C. D. SEEBERGER.

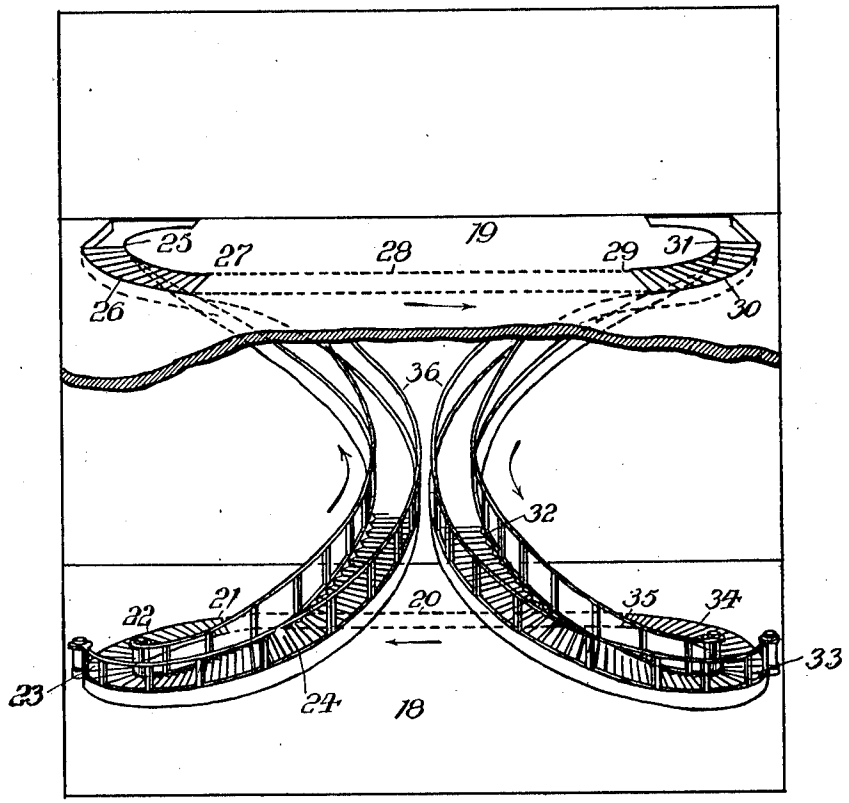
CONVEYER.

APPLICATION FILED APR. 29, 1902.

984,495. **Patented Feb. 14, 1911.**

5 SHEETS—SHEET 1.

Fig. 1



Witnesses
Lutie J. Alter
Hattie O. Halvorson.

Inventor
Charles D. Seeberger,
per
Coburn, McRoberts & McElroy,
Attorneys

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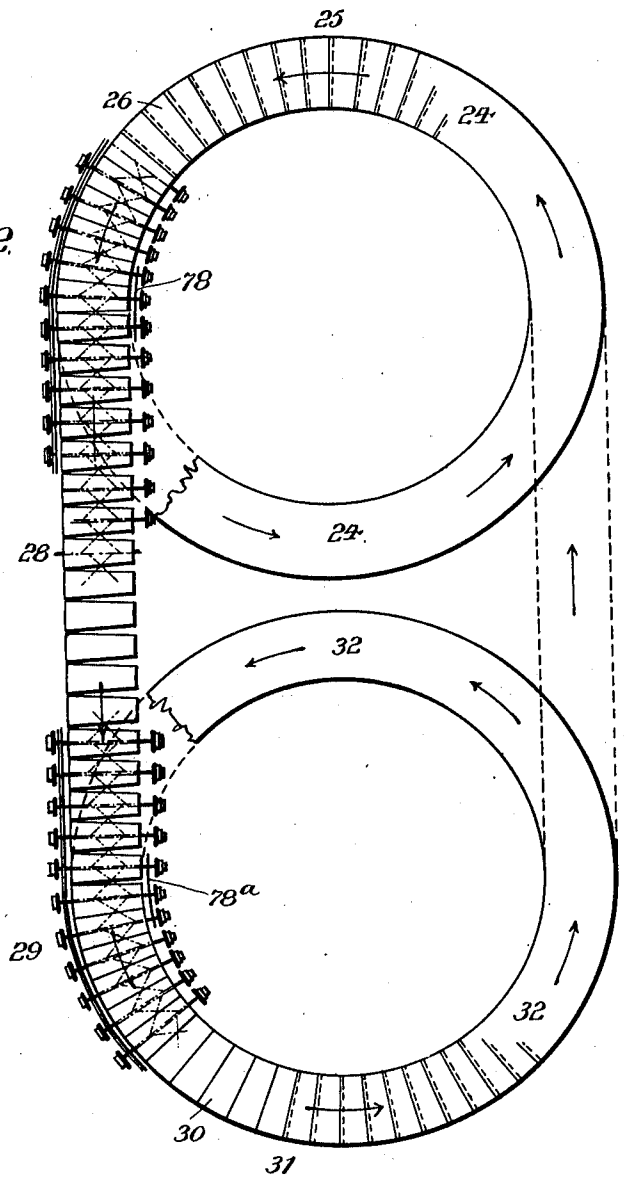
5 SHEETS—SHEET 2.

Fig. 2.



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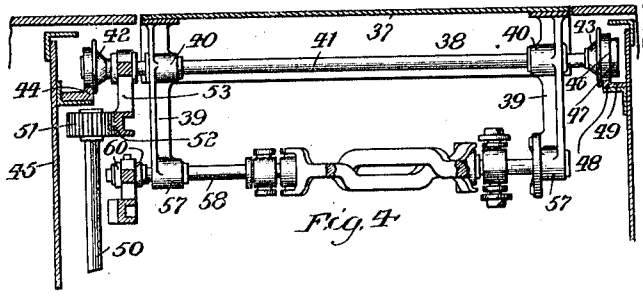

Fig. 4.

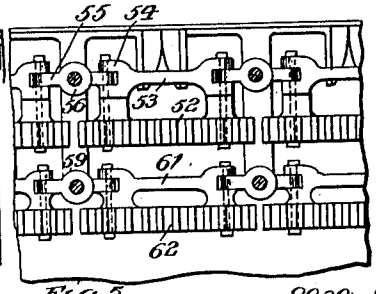

Fig. 5.

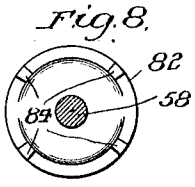

Fig. 8.

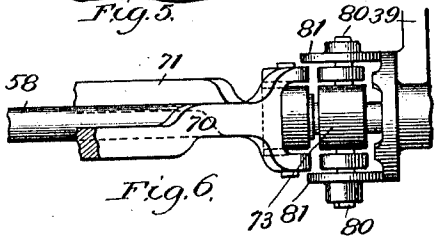

Fig. 6.

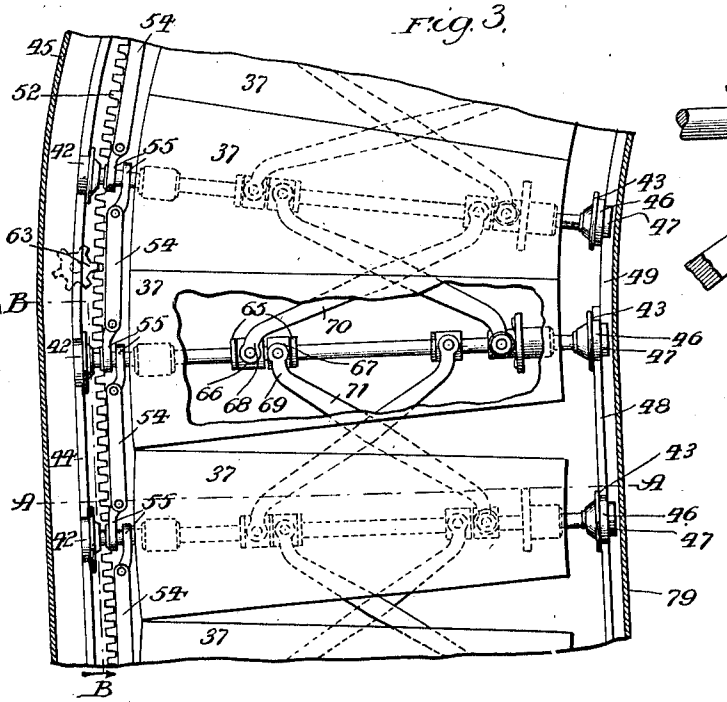

Fig. 3.

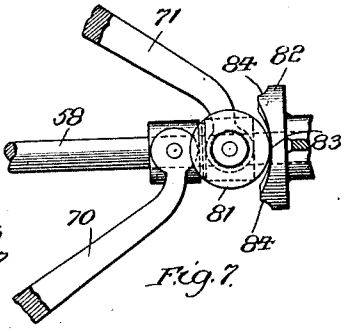

Fig. 7.

Witnesses:

Lutes S. Alter,

Hattie O. Halvorson.

Inventor:

Charles D. Seeberger,

Per Coburn, McRoberts & McElroy

Attorneys.

C. D. SEEBERGER.

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5 SHEETS—SHEET 4.

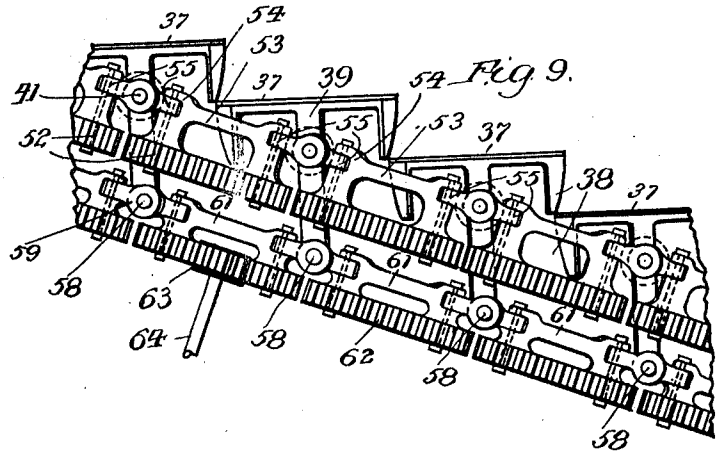

Fig. 9.

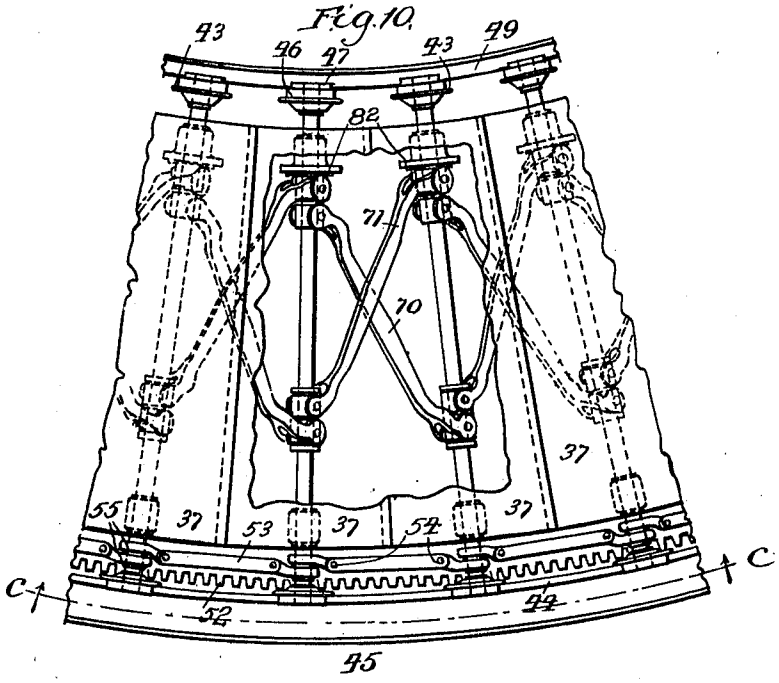

Fig. 10.

Witnesses
Lutz J. Alter,
Hattie O. Halvorson.

Inventor
Charles D. Seeberger,
per
Colum, Mc Robert & McElroy
Attorneys.

C. D. SEEBERGER.

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5 SHEETS—SHEET 5.

Fig. 11

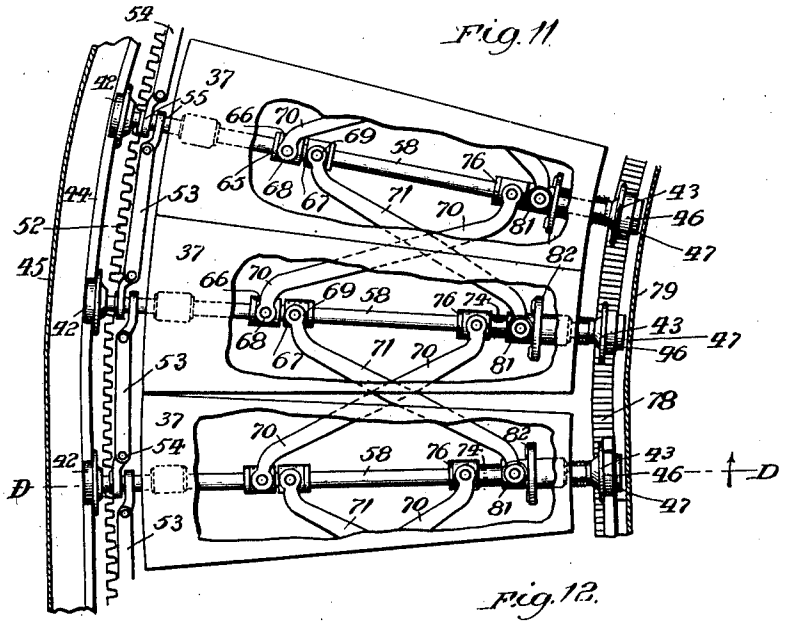


Fig. 12.

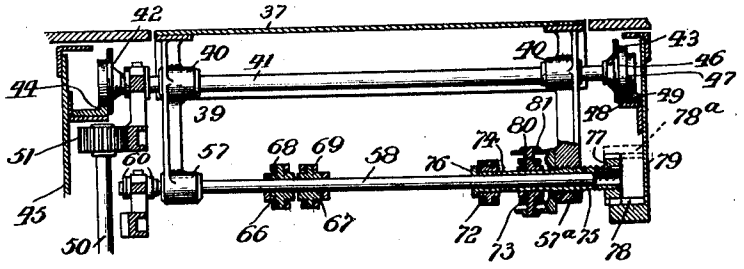
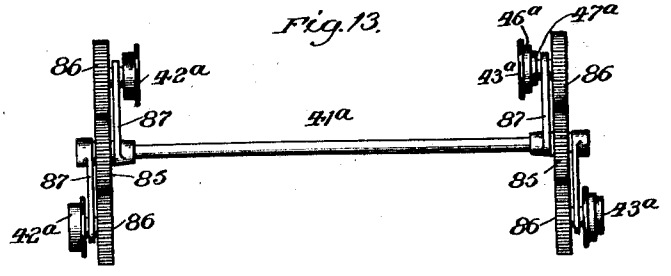


Fig. 13.



Witnesses:

Lute L. Alter

Hattie O. Halvorson.

Inventor:

Charles D. Seeberger,

Per Colum, McRobt. McClung

Attorney

UNITED STATES PATENT OFFICE.

CHARLES D. SEEBERGER, OF YONKERS, NEW YORK.

CONVEYER.

984,495. Specification of Letters Patent. Patented Feb. 14, 1911.

Application filed April 29, 1902. Serial No. 105,172.

To all whom it may concern:

Be it known that I, CHARLES D. SEEBERGER, citizen of the United States, residing at Yonkers, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Conveyers, of which the following is a specification.

My present invention relates to conveyers, and is concerned especially with the spiral type of conveyer by which a single set of steps can be employed in a small space for both ascending and descending stairs.

My present invention is concerned with the modes of operation and novel mechanisms by which such a system can be employed and the steps kept in perfect alinement while moving through the different portions of the tracks upon which they operate.

To illustrate my invention, I annex hereto five sheets of drawings, in which the same reference characters are used to designate identical parts in all the figures, of which—

Figure 1 is a perspective view showing a design for an ascending and descending spiral conveyer connecting two floors of a building; Fig. 2 is a plan view of the same, diagrammatic in its nature, with some of the parts broken away to illustrate the positions the steps assume in different portions thereof; Fig. 3 is a plan view, on an enlarged scale, of a portion of the track where it passes from a straight to a curved portion, the adjacent run of the floor being cut away, and the tread surface and axle of one of the steps being broken out to more clearly disclose the parts beneath; Fig. 4 is a vertical section of the same on the line A—A of Fig. 3; Fig. 5 is a side elevation of a portion of the steps on the horizontal run of the track in section on the line B—B of Fig. 3; Figs. 6 and 7 are a side elevation and plan view, respectively, of a portion of the inner end of the strut linkage in the position it occupies on the curved horizontal portions of the tracks; Fig. 8 is a detail view showing the face of the cam for keeping the axles radial when passing from a horizontal curved portion of the track to an inclined curved portion; Fig. 9 is a side elevation of the stairs on an inclined portion thereof in section on the line C—C of Fig. 10; Fig. 10 is a plan view of the same with a portion of the tread surfaces and the axles of two of the steps broken away to disclose the parts beneath; Fig. 11 is a plan view of three of the steps at a point where the stairs pass from a straight horizontal to a curved horizontal portion, with portions of the tread surfaces and the axles broken away to disclose the mechanism I may employ for keeping the axles radial; Fig. 12 is a sectional view of the same on the line D—D of Fig. 11; and Fig. 13 is a modified form of a step axle and truck employed where four wheels are used on each step.

Referring first to Figs. 1 and 2, the specific design shown consists of a double conveyer spiral connecting two floors, and the series of steps are supported by a continuous track providing two inclined spiral runs connected at their ends by lateral loops or curves to make a complete circuit, and which starts with the lower horizontal straight portion or run 20, which preferably causes the steps to pass just beneath the floor 18 for reasons which will hereafter be apparent. The steps at the termination of this portion or run emerge from beneath the floor at 21, where the track makes a curved horizontal portion or run 22, which at 23 changes to a curved ascending portion or run 24, which preferably makes one complete spire reaching to the upper floor 19, through which the steps emerge at 25, and form the landing 26 on the curved horizontal portion, which at 27 changes to a horizontal connecting straight portion or run 28, and the steps dip beneath the floor 19, whence they emerge at 29 and change to a curved horizontal landing portion or run 30, which at 31 descends through the floor and changes to the descending curved inclined portion or run 32, which preferably makes a complete spire and at the point 33 changes to a horizontal making the curved horizontal landing portion or run 34, which at 35 preferably dips beneath the floor 18 and changes to the horizontal straight portion or run 20 completing the circuit. In use it will be apparent that in ascending the passengers step on at the landing 22 and are carried up and leave the stair at the landing 26. Those wishing to descend step on the landing 30 and are carried down and step off at the landing 34. Balustrades 36, traveling or otherwise, may be employed, and shunts may also be employed at the ends of the landings if desired. They are not, however, shown in the figure, as it is merely diagrammatic and intended

to show the outline of one design of steps to which my present invention is peculiarly adapted.

Referring now to Figs. 3 to 10, each step consists of the horizontal tread portion 37, which, as seen, is segmental in its general outline, its sides being converging, and its inner concave end being slightly shorter than its outer convex end. The exact shape of the steps will depend on the radius of the curve of the horizontal and inclined portions of the tracks for which it is designed. The steps are provided with the risers 38, preferably curved, which in the present embodiment are placed on each side in case the design contemplates an ascending and descending conveyer, as in the particular form shown. The tread surfaces and the risers are supported by the two T-shaped brackets 39 located at the outer ends, and forming bars provided with the bearings 40 for the axle shaft 41. This axle shaft preferably rotates in the bearings and has the wheels 42 and 43 fastened on the outer and inner ends thereof respectively. The outer wheels 42 roll on the track 44 secured in any suitable manner to the inner side of the supporting structure 45. To enable me to use the wheels rigidly secured on the axle both upon the curved and tangent portions, I provide the inner wheel 43 with the differentiated tread surfaces 46 and 47 on its periphery. The portion of the periphery constituting the tread surface 46 is of the same diameter as the tread surface of the periphery of the wheel 42, and when the steps are traveling on the tangent portion of the tracks, the surface 46 of the wheel 43 rolls upon the outer portion 48 of the inner track. The tread surface 47 of the inner wheel is enough smaller in its diameter so that when the steps are running on the curved portions of the track, the tread surface 47 coöperating with the inner portion 49 of the inside track, which is raised above the outer portion a distance equal to the difference between the length of the radii of the two peripheral surfaces 46 and 47, will, while moving at the same angular velocity as the tread surface of the outer wheel, pass over enough less actual length of track so that the axle 14 is always directed toward the center of curvature of the spiral track upon which it is running. The raised inner portion of the track 49 begins a little in advance of where the portion 48 of the inside track ceases, the two parts running into each other so that the inner wheels will pass from one part to the other without any jar.

To drive the system, I employ one or more rotating shafts 50, which are provided with the spur gears 51 meshing with the teeth of a rack bar 52 so designed as to prevent interference between adjacent rack bars while passing from the inclined portion to the horizontal portion, and preferably formed on the outer face of the bottom portion of a series of links 53, each of which by means of the ears 54 is pivotally secured at either end to the intermediate links 55 which have the bearings 56 by which they are journaled upon the axles 41 between the outer wheel 42 and the outer bearing 40. The links 55 being pivoted to the links 53 in one plane, and on the axles 41 in another plane, the connections thus formed are those of a universal joint. As I may desire to locate the spur gears 51 in the horizontal curved portions of the track, I make the outer face of the rack curved on the arc of a circle of which the center is the center of curvature of the spiral track. If the gear pinions 51 are applied at one or more points, as indicated in Figs. 3 and 4, and the shafts 50 are rotated, it will be apparent that the series of steps will be driven over the tracks in the manner customary in this class of devices.

Where two points of support only, such as the two wheels 42 and 43, are provided for each carriage, it becomes necessary to provide a system of parallel linkage to hold the steps with their tread surfaces horizontal, and for this purpose, I form a pair of bearing sleeves or collars 57 in the lower ends of the T-shaped brackets 39 beneath the bearings 40, and in these bearings I secure the step bar 58. This step bar has journaled on its outer end beneath the links 55 a corresponding link 59, which is held in place by the collars 60. The links 59 have pivoted to either end thereof the links 61, which I preferably provide with rack bars 62 on the lower outer edge thereof, these rack bars corresponding in all respects to the rack bars 52 except that in as much as I prefer to apply the driving power to them from the spur gear 63 and the shaft 64 to which it is secured at an inclined portion of the track, as shown in Fig. 9, I have to make the curve of the rack bars 62 slightly less than the curve of the rack bars 52, as it will be apparent that as applied to the surface of the imaginary cylinder in which the tracks are located, the same length of link on the inclined portion will not be curved as much as the same length of link on the horizontal portion, the difference being that of a line of the same length drawn at right angles to the axis of the cylinder and one drawn obliquely to said axis. This system of parallel linkage constituted by the links 53 and 61 serves to keep the tread surfaces of the steps substantially horizontal in all portions of the track as will be readily apparent. While parallel linkage suffices to maintain the treads in parallel planes, it is obvious that such parallel planes may occupy any angular relation to the path on which they travel, depending on the relation of the parallel links to each other, therefore in order

to maintain the links in such relation as to provide horizontal treads I establish and fix such relation by any suitable holding or locking means, such as the driving mechanism applied to both the parallel links.

It will be apparent that in a device of this kind where the tracks pass from the straight portions or runs to the horizontal curved portions or runs, and from the horizontal curved portions or runs to the inclined curved portions or runs, it is impossible to connect both ends of the axles or steps by fixed links having a constant length without throwing the axles out of radial position on some portion of the track. Consequently, I have devised a novel link connection between the steps in which links of a constant length are employed, and are fixed to the steps at one end, while the other end can move longitudinally thereon so as to permit the inner ends of the steps to approach or recede from each other as may be necessary in passing from one portion of the track to another. Owing to the fact that a very large portion of the chain of steps is wound in a helical spire, it will be apparent that there is an enormous pressure resulting from the weight of the steps and any load that may be thereon tending to carry them toward the center, and resisted only by the centrifugal force of the steps when they are in motion, and which is relatively small as the velocity is not high. If the flanges of the wheels alone were depended upon to resist this centripetal thrust, the friction would be too great, and the strut linkage to be described also serves to overcome this thrust. For this purpose, I provide the linkage system best shown in Figs. 3, 4 and 11, which, when the two wheels or supports are employed and the step bar 58 is necessary, I preferably mount on said step bar. If a four wheeled truck or carriage were employed, such as is shown in my application No. 79,520, filed October 22, 1901, I would then apply the linkage to be described to the axles 41. Secured upon the step bars 58 toward the outer end thereof is a pair of collars 65, and between these collars I journal upon the shaft the short sleeves 66 and 67 which have pivotally secured thereon the yokes 68 and 69 forming the outer ends of the links 70 and 71. It will be apparent that the construction thus formed constitutes a universal joint between the step bars and the links. The inner ends of the links are provided with similar yokes and sleeves, which, however, are free to slide on the portion of the adjacent step bar which is circular in cross section, within the limits to be hereinafter more specifically defined, these limits being sufficient to permit the steps to separate at their inner ends as they must on the straight portions or runs of the track, as shown in the lower portion of Fig. 3, or to approach each other on the curved portions or runs of the track, as shown in the upper portion of Fig. 3. By this system of linkage, it will be apparent that the inner ends of the steps can move freely toward and from each other as may be necessary on the different sections of the track, and that without the possibility of their becoming unduly separated or misplaced.

In order that the steps may run with perfect smoothness over the different sections of the track, it is necessary that the axles always point directly to the axis of the curve upon which they move, or in other words that the axles must always be exactly at right angles to the line of the particular portion or run of the track upon which they are moving. When the steps are on the straight portion or run, the axles are parallel to each other, and when they pass to the curved horizontal portion or run their inner ends must converge toward the axis of the spiral upon which they run. I preferably provide means to force these axles to converge, and the mechanism which I preferably employ is illustrated only in Figs. 11 and 12, being omitted from the other figures. When this mechanism is employed, the inner collars 72 and 73 are mounted to slide on a sleeve 74, which surrounds the inner end of the axle bar 58 and has an enlarged screw threaded portion 75 which is screwed through a bearing 57^a. On the outer end of this sleeve 74 is a collar or flange 76 and its inner end has feathered thereon the gear pinion 77 which meshes with a rack 78 located on the under side of the pinion and carried by the frame support 79. With the parts as they are in the lowermost step in Fig. 11, it will be apparent that as the step advances onto the rack 78, the sleeve 74 being rotated through the medium of the pinion 77 will be screwed inward carrying with it the collar 72, so that the axle bar 58 and consequently the step to which it is attached is forced to assume the desired radial position. The pitch of the screw, size of the pinion 77, and the length and location of the track 78 are such that as the step passes from the horizontal straight portion to the horizontal curved portion or run, the collars 72 and 73 will be moved so as to bring the steps into the desired radial position, and prevent their accidentally being moved therefrom.

When the steps pass from the horizontal curved portion to the straight portion or run of the track as at 27 and 35, the process described is reversed, the rack 78^a therefore, indicated in dotted lines in Fig. 12, being of course located on the upper side of the pinion in order to reverse the direction of movement. It will also be apparent that when the steps pass from the horizontal curved portion or run to the inclined curved portion, in order to maintain the true radial relation of the steps, the sliding ends of the

links 70 and 71 will have to move inward a very slight distance. In order to compel this inward movement, and to prevent any failure of the steps assuming the proper radial relation owing to the action of inertia, I place upon the ends of the pins 80 projecting upward and downward from the collar 73, and upon which the yokes on the inner ends of the lugs 71 are pivoted, the disks 81, best shown in Figs. 6 and 7, which coöperate with the cam disks 82 which are rigidly secured to or formed integral with the inner bearing 57a. These cam disks 82 have the reduced surfaces 83 with which the disks 81 coöperate when the steps are on the horizontal curved portion, and on either side of the reduced portions are the projections 84, upon which the disks 81 are forced to ride as the steps pass from the horizontal to the incline. It will be apparent that the action of these projections 84 on the disks 81 as the steps pass from the horizontal to the inclined portion or run will be to force the collars 73 outward slightly, thus serving to positively move the step the necessary amount to insure its remaining in the proper radial position on the inclined portion of the track.

In case a four wheeled truck is employed, as indicated in Fig. 13, in order to permit of the wheels being in effect rigidly secured to the axle so that they will necessarily roll the proper amount on the two tracks to keep them at right angles to the line of the track at all points whether on the straight or curved portions; I secure to the axles 41a the gear pinions 85, which mesh with the gear pinions 86 secured on the axles of the wheels 42a and 43a, which are mounted to rotate in bearings formed in the arms 87 on the truck. By the interposition of these gear pinions I am enabled to cause the wheels 42a and 43a to rotate in unison and secure the same effect resulting from having the two tread portions 46a and 47a of the different diameters in the same manner as if two wheels only were employed on the truck.

While I have shown my invention as embodied in the forms which I at present consider best adapted to carry out its purposes, it will be understood that it is capable of some modifications, and that I do not desire to be limited in the interpretation of the following claims except as may be necessitated by the state of the prior art.

What I claim as new, and desire to secure by Letters Patent of the United States is—

1. In a device of the class described, the combination with tracks having straight and curved portions, of the steps, link connections of constant length between said steps which permit their axes to remain at right angles to the line of movement of the steps at every portion of the track, and means for driving said steps.

2. In a device of the class described, the combination with tracks having straight and curved portions, a series of steps, parallel link connections of constant length between said steps arranged to permit their axes to remain at right angles to the line of movement of said steps at every portion of the track, and means for driving the steps, substantially as described.

3. In a device of the class described, the combination with tracks comprising straight and laterally curved portions, of a series of steps, link connections of constant length between said steps arranged to permit their axes to remain at right angles to the line of movement of said steps at every portion of the track, and means for driving the steps, substantially as described.

4. In a device of the class described, a way providing horizontal and inclined curved runs and a straight run, a series of steps moving on said way, and rigid links adjustably connecting the steps on the curved and straight runs.

5. In a device of the class described, the combination with tracks having horizontal and inclined curved portions, of steps, link connections of constant length between said steps which permit their axes to remain at right angles to the line of movement of the steps at every portion of the track, and means for driving said steps.

6. In a device of the class described, the combination with the tracks having the straight and curved horizontal portions on the different floors and the inclined spiral portions connecting said curved portions, of the steps having the segmental shaped tread surfaces, link connections between said steps which permit their axes to remain at right angles to the line of movement of the steps at every portion of the track, and means for driving said steps.

7. In a device of the class described, the combination with the tracks having the straight and curved horizontal portions on the different floors and the inclined spiral portions connecting said curved portions, of the steps having the segmental shaped tread surfaces forming the landings on the curved horizontal portions and the stair steps on the inclined portions, coverings for said steps on the straight portions of the tracks, link connections between said steps which permit their axes to remain at right angles to the line of movement of the steps at every portion of the tracks, and means for driving said steps.

8. In a device of the class described, the combination with the tracks having the straight and curved horizontal portions on the different floors and the ascending and descending spiral portions connecting said floors and constituting one or more spires which are connected by the curved and

straight horizontal portions on each floor making a continuous track, of the steps having the segmental shaped tread surfaces, link connections between said steps which permit their axes to remain at right angles to the line of movement of the steps at every portion of the track, and means for driving said steps.

9. In a device of the class described, the combination with the tracks having the straight and curved horizontal portions on the different floors and the inclined spiral portions connecting said curved portions, of the steps coöperating therewith and having the segmental shaped tread surfaces, link connections between said steps which permit their axes to remain at right angles to the line of movement of the steps at every portion of the track, means for driving said steps, and mechanism for compelling them to remain at the aforesaid right angular position at every portion of the track.

10. In a device of the class described, the combination with the pair of inclined spiral tracks and horizontal portions, of the steps having a single bearing support upon each track, the parallel linkage system to hold the tread surfaces of the steps horizontal on all portions of the track, and means engaging the linkage for driving said steps.

11. In a device of the class described, the combination with spiral tracks, of the steps moving thereon, parallel links connecting said steps, and driving mechanism engaging said links and tending to advance the steps and hold their tread surfaces horizontal.

12. In a device of the class described, the combination with the steps or carriages and the spiral tracks therefor, of parallel linkage connecting said steps to maintain them in predetermined relation to each other upon the landing as well as upon the incline and driving mechanism engaging the linkage.

13. In a device of the class described, the combination with the steps or carriages and spiral tracks therefor, of parallel linkage of constant length connecting said steps to maintain their treads horizontal and driving mechanism engaging the linkage.

14. In a device of the class described, the combination with the steps or carriages and spiral inclined and horizontal tracks therefor, of parallel links connecting said steps to maintain them in horizontal position on both the inclined and horizontal runs, and driving mechanism engaging the links.

15. In a device of the class described, the combination with a pair of tracks including horizontal and inclined portions and the necessary lateral curves to make a complete circuit, of a series of steps each provided with a pair of supports coöperating with said tracks, and a system of parallel links having a constant length connecting said steps so as to hold their tread surfaces in predetermined relation to each other on the horizontal and inclined portions of the track, and driving means engaging the links.

16. In a device of the class described, the combination with a pair of tracks consisting of horizontal and inclined portions and the necessary lateral curves to make a complete circuit, of a series of steps each provided with a pair of supports coöperating with said tracks, a system of parallel links of constant length connecting said steps so as to hold their tread surfaces in horizontal position on the horizontal and inclined portions of the track, and means for driving said steps.

17. In a device of the class described, the combination with tracks including horizontal and inclined portions and the necessary lateral curves to make a complete circuit, of a series of steps each provided with a pair of supports coöperating with said tracks, parallel links of constant length connecting said steps and provided with rack teeth formed thereon, and driving means engaging the teeth of said links, substantially as described.

18. In a circular elevator, the combination with spiral ways, of carriers each having a single support near each end, and a linkage of fixed lengths connecting the carriers throughout the cycle or circuit of travel and driving mechanism engaging the linkage.

19. In a circular elevator, the combination with spiral ways, of steps each having a single support near each end, and a linkage system of fixed lengths connecting the steps in the entire circuit of travel and driving mechanism engaging the linkage.

20. In a device of the class described, the combination with a pair of tracks including horizontal and inclined portions and the necessary lateral curves to make a complete circuit, of a series of steps each provided with a single pair of supports cooperating with said tracks, and a system of links connecting the central portions of said steps and located entirely beneath them.

21. In a device of the class described, the combination with the curved tracks, of the steps coöperating therewith, the direct links pivotally connecting said steps, and the diagonal links connecting said steps and free to move relatively thereto at one end.

22. In a device of the class described, the combination with the curved tracks, of the steps coöperatng therewith each provided with an axial rod, the direct links pivotally connecting said steps, two pairs of collars mounted to rotate on each of said axial rods, one pair held from longitudinal movement

while the other is free to move thereon, and the diagonal links connecting said collars for the purpose described.

23. In a device of the class described, the combination with the tracks having the straight and curved horizontal portions, of the steps mounted to move thereon, automatically adjustable links connecting said steps and permitting the axes of the steps to stand at right angles to their line of movement on all portions of the tracks, and mechanism for compelling the steps to stand in said right angular position as they pass from the straight to the curved portion of the tracks.

24. In a device of the class described, the combnation with the tracks having the straight and curved portions, of the steps mounted to move thereon, and links connecting and automatically adjusting said steps and permitting the axes of the steps to stand at right angles to their line of movement on all portions of the tracks.

25. In a device of the class described, tracks having horizontal and inclined curved carrying runs, steps adapted to travel on the tracks, and a rigid link associated with each step and having adjustable connection with an adjacent step on the carrying run.

26. In a device of the class described, a way having horizontal and inclined curved carrying runs, steps adapted to travel on the way and varying in their angular relation on different portions of the way, and rigid links automatically adjustable to connect the steps in their various relations on the carrying run.

27. In a device of the class described, tracks providing a spiral run, steps adapted to travel on the tracks, and crossed linkage connecting the steps and comprising a rigid link associated with each step and having adjustable connection with an adjacent step.

28. In a device of the class described, a way providing carrying runs of different angular relation, steps adapted to travel on the way, means to vary their angular relation on different portions of the way, and crossed links automatically adjustable to connect the steps in their various relations.

29. In a device of the class described, the combination with a series of steps adapted to travel upon curved ways, of crossed linkage having automatically adjustable connection with said steps and arranged in a plane parallel to the direction of movement of the steps, and means to move the steps.

30. In a device of the class described, the combination with a series of steps adapted to travel upon horizontal and inclined curved ways, of trussed linkage having automatically adjustable connection with said steps to take up lateral strains, and means to move the steps.

31. In a device of the class described, the combination with a series of steps adapted to travel upon horizontal and inclined curved ways, of strut linkage connecting the steps to overcome centripetal thrust, and means to move the steps.

32. In a device of the class described, tracks providing carrying runs at different angles, steps adapted to travel on the tracks, crossed linkage connecting the steps and comprising a rigid link associated with each step and having adjustable connection with an adjacent step, and means for maintaining the axes of the steps at right angles to their direction of travel.

33. In a device of the class described, a way providing carrying runs of different angular relation, steps adapted to travel on the way and to vary in their angular relation on different portions of the way, crossed links automatically adjustable to connect the steps in their various relations, and means to maintain the axes of the steps at right angles to their direction of travel.

34. In a device of the class described, the combination with a series of steps adapted to travel upon horizontal and inclined curved ways, of crossed linkage having automatically adjustable connection with said steps and arranged in a plane parallel to the direction of movement of the steps, means to move the steps, and means to maintain their axes at right angles to their direction of travel.

35. In a device of the class described, the combination with a series of steps adapted to travel upon horizontal and inclined curved ways, of trussed linkage having automatically adjustable connection with said steps near their inner ends, means to move the steps, and means to maintain their axes at right angles to their direction of travel.

36. In a moving stairway, a spiral run, step sections shaped to travel in connected series on the spiral run, crossed linkage connecting the steps, and means for driving said sections.

37. In a moving stairway, two spiral runs each having tracks, horizontal runs including straight portions connecting the two spirals at top and bottom, step sections arranged to travel in the endless path formed by the spirals and the horizontal runs, crossed linkage adjustably connecting the sections, means for driving the said sections, and means to vary the angular relation of the steps on different runs.

38. In a moving stairway, two spiral runs each having tracks, horizontal tracks at top and bottom of the stairway connected to the spiral tracks, step sections having wheels arranged to travel on said tracks, crossed linkage of constant length arranged in a plane parallel to the direction of the movement of the steps and to which the steps are

adjustably connected, means for driving the step sections in an endless path, and means to vary the angular relation of the steps on different tracks.

39. In a moving stairway, two spiral guides each having an outer and an inner track, horizontal portions connecting the two spirals at top and bottom, step sections arranged to travel in the endless path formed by the spirals and the horizontal portions, trussed linkage adjustably connecting the steps to take up lateral strains, and means for driving the said sections.

40. In a moving stairway, two spiral guides, each having an inner and an outer track, horizontal tracks at top and bottom of the stairway connected to the spiral tracks, step sections having wheels arranged to travel on said tracks, an endless linkage to which each step is adjustably connected to overcome centripetal thrust, and means for driving the step sections in an endless path.

41. The combination in a moving stairway, of two spirals each having an inner and an outer track, horizontal straight tracks at top and bottom connecting the tracks of the two spirals, the outer track of the ascending spiral joining the outer track of the descending spiral and the inner track of the ascending spiral joining the inner track of the descending spiral, step sections arranged to travel on the said endless track, trussed linkage adjustably connecting the steps, means for driving the steps, and means to maintain their axes at right angles to their path of travel.

42. The combination in a moving stairway, of two spiral runs connected together at top and bottom by curved and straight horizontal runs, step sections each having flat treads and curved risers, said curved risers being such that the steps will be close together on the elevating and return runs as well as on the curved horizontal runs, crossed linkage adjustably connecting the steps, means for driving said step sections, and means to maintain their axes at right angles to their path of travel.

43. In a device of the class described, the combination with a series of steps adapted to travel upon horizontal and inclined curved ways, of linkage having automatically adjustable connection with said steps, and means to move the steps.

44. In a device of the class described, the combination with a series of steps adapted to travel upon horizontal and inclined curved ways, of linkage having automatically adjustable connection with said steps near their inner ends, and means to move the steps.

45. In a device of the class described, a series of steps moving on the ways and each having a segmental tread and curved riser, curved ways for said steps, and automatically adjustable linkage connecting the steps near one end.

46. In a device of the class described, the combination with a series of steps adapted to travel on horizontal and inclined curved ways, and automatically adjustable linkage connecting said steps, of means to adjust the links in radial position, and means to move the steps.

47. In a device of the class described, a series of sections running on spiral ascending and descending ways joined by straight runs, and means to guide the sections into radial position when they pass from a straight to a curved run.

48. In a device of the class described, a series of sections running in spiral ascending and descending ways joined by straight runs, and means to cause their inner ends to converge toward the axis of the spiral upon which they run when they pass to a curved run.

49. In a device of the class described, a series of sections running on spiral ascending and descending ways joined by straight runs, and means to guide the sections into parallel position when they pass from a curved to a straight run.

50. In a device of the class described, a series of sections running in spiral ascending and descending ways joined by straight runs, and means to cause their inner ends to recede from each other when they pass from a curved to a straight run.

51. In a device of the class described, a series of sections running in spiral ascending and descending ways joined by straight runs, and means to cause their inner ends to approach and recede from each other when changing runs.

52. In a moving stairway, straight and curved guides, step sections arranged to travel on said guides, two sets of links connecting the steps in an endless chain so that the step sections are free to swivel on the links and free to assume different planes in respect to each other, and means for making the steps assume a radial position on the curved portion of the stairway.

53. In a moving stairway, an endless series of step sections, an endless guideway comprising inclined curved portions connected by straight portions, means for retaining the tread surfaces of the step sections in parallel horizontal planes when on said inclined portions, the step sections on the straight portion having their longitudinal axes in parallel planes, and those on the curved incline being disposed with their longitudinal axes in planes oblique to each other, and means for driving the step sections.

54. In a moving stairway, an endless series of step sections, each having a tread

and symmetrically curved convex risers, means for everywhere retaining the tread surfaces of the step sections horizontal, an endless guideway comprising a carrying run including curved inclined and straight horizontal portions, means to move the steps to position their axes at right angles to their line of movement, and means to drive the steps.

55. In a device of the class described, a series of steps adapted to travel on horizontal and inclined curved ways, automatically adjustable linkage connecting said steps, means to adjust the steps in radial position to assist in the coöperation of the links, and means to move the steps.

56. In a device of the class described, the combination with the tracks having the straight and curved horizontal portions, of the steps mounted to move thereon, automatically adjustable links connecting said steps and permitting the axes of the steps to stand at right angles to their line of movement on all portions of the tracks, and mechanism for compelling the steps to stand in said right angular position as they pass from the straight to the curved portion of the tracks consisting of the diagonal links connected to said steps and secured from longitudinal movement at one end, a sleeve controlling the movement of the other ends of said links, a screw thread on said sleeve, a stationary nut on the step, and means for rotating the sleeve when passing from the straight to the curved portion of the track and vice versa.

57. In a device of the class described, the combination with the tracks having the straight and curved horizontal portions, of the steps mounted to move thereon, automatically adjustable links connecting said steps and permitting the axes of the steps to stand at right angles to their line of movement on all portions of the tracks, and mechanism for compelling the steps to stand in said right angular position as they pass from the straight to the curved portion of the tracks consisting of the diagonal links connected to said steps and secured from longitudinal movement at one end, a sleeve controlling the movement of the other ends of said links, a screw thread on said sleeve, a stationary nut on the step, a pinion on the sleeve, and racks located adjacent the track in position to engage said pinion when the steps are passing from the straight to the curved portions and vice versa.

58. In a device of the class described, the combination with the tracks having the straight and curved portions, of the steps mounted to move thereon, automatically adjustable links connecting said steps and permitting the axes thereof to stand at right angles to the line of movement in all portions of the track, the axial rods having the pair of collars held from longitudinal movement thereon, the sleeve on said axial rod having the second pair of collars capable of longitudinal movement thereon, diagonal links connecting said collars, the screw thread on the sleeve, the stationary nut on the step, the flanged collar on one end of the sleeve, the gear pinion on the other end, and the racks located adjacent the tracks and adapted to engage with the pinion when the steps are passing from the straight to the curved portion of the tracks and vice versa.

59. In a device of the class described, the combination with the curved tracks having the horizontal and inclined portions, of the steps mounted to move thereon, automatically adjustable linkage connecting said steps and permitting the axes thereof to stand substantially at right angles to the line of movement of the steps on all portions of the tracks, and mechanism for compelling the steps to retain their said right angular position as the steps pass from the horizontal to the inclined portion.

60. In a device of the class described, the combination with the curved tracks having the horizontal and inclined portions, of the steps mounted to move thereon, automatically adjustable linkage connecting said steps and permitting the axes to stand at right angles to the line of movement of the steps on all portions of the track, the axial rod having a pair of collars held from longitudinal movement thereon, another pair of collars capable of longitudinal movement thereon, diagonal links connecting said collars, and a stationary cam disk adapted to coöperate with one of the movable collars when the diagonal links are inclined in passing from the horizontal to the inclined portion of the track.

61. In a device of the class described, the combination with the curved tracks having the horizontal and inclined portions, of the steps mounted to move thereon, automatically adjustable links connecting said steps and permitting the axes to stand exactly at right angles to the line of movement of the steps on all portions of the track, the axial rod having a pair of collars thereon held from longitudinal movement, a second pair of collars thereon capable of longitudinal movement, the diagonal links connecting said collars, the rollers on the innermost of the longitudinally movable collars, and a stationary cam disk on the step with which the rollers on the collar coöperate as the steps pass from the horizontal to the inclined portion.

62. In a device of the class described, the combination with the tracks having the straight and curved portions, of the steps mounted to move thereon, and wheels connected to said steps and rolling on the tracks

and having tread surfaces of one diameter for running on the straight portion of the tracks and of another diameter for running on the curved portion of the tracks.

63. In a device of the class described, the combination with the tracks having the straight and the curved portions, of the steps mounted to move thereon, wheels on the outer ends of the steps rolling on the tracks, and wheels on the inner ends of the steps having tread surfaces of one diameter for running on the straight portion of the tracks and a tread surface of a lesser diameter for running on the curved portion of the tracks.

64. In a device of the class described, the combination with the tracks having the straight and the curved portion, of the steps mounted to move thereon, the axles mounted to rotate in said steps, and wheels rigidly secured to said axles rolling on the tracks and having tread surfaces of one diameter for running on the straight portion of the tracks and of another diameter for running on the curved portion of the tracks.

65. In a device of the class described, the combination with the tracks having the straight and the curved portions, of the steps mounted to move thereon, the axles journaled in said steps, the wheels rigidly secured on the outer ends of said axles having the tread surfaces of one diameter, and the wheels rigidly secured on the inner ends of said axles having tread surfaces for running on the straight portion of the track of the same diameter as the tread surfaces of the outer wheels and having tread surfaces of a smaller diameter for running on the curved portion of the track.

66. In a device of the class described, the combination with the spiral tracks, of the steps moving thereon, the links connecting the outer ends of said steps and having the rack bars secured thereto, and a driving pinion engaging the rack bars.

67. The combination in a moving stairway, of a plurality of steps, two substantially parallel series of toothed links connected to the steps and arranged with their toothed faces vertical, with driving means mounted to simultaneously engage the toothed links of both series.

68. In a device of the class described, the combination with the steps or carriages and the tracks therefor, of parallel links connecting said steps for maintaining them in a predetermined relationship to each other, rack teeth on said links in the same vertical plane, and driving means engaging said rack teeth.

69. A moving stairway consisting of a series of step sections forming an endless system, two series of toothed links carried by the step sections so as to form a continuous rack and arranged with their toothed faces in a substantially vertical plane, and two driving gears engaging said toothed links.

70. In a device of the class described, a series of steps, tracks therefor providing a curved inclined and a straight horizontal way, parallel linkage connecting said steps, and drive means engaging the lines of links.

71. The combination in a moving stairway, of a series of steps forming an endless system, two series of toothed links connected to the steps and forming substantially continuous racks, drive means to simultaneously engage the toothed links of both series, and means for counteracting the thrust of the drive upon said toothed links.

72. A moving stairway having substantially parallel toothed links connecting the steps and arranged in two series, the members of which are staggered relatively to each other.

73. A moving stairway including two series of parallel toothed links connecting the steps, the ends of the links of one series being opposite the breaks of the links of the other series and the ends of each link being overhung to form substantially continuous racks.

74. A moving stairway consisting of a plurality of steps, two series of toothed links connecting said steps to form an endless system and staggered relatively to each other, and a driving means for the system simultaneously engaging the toothed links of both series.

75. In a moving stairway, a series of step sections connected to form an endless system having an ascending and a descending curved run, toothed links carried by the step sections, and two gears respectively engaging the toothed links of the system.

76. In a device of the class described, the combination with the spiral tracks, of the steps moving thereon, the links connecting the outer ends of said steps and having the two rack bars formed thereon, a driving pinion located so as to engage one of the rack bars on a horizontal portion of the track, and another driving pinion located so as to engage the other rack bar on an inclined portion of the track.

77. In a device of the class described, the combination with the spiral tracks, of the steps moving thereon, the links connecting the outer ends of said steps and having the two rack bars formed thereon, a driving pinion located so as to engage one of the rack bars on a horizontal portion of the track, and another driving pinion located so as to engage the other rack bar on an inclined portion of the track, both of said rack bars being convex, but the one engaging with the pinion on the horizontal portion of the track being slightly more convex than the others.

78. In a device of the class described, the

combination with the curved tracks, of the steps mounted to travel thereon, and universal joint link connections between said steps on one end thereof which permit the steps to rise and fall relative to each other and to have the necessary movement to and from each other at their other ends on the curved and straight runs respectively.

79. In a moving stairway, an endless series of step sections connected together at their axes and capable of swinging relatively to each other in two planes at right angles to each other.

80. In a device of the class described, the combination with tracks including horizontal and inclined portions and the necessary lateral curves to make a complete circuit, of a series of steps coöperating therewith, links of constant length connecting said steps and mounted so as to be free to swing in two planes substantially at right angles to each other, said links being provided with rack teeth formed thereon, and a driving pinion engaging the teeth of said links.

81. In a moving stairway, the combination with tracks having straight and laterally curved portions, of a series of steps, link connections of constant length between said steps arranged to permit their axes to remain at right angles to the line of movement of the steps on every portion of the track and the centers of their axes to remain at a uniform distance apart on the curved track, and means for driving said steps, substantially as described.

82. The combination in a moving stairway, of two spiral runs connected at top and bottom by horizontal runs including straight portions, step sections shaped to travel in an endless path up one spiral run and down the other spiral run, and means including a double chain for driving said sections.

83. The combination in a moving stairway, of two spiral runs each having an outer and an inner track, horizontal runs including straight portions connecting the two spirals at top and bottom, step sections arranged to travel in the endless path formed by the spirals and the horizontal runs, and means for driving the said sections.

84. The combination in a moving stairway, of two spiral runs, each having an inner and an outer track, horizontal tracks at top and bottom of the stairway connected to the spiral tracks, step sections having wheels arranged to travel on said tracks, an endless linkage of constant length to which each step is pivoted, and means for driving the step sections in an endless path.

85. The combination in a moving stairway, of two similar but oppositely turned spiral guides each having an outer and an inner track, horizontal portions connecting the two spirals at top and bottom, step sections arranged to travel in the endless path formed by the spirals and the horizontal portions, and means for driving the said sections.

86. The combination in a moving stairway, of two similar but oppositely turned spiral guides, each having an inner and an outer track, horizontal tracks at top and bottom of the stairway connected to the spiral tracks, step sections having wheels arranged to travel on said tracks, an endless chain to which each step is pivoted, and means for driving the chain so that the step sections will travel in an endless path.

87. The combination in a moving stairway, of two similar but oppositely turned spiral ways, each having an inner and an outer track, horizontal tracks at top and bottom connecting the tracks of the two spirals, the inner track of the ascending spiral joining the inner track of the descending spiral and the outer track of the ascending spiral joining the outer track of the descending spiral, step sections arranged to travel on the said endless track, and means for driving the said step sections.

88. The combination in a moving stairway, of two spiral runs connected together at top and bottom by curved horizontal runs, step sections each having flat treads and curved risers, said curved risers being such that the steps will be close together on the elevating and return runs as well as on the curved horizontal runs, and means for driving said step sections.

89. The combination in a moving stairway, of two spiral runs connected together at top and bottom by curved horizontal runs, step sections each having a curved riser, the curves of the risers being such that the step sections will be close together while their relative positions are changing, and means for driving said step sections.

90. The combination in a moving stairway, of two spiral guides connected together at top and bottom by horizontal sections, step sections each having flat treads and curved risers at each side, said curved risers being such that the steps will be close together on the elevating and return runs as well as on the horizontal runs, and means for driving said step sections, substantially as described.

91. The combination in a moving stairway, of two spiral guides connected together at top and bottom by horizontal sections, step sections each having curved risers at each side, the curves of the risers being such that the step sections will be close together while their relative positions are changing, and means for driving said step sections, substantially as described.

92. The combination in a spiral moving stairway, of a single track at each side of the

stairway, step sections each having a single wheel at each end arranged to travel on the said tracks, parallel linkage of constant length for retaining the step sections in a horizontal position, and means for driving said step sections.

93. The combination in a spiral moving stairway, of spiral tracks, step sections arranged to travel on said tracks, said step sections having treads, the tread of one step section overlapping the tread of the one below it at the inner edge of the stairway as the step sections travel on the spiral tracks, with a double chain to drive the steps.

94. The combination in a spiral stairway, of guides, step sections arranged to travel on said guides, each step section having an axle, two sets of links of constant length pivotally extending from one axle to another, and means to drive the steps.

95. The combination in a spiral stairway, of spiral tracks, step sections arranged to travel on said tracks, a bar on each step section, two sets of links of constant length pivotally connecting the bars, and means for driving the said sections.

96. The combination in a spiral stairway, of spiral inclined and horizontal tracks, step-sections arranged to travel over both tracks and arranged in step form on the inclined portion and flat on the horizontal portion, links of constant length connecting the sections together, said links being free to turn on the steps.

97. The combination in a spiral stairway, of tracks, step sections arranged to travel on said tracks, a bar on each step section, sleeves on the bars, and links of constant length connecting the sleeves of the several bars so as to form an endless connection.

98. The combination in a spiral stairway, of inclined and horizontal spiral tracks of step sections each having a single wheel at each end arranged to travel on the tracks, a bar on each step section, and links of constant length connecting the bars of the several steps.

99. The combination in a stairway, of inclined curved and horizontal straight tracks, step sections arranged to travel on said tracks, bars on said step sections, sleeves on the bars, and links of constant length connecting the sleeves, and means to shift the links as the steps change direction of travel.

100. The combination in a stairway, of inclined and horizontal curved tracks, step sections arranged to travel on said tracks, bars on said step sections, two sets of sleeves on each bar, and two sets of links connecting the sleeves forming an endless connection.

101. The combination in a stairway, of inclined and horizontal curved tracks, step sections arranged to travel on said tracks, a bar on each step section, two sets of sleeves swiveled on each bar and two sets of links connecting the sleeves forming an endless connection so that the step sections are free to swivel on the links to assume different planes in respect to each other, and means to move the steps.

102. The combination in a moving stairway, of inclined and horizontal curved tracks, step-sections arranged to travel on said tracks, a bar depending from each step section, sleeves on the bars, two sets of links alternately arranged and pivoted to the sleeves forming an endless universal connection between the steps, and driving mechanism for the steps.

103. The combination in a spiral stairway, or tracks, step-sections arranged to travel on said tracks, two sets of links of constant length connecting the steps, and a drive engaging one set of the links.

104. A step having a plurality of bearings respectively operative in curved and straight runs of travel.

105. A track having curved and tangent runs, a series of steps each having a plurality of bearing surfaces at one end respectively operative on curved and straight runs, and means to move the steps.

106. A track having curved and tangent runs, a series of steps each having a plurality of bearing surfaces at its inner end respectively operative on curved and straight runs, and means to move the steps.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES D. SEEBERGER.

Witnesses:
W. H. BRADY,
THOS. M. LOGAN.