

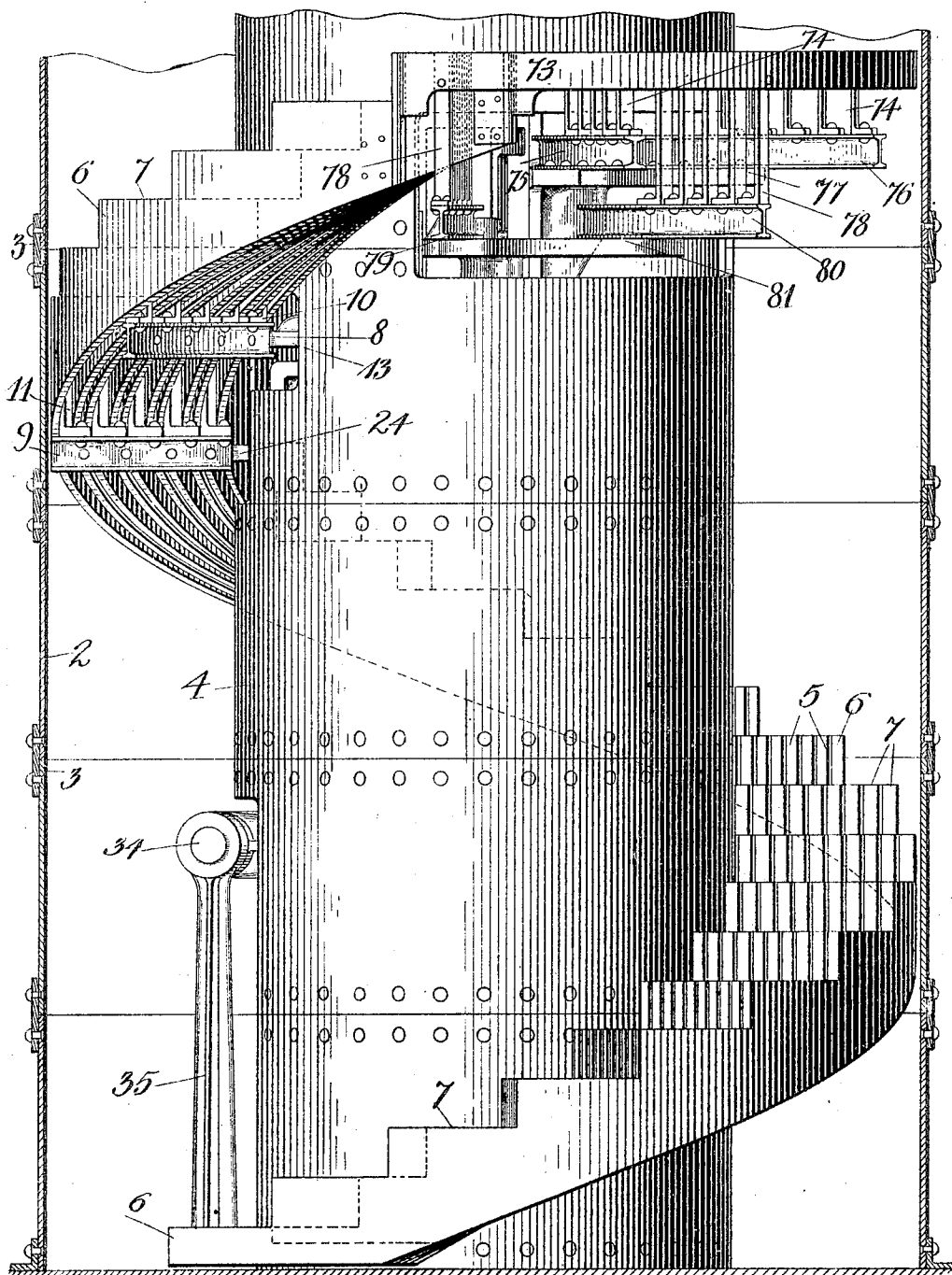
No. 807,565.

PATENTED DEC. 19, 1905.

P. LORILLARD.
CONVEYER.

APPLICATION FILED APR. 10, 1905.

7 SHEETS—SHEET 1.



WITNESSES:

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FIG. 1

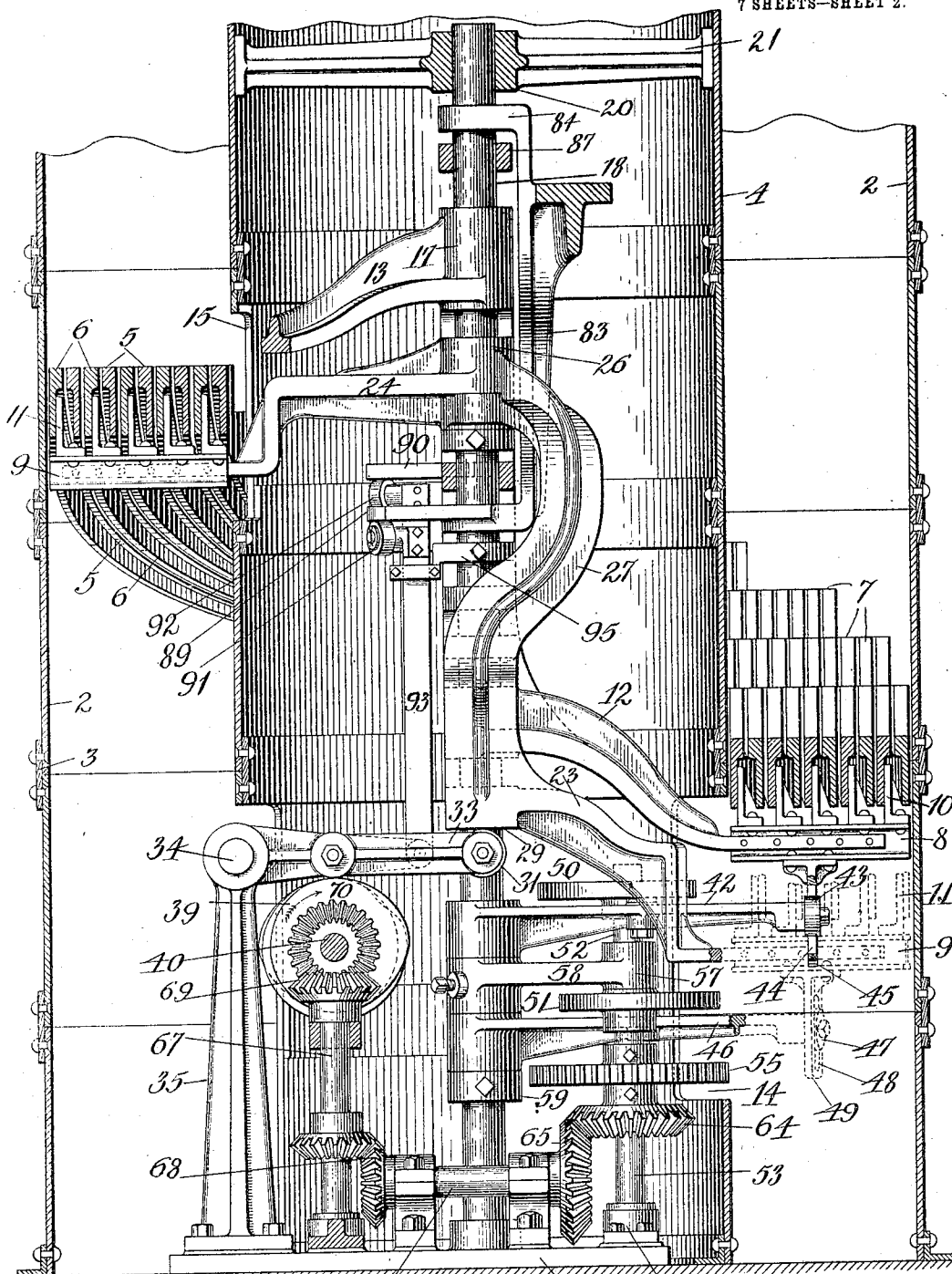
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7 SHEETS—SHEET 2.



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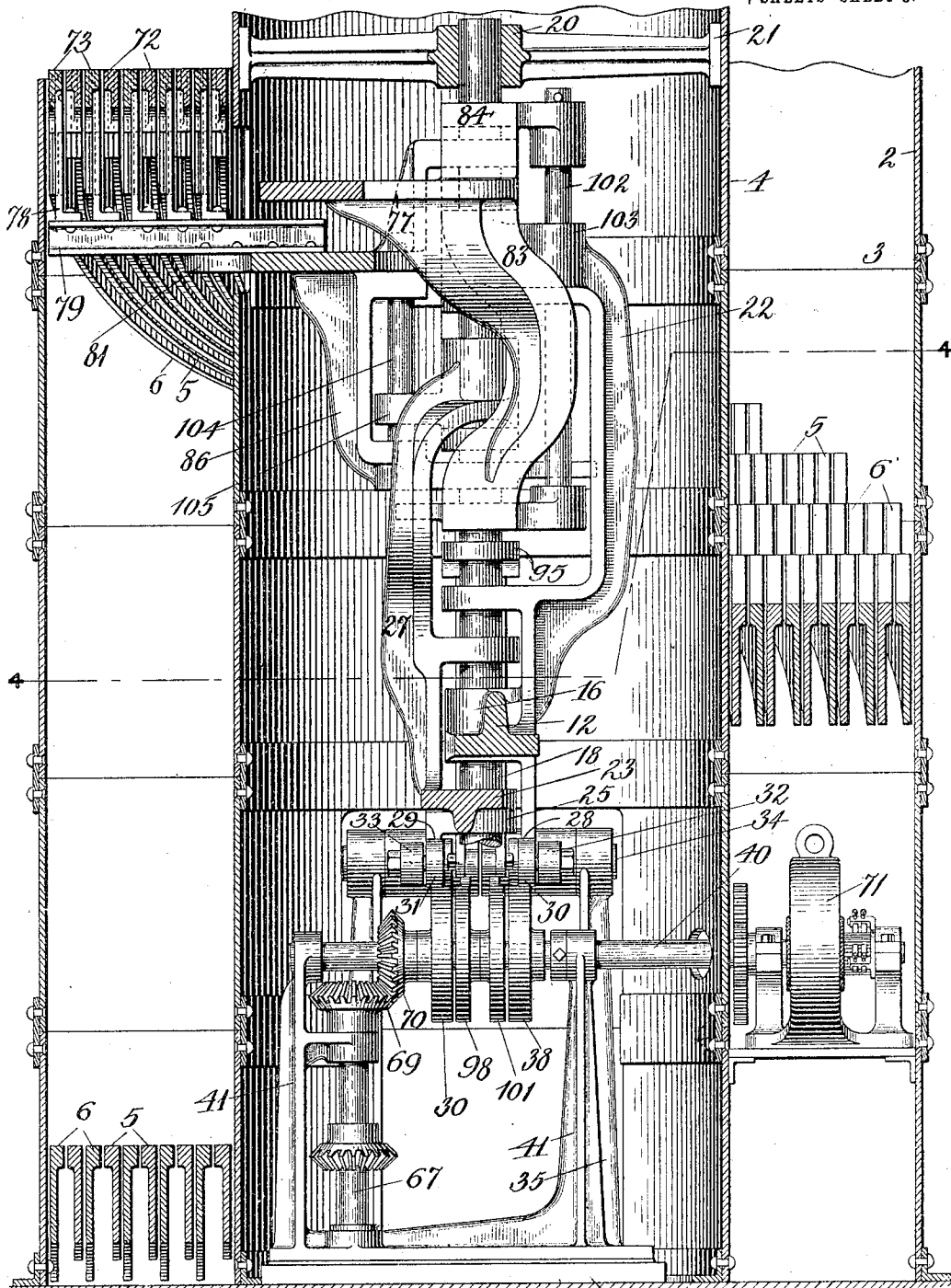
66 FIG. 2. 19

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7 SHEETS—SHEET 3.



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Fig. 3

19

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7 SHEETS—SHEET 4.

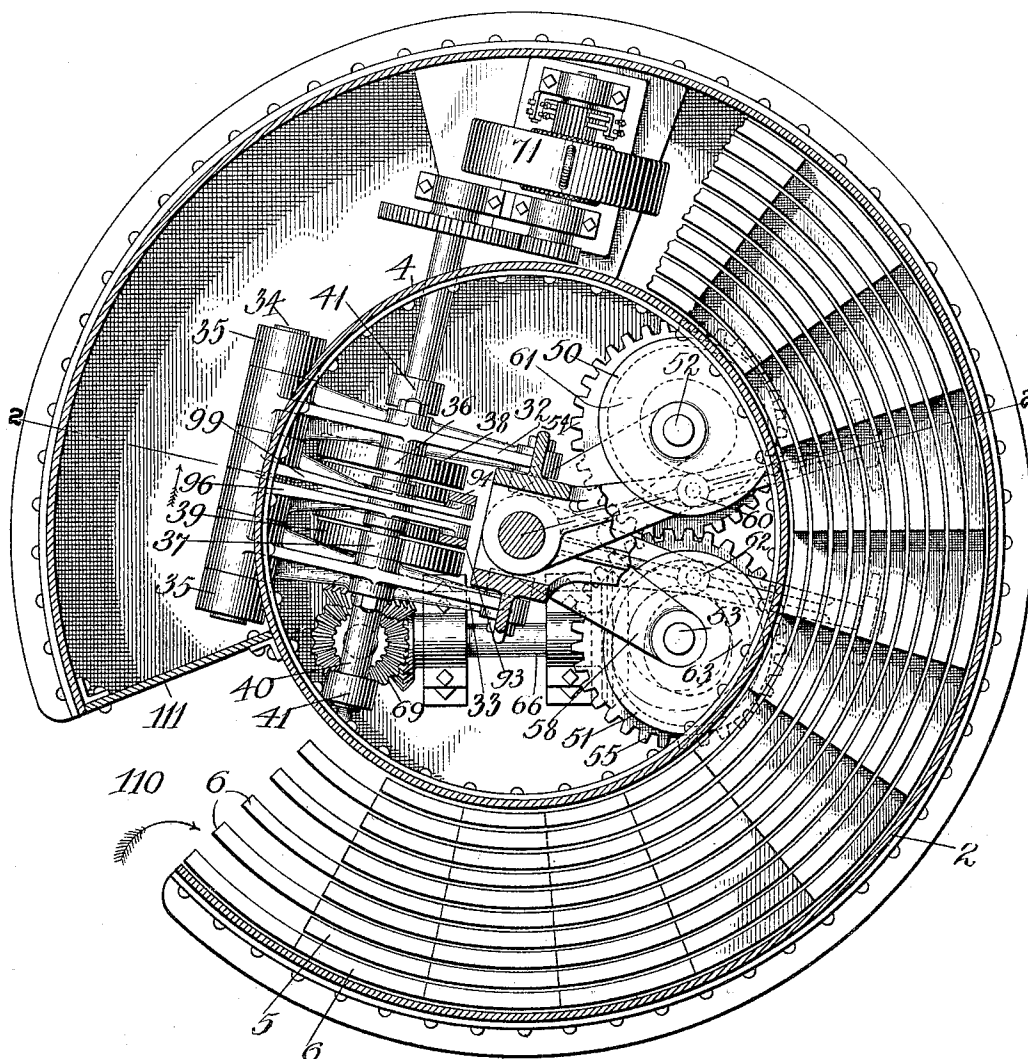


Fig. 4.

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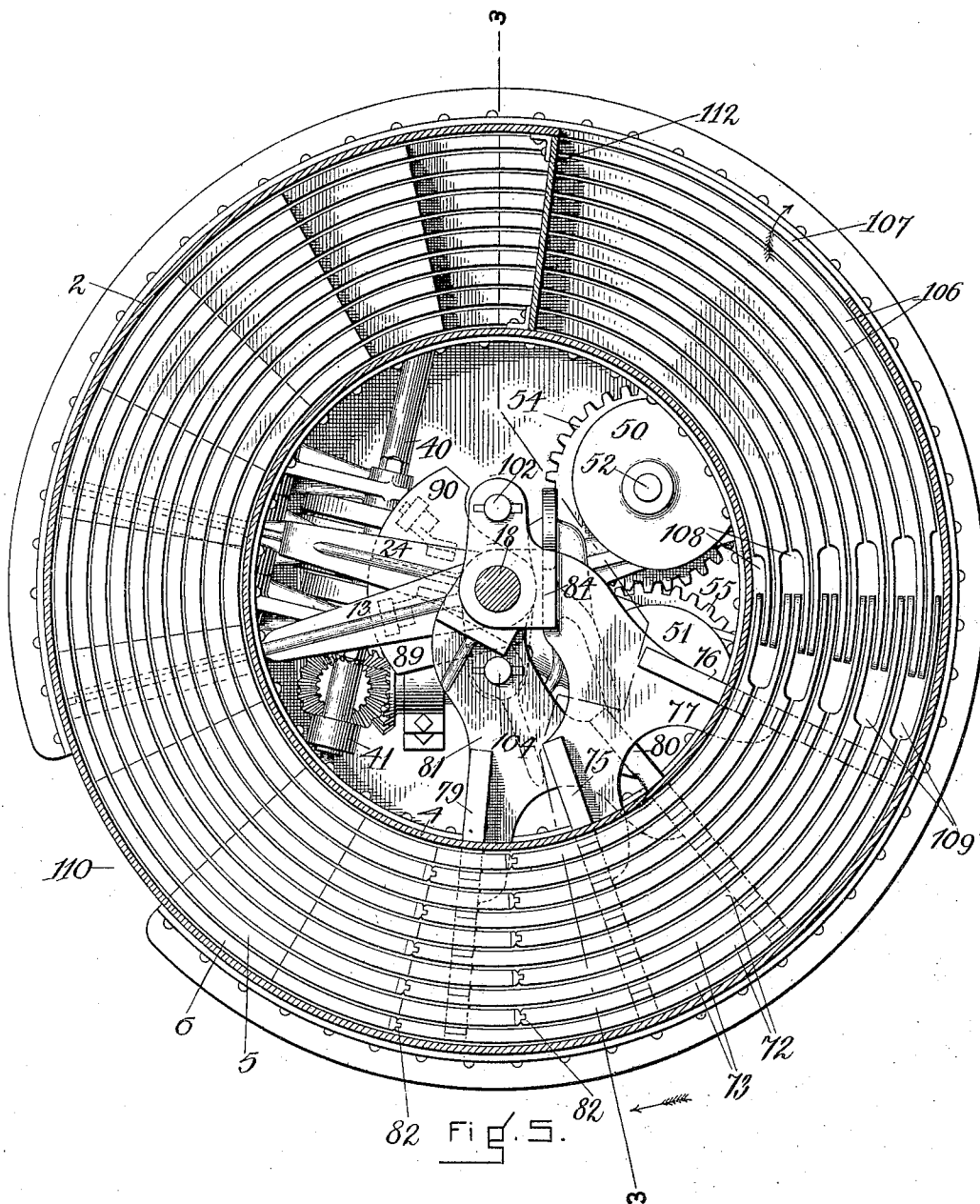
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7 SHEETS—SHEET 5.



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7 SHEETS—SHEET 6.

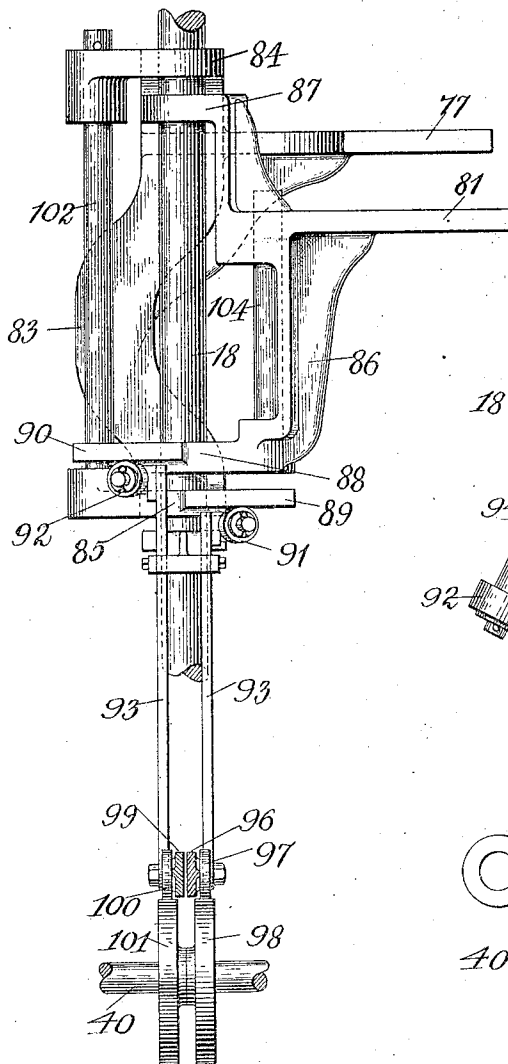


FIG. 6.

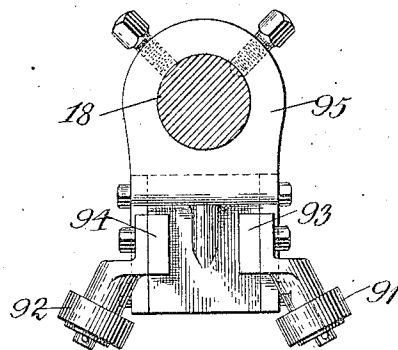


FIG. 7.

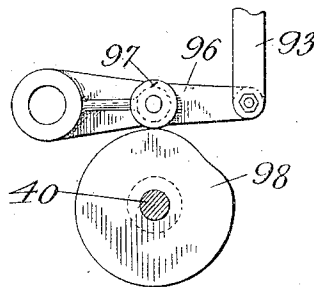


FIG. 8.

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7 SHEETS--SHEET 7.

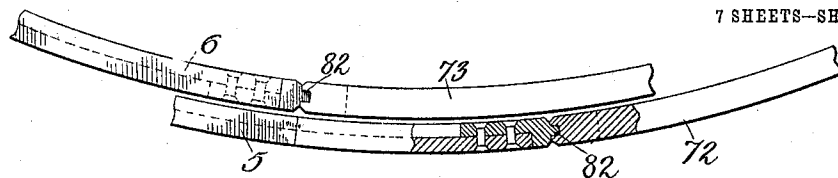


Fig. 9.

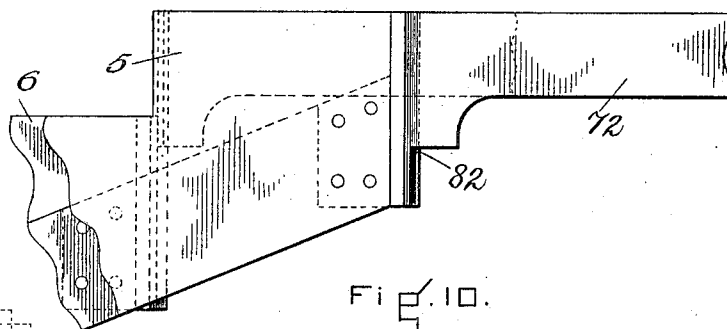


Fig. 10.

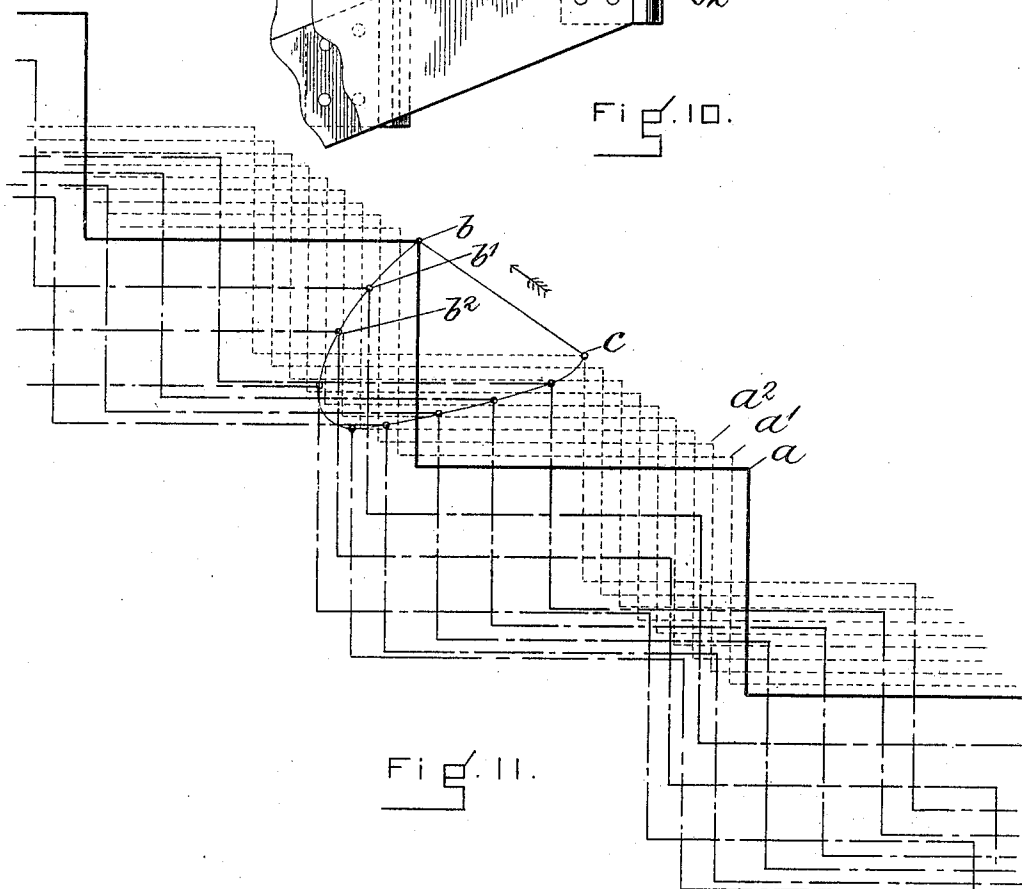


Fig. 11.

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UNITED STATES PATENT OFFICE.

PIERRE LORILLARD, OF TUXEDO PARK, NEW YORK.

CONVEYER.

No. 807,565.

Specification of Letters Patent.

Patented Dec. 19, 1905.

Application filed April 10, 1905. Serial No. 254,780.

To all whom it may concern:

Be it known that I, PIERRE LORILLARD, a citizen of the United States, and a resident of Tuxedo Park, in the county of Orange and State of New York, have invented certain new and useful Improvements in Conveyers, of which the following is a specification.

My invention relates to apparatus for conveying passengers from one elevation to another, and more particularly to that class of apparatus which is continuously operative to convey its load in a given direction as distinguished from elevators of the ordinary cage or lift type, which move alternately upward and downward.

Conveyers of the class to which my invention relates as heretofore constructed have in each case consisted substantially of an endless-belt-like structure propelled continuously in a predetermined path, its outer face being provided in one way or another with suitable tread-surfaces and having its exposed portion arranged to run up or down an incline between stationary landings located at the respective elevations between which the passengers are to be conveyed. Such conveyers require a considerable amount of space for their installation and cannot be employed in situations where a continuous incline joining the landings would have so great a pitch that it would be impracticable to convey passengers with safety up or down such an incline.

My present invention is intended to provide a conveying apparatus by means of which passengers may safely be conveyed between landing-points located at widely-different elevations, but at a relatively short distance apart in a horizontal direction and which may therefore be successfully employed in situations such as just referred to, where the amount of horizontal space available for its installation is limited. To this end I have devised a conveying apparatus which operates to transport passengers in a spiral direction from one elevation to another, so that the horizontal distance between the landing-points becomes immaterial, it being necessary merely to cause the spiral path of conveyance to extend from one landing-point to another.

Broadly speaking, my apparatus resembles in its construction and mode of operation the conveying apparatus shown and described in another application for United States Letters Patent, Serial No. 254,779, filed by me on April 10, 1905—that is to say, each apparatus comprises a number of conveyer-sections

providing laterally-adjacent tread-surfaces at their upper edges and arranged side by side in two sets, the sections of each set being interleaved between those of the other set and being capable of movement between them and the operation being such that the collective tread-surfaces of each set of sections are alternately exposed above and withdrawn beneath the tread-surfaces of the other set of sections and are given a forward movement in the direction of conveyance while exposed and a return movement along a depressed path. In the present case, however, these conveyer-sections instead of extending in parallel planes throughout their entire lengths are wrapped around a central vertical axis which is common to all of them and perform their forward or conveying movements in co-axial spirals, the movements of the two sections relative to each other being otherwise substantially the same as that above described, so that a passenger who steps upon a collective set of tread-surfaces of either set of sections is carried by them in a spiral direction for a limited distance coinciding with their travel while exposed above the tread-surfaces of the other set of sections and is then picked up by the latter set of tread-surfaces and carried an additional equal distance in the same spiral direction, while the tread-surfaces on which he first stood are performing their return movement, and so on in continuous alternation until a landing-point is reached by the passenger.

My invention also includes means whereby passengers may be automatically taken up from or deposited upon my spiral conveyer, and I have shown in the accompanying drawings a construction for this purpose which will also serve to convey passengers horizontally for a limited distance before or after reaching the corresponding end of the spiral conveyer. This construction is similar in its broad features and mode of operation to the conveying-landing shown and described in my application, Serial No. 254,779, above referred to and like it is shown as combined with a stationary landing upon which it is adapted to deposit passengers or from which it will pick them up automatically.

My invention also includes certain structural features and details hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a side elevation of a spiral conveyer embodying my improvements in their preferred

form, an outer casing, hereinafter described, being shown in vertical section. Fig. 2 is a sectional view showing some of the operating parts of my apparatus in side elevation, the planes of section being indicated by the line 22 in Fig. 4. Fig. 3 is a similar sectional view taken on the line 33 of Fig. 5. Fig. 4 is a horizontal section on the line 44 in Fig. 5 looking downward. Fig. 5 is a top plan view of the apparatus. Fig. 6 is a side elevation of a portion of the operating mechanism hereinafter described. Fig. 7 is a plan view showing in detail some of the parts represented in Fig. 6. Fig. 8 is a side elevation of the parts shown at the lower portion of Fig. 6 looking from the right. Fig. 9 is a detail plan view, partly in section, illustrating the construction at the junction of the spiral conveyer with the horizontal conveying-landing hereinafter described. Fig. 10 is a side elevation of the parts shown in Fig. 9. Fig. 11 is a diagram illustrating the operation of the spiral conveyer.

The moving parts of my apparatus are shown in the drawings as contained within a vertical cylindrical shell 2, which may be composed of a suitable number of superimposed segments suitably bolted or riveted together or to connecting-bands 3 and is supported at its lower end on the floor of the building or the like in which the apparatus is to be used or upon any other suitable foundation. Within this shell 2 is preferably located in concentric relation a similar shell 4, the diameter of which is enough less than the diameter of the shell 2 to provide a sufficient space between the shells to receive and permit the proper operation of the conveyer-sections, hereinafter described, on and by which the passengers are transported from one end of the conveyer to the other. The shells 2 and 4 thus provide walls which serve to prevent passengers from falling off or leaving the conveyer at either edge of the latter.

At 5 and 6 are represented a number of similar conveyer-sections located between the shells 2 and 4, each of which sections extends at a suitable pitch from one end of the spiral conveyer to the other and is also given a lateral curvature, the central axis of which coincides with the axis of said shells, the result being that each of these sections passes spirally around the exterior of the shell 4. The sections 5 and 6 are located side by side, closely adjacent to one another, and as many of them are employed as are required to extend across the space between the shells 2 and 4 in a radial direction, or, in other words, to give the conveyer the desired width and capacity. Said sections are arranged in two sets, the sections 5 forming one set and the sections 6 forming the other set, and these sections 5 and 6 alternate with one another in lateral arrangement, so that the sections of each set are interleaved between those of the

other set. The sections of each set are operated in unison and are preferably connected to form a unitary element, as hereinafter described, and each section is constructed to provide a series of tread-surfaces 7, arranged like a flight of steps, the corresponding tread-surfaces of each set of sections being located in the same plane and having such width that a passenger standing upon either set will be supported by the collective tread-surfaces of several of the sections. It will be evident that the depth of these steps from front to back will increase from the inner to the outer edge of the conveyer by reason of the progressively-increasing length of the outer sections corresponding to their greater radius of curvature.

The sections 5 and 6 may be constructed in any suitable manner which will give them the necessary strength and rigidity between the points at which they are supported, and for connecting the sections of each set to form a rigid unitary element I provide a suitable number of horizontal I-beams 8 and 9, extending radially beneath all the sections and united, respectively, to the sections 5 and 6 by means of posts or brackets 10 and 11, each of which is supported on and bolted to the top face of the corresponding I-beam and extends upward therefrom and is also bolted at its upper end to one of the sections. One side of each section, beneath its upper edge, is preferably cut away to receive the corresponding posts, as shown, thus permitting the tread-surfaces of the sections to remain closely adjacent to one another.

The two sets of treads however constructed are provided with means for operating them in the following manner: Starting from a position in which the corresponding tread-surfaces of both sets are flush with each other, which is the position shown in the drawings, one unitary element or set of treads, which I will designate as the A treads, is given a forward movement in the direction of conveyance—that is to say, up or down the spiral incline, as the case may be—and concurrently with this movement the other element or set of treads, which I will call the B treads, is given a downward or disappearing movement such that a passenger will be left standing on and supported by the A treads alone, by which he will be conveyed in the desired direction for a distance corresponding to their forward movement. During such movement the B treads are moved in the opposite direction and at a lower elevation, so that they remain concealed during the movement to another position of coincidence with the A treads; but in this position any given step formed by the A treads is located behind that step formed by the B treads with which it was previously flush with respect to the direction of conveyance. Thereupon the movements just described are interchanged—that is to say, the

A treads are caused to disappear and perform a return movement to their first position, leaving the passenger supported by the B treads—and the latter treads are simultaneously moved forward in the direction of conveyance until their original position of coincidence with the A treads is reached, whereupon the movements above described are repeated in the same order. It will thus be seen that each set of tread-surfaces is caused to move in a closed path so determined that they are alternately exposed above and concealed beneath the other set of surfaces and perform a limited forward movement in the direction of conveyance while exposed and a return movement while concealed, all the forward movements being caused to start from a position of coincidence of the two sets of surfaces and uniting to impart to a passenger supported thereon a continuous movement in the direction of conveyance until the end of the conveyer is reached.

In order to secure the cyclical movements above described, I prefer to provide means for imparting to each set of treads reciprocating movements in a vertical direction and also in a circular arc concentric with the central axis of the apparatus, which movements are compounded to produce the cyclical movements desired. In the particular arrangement illustrated the horizontal I-beams 8, which carry the sections 5, are rigidly secured to the outer ends of the two arms 12 and 13, which extend outward through openings 14 and 15 in the shell 4 and are provided, respectively, at their inner ends with hubs 16 and 17, mounted to slide vertically on a stationary guiding rod or column 18, located at the center of the shell 4 and extending from the top to the bottom thereof, the lower end of said column being suitably supported on a base-piece 19 and its upper end being held in the central hub 20 of a spider 21, which is secured to the inside of the shell 4 and serves as a brace to stiffen the same. The hubs 16 and 17 are united by a connecting portion 22, which is preferably formed integral therewith and is curved or bowed laterally, as shown in Fig. 2, to provide space for its own movements and those of the other operating parts, said hubs, arms, and connecting portion thus forming practically one solid part. The horizontal I-beams 9, which carry the sections 6, are supported in a similar manner on the outer ends of arms 23 and 24, extending outwardly through said openings 14 and 15 and provided, respectively, at their inner ends with hubs 25 and 26, mounted to slide on the central column 18 and united by an integral connecting portion 27, which is also bowed, as shown, to provide for the relative movements of the operating parts. The frames composed of the portions 22 and 27 and their connected hubs and arms are provided at suitable points, and preferably at

the lower ends of said connecting portions, with flat horizontal edges 28 and 29, respectively, forming tracks adapted to run on rollers 30 and 31, these tracks having such length as to permit the turning movements herein-after described without leaving the rollers. Means are provided for raising and lowering said frames consisting in the present instance of arms 32 and 33, Fig. 4, each journaled at one end on a stationary horizontal rod 34, supported by brackets 35 at its ends, which arms carry the rollers 30 and 31 at their respective free ends. Between their ends said arms carry rollers 36 and 37, respectively, which rollers bear on cams 38 and 39, secured to a driving-shaft 40, journaled in uprights 41, rising from the base-piece 19. The two sets of sections 5 and 6 and the frames which carry them are thus supported, by means of the cams 38 and 39 and arms 32 and 33, in such manner that upon the rotation of the driving-shaft 40 said sets of sections will be elevated or depressed according to the contour of the respective cams, the rollers which run on these cams being always held in contact therewith by the weight of the sections and connected parts.

The oscillating movements in a circular arc are imparted to the sections 5 in the construction illustrated by means of a horizontal arm 42, journaled at one end on the central column 18 and provided at its free or outer end with a roller 43, located and adapted to run in a vertical slot 44, formed in a plate 45, which is rigidly secured to one of the I-beams 8. In a similar manner the corresponding movements of the sections 6 are imparted to them through the medium of an arm 46, also journaled on the central column 18 and provided at its outer end with a roller 47, located in a vertical slot 48, formed in a plate 49, which is rigidly secured to one of the I-beams 9. These slots 44 and 48 permit the vertical movements imparted to the corresponding sets of sections by the operation of the cams 38 and 39 without interfering with their movements in the arc of a circle, and these latter movements are produced by cams 50 and 51, secured, respectively, to vertical counter-shafts 52 and 53, which are connected to rotate in unison and at the same speed by intermeshing gears 54 and 55, carried thereby. These counter-shafts are journaled at their lower ends in steps 56, secured to the base-piece 19 and at or near their upper ends in bearings 57, carried by the free ends of a horizontal V-shaped bracket 58, which is rigidly secured at the angle of the V to the column 18, said bracket and a fixed collar 59 serving also as stops to prevent vertical play of the arms 42 and 46 on said column. The arm 42 is provided between its ends with a roller 60, located and adapted to travel in a groove 61, cut in the under face of the cam 50, and a similar roller 62 is carried by the arm 46 and adapted to travel in a groove 63 cut in the cam 51, the

object of employing cam-grooves as distinguished from external cam-surfaces being to render the oscillatory movement of the two sets of sections positive in both directions upon the rotation of the counter-shafts 52 and 53. Such rotation may be secured by connecting one of these counter-shafts, as 53, to the driving-shaft 40 by means of gears 64 and 65, supplementary counter-shafts 66 and 67, geared together at 68, and gears 69 and 70, connecting the counter-shaft 67 with said driving-shaft. The latter is rotated by any suitable means, such means being herein represented as an electric motor 71, geared thereto and located in the space between the shells 2 and 4 beneath the conveyer-sections, and the several gears described are so proportioned and the various cams are so cut and timed that the resultant movements imparted to the two sets of conveyer-sections will have the proper extent and sequence, as hereinafter explained. It is to be understood that while the operating means above described are convenient and practical for their intended purpose, yet my broad invention is by no means limited to these or any specific means for operating the conveyer-sections.

The mode of operation of the apparatus above described, resulting from the movements imparted to the two sets of conveyer-sections by the action of the various cams, is illustrated diagrammatically in Fig. 11, in which for convenience the actual paths traversed are developed, or, in other words, unrolled sufficiently to cause them to coincide with a plane surface. In this diagram the heavy line is assumed to represent the position of a portion of the tread-surfaces and risers—that is to say, a profile of a portion of the upper edges of the conveyer-sections when all the tread-surfaces are in a position of coincidence—while the dotted lines and the dot-and-dash lines, respectively, represent successive positions assumed by said tread-surfaces while performing their cyclical movements, the dotted lines indicating the movements of the tread-surfaces which for the time being are exposed and operative to convey passengers, and the dot-and-dash lines indicating the concurrent return movement of the other set of tread-surfaces along a depressed path. The light full line represents the closed path traversed by a point located at the front edge of one of the tread-surfaces, the path of any other point of the conveyer-sections being exactly similar, and the small circles through which the curved portion of this line passes indicate the positions reached by the point which generates this path after equal intervals, each of which is one-eighteenth of the interval required for the completion of a cyclical movement. In other words, referring to the specific construction previously described, one complete rotation of the driving-shaft 40 is assumed to be divided into

eighteen equal parts each representing twenty degrees of angular movement, and the small circles in Fig. 11 indicate the positions of the point which generates the closed path, corresponding to these divisions of a half-rotation of the driving-shaft. The arrow in Fig. 11 indicates the direction in which said path is assumed to be traversed, the direction of conveyance being upward in the case supposed, and it will be evident that while the tread-surfaces of one set of conveyer-sections are moved from one position of coincidence through the successive dotted-line positions represented the tread-surfaces of the other set of sections are moved from a position of coincidence through the dot-and-dash-line positions into a position of coincidence with the tread-surfaces next below, which have simultaneously been moving through the dotted-line positions indicated. Thus if the point a be assumed to represent the position of the front edge of an A tread at a given instant and the point b be assumed to represent the corresponding position of the front edge of a B tread, then while the point a is moving successively to a' , and a'' the point b will move successively to b' and b'' , and so on. The movement of the point a during a half-rotation of the driving-shaft will take it to the point c along a straight line drawn through the points a , a' and a'' and coinciding with the direction of conveyance, and simultaneously the movement of the point b will carry it along the depressed or return portion of the closed path to the same point c , during which movements the A treads will be operative to convey passengers in the required direction for a distance represented by the distance from a to c in the diagram. After the point a reaches c in the diagram the succeeding half-rotation of the driving-shaft will cause it to return to its original position along the depressed portion of a closed path exactly similar to the curved path indicated in the diagram, which is assumed to be the path of the point b , and simultaneously said point b will return from the point c to its original position along the flat exposed portion of the path illustrated, and the B treads will be operative in precisely the same manner as above described to convey through an equal distance any passengers which may have been deposited upon them by the A treads by the passing of the latter through a position of coincidence with the B treads, which position of coincidence occurs at the point c . The equal spacing of the points a , a' , and a'' indicates that the movement of conveyance by either set of treads is uniform in speed, so that passengers will suffer no disturbance in their movement of conveyance by reason of changes in their velocity. It will be seen that the depressed or return portion of the closed path traversed by the front or outer edge of a tread-surface is such that said surface clears

the path of the inner edge of that tread-surface which is next below it on the other set of sections—that is to say, it is at all times located ahead of the succeeding tread-surface until it has passed beneath it and conversely it is always located below said succeeding tread-surface after its rearward movement has carried it past the inner edge of the latter until the next position of coincidence is reached, showing that the tread-surfaces of each set of conveyer-sections remain completely concealed during their return movements and do not project at any time into the space liable to be occupied by a passenger standing on the corresponding tread-surfaces of the other set of conveyer-sections. In the specific apparatus illustrated the conveyer-sections are readily caused to traverse a closed path such as is represented in developed form in Fig. 11 by so cutting and timing the cams that the forward or effective vertical and circular movements imparted to each set of sections in turn are performed simultaneously and are each uniform in velocity, the ratio between them being equal to the tangent of the angle corresponding to the pitch of the conveyer, while during their return movements the circular movements of the sections are continued in the same direction until said sections have dropped vertically to a sufficient extent, as above described, and are then reversed, the sections being simultaneously elevated until the next position of coincidence is reached.

It will appear from a study of Fig. 11 that the closed path represented therein is such that while any given A tread, for example, is moved in the direction of conveyance from one position of coincidence with a B tread to another, as from *a* to *c*, the B tread located next above that B tread with which said A tread was in coincidence at the point *a* will be moved simultaneously along its return-path to that position of coincidence with the A tread referred to which is indicated by the point *c*—that is to say, each tread-surface of either set of conveyer-sections will coincide alternately with two consecutive tread-surfaces of the other set of sections. It is to be pointed out, however, that this specific arrangement is not essential and that the tread-surfaces of either set of sections may be caused to coincide alternately with tread-surfaces of the other set of sections, which are not consecutive, but have one or more tread-surfaces between them, without interfering with the operativeness of the apparatus, since the positions of coincidence depend merely upon the dimensions of the closed path traversed as determined by the proportioning of the operating-parts. With two sets of sections, however, the length of the flat portion of this closed path cannot be less than one-half the distance between the front edges of two consecutive tread-surfaces, and in the

present instance I prefer to give it this length, because it minimizes the necessary vertical and oscillatory movements of the sections, and thus makes it easier to locate the operating parts compactly at the center of the apparatus. It will be evident that the shape of the closed path traversed by the conveyer-sections may be varied to any extent desired so long as the tread-surfaces are not exposed while performing their return movements and suitable provision is made for transferring passengers from one set of tread-surfaces to the other.

The parts above described are sufficient for conveying passengers from one end of the spiral conveyer-sections to the other; but in practice it is desirable to provide in connection therewith means for automatically transferring passengers to or from said spiral sections, and I have shown in the accompanying drawings an apparatus for accomplishing this result at the upper end of the spiral conveyer proper. This supplementary apparatus will be termed herein a "conveying-landing" and is similar in principle and mode of operation to the spiral conveyer already described in that it comprises a number of laterally-adjacent conveyer-sections which are combined to form two relatively movable sets or unitary elements, the sections of each set being interleaved between those of the other set and being bent or curved laterally to coincide with circular arcs concentric with the central axis of the apparatus. In this case, however, the tread-surface of each section is continuous and horizontal, or substantially so. According to the particular construction illustrated, this conveying-landing is composed of conveyer-sections 72 and 73, which are equal in number and in lateral thickness to the conveyer-sections 5 and 6, respectively, and each of which provides a continuous tread-surface at its upper edge. These sections extend horizontally for any convenient distance from the upper end of the spiral conveyer between the outer and inner shells 2 and 4, the sections 72 forming one set and the sections 73 forming the other set. The sections 72 are each provided with two downwardly-extending posts 74, the corresponding posts of these sections being located in radial alinement and secured to and supported by the top surfaces of two radial I-beams 75 and 76, carried at their inner ends by a plate 77, the contour of which as viewed in plan is best shown in Fig. 5. Similarly the sections 73 are provided with two radial series of supporting-posts 78, secured to the top faces of a pair of radial I-beams 79 and 80, carried by a plate 81, Figs. 1 and 5. One of the radial series of posts for each set of sections is located between the two series of posts which carry the other set of sections, and the posts carrying one set of sections, as 78, are enough longer than the other posts to provide for the

overlapping of the plates 77 and 81, one above the other, and for the relative vertical movements of these plates and the corresponding sections, as hereinafter described. These two sets of sections 72 and 73 are thus united in interleaved relation to form two relatively movable unitary elements, as aforesaid, and these elements are so operated that the collective tread-surfaces provided at the upper edges of the sections forming each element are alternately exposed above and depressed beneath the tread-surfaces of the other element and are given a forward movement in the direction of conveyance while exposed and a return movement while depressed. Each of these elements thus has a cyclical movement analogous to that of the spiral conveyer-sections; but the closed path traversed by the horizontal sections is of a different shape and has different proportions, the upper or exposed portion of this path being flat and horizontal and the vertical dimension of the path being relatively small, by preference, although this is not essential. Each of the sections 72 is located in circumferential alinement with one of the sections 5, and each section 73 is similarly alined with one of the sections 6. Each pair of these alined sections abut against each other at their adjacent ends, and said ends are fitted to have a relative sliding movement in a vertical direction, being preferably provided with a tongue-and-groove connection, such as is illustrated at 82 in Figs. 9 and 10, in order to preserve the alinement of the sections with accuracy.

Means are provided for operating the sets of sections 72 and 73 in such manner that whenever either of the sets of sections 5 and 6 is caused to perform its forward or operative movement in the spiral direction of conveyance the corresponding set of horizontal sections is also given a forward movement in exposed position, but is held stationary so far as vertical movement is concerned, while during the return movements of the spiral sections along their depressed paths the corresponding horizontal sections are synchronously elevated or depressed, as the case may be, and also perform their rearward return movements, the difference in extent of their vertical movements being provided for by the tongue-and-groove connection above referred to. To this end the plates 77 and 81 may be provided with supporting and operating devices, such as are illustrated in detail in Fig. 6, the plate 77 being therein shown as forming a part of an integral frame 83, comprising upper and lower hubs 84 and 85, mounted to slide vertically on the central column 18, while the plate 81 forms a part of a similar integral frame 86, having upper and lower hubs 87 and 88, also mounted to slide on said central column. The lower hubs 85 and 88 are provided, respectively, with laterally-projecting plates 89 and 90, which form tracks, said plates being sup-

ported by and adapted to run on rollers 91 and 92, respectively. The required vertical movements are imparted to these rollers and the parts carried thereby by means of two bars 93 and 94, mounted near their upper ends to slide in fixed guides carried by a collar 95, rigidly secured to the central column 18, as shown in plan view in Fig. 7, the roller 91 being carried by the upper end of the bar 93 and the roller 92 being carried by the upper end of the bar 94. The bar 93 is pivotally connected at its lower end to and supported by the free end of an arm 96, journaled on the rod 34, and provided between its ends with a roller 97, bearing upon a cam 98, secured to the driving-shaft 40, and in like manner the bar 94 is pivotally connected at its lower end to the free end of an arm 99, also journaled on the rod 34, and provided with a roller 100, bearing upon a cam 101, secured to said driving-shaft, these cams 98 and 101 being so cut and timed that the two sets of sections 72 and 73 are given the desired vertical movements at the proper times and in the proper sequence.

Each set of sections 72 and 73 is also given longitudinal movements in unison with those of the corresponding sets of spiral conveyer-sections, these movements being such as to keep the abutting ends of the spiral and horizontal sections in contact with each other at all times. To this end a vertical rod 102 is rigidly secured to the frame 83, on which rod is mounted to slide a sleeve 103, carried by the portion 22, forming a part of the vertically-movable frame which carries the spiral sections 5. In a similar manner the frame 86 is provided with a vertical rod 104, on which is mounted to slide a sleeve 105, carried by the portion 27, forming a part of the frame which carries the spiral sections 6. Thus whatever oscillatory movements are imparted to either set of spiral conveyer-sections will be transmitted through the corresponding part 22 or 27 and sleeve 103 or 105 to the rod 102 or 104, as the case may be, and thence to the corresponding frame 83 or 86 and the horizontal conveyer-sections carried thereby, the relative vertical movements of the spiral and longitudinal sections being permitted by the capacity of the sleeves 103 and 105 to slide on the rods 102 and 104, respectively.

The operation of the apparatus as thus constructed is as follows: Assuming that the apparatus is being used as an ascending conveyer and that a passenger steps upon the lowermost exposed tread-surfaces of the spiral conveyer-sections, the operation of the parts above described causes the set of spiral sections on which he is standing to perform a limited forward and upward movement, at the end of which he is deposited upon the other set of spiral sections, and so on in alternation, the result being that he is carried up the spiral incline in the manner already described. Ulti-

mately he will be deposited upon the topmost tread-surfaces of one of the sets of spiral conveyer-sections at the beginning of their forward and upward movement, at which time he will evidently be located half of the height of a step below the level of the horizontal conveying-landing, and thereupon the tread-surfaces upon which he is standing perform said forward and upward movement. Simultaneously the other set of sections of the spiral conveyer perform their return movement and the corresponding horizontal conveyer-sections move with them in a path which is sufficiently depressed to prevent the exposure of the extreme outer ends of said horizontal sections above the tread-surfaces on which the passenger is standing at any point. The ends of one set of the horizontal sections are thereby brought beneath the feet of the passenger, and as the tread-surfaces on which he is standing commence their return movement he is deposited thereby upon said horizontal sections and moves forward with them as the corresponding spiral sections move upward and forward. At the end of this forward movement of the exposed horizontal tread-surfaces on which he is standing said tread-surfaces disappear beneath the tread-surfaces of the other set of horizontal sections and perform their return movement, and by this disappearing movement the passenger is deposited on the latter tread-surfaces and is thereupon carried forward by them in like manner until they in turn disappear and leave him standing upon the horizontal sections on which he was first deposited, but at a short distance ahead or in the forward direction of conveyance. The result of the continued repetition of these cyclical movements of the horizontal conveyer-sections is that the passenger is continuously propelled forward until the remote end of the conveying-landing is reached.

The herein-described construction of my apparatus is such that the conveyer is reversible—that is to say, it will operate either as an ascending conveyer or as a descending conveyer, according to the direction in which the main driving-shaft is rotated; but as its operation as a descending conveyer will be readily understood from the foregoing description it will not be necessary to set it forth in detail.

In order to transfer passengers automatically from the conveying-landing to the stationary floor or the like to which it is adjacent, or vice versa, said conveying-landing may be combined with a stationary grating located at the same level with said floor and forming, in effect, a continuation thereof, the bars of this grating being arranged to interleave with the adjacent ends of the horizontal conveyer-sections and having their collective top surfaces located slightly below the tread-surfaces of said horizontal sections when the latter are in their position of maximum ele-

vation. My preferred construction of this landing is illustrated in Fig. 5, according to which a series of bars 106, corresponding in number to the sections 72 and 73 and curved laterally about the same axis as a center, are located between the shells 2 and 4 and supported thereby in fixed position in such manner that their collective top surfaces form a horizontal platform located at substantially the level of the conveying-landing and extending circumferentially for a short distance from the end of the latter. The stationary platform thus provided communicates with the adjacent floor through an opening or passageway 107 formed in the outer shell 2, and thus permitting the exit or entrance of passengers from or to the conveyer, and said platform at that end which is adjacent to the conveying-landing carries or is combined with a stationary grating, which in the present instance is formed by cutting away one side of each of the bars 106 in such manner as to provide a series of vertical slots or recesses 108, each extending circumferentially for a distance slightly greater than the horizontal travel of the corresponding section 72 or 73. The adjacent extremities of said sections are also cut away, respectively, on one side, thus providing vertical recesses 109 of similar length and configuration to the recesses 108 and having a width sufficient to receive freely the corresponding bars which compose the grating, and these bars and the extremities of the sections 72 and 73 are arranged in interleaved relation, as shown in Fig. 5, the upper or supporting surface of the grating being located at such an elevation that during the forward movement of the interleaved ends of the horizontal conveyer-sections the tread-surfaces of the latter are located slightly above the grating. It will be understood that the cut-away extremities of the horizontal conveyer-sections and the bars which form the grating are of such width and are located so close together as to provide collectively a sufficiently continuous supporting-surface, and in operation as soon as a passenger has been deposited upon the cut-away ends of one of the sets of horizontal conveyer-sections by the operation of the latter, as previously described, he will be carried thereby over the grating during the forward movement of said sections, whereupon their disappearing movement will deposit him upon the grating and leave him free to walk off the same. Conversely, in case the apparatus is used as a descending conveyer a passenger who walks upon the grating toward the conveyer will ultimately be picked up by the cut-away extremities of one of the sets of horizontal conveyer-sections as the latter rise through the grating and will then be removed from the grating and carried forward by the conveying-landing and thence down the spiral conveyer.

It will be evident that a conveying-landing

similar to the one herein described or a stationary grating, or both, may be combined with the lower end of my spiral conveyer; but for the sake of clearness of illustration such landing and grating are not shown herein, as their arrangement and mode of operation will be readily understood from the foregoing description and from a study of the corresponding landing and grating in my other application, Serial No. 254,779, above referred to. In the present instance the lower end of the spiral conveyer terminates in an open or free space between the shells 2 and 4, a passageway 110 being cut through the outer shell 2 to permit the entrance or exit of passengers to or from said open space at the corresponding floor-level. This space is preferably bounded on that side which is opposite to the conveyer by a radially-extending vertical partition 111, connecting the inner and outer shells, whereby passengers are prevented from entering the space beneath the conveyer-sections where certain of the operating parts are located. A similar partition 112 is also located at the upper portion of the apparatus at that end of the stationary platform which is remote from the conveying - landing. By this arrangement, in connection with the shells 2 and 4, passengers are at all times confined to their intended course during their transit from one end of the apparatus to the other and are prevented from interfering with or being injured by the moving parts.

While it will be desirable in most cases to provide the spiral conveyer-sections with horizontal tread-surfaces separated by risers, as shown, yet the tread-surfaces may be otherwise arranged in case the pitch of the apparatus is such that passengers can stand upon said surfaces without danger or inconvenience. In any case it will be evident that a passenger may add to his movement, which is due to the operation of the conveyer-sections, by walking up or down the conveyer in the direction of conveyance, if he so desires, and that my apparatus may be used for conveying inanimate objects as well as persons.

I claim as my invention—

1. In a conveyer, the combination of laterally-adjacent conveyer-sections extending spirally from one elevation to another, and means for operating the same to impart a continuous forward movement to a passenger supported thereby.

2. In a conveyer, the combination of laterally-adjacent conveyer-sections extending spirally from one elevation to another and provided with supporting-surfaces forming steps, and means for operating said sections to impart a continuous forward movement to a passenger supported thereby.

3. In a conveyer, the combination of two sets of interleaved conveyer-sections curved laterally about a common axis, and means for imparting thereto cyclical movements the forward

portions of which are conjointly effective to propel a passenger in the direction of conveyance.

4. In a conveyer, the combination of two sets of interleaved conveyer-sections extending spirally from one elevation to another, and means for imparting thereto cyclical movements the forward portions of which are conjointly effective to propel a passenger in the direction of conveyance.

5. In a conveyer, the combination of two sets of interleaved conveyer-sections extending spirally from one elevation to another and provided with supporting-surfaces forming steps, and means for imparting to said sets of sections cyclical movements the forward portions of which are conjointly effective to propel a passenger in the direction of conveyance.

6. In a conveyer, the combination of two sets of interleaved conveyer-sections curved laterally about a common axis, and means for exposing the supporting-surfaces of each set in alternation above those of the other set, and for imparting a forward movement to each set while its supporting-surfaces are exposed and a return movement along a depressed path.

7. In a conveyer, the combination of two sets of interleaved conveyer-sections extending spirally from one elevation to another, and means for exposing the supporting-surfaces of each set in alternation above those of the other set, and for imparting a forward movement to each set while its supporting-surfaces are exposed and a return movement along a depressed path.

8. In a conveyer, the combination of two sets of conveyer-sections each having a spiral series of supporting-surfaces forming steps, the sections of each set alternating in lateral arrangement with those of the other set, and means for exposing the supporting-surfaces of each set in alternation above the corresponding surfaces of the other set, and for imparting a forward movement to each series of supporting-surfaces while exposed and a return movement along a depressed path.

9. In a conveyer, the combination of interleaved and laterally-adjacent conveyer-sections extending spirally from one elevation to another, and means for moving the same in closed paths each having a flat upper portion extending in the spiral direction of conveyance, the movements of alternate sections along their respective paths being similar in direction but opposite in phase.

10. In a conveyer, the combination of two sets of conveyer-sections each having a spiral series of supporting-surfaces forming steps, the sections of each set alternating in lateral arrangement with those of the other set, and means for moving each of said sets in a closed path having a flat upper portion extending in the spiral direction of conveyance, said means

being timed to impart to each of said sets in alternation a forward movement along the flat portion of its path while the other set is performing its return movement.

11. In a conveyer, the combination of laterally-adjacent conveyer-sections extending spirally from one elevation to another, supplementary conveyer-sections each extending horizontally from one end of one of the spiral conveyer-sections, and means for imparting to said spiral and horizontal sections cyclical movements the forward portions of which are conjointly effective to propel a passenger in the direction of conveyance.

12. In a conveyer, the combination of laterally-adjacent conveyer-sections extending spirally from one elevation to another, supplementary conveyer-sections each extending horizontally from one end of one of the spiral conveyer-sections, means for imparting to said spiral and horizontal sections cyclical movements the forward portions of which are conjointly effective to propel a passenger in the direction of conveyance, and a grating interleaved with the free ends of the horizontal conveyer-sections.

13. In a conveyer, the combination of two sets of interleaved conveyer-sections extending spirally from one elevation to another and provided with supporting-surfaces forming steps, two corresponding sets of supplementary conveyer-sections each extending horizontally from one end of one of the spiral sections, and means for imparting to said sets of spiral and horizontal sections cyclical movements the forward portions of which are conjointly effective to propel a passenger in the direction of conveyance.

14. In a conveyer, the combination of two sets of interleaved conveyer-sections extending spirally from one elevation to another and provided with supporting-surfaces forming steps, two corresponding sets of supplementary conveyer-sections each extending horizontally from one end of one of the spiral sections, means for imparting to said sets of spiral and horizontal sections cyclical movements the forward portions of which are conjointly effective to propel a passenger in the direction of conveyance, and a grating interleaved with the free ends of the horizontal conveyer-sections.

15. In a conveyer, the combination of laterally-adjacent conveyer-sections extending spirally from one elevation to another, supplementary conveyer-sections each extending horizontally from one end of one of the spiral sections and curved laterally on an arc concentric with the axis of the latter, the adjacent ends of each pair of spiral and horizontal sections having a sliding engagement with each other in a vertical direction, and means for imparting to said spiral and horizontal sections cyclical movements the forward por-

tions of which are conjointly effective to propel a passenger in the direction of conveyance.

16. In a conveyer, the combination of laterally-adjacent conveyer-sections extending spirally from one elevation to another, supplementary conveyer-sections each extending horizontally from one end of one of the spiral sections and curved laterally on an arc concentric with the axis of the latter, the adjacent ends of each pair of spiral and horizontal sections having a sliding engagement with each other in a vertical direction, means for imparting to said spiral and horizontal sections cyclical movements the forward portions of which are conjointly effective to propel a passenger in the direction of conveyance, and a grating the bars of which have a lateral curvature concentric with said supplementary sections and interleave therewith, said bars having their upper surfaces not higher than the path of forward movement of the supporting-surfaces of the supplementary sections.

17. In a conveyer, the combination of two sets of conveyer-sections each having a spiral series of supporting-surfaces forming steps, the sections of each set alternating in lateral arrangement with those of the other set, means for exposing the supporting-surfaces of each set in alternation above the corresponding surfaces of the other set, and for imparting a forward movement to each series of supporting-surfaces while exposed and a return movement along a depressed path, two corresponding sets of supplementary conveyer-sections each extending horizontally from one end of one of the spiral sections and curved laterally on an arc concentric with the axis of the latter, and means for imparting to said supplementary conveyer-sections cyclical movements which are similar to and synchronous with the corresponding movements of the aligned spiral conveyer-sections.

18. In a conveyer, the combination of two sets of conveyer-sections each having a spiral series of supporting-surfaces forming steps, the sections of each set alternating in lateral arrangement with those of the other set, means for exposing the supporting-surfaces of each set in alternation above the corresponding surfaces of the other set, and for imparting a forward movement to each series of supporting-surfaces while exposed and a return movement along a depressed path, two corresponding sets of supplementary sections each extending horizontally from one end of one of the spiral sections and curved laterally on an arc concentric with the axis of the latter, means for imparting to said supplementary conveyer-sections cyclical movements which are similar to and synchronous with the corresponding movements of the aligned spiral conveyer-sections, and a relatively fixed grating the bars of which are laterally curved concentrically with said supplementary sections and

interleave therewith, said bars having their upper surfaces not higher than the path of forward movement of the supporting-surfaces of the supplementary sections.

19. In a conveyer, the combination of two sets of interleaved conveyer-sections curved laterally about a common axis, means for raising and lowering said sets of sections independently of each other, and means for independently oscillating said sets about said axis as a center.

20. In a conveyer, the combination of two sets of interleaved conveyer-sections extending spirally from one elevation to another, means for raising and lowering said sets of sections independently of each other, and means for independently oscillating said sets about the axis of the spiral as a center.

21. In a conveyer, the combination of two sets of interleaved conveyer-sections extending spirally from one elevation to another, means for raising and lowering said sets of sections independently of each other, means for independently oscillating said sets about the axis of the spiral as a center, two corresponding sets of supplementary conveyer-sections, each extending horizontally from one end of one of the spiral sections, means for raising and lowering said sets of horizontal sections independently of each other and of the spiral sections, and means for moving each set of horizontal sections longitudinally in correspondence with the aligned spiral sections.

22. In a conveyer, the combination of guided frames mounted to slide vertically and to oscillate laterally, independently of each other, means for raising and lowering said frames and for oscillating the same, and two sets of interleaved conveyer-sections carried by said frames respectively.

23. In a conveyer, the combination of a vertical column, frames mounted to slide vertically and to oscillate laterally thereon, independently of each other, two sets of interleaved conveyer-sections carried by said frames respectively, means for oscillating said frames, and means for raising and lowering the same comprising a driving-shaft, cams carried thereby, arms provided with rollers and resting upon said cams, and tracks carried by said frames and adapted to run on said rollers respectively.

24. In a conveyer, the combination of a vertical column, frames mounted to slide vertically and to oscillate laterally thereon, independently of each other, two sets of interleaved conveyer-sections carried by said frames respectively, means for raising and lowering said frames, and means for oscillating said frames comprising vertically-slotted plates rigidly connected thereto, respectively, pivoted arms having rollers adapted to travel in said slots, and devices for oscillating said arms.

25. In a conveyer, the combination of a ver-

tical column, two sets of frames mounted to slide vertically and to oscillate laterally thereon, two sets of interleaved conveyer-sections carried respectively by one set of frames and extending spirally around said column, two corresponding sets of supplementary conveyer-sections each extending horizontally from one end of one of the inclined sections and curved laterally about the axis of the spiral as a center, said horizontal sections being carried by the other set of frames respectively, connections between each frame which carries the spiral sections and the frame which carries the corresponding horizontal sections, permitting relative vertical movements of the same, means for independently oscillating the frames of one set, and means for raising and lowering the frames of both sets independently of one another.

26. In a conveyer, the combination of a vertical column, two sets of frames mounted to slide vertically and to oscillate laterally thereon, one of the frames of each set having a vertically-sliding connection with one of the frames of the other set and each of said frames being provided with a track, supporting devices for said frames having rollers on which said tracks are respectively adapted to run, means for raising and lowering said supporting devices, means for laterally oscillating the frames comprising one set, two sets of interleaved conveyer-sections independently supported by one set of frames and extending spirally about said column, and two corresponding sets of supplementary conveyer-sections each extending horizontally from one end of one of the spiral sections and having a lateral curvature about the axis of the spiral as a center.

27. In a conveyer, the combination of a vertical column, frames mounted to slide vertically and to oscillate laterally thereon, independently of each other, two sets of interleaved conveyer-sections carried by said frames respectively and curved laterally about a common axis, a main driving-shaft, cams carried thereby, pivoted arms resting upon said cams and supporting said frames respectively, and means for oscillating said frames comprising vertical counter-shafts geared to rotate in unison and provided respectively with cams, driving connections between said counter-shafts and the main driving-shaft, pivoted arms provided with rollers engaging said cams respectively, and laterally-rigid connections between said arms and the respective frames, permitting vertical movements of the latter.

28. In a conveyer, the combination of a vertical shell, two sets of interleaved conveyer-sections extending spirally around the same, in proximity thereto, and means contained within said shell for supporting said sections and imparting thereto cyclical movements, the forward portions of which are conjointly

effective to propel a passenger in the direction of conveyance.

29. In a conveyer, the combination of a vertical shell provided with lateral openings, 5 guided supporting devices contained within the shell and provided with arms extending outward through said openings, two sets of interleaved conveyer-sections extending spirally about said shell, in proximity thereto, 10 and supported upon said outwardly-extending arms, and means contained within the shell for operating said supporting devices to impart to the corresponding sections cyclical movements, the forward portions of which 15 are conjointly effective to propel a passenger in the direction of conveyance.

30. In a conveyer, the combination of a vertical shell, two sets of interleaved conveyer-sections extending spirally around the same, 20 two sets of supplementary sections each extending circumferentially around a portion of said shell from one end of one of the spiral sections, and means contained within said shell for supporting said sections and imparting thereto cyclical movements, the forward 25 portions of which are conjointly effective to propel a passenger in the direction of conveyance.

31. In a conveyer, the combination of vertical shells providing an annular space between them and forming lateral walls therefor, two sets of interleaved conveyer-sections extending circumferentially between said shells, and means for imparting to said sets 35 of sections cyclical movements, the forward portions of which are conjointly effective to propel a passenger in the direction of conveyance.

32. In a conveyer, the combination of vertical shells providing an annular space between them and forming lateral walls therefor, conveyer-sections extending spirally from one elevation to another between said shells, supplementary conveyer-sections each extending 45 circumferentially in a horizontal plane from one end of one of the spiral sections, and means for operating said sections to impart a continuous forward movement to a passenger supported thereby.

33. In a conveyer, the combination of vertical shells providing an annular space between them and forming lateral walls therefor, conveyer-sections extending spirally from one elevation to another between said shells, supplementary conveyer-sections each extending 55 circumferentially in a horizontal plane from one end of one of the spiral sections, means for operating said sections to impart a continuous forward movement to a passenger supported thereby, and a grating located between said shells and having its bars adapted to interleave with the adjacent ends of the horizontal conveyer-sections. 60

34. In a conveyer, the combination of vertical shells providing an annular space be-

tween them and forming lateral walls therefor, the outer shell being provided with openings to permit the entrance and exit of passengers, conveyer-sections extending spirally from one elevation to another between said shells, means contained within the inner shell 70 for operating said sections to impart a continuous forward movement to a passenger supported thereby, a conveying-landing extending horizontally from one end of the spiral conveyer, means for operating said landing, 75 and a grating cooperating with said landing to transfer passengers to or from the same.

35. In a conveyer, the combination of vertical shells providing an annular space between them and forming lateral walls therefor, the outer shell having openings to permit the entrance and exit of passengers, two sets of interleaved conveyer-sections extending spirally from one elevation to another between 85 said shells, two sets of supplementary conveyer-sections each extending circumferentially in a horizontal plane from one end of one of the spiral sections, and means contained within the inner shell for imparting to 90 said sets of sections cyclical movements the forward portions of which are conjointly effective to propel a passenger in the direction of conveyance.

36. In a conveyer, the combination of vertical shells providing an annular space between them and forming lateral walls therefor, the outer shell having openings to permit the entrance and exit of passengers, two sets of interleaved conveyer-sections extending spirally from one elevation to another between 100 said shells, two sets of supplementary conveyer-sections each extending circumferentially in a horizontal plane from one end of one of the spiral sections, means contained within 105 the inner shell for imparting to said sets of sections cyclical movements the forward portions of which are conjointly effective to propel a passenger in the direction of conveyance, and a grating located between said shells and 110 having its bars adapted to interleave with the adjacent ends of the horizontal conveyer-sections.

37. In a conveyer, the combination of vertical shells providing an annular space between them, the outer shell having openings 115 to permit the entrance and exit of passengers, two sets of interleaved conveyer-sections extending spirally from one elevation to another between said shells and forming a conveyer 120 having substantially the same width as said annular space, two corresponding sets of supplementary conveyer-sections each extending horizontally from one end of one of the spiral sections, said supplementary sections forming 125 a conveying-landing extending circumferentially between said shells, means contained within the inner shell for operating said sets of sections to impart a continuous forward movement to a passenger supported thereby, 130

a stationary platform also extending circumferentially between said shells and leading from said conveying-landing to one of the openings in the outer shell, said platform being provided with bars forming a grating and adapted to interleave with the adjacent ends of the horizontal conveyer-sections, and vertical partitions extending radially between the outer and the inner shells at one side of the adjacent openings.

38. In a conveyer, a set of laterally-spaced conveyer-sections curved laterally about a common axis and rigidly connected to form a unitary element.

39. In a conveyer, a set of laterally-spaced conveyer-sections extending spirally from one elevation to another and rigidly connected to form a unitary element.

40. In a conveyer, a set of laterally-spaced spiral conveyer-sections providing collectively a series of supporting-surfaces forming steps, said sections being rigidly connected to form a unitary element.

41. In a conveyer, a set of laterally-spaced

conveyer-sections curved laterally about a common axis, said sections being provided beneath their supporting-surfaces with recesses and rigidly secured to downwardly-extending supporting-posts located therein, and beams extending transversely beneath said sections and carrying said posts, thereby uniting said sections to form a unitary element.

42. In a conveyer, a set of laterally-spaced spiral conveyer-sections providing collectively a series of supporting-surfaces forming steps, each of said sections being laterally recessed beneath its upper edge and rigidly secured to downwardly-extending posts located in said recesses, and transversely-extending beams located beneath said sections and rigidly secured to said posts, thereby uniting said sections to form a unitary element.

In testimony whereof I have hereunto subscribed my name this 4th day of April, 1905.

PIERRE LORILLARD.

Witnesses:

HORACE H. WESTCOTT,
J. P. STORY, Jr.