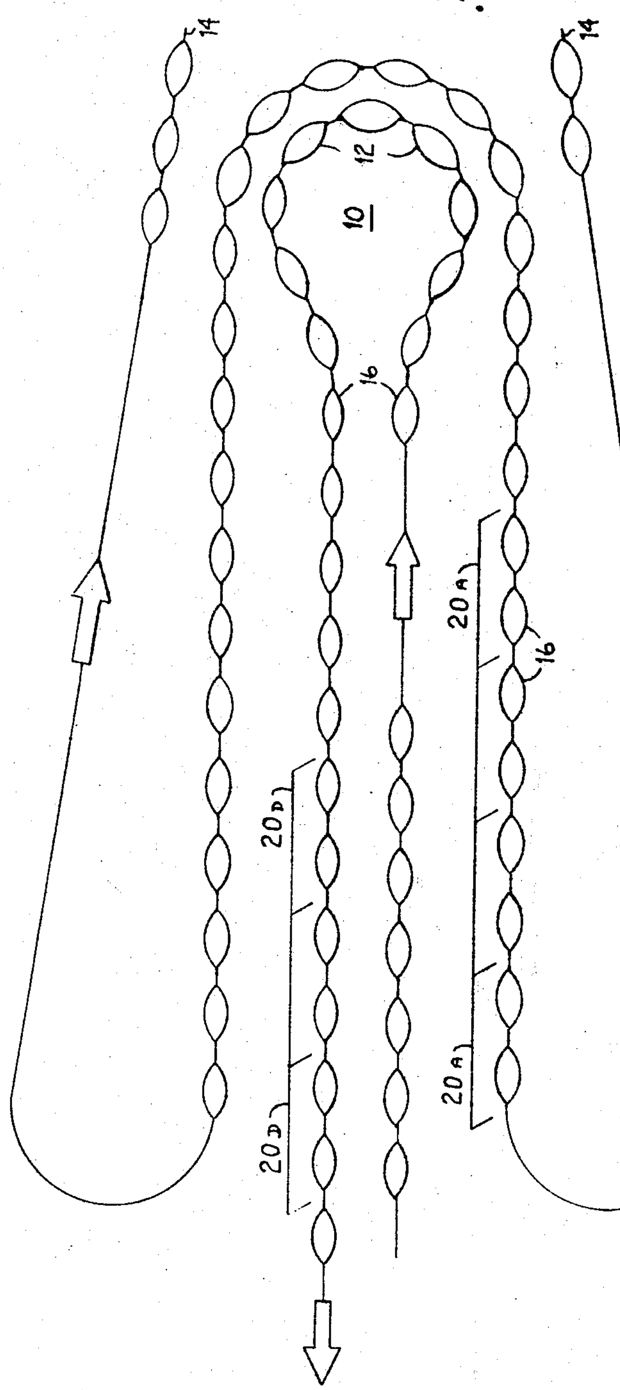


Fig. 1

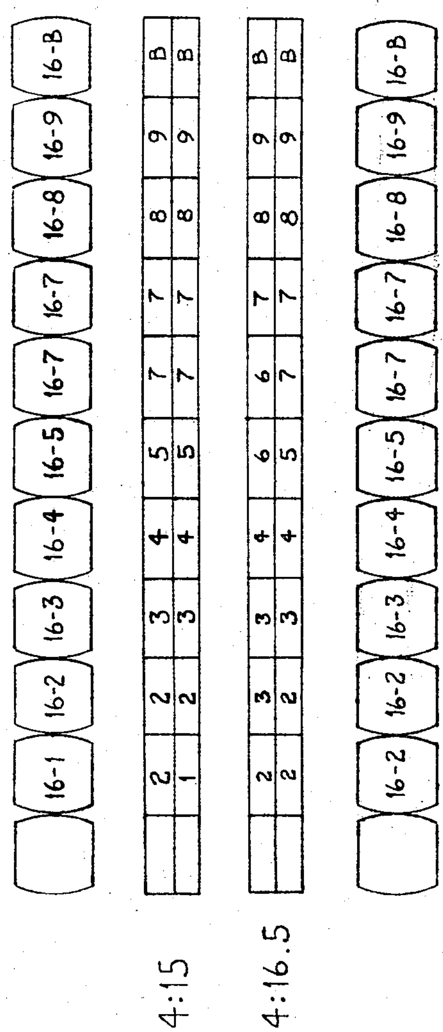
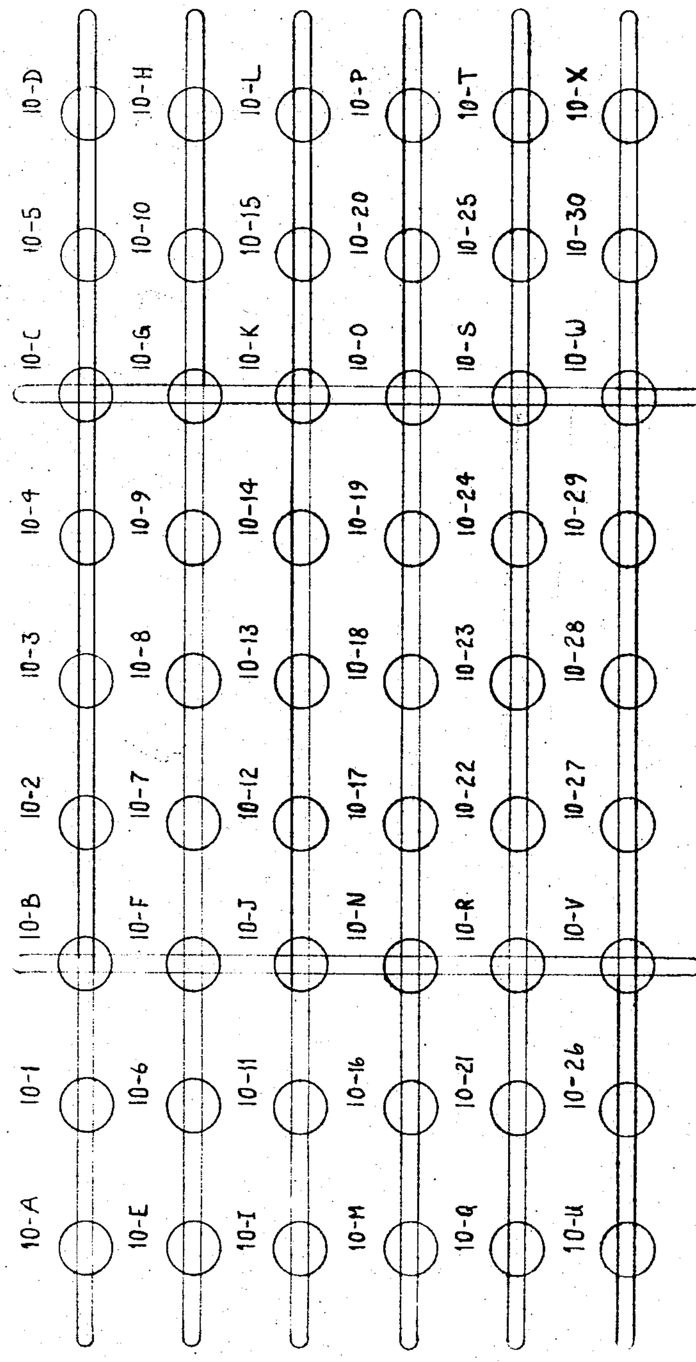


Fig 2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10-B
10-2
10-3
10-4
10-C
10-5
10-D
10-E
10-6
10-F
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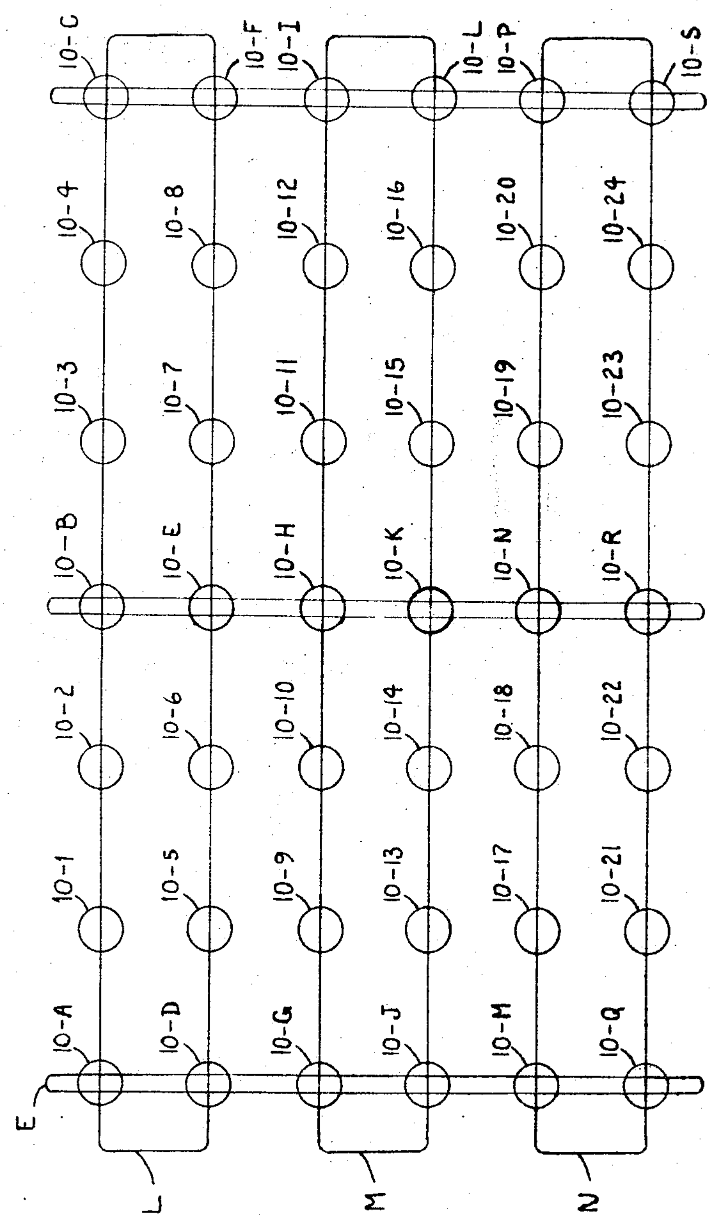
10-8
10-9
10-G
10-10
10-H
10-I
10-11
10-J
10-12
10-13
10-14
10-K
10-15
10-L
10-M
10-16
10-N
10-17
10-18
10-19
10-O
10-20
10-P
10-Q
10-21
10-R
10-22
10-23
10-24
10-S
10-25
10-T
10-U
10-26
10-V
10-27
10-28
10-29
10-W
10-30
10-X

Fig. 3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10-F
10-I
10-L
10-P
10-S
10-4
10-8
10-12
10-16
10-20
10-24
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10-7
10-11
10-15
10-19
10-23
10-B
10-E
10-H
10-K
10-N
10-R
10-2
10-6
10-10
10-14
10-18
10-22
10-1
10-5
10-9
10-13
10-17
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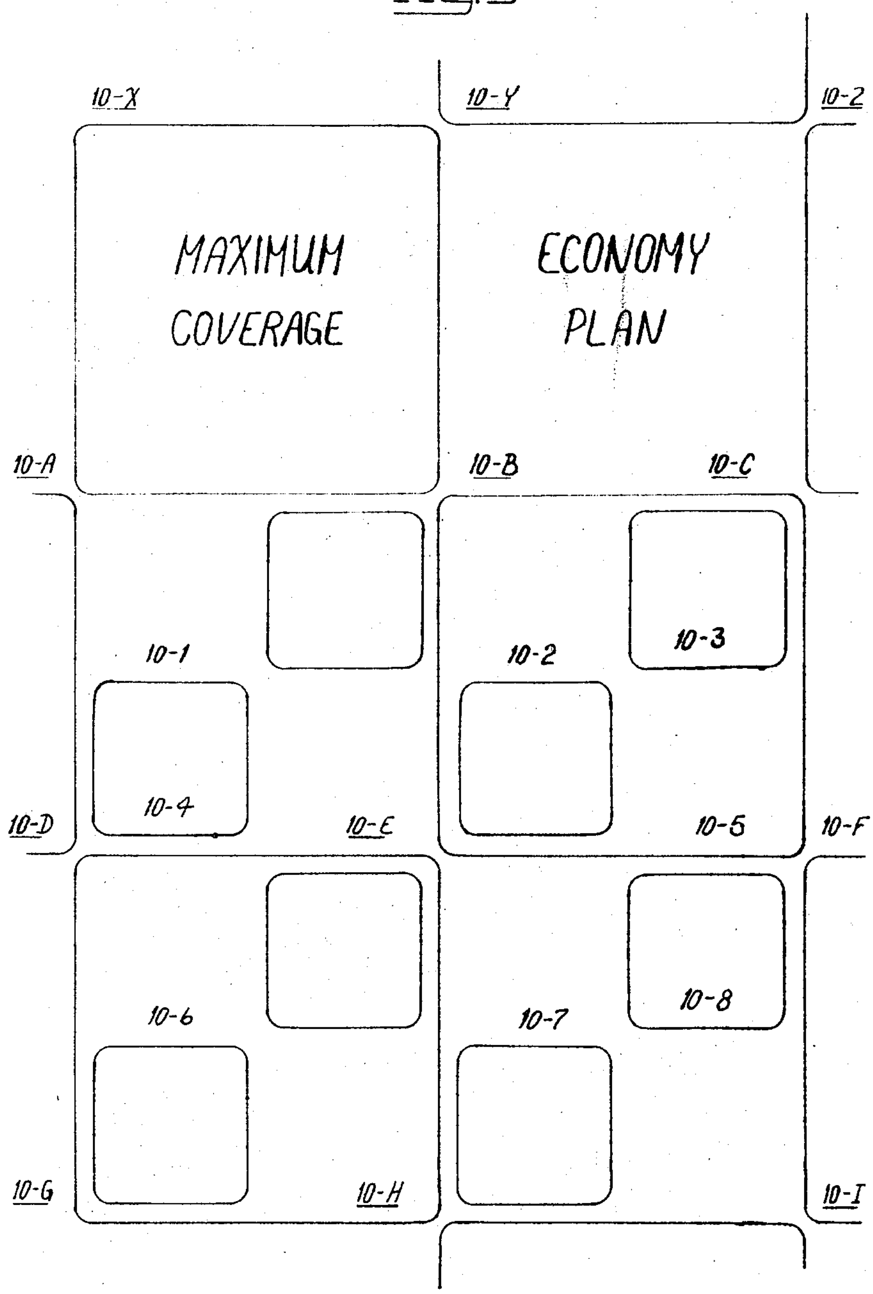
10-G
10-J
10-M
10-Q
E
L
M
N

Fig. 4

Fig. 5


10-X
10-Y
10-Z
MAXIMUM COVERAGE
ECONOMY PLAN
10-A
10-B
10-C
10-1
10-2
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10-G
10-H
10-I

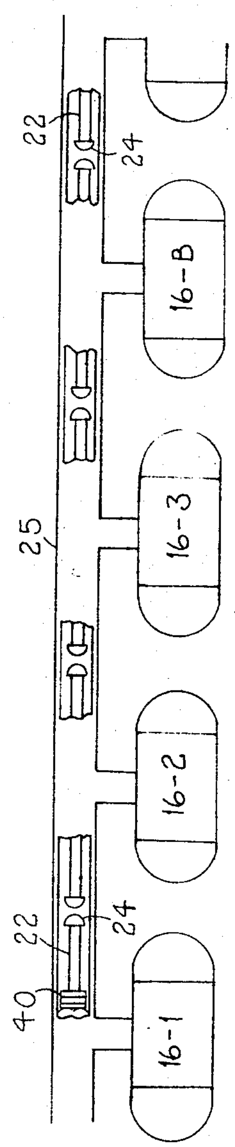
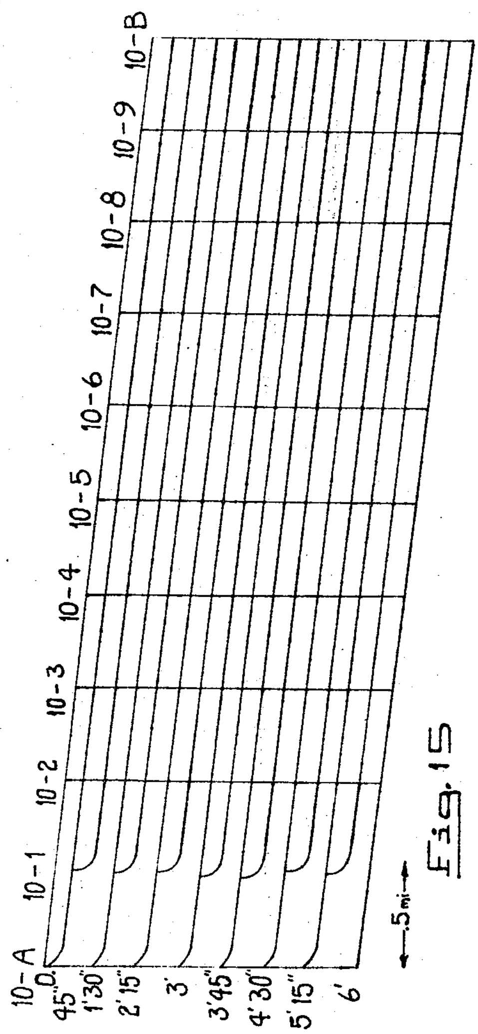

22
24
16-B
25
16-3
16-2
22
24
40
16-1

Fig. 6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10-2
10-3
10-4
10-5
10-6
10-7
10-8
10-9
10-B
0
45"
1'30"
2'15"
3'
3'45"
4'30"
5'15"
6'
.5mi

Fig. 15

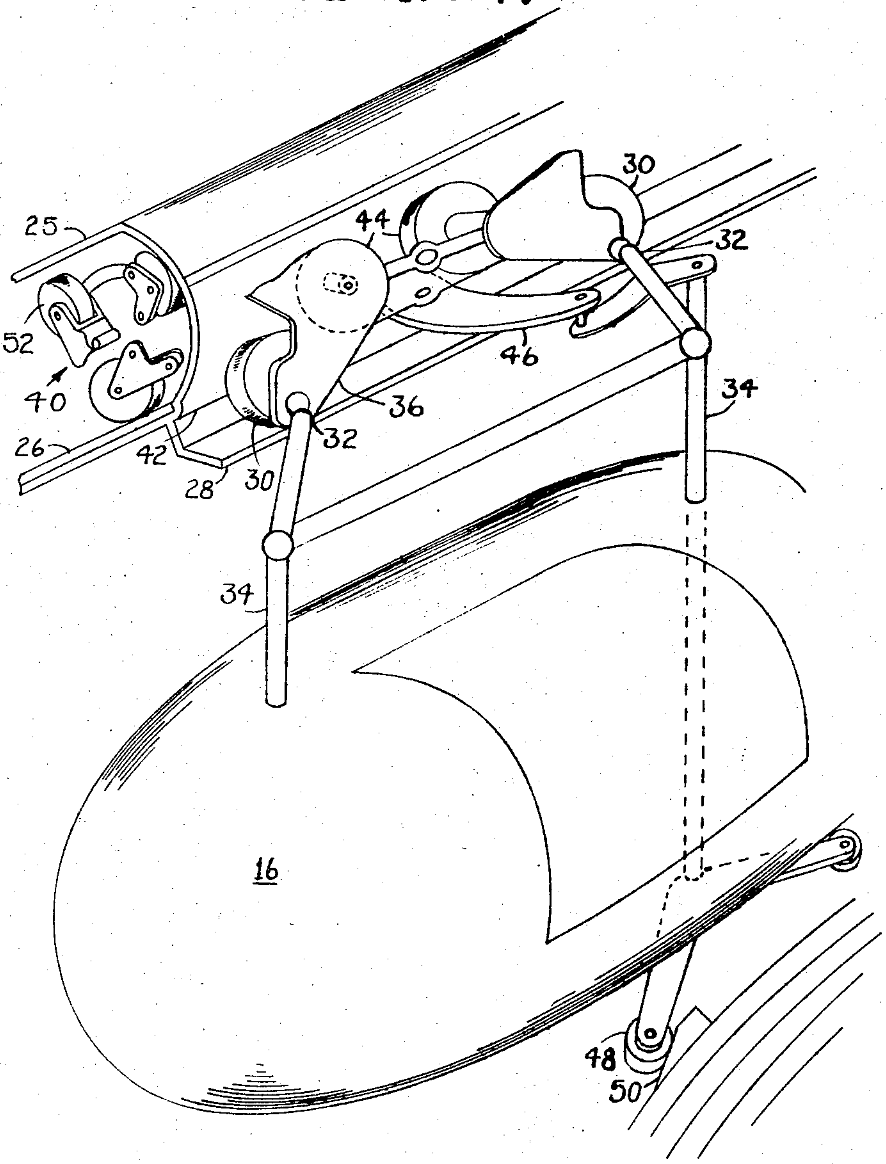

Fig. 7

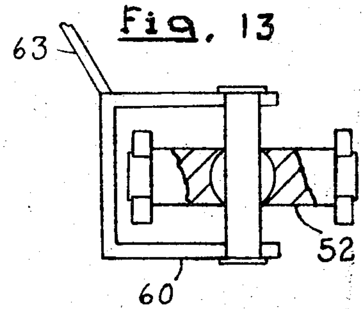

Fig. 13

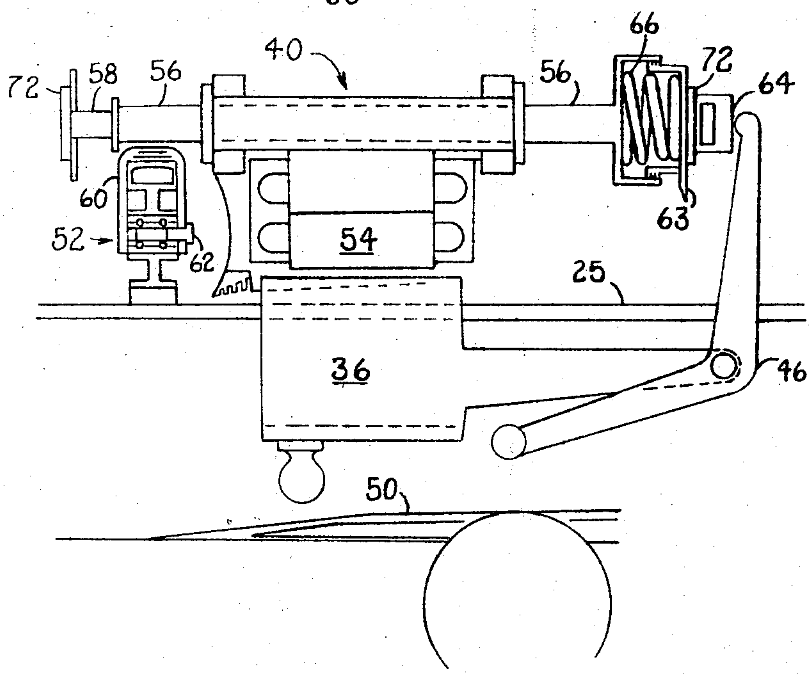

Fig. 8

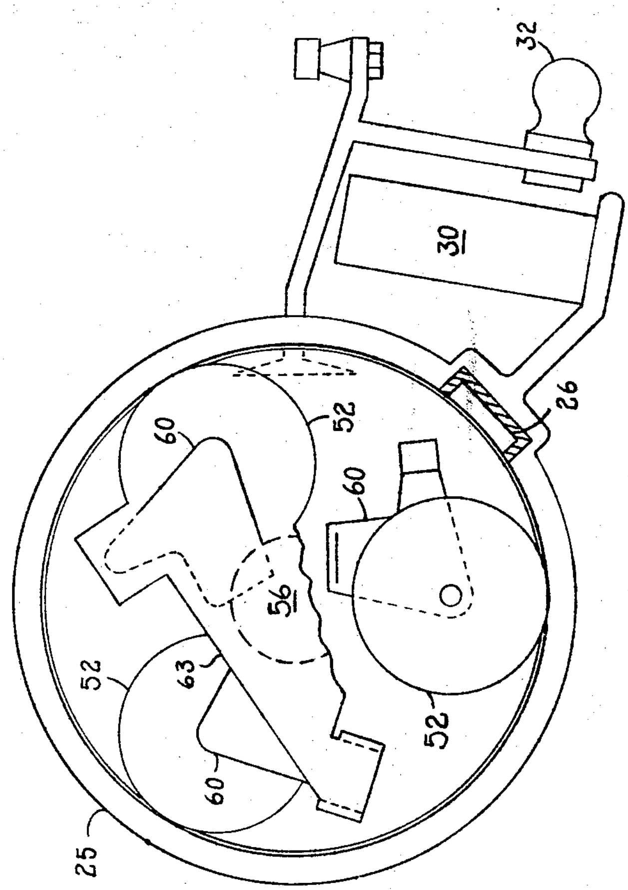

Fig. 9

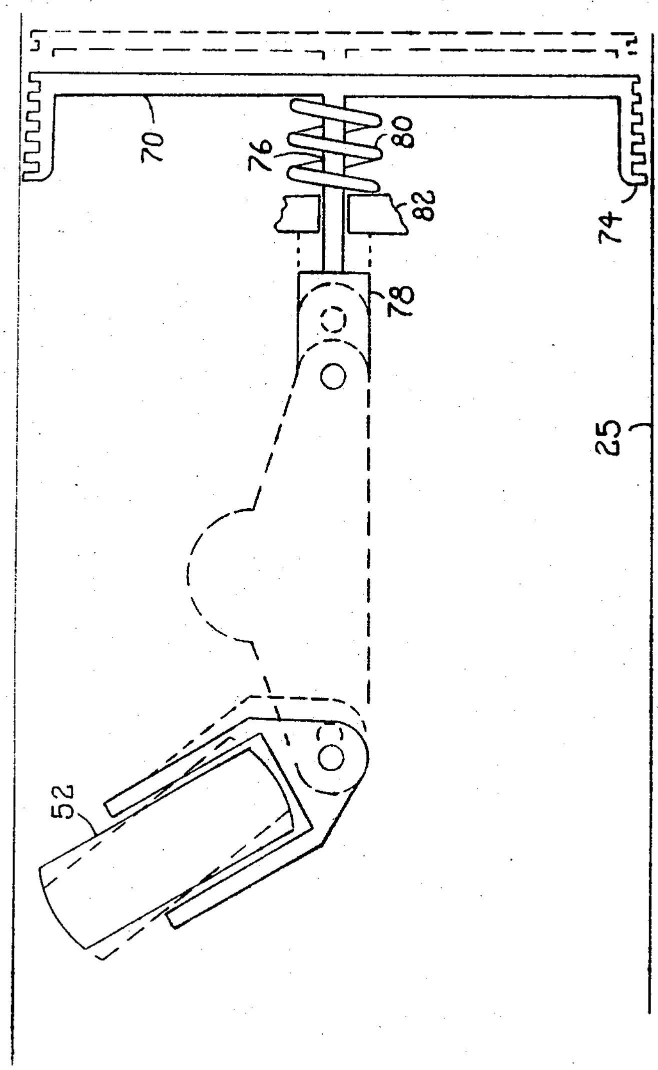

Fig. 10

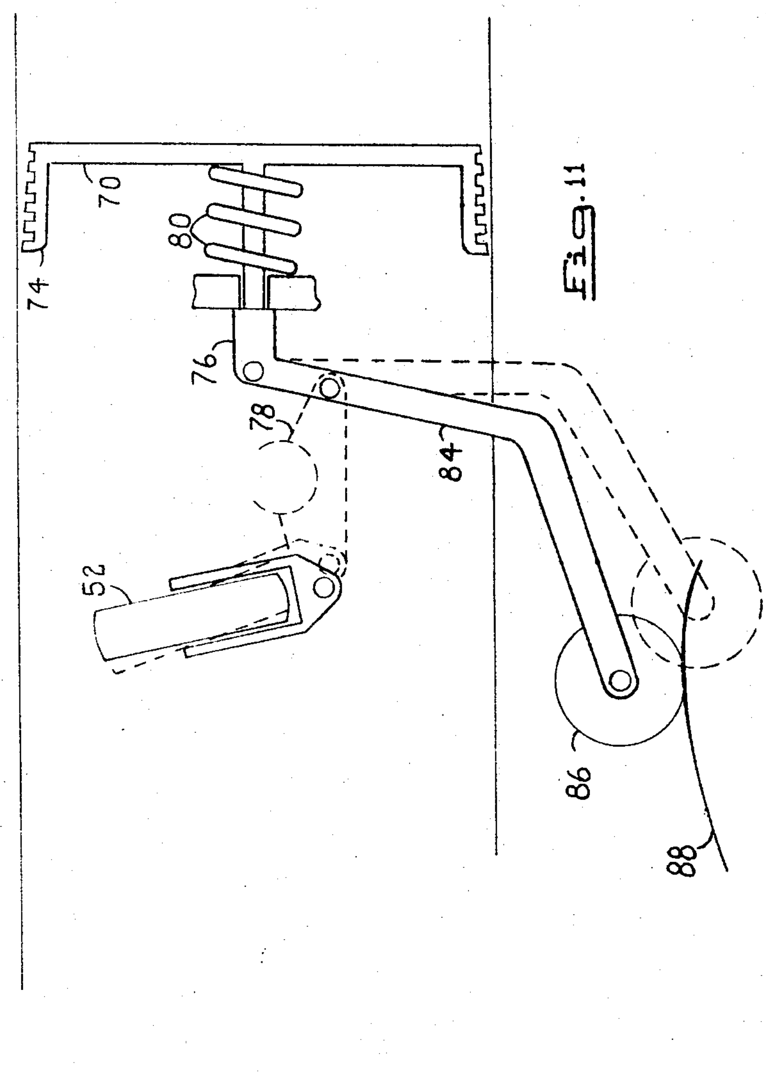

Fig. 11

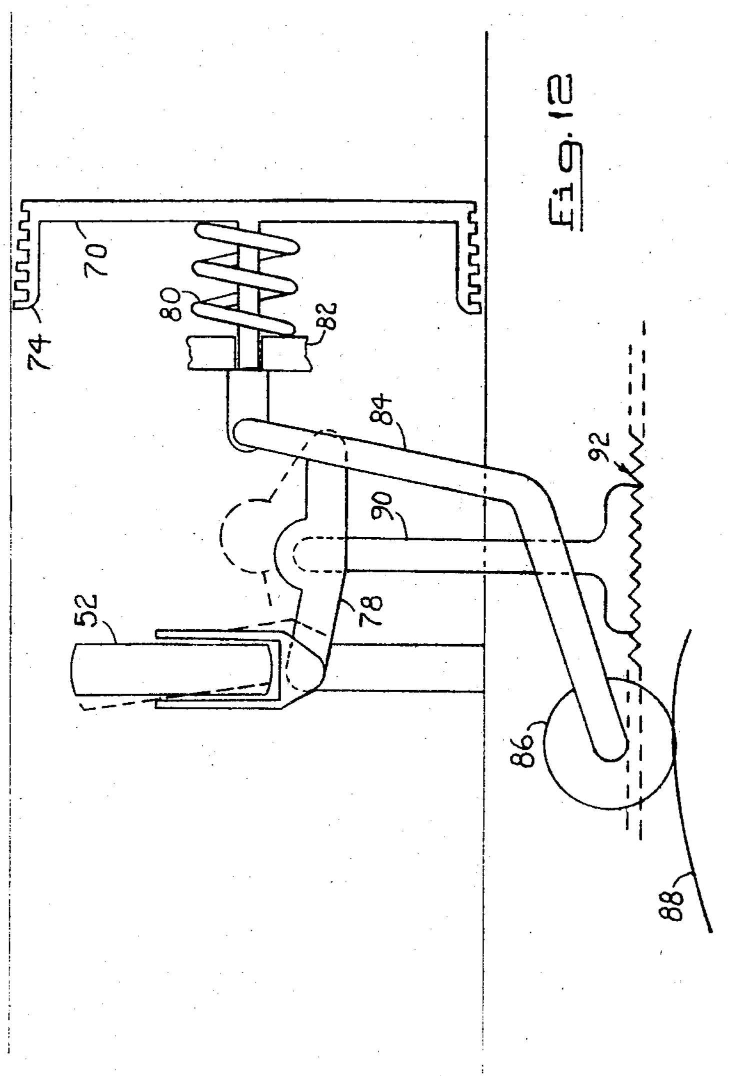

Fig. 12

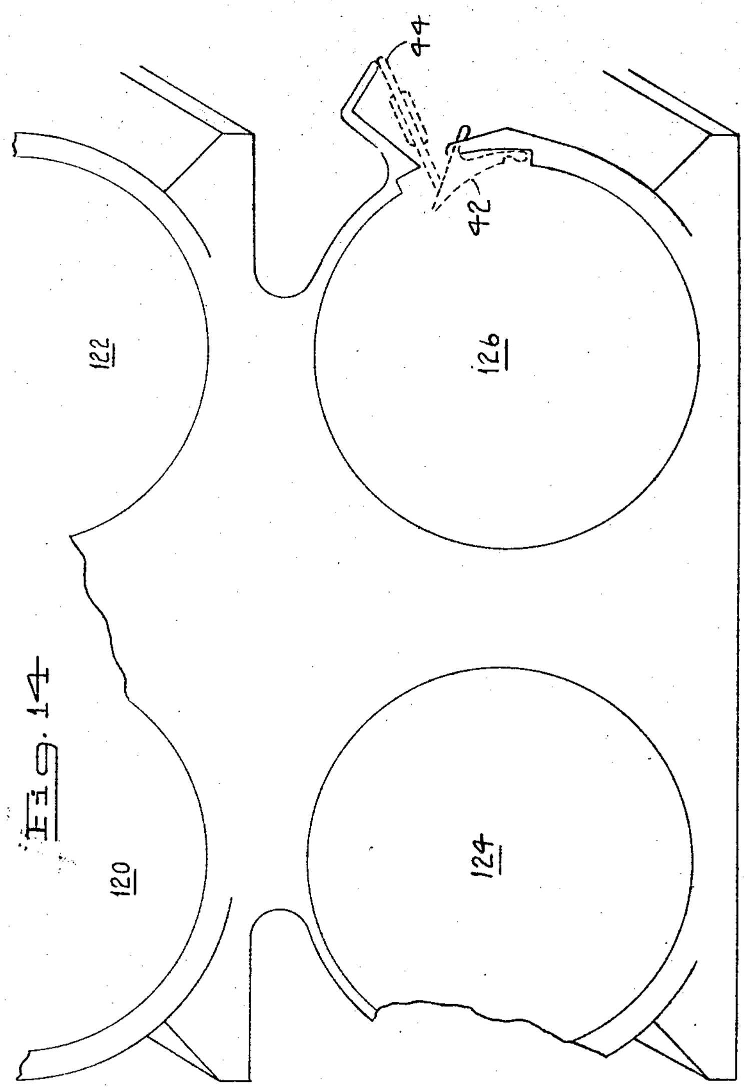

Fig. 14

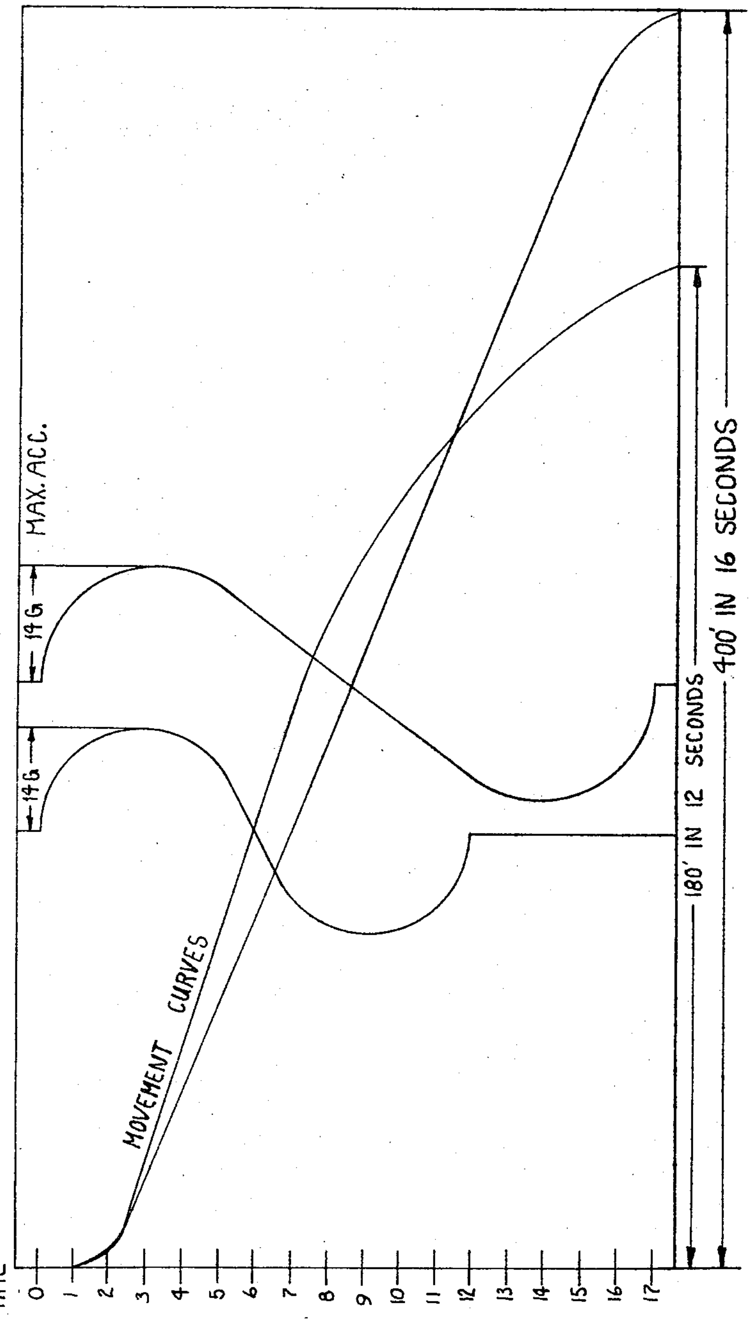
MAX. ACC.
19G
14G
MOVEMENT CURVES
180' IN 12 SECONDS
400' IN 16 SECONDS
TIME
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

Fig. 16

PNEUMATIC-ELECTRIC TRANSIT SYSTEMS

OBJECTS

Urban transportation with its current problems of pollution, congestion, accidents and inconvenience, has plagued the world urban centers for years, and the situation, in fact, has been getting worse instead of better. Various solutions have been offered with varying degrees of success in coping with the problems. For example, the inventor herein has recommended a transit system using linear electric motors as epitomized in his U.S. Pat. No. 3,403,634, and also a pneumatic transit system as shown in U.S. Pat. application Ser. No. 146,352, filed May 24, 1971, now U.S. Pat. No. 3,722,427 both of which have enjoyed considerable interest and preliminary development.

The present invention goes beyond the previously filed inventions in the field of transportation to accomplish the ultimate with respect to the solution to the many problems currently inherent in the hodge-podge urban transit of people and materials by automobiles, cabs, trucks, buses and trains.

It is obvious that urban areas will survive and be maintained as commericial centers, only when an inexpensive, healthy and nonwaiting transit system is employed. Such a system must be geared to the traffic needs of the urban centers with respect to the residential areas so that large numbers of people may be accommodated during rush hours and other times in an expeditious manner. This is predicated upon the fact that fewer vehicles are needed if the trip is faster, i.e., less vehicles in transit.

The present invention contemplates a transit system in which the following hard line parameters are met:

1. The system must be non-pollutant. There can be no emission into the air, it should not add to the already overburdened local utilities, and it has to be whisper quiet.
2. It must be clean and easily maintained.
3. The individual car concept (two to four persons, such as a family) provides privacy and the minimum exposure to communicable diseases.
4. Waiting periods must be eliminated not just shortened.
5. A single line for each direction and loop to concentrate traffic with planned coverage of both the urban center and residential areas.
6. Giant terminals must be eliminated or not required as there is no need for large idle loitering areas.
7. Terminals need to be many and small. They have to be fully protected from the weather, and if desired television surveillance can be provided.
8. Complete protection must be given to the transit system in general from the inclement weather, so there is not disrupted service.
9. Vehicles must be part of the complete system, maintenance and operation must always be under the control of the supervisory or maintenance staff.
10. It must be fare box supported and preferably computerized both as to fares and destinations.
11. There need not be any relocation of citizens, the tax base loss would be too great a burden and unnecessary to accomplish the goals of the transit system. Rather, the transit system should be correlated between congested residential areas and the urban centers.
12. Great flexibility is required, it must fit the "now" picture, and be easily disassembled for relocation when necessary.
13. Site erection must be minimal and non-disruptive so that local business is relatively unaffected.
14. Vehicles must move even though not filled to capacity in order to avoid tie-ups and undue concentration in unwanted areas.
15. Prime urban and suburban real estate is not required as terminals should be small and dispersed, while automobile parking is also not required. Terminals must be located within reasonable walking distance from residences and of course, the urban centers.
16. A complete transit system includes the adaptation for small freight especially in large cities where warehouse sites are scarce and therefore relatively expensive. This is an economic necessity.
17. Operational costs for installation, labor, maintenance and electric power must be moderate.
18. Space requirements should be scaled to the very minimum whether above, on or below the ground. Provision should also be made and considered for travel into and beneath existing buildings to furnish maximum convenience and efficiency.
19. Design of the system and terminals must fit the surroundings and be esthetically pleasing.
20. Vehicles and supports must be lightweight and flexible.

In order to accomplish the foregoing parameters and as objects this invention provides the following salient features:

A primary object of this invention is to provide a helical drive means for the vehicles of this transit system such that an infinitely variable ratio between circumferential velocity and linear velocity is achieved by simply changing the pitch of the driving helical traction wheels.

Another object of this invention is to provide pneumatic tube means having a longitudinal sealed slit for the transit system which furnishes the following structural functions:

1. A cylinder for pneumatic gueuing control of vehicles.
2. A tractive surface for the infinitely variable drive.
3. An efficient structural guideway for the vehicles.
4. A housing for the electrical conductors and auxiliary equipment.
5. An all-weather enclosure for the motor and drive means.

A further object of the invention is to provide a multiple purpose motor drive assembly which provides the following:

1. A driving means for the vehicle.
2. Queuing and safety air pistons.
3. Guide rollers for the vehicle in the cylinder.
4. An infinitely variable speed drive.
5. Current generation during deceleration.
6. Relatively short motors to effect a small turning radius.

A still further object of the invention is to provide drive means in which the variable pitch traction wheels are responsive to thrust and motor torque so that the pitch will automatically increase as speed increases to obtain a planned thrust to keep trip time to a minimum.

These and further objects will be more particularly defined in the following specification, claims and drawings, in which:

DRAWINGS

FIG. 1 is a top plan view of a representative major or express terminal showing the arrangment of incoming and outgoing vehicles for access by passengers.

FIG. 1A is an extension of FIG. 1 showing a representative local sub-terminal.

FIG. 2 is a plan view of vehicles in storage areas of the terminal with relation to departure times and vehicles availability for specific major or local terminals.

FIG. 3 is a representative chart showing an economy transit grid for accomodating premium rights of way.

FIG. 4 is a chart of transit loops for a maximum economy grid.

FIG. 5 is a representative chart of transit loops showing relationship between express and local loops.

FIG. 6 is a side view of the vehicles and the guide tube with respect to pressure differentials existing between vehicles at different distances.

FIG. 7 is a perspective view of a vehicle and the guide tube with portions removed to show inner details.

FIG. 8 is a side view of the drive means shown in relation to the guide tube and the vehicle, the upper half being shown in outline because it is similar to the detailed lower half.

FIG. 9 is an end view looking thru a section of the guide tube and illustrating the helical traction wheels and the vehicle supporting structure.

FIG. 10 is a schematic side view thru a section of the guide tube showing the servo speed control.

FIG. 11 is a view similar to FIG. 10 showing the terminal cam control.

FIG. 12 is a view similar to FIGS. 10 and 11 showing the positive terminal indexing.

FIG. 13 is a perspective view of the terminal position selective for the vehicles.

FIG. 14 is a sectional view of the guide tube structure for a double loop system with four way tubes.

FIG. 15 is a graph or flow chart showing distance versus time for the vehicles in transit.

FIG. 16 is a pair of graphs illustrating index docking and acceleration of the vehicles by time and different distances.

Referring now to FIG. 1, there is shown a terminal 10 having an inner loop 12 and an outer loop 14. Each loop consists of a string or chain of vehicles 16 for carrying passengers or freight. The number of vehicles 16 will be dependant upon the density requirements of a given area both with respect to time and need. In connection with the various drawings, the vehicles 16 and the terminals 10 use suffixes with capital letters that indicate main terminals and vehicles destined for main terminals, while the use of number suffixes indicate intermediary or local terminals. Thus a vehicle bearing the designation 16B is destined for main terminal 10B, vehicle 16-7 has as its destination local terminal 10-7, etc.

In FIG. 1 the terminal 10 represents either a main or local terminal and the directions indicated are merely representative of any convenient direction between points of passenger arrival and destination. The important aspects of the terminal location and arrangement is to ensure convenience, ease of access and egress, safety and rapidity of movement between the vehicles and the passengers or cargo. Note, that the closed traffic loops 12 and 14 do not intersect at any point but are designed to accomplish and accomodate ready transferal therebetween. In some respects, this feature is described in the inventor's copending Pat. application Ser. No. 146,352, filed May 24, 1971 now U.S. Pat. No. 3,722,427.

Passengers 20 that are arriving at terminal 10 and leaving the terminal for another destination, either by walking or transferring to a different loop are designated by suffix A, and in FIG. 1 and graphically shown in chart form in FIG. 2 with respect to departure time and vehicle availability for various terminal destinations.

In FIG. 1A there is shown a schematic illustration of a representative local terminal 10-4 which could be connected to other local terminals and a major or express terminal 10 as shown in FIG. 1. A chain of vehicles comprising forward vehicle 16A, vehicle 16-1 and rearward vehicle 16-4 are shown arriving from express terminal 10-B. The only vehicles of the chain that will stop at terminal 10-4 are those at the end of the chain and designated 16-4. The other vehicles proceed thru the terminal 10-4 on to their destination. Similarly upon arrival at terminal 10-1 the vehicle 16-1 drops off the chain while vehicle 16A proceeds as an express vehicle directly to terminal 10A.

Note that vehicles 16-6, 16-9 and 16B are similarly arranged to proceed in a chain toward their respective terminals.

FIG. 2 represents a transit chart located at the particular terminal for arriving passengers to acquaint themselves with destination and vehicle availability data. For example, consider passengers travelling between main terminals 10A and 10B with selective intermediate stops at local terminals 10-1 thru 10-9, and the chart being located at terminal 10A, then a passenger going to local terminal 10-1 boards a vehicle 16-1 which proceeds immediately to that terminal, which is the first terminal on that particular local loop route. The frequency and number of vehicles 16 designated for particular main or local terminals will be determined by traffic requirements which are preprogrammed by computers.

These computers are based upon experience data as well as computer destination cards which are purchased by the users and then inserted at the departing terminal to communicate destination information to the computer. In such a computer controlled system it is obvious that speed of response and availability of vehicles will be prompt, provided that information is fed to the computer quickly and accurately as to the needs and areas to be served.

As shown in FIG. 2, for example only, destination demand is greatest at terminals 10-2 (three vehicles available) and 10-7 (four vehicles available), while terminal 10-6, at this particular time has no available vehicles because no user requirement exists. However, in any unit of time this situation may change depending upon user demand and therefore vehicle requirements. Thus, FIG. 2 is representative of a particular time and destination situation which is unique.

It should be noted that vehicles 16 are strictly and sequentially controlled such that vehicle 16-1 is always behind vehicle 16-2, 16-2 behind 16-3, etc. This means that thru passengers are conveyed beyond terminals that are not desired while passengers for such terminals are permitted to stop and disembark at their selected destinations. Thus a passenger, having terminal **10B** for a destination, boards vehicle **16B** at the head of the departing chain of vehicles, which will ensure arrival at terminal **10B** without stopping at any intermediate local terminals such as **10-1** to **10-9**, inclusive, etc.

Note that the chart of FIG. **2** shows two sets of vehicle information. The top set indicates the availability of vehicles for the designated terminals **10-1** to **10B** (only the suffixes being shown) at 4:15. The upper column of the upper set illustrates the sequential arrangement of the vehicles **16** at the starting terminal **10A**. The lower set has an upper column which shows the availability of vehicles at **4:16.5** or one minute and a half later.

The departing chain of vehicles **16** travel from left to right as indicated so that vehicle **16B** is at the head and vehicle **16-1** is at the end of the chain. Due to the closed loop system and sequential vehicle destination, there is no switching nor intersecting of vehicles which has heretofore created the problems affecting safety and speed, as well inconvenience to the passengers or freight.

In FIG. **3** an economy loop array or consecution is shown that is specifically designed to accomodate expensive rights of way, such as tunnels, or buildings. Therefore, the loops are spaced closely to require minimum expenditures of land or space. An express loop is indicated between terminals **10B**, **10F**, **10J**, **10N**, **10R** and **10V** with vehicle storage areas at the ends of the loop at terminals **10B** and **10V**. Similarly, at the other major or express loops, there are storage areas for vehicles, which may be located there temporarily, or used immediately.

In FIG. **4** the transit loops are located further apart for reasons of convenience in another locality. Thus, the vehicle storage areas, as before, may be convenient to a residential area or business area, whereby crossterminals and/or intermediate local terminals may be used.

Referring now to FIG. **5**, a maximum coverage economy loop array is shown. As an example, at main terminal **10-E** arriving passengers have the choice of express loops for main terminals **10D**, **10B**, directly; main terminals **10G** and **10C** via **10D** and **10B**, respectively, main terminals **10H** and **10F**, via terminals **10D** and **10G**, **10B** and **10C**, respectively, and other main terminals like **10Y**, **10X** and **10A** by disembarking at terminal **10B**. Also local loops **10-4**, **10-6**, **10-7**, **10-2**, **10-3** and **10-5** are readily available and directly accessible from terminal **10E**.

A passenger, residing in an area near terminal **10-1**, for example, while working near terminal **10G**, would board a vehicle **16D** at terminal **10-1**, disembark at terminal **10D** and board an express vehicle **16G** to arrive at the place of employment. The return trip would be effected via terminals **10H** and **10E** to terminal **10D** and then the old local loop to terminal **10-1**.

With reference to FIGS. **1**, **3**, **4**, and **5** it would be noted that closed and non-intersecting loops enable the maximum transferance of people and material in minimum time. In FIG. **5**, for example passengers travelling from terminal **10A** to terminal **10B** board vehicles designated **16B**, which is an express vehicle that does not stop at local terminals in between terminals **10A** and **10B**, although, if a single conduit or guideway system is used the vehicle **16B** will be routed thru such local terminals without requiring the passengers to disembark, however. Similarly, passengers coded for local terminals will be routed automatically to desired local terminals in sequence.

Referring now to FIG. **6**, there is shown a sequential chain of vehicles **16-1**, **16-2**, **16-3** and **16B** in a queuing position at a terminal **10A**, for example. Each vehicle **16** has attached thereto by intermediate means, control bars **22** having contact ends **24**. FIG. **6** shows the contact bars **22** in a schematic form which is more fully detailed in FIGS. **10**, **11** and **12**. The control bars **22** perform several functions. At the terminal **10**, the contact between ends **24** retain the vehicles **16** evenly spaced but in intimate contact at the control bar **22** location without the vehicles touching each other. Thus upon acceleration, the vehicle chain moves as a unit or like a connected train, albeit they are not connected. Similarly, upon deceleration and coming into a terminal **10** the vehicles **10** will be maintained, after contact, in a safe, spaced chain. In the event a forward vehicle has motive problems of any kind, the vehicles behind such vehicle can push the disabled vehicle into a terminal for removal from the loop and maintenance or repair thereof.

In FIG. **7**, there is shown a vehicle **16** in relationship to cylindrical guide tube **25**. The guide tube **25** may be constructed as a cylinder liner, either metal or plastic, or integrally as shown in FIG. **14**. However it should be noted that the guide tube **25**, as well as carrying the drive assembly **40** (FIG. **8**), is also readily adaptable to contain the electrical power components such as the positive conductor **26** and the shell of the tube **25** (if conductive material) as the negative conductor, and also provided that the positive conductor **26** is electrically insulated from the tube **25**. This arrangement is a matter of convenience and depends upon the particular requirements. Thus it is not limited by the scope or extent of this invention.

A track or V-shaped channel **28** is used to contain and support vehicle **16** by means of weight-bearing rollers **30**, support balls **32** and support rods **34**. In addition, support arms **36** (FIG. **9**, also) connect vehicle **16** with the drive assembly **40** via slit seal **42** which is self-closing to maintain the inner portion of tube **25** in a pressure or pneumatic condition. In this respect, slit-opening discs **44** are provided to permit support arms **36** and speed control arm **46** to traverse the slit and enable access to the drive assembly **40** within the guide tube **25**. Note, that speed control arm **46** (also FIG. **8**) is connected to a cam follower **48** which is engageable with a cam **50** located at terminal **10** location. The function and use of this cam arrangement (**48–50**) will be more particularly described in connection with the description of FIGS. **10**, **11**, and **12** hereinafter.

In FIG. **8** there is shown the drive assembly **40** in reference to a cut-away portion of guide tube **25**. Helical traction wheels **52** (one of which is shown) are peripherally spaced within tube **25** and drive against the inner surface thereof. An electrical motor **54** has a shaft **56** which is attached to helical traction wheels **52** to drive them within the guide tube **25**. Support arm **36** connects the drive assembly **40** with the vehicle **16** as shown in FIG. **7**.

Note that the view of FIG. **8** shows merely the lower half of the drive assembly **40** from the center line of guide tube **25.** As the upper half is just a duplicate of the parts thereof, it is not shown.

The helical traction wheels **52** are supported by a U-shaped bracket **60** which is pivotally mounted on shaft **56** as also shown in FIG. **9.** The U-shaped bracket **60** has a pivot **61** which permits the wheels **52** to rotate as to pitch within the guide tube **25.** A rod inside of shaft **56** is reciprocable relative thereto but enables a triple yoke **63** to change the angular or pitch relationship of the wheels **52** relative to the perpendicular position within the guide tube **25.** The rod **58,** however, is keyed to shaft **56** with respect to rotary movement of motor **54** so that it rotates therewith, although this is not an essential aspect. The wheels **52** are also rotatably mounted on rods **62** to rotate on their own axes within the guide tube **25.** The pivotal mounting of bracket **60** permits change of pitch for the wheels **52** such that an infinitely variable speed may be achieved. Three helical traction wheels **52** are shown as the optimum number. However it may be realized that any number could be used without departing from the scope of this invention. If one wheel is used, then a counter-weight could be added to maintain smooth rotation within tube **25.** It has been demonstrated that two large and opposed wheels or three helical traction wheels perform successfully and accomplish the necessary desiderata for this invention. As shown in FIG. **8** the helical traction wheels **52** are at a 90° angle with respect to the inner wall of guide tube **25.** This position constitutes the stop condition at a terminal or storage area. Note that as illustrated in FIG. **10** the drive wheels **52** are normally spring biased by means of thrust spring **66** to approximately a 60° angle with respect to the inner wall of guide tube **25** which constitutes a **40** MPH speed position. Therefore, in FIG. **8** the stop position is maintained against such spring bias by the speed control arm **46** which is connected to cam follower **48** in engagement with cam **50** at the terminal. The control arm **46** bears against an abutment member **64.** The member **64** is spring biased outwardly (towards the right in FIG. **8**) by means of a thrust spring **66.**

Note, that the pitch of traction wheels **52** is responsive to several conditions. First, the speed control arm **46** which contacts abutment member **64** to reciprocate rod **58** to the position shown in FIG. **8,** for example, secondly, pressure against the diaphragm **70** of FIGS. **10, 11,** and **12.** Thirdly, the torque and thrust of the drive assembly **40** which also maintains the proper operating conditions for the motor to correct RPM to obtain no overload conditions and to generate smooth acceleration.

In FIG. **9,** there is shown a view looking into guide tube **25.** The triple yoke **63** connects the brackets or forks **60** of each wheel **52** to control the pitch thereof. The yoke **63** is connected to flange **72** which in turn is attached to rod **58.** As heretofore mentioned movement of rod **58** within shaft **56** pivots the helical traction wheels **52** about their individual pivots but in unison such that the relative angularity therebetween is the same. Similarly, torque and thrust of the motor **54** will affect pitch of wheels **52,** however, again in unison.

In FIG. **10,** a schematic illustration is shown looking at a section of guide tube **25** with the drive assembly linkage in a servo speed control position. The diaphragm **70** is air sealed within the tube **25** by means of a labyrinth type seal **74.** The diaphragm **70** is responsive to air pressure inside the tube **25** to exert a longitudinal force along rod **76** to effect position changes of link **78** which in turn pivots helical traction wheels **52.** As shown in the solid lines, the wheel **52** is at approximately **40** M.P.H. position. Upon decrease of air pressure in front of diaphragm **70,** the diaphragm **70** moves to the right, pulling rod **76** and link **78** to the dashed line position of wheel **52.** In this position the optimum speed (for this arrangement) obtains a speed of 55 M.P.H. for the vehicle **16.** The air pressure and servo speed control of FIG. **10** is in addition to the mechanical control of FIG. **8.** Note, that a spring **80** between fixed abutment **82** and diaphragm **70** is biased to retain the speed control and therefore wheel 52 at the 40 M.P.H. position.

In FIG. **11** there is shown the station cam control which incorporates additional linkage, such as control link **84** attached to cam follower **86.** The cam follower **86** is adapted to cooperate with a station cam **88,** located at the embarking terminal **10** to slow the vehicle **16** and wheel **52** (solid lines) to approximately **15** M.P.H. prior to stopping or soon after starting. In the dashed line position, the vehicle **16** speed is being increased preparatory to leaving the terminal and attaining transit speed.

In FIG. **12** a positive Station indexing for vehicles **16** is shown. A latch **90** which is pivotally mounted to link **78** is arranged to move up (dashed line position) or down (solid line position). A door indexing lock **92** which has mating serrations maintains the helical traction wheel **52** in the 90° or stop position while vehicle **16** is at the terminal **10** for loading or unloading. An interlock (not shown) maintains the latch **90** in engagement with the indexing lock **92** so long as the vehicle **16** door is open. After the vehicle **16** is loaded at the terminal the interlock disengages the latch **90** from lock **92** upon closure of the vehicle door. The control link **84** is also moved upwardly thereby to move the helical traction wheel **52** to the dashed line position which starts the vehicle **16** forwardly at low speed.

In FIG. **13** an optional terminal position selector **94** is shown. This modification may be used to positively space vehicles **16** for turnstile boarding where that is desirable. A series of different level vehicle position cams **96, 98** and **100** are spaced to maintain vehicles **16** in precise positions at a terminal **10.** A selector **102** which may be solenoid (not shown) actuated has a series of selector fingers **104, 106, 108** and **110** arranged for pivotal movement on a common shaft **112.** A selecting cam follower **114** is selectively positioned on shaft **116** to route vehicles into cam area **96** as shown. Counter clockwise movement by the solenoid on finger **104** permits and holds the cam follower **114** in the position shown. However, the fingers **104, 106, 108,** and **110** are spring (not shown) biased to their clockwise position as shown for fingers **106, 108** and **110.** Release of the solenoid on finger **104** and activation of finger **106** permits the cam follower **114** to drop down into juxtaposition with finger **106** to guide the vehicle into the cam area **98.** Similarly finger **108** guides the vehicle **16** via cam follower **114** into cam area **100.** Finger **110** acts to provide an emergency stop position in the event of malfunction.

In FIG. **14** a portion of a double loop system is shown which is capable of four transit lines **120, 122, 124** and **126.** In this arrangement of the transit system it is possible to transport **40,000** person per hour utilizing the teachings of this invention. Using line **122** as an example details of the slit seal **42** and one of the slit-opening discs **44** which enables the vehicle **16** to be connected internally with drive assembly **40** with the guide tube **25.**

In FIG. **15** there is shown a flow chart in distance versus time illustrating the travel of vehicles between main terminals **10A** and **10B** with intermediate vehicle handling at local or sub-terminals **1** to **9** inclusive. Assuming one-half mile intervals between local terminals and therefore a five mile distance between main terminals **10A**, and **10B**, a vehicle leaving terminal **10A** will arrive at terminal **10-1**, forty five seconds later either for dis-embarking a passenger or continuing on to a further terminal. At that time another chain of vehicles is leaving terminal **10A**, etc. Thus it can be apparent that with minimum time of loading and un-loading with sequential vehicle transit, a maximum number of people can be accomodated.

In FIG. **16** a pair of graphs illustrating docking and acceleration by different distances with respect to time. These graphs emphasize the importance of the variable speed drive to obtain smooth and fast acceleration and deceleration for docking in the minimum time for maximum or desired distances.

With respect to the transit system shown and described herein it should be noted that the drive assembly **40** can be considered as a flywheel in motion such that the kinetic energy of the drive assembly **40** is efficiently transferred into thrust by means of the helical drive.

These and other features of the invention are easily subject to modifications and it is intended that the invention be limited only by the scope of the appended claims.

What is claimed is:

1. A drive system for vehicles comprising,
- cylindrical guide means having a tubular opening therein,
- drive means in said guide means movable within said opening,
- said drive means including electric motor means powered by conductor means in said guide means,
- said drive means including helical traction wheel means in said opening operable by said motor means to operate a vehicle exteriorly connected to said guide means and said drive means, and
- pitch control means for said helical traction wheel means responsive to torque and thrust of said drive means for varying the pitch of said helical traction wheel means.

2. A drive system according to claim **1** wherein said pitch control means includes buffer means in said opening for varying the pitch of said helical traction wheel means upon contact of said buffer means with contiguous buffer means connected to another vehicle.

3. A drive system according to claim **1** wherein said pitch control means includes pneumatic responsive means for varying the pitch of said helical traction wheel means.

4. A drive system according to claim **1** wherein said helical traction means includes two diametrically opposed wheels rotatable within said opening.

5. A drive system according to claim **1** wherein said helical traction means includes three wheels peripherally opposed within said opening at equal angles of 120°.

6. A drive system according to claim **1** wherein said pitch control means includes mechanical means controlled exteriorly of said guide means for varying the pitch of said helical traction wheel means.

7. A drive system according to claim **1** wherein said helical traction wheel means and said pitch control means include planetary yokes for each of said helical traction wheel means to permit uniform pitch variation thereof.

8. A drive system according to claim **1** wherein said helical traction wheel means includes yoke means coupling said helical traction wheel means for uniformly varying pitch thereof in response to said pitch control means.

9. A pneumatic - electric transit system for vehicles comprising,
- cylindrical guide means having a self - sealing longitudinal opening for connecting vehicles outside of said guide means to drive means within said guide means,
- said drive means includes electric motor means for each of said vehicles and powered by conductor means associated with said guide means,
- said drive means includes helical traction wheel means driven by said motor means for moving said vehicles,
- pitch control means associated with said drive means responsive to torque and thrust of said drive means for varying the pitch of said helical traction wheel means,
- and pneumatic means in said guide means for maintaining pressure in said guide means to prevent proximate vehicles from colliding.

10. A transit system according to claim **9** wherein said pitch control means includes buffer means in said guide means for each of said vehicles for varying the pitch of said helical traction wheel means upon contact between contiguous buffer means.

11. A transit system according to claim **9** wherein said pitch control means includes pneumatic responsive means for varying the pitch of said helical traction wheel means upon proximity between adjacent vehicles.

12. A transit system according to claim **9** wherein said pitch control means includes mechanical means controlled exteriorly of said guide means for varying the pitch of said helical traction wheel means.

13. A transit system according to claim **9** wherein said drive means includes planetary yoke means connected to said helical traction wheels to permit uniform pitch variation thereof.

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