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⑤④ **A moving walkway.**

⑤⑦ A moving walkway which has a main support belt (50) having a secondary support belt (51) which lies thereover over most of the run of the main support belt but extends therebeyond at each end thereof to terminate closely adjacent a further support belt (20) with means (10) between the secondary support belt and the further support belt over which a passenger can pass whilst being propelled forwardly by either the secondary support belt (51) or the further support belt (20).

Also described is a hand rail assembly, the speed of which can vary so as to be complementary to the variations in the speed of the walkway

Description

A MOVING WALKWAY

This invention relates to a moving walkway being a moving beltway and, particularly, to beltways which can be used for travel over a relatively substantial distance.

At the present time there have basically been proposed two different types of moving walkways, one of which uses plates which are connected to endless belts or chains and which come into alignment whilst on the upper surface of the walkway, and the other, using continuous rubber belts.

Whilst the first of these forms is very much more expensive than the second form, both work quite satisfactorily in broad terms, but each has a major disadvantage that the speed of the walkway can only be such that a user can readily step from the surface adjacent to the walkway onto the walkway itself and from the walkway to an adjacent surface. Practically, this has limited the speed of the belt to approximately 0.6 to 0.9 m/sec (2.2-3.2 km/hr).

This means, particularly where long runs of walkway are provided, that the actual speed of movement is relatively slow.

Proposals have been made to vary this speed, and one of these proposals basically contemplates having a beltway split transversely with each belt overlapping the following belt, with adjacent areas moving at different speeds so that one initially steps on to the first, slow beltway and then, part way along its movement, down onto a second, faster, beltway and so on. When one is to leave the beltway, one moves off the fast moving portion onto a slower moving portion and then eventually to the adjacent surface.

The concept is unsatisfactory because, at the higher speeds, passengers could not be relied upon to make the step between belts at the correct time, with many falls a likely consequence.

Another form of beltway which is proposed comprises two belts or the like, side by side, with the outer belt running at, say, half the speed of the inner belt so that a user first steps onto the outer belt and then steps sideways across to the inner belt.

In such an arrangement, the two belts can be very closely adjacent but a problem can arise if the inner belt is effectively loaded to capacity then a user on the outer belt may not be able readily to move across the inner belt and, as the outer belt would normally only run a relatively short distance, a user could be left trying to make the crossing with the belt terminating with a consequent likelihood of injury. Many people would also find a lateral manoeuvre difficult.

A third type of accelerating walkway involves the surface of the walkway deforming; however these systems have proved so mechanically complex, noisy and expensive that none has ever been installed in a public place.

An object of the present invention is to provide a moving beltway where the speed of the beltway can be varied but which does not provide a danger to

users when passing from one portion of the beltway to the other.

The invention includes a moving beltway which comprises a main moving support belt which passes over main rollers at each end thereof and a secondary moving support belt which, over most of the length of the beltway, is in abutting relationship with the main support belt but which, at each end thereof, passes over a secondary roller or relatively small diameter which is spaced from the adjacent main roller about which the main support belt passes, the secondary roller being located to retain the secondary support belt substantially tangential to the main roller and a further moving support belt which is in close longitudinal abutment with the secondary support belt, the main support belt and the associated secondary support belt being driven at a first speed and the further support belt being driven at a second speed and means between the secondary support belt and the further support belt over which a passenger can pass whilst being in contact with either the secondary support belt or the further support belt.

By using the concept of the invention the actual spacing between the ends of the secondary support belt and the further support is minimised. A shaped member is located across and between the belts at the point of junction, which member may have a low friction surface or the like whereby a passenger moving from one belt to the other belt will move from the first belt onto this low friction surface and then from this surface onto the second belt so that transmission is facilitated.

A principal feature of the invention is that the passenger is transported, without walking, from one belt to the next, passing over a stationary plate, the width of which is so small that the shoes of passengers, including children and women in stilleto heels, will always be sufficiently supported by one of the belts on each side of the stationary member that they will be pushed by the preceding belt, or pulled by the succeeding belt, over the stationary support, as its co-efficient of friction is substantially less than the belt surface.

In order that the invention may be more readily understood, we shall describe one particular form of moving beltway made in accordance with the invention, in relation to the accompanying drawings, in which:-

Fig. 1 is a schematic side elevation of the accelerating or decelerating belts and their conjunction with the main high speed section;

Fig. 2 is a view showing, in enlarged form, one of the sub-assemblies of Fig. 1 and the beginning of the main high speed section of beltway;

Fig. 3 is a plan view of portion of the beltway;

Fig. 4 is a broken view, generally shown by the arrows 4-4 of Fig. 3;

Fig. 5 is a section along line 5-5 of Fig. 4;

Fig. 6 is a view similar to Fig. 5 but showing a

flat rather than a ribbed belt;

Fig. 7 is a partial section along line 7-7 of Fig. 4;

Fig. 8 is a schematic view along line 8-8 of Fig. 3;

Fig. 9 is a schematic view along line 9-9 of Fig. 3;

Fig. 10 is a schematic view showing the interconnection of two main beltway components;

Fig. 11 is a schematic view of a hand rail for use with the beltway of the invention;

Fig. 12 is a side elevation of part of the hand rail, generally taken along line 12-12 of Fig. 11;

Fig. 13 is a section through a hand rail component taken along line 13-13 of Fig. 11; and

Fig. 14 is an exploded view showing the various operating belts of the hand rail of Fig. 11.

In this description we shall refer to the beltway as being comprised of belts, although it is to be appreciated that the main belt could be made of interconnected plates without departing from the concept of the invention.

Also, generally, we shall describe the belts as having longitudinal ribs and, where appropriate, combs engaging with these ribs, but the invention is equally applicable to plane belts which can act closely in association with what are plane edged wipers or the like which are located relatively close thereto.

Schematically, Fig. 1 shows the arrangement whereby the beltway permits changes in speed to be accomplished so that a user simply has to stand on the belt and his or her speed will be varied as they pass along the belt.

Specifically, there is a first beltway section 1, eight intermediate beltway sections 2 and a main beltway section 3.

The number of intermediate sections can vary depending upon the final speed required and, in one practical form, the first section 1 would be 1000 mm long and would be travelling at 0.6 m per second, which is a conventional speed for moving beltways, and each of the intermediate sections 2 would be approximately 400 mm long and each would be travelling at 0.2 m per second faster than the preceding section so that, at the eighth intermediate section, the speed would be 2.2 m per second and the main beltway 3 could be travelling at 2.45 m per second.

To give some idea of the effect of this, a normal moving beltway travelling at 0.6 m per second takes approximately 5.5 minutes to travel 200 m where, by the use of a beltway of the invention, the same distance would take approximately 1.5 minutes.

This would mean that, using the beltway of the invention, the distance travelled in 5 minutes would be over 700 m.

This means that beltways of the present invention offer rapid transit for a large number of people, with the beltway itself, as shall become clear from the further description herein, being completely safe.

Fig. 2 shows the last two intermediate sections 2

and the main beltway 3 and it will be seen that between each of these there is a plate 10 which can be visualised from Figs. 3 and 5.

The belt 20 is shown as a ribbed belt having a substrate carrier 21 and longitudinal ribs 22 extending upwardly therefrom.

The plate 10 has an upper surface 11 which can be polished and is provided with comb teeth 12 which extend between each adjacent pair of ribs.

The plate may be mounted on a stem 13 which is attached to the frame of the assembly and the arrangement is such, as can best be seen from Figs. 5 and 6, that the upper surface 11 of the plate is effectively in alignment with the top of the belts 20.

There is shown a pair of rollers 15, one associated with each belt 20 which act as idler rollers for the belt and the arrangement shown in Fig. 5 is effectively full size.

Thus, the top of each plate is approximately only 40 mm wide and this is substantially less than the length of even very small shoes, including the shoes of infants.

The arrangement illustrated in Fig. 6 is that used for plane rather than ribbed belts, and it can be seen that the total spacing between the belts is minimised.

It can be seen, therefore, that, if a passenger steps onto the first beltway section 1, the speed of this is relatively slow, so there is no difficulty in making this step, either by juveniles or persons who are aged or infirm, and that, once they are standing on this belt, they may keep their feet firmly on the belt, preferably side by side, and, when the belt reaches the first plate 10, the person's shoes will pass over the plate and come into contact with the next adjacent intermediate belt, or the main beltway section which is travelling somewhat faster than the first belt, but the transition will be minor and will cause no difficulties.

Thus, the passengers can travel from beltway section to beltway section without moving their feet and the transition from section to section will be gentle but, at the same time, after passing over the required number of intermediate sections, the speed reached by the passenger may be substantially greater than normal walking pace.

Referring to Fig. 2, each of the intermediate sections 2 is arranged to be readily removed and each is provided with a sub-assembly 30 which can include the idler rollers 15 previously mentioned and two other idler rollers 31 and the assembly itself can be in connection with a driven roller 32.

In the arrangement shown in Fig. 2, the sub-assembly can be permitted to be moved outwardly from its position without disconnection of any drive.

In an alternative form, it may be desirable that the drive roller 32 be provided as part of the sub-assembly, in which case the method of removal may be different, but it is preferred that removal be basically simple so that, if a belt is to be replaced, it is a simple and rapid operation.

It can also be seen that the arrangement in the sub-assemblies is such that they are not of substantial depth and the whole beltway of the invention, except for the main drive rollers, to be

described hereinafter, may be able to be received in a depth of only some 300 mm so that the beltway can be readily post fitted into an area simply by making a relatively low sub-frame to carry the beltway.

Figs. 8 and 9 show the drive means for the first and intermediate beltway sections.

This drive is all obtained from the main beltway section as it will be appreciated, when this is described later, that the main beltway section has a great deal of inertia and, should there be any power breakdown, there will be a certain time delay before the main beltway stops moving and, as long as this is moving, it is most desirable that the intermediate beltways, at each end, continue to move at their same relative speeds so as to ensure that no passenger suddenly transfers from a moving to a stopped beltway section.

The main drive can be obtained, as can be seen in Figs. 3 and 9, by a number of belts 40 which drive onto paired pulleys 41, which pulleys are on a shaft 42 which passes beneath the beltway and drives a pulley 43 which is in driven connection to a pair of pulleys 32 and which has an idler 44.

The belt 45 which drives these pulleys may well be a ribbed belt of the type known in the art which provides positive drive but, at the same time, a relatively silent drive.

The belts 40 can be of the same type.

By arrangement of the diameters of the pulleys 41, 43 and 32, the required speeds of each adjacent beltway section can be achieved.

The commencement of the main beltway 3 is best illustrated in Fig. 2.

This beltway comprises two belts, a main belt 50 and a secondary belt 51, the main belt 50 being a heavy duty belt of the type currently used in beltways and which passes over a roller 52 which has a substantial diameter, of the order of some 300 mm or greater, which is necessary for a belt of this type.

The subsidiary belt 51 can be of a thinner material and, indeed, can be a belt similar to the belts 20 on the intermediate beltway sections.

As illustrated in Fig. 2, the roller 53 about which this belt passes can be identical to the rollers 15 of the intermediate sections and the belt can co-operate with a plate 10 identical to the plates between the intermediate sections.

As illustrated in Fig. 2, there are a plurality of rollers 54 which permit the belt 51 to become spaced from the belt 50, as the belts are travelling on a different radius, and, also shown in this Figure, there can be a plate 55 on which the belt 51 rests between the roller 53 and the roller 52, at which it comes into contact with belt 50.

Whilst we have referred to the plate 55 it is to be understood that this could be a plurality of closely spaced roller, but it could also be any form of low friction surface which can support the belt 51 but not restrict its movement.

On the other side of the roller 52 and belt 50 can be supported on transverse rollers which extend the length of the beltway.

In this particular construction, the belt 50 would normally have a flat upper surface with the belt 51 having ribs thereon, although, if the intermediate

belts 20 have a plain upper surface, then belt 51 would normally have such a surface.

It will be seen that by using the subsidiary belt 51 and the roller 53, the spacing between the last of the intermediate beltway sections 2 and the main beltway 3 is the same as the spacing between adjacent intermediate beltway sections and so, the movement of a passenger from the last of the intermediate sections to the main beltway section 3 is identical to the movement between each of the intermediate sections.

As can also be seen in Fig. 2, the belts 50 and 51 may pass over an idler roller 56 or the like so the total height of the main beltway section between the rollers at each end is effectively the same as the height of the intermediate portion so that, in order to locate a beltway it is only necessary to have a deeper portion for the end rollers.

Fig. 10, which is, again, substantially schematic, shows an arrangement which can be used where two adjacent main beltway sections are to abut.

This can be particularly useful where a long beltway is required and where it is desired that the beltway be divided.

In this arrangement there are two rollers which are equivalent to rollers 52 previously described and two idler rollers which are equivalent to rollers 53 and which have a plate equivalent to plate 10 therebetween.

Normally, in these circumstances there would be no difference in speed between the two beltway sections although it could be, if a number of beltway sections are required, one of the sections could travel faster than the other, as the transition from one to the other would be effectively the same as the transition between the various intermediate sections previously described.

By the use of an angled roller 53 and an additional roller at a reverse angle the direction of the main beltway could be changed at such a junction without discontinuing the beltway.

Figs. 11 to 14 illustrate, somewhat schematically, a hand rail arrangement for use with a moving beltway of the invention.

It must, however, be understood that, whilst this hand rail is particularly suitable for use with the beltway of the invention, it may also be used with other moving beltways, should this be required.

We have provided with the hand rail a provision to provide four different speeds of movement of the hand rail members and the formation and operation of these members 60 can best be understood from Figs. 12 and 13.

Each member comprises a trolley 61 having a substantially horizontal plate 62 which can be provided, as illustrated, with two pairs of wheels 63 and which has an upwardly directed plate 64 to which the hand rail 65 is connected.

The trolley is located in a frame 70, which may be extruded or otherwise formed, and which has a pair of tracks 71 adapted to receive the wheels 63 and which is adapted to carry three different types of pulleys 74, each of which is adapted to have a resilient belt 75, which, as illustrated, is a round belt associated therewith.

We also provide a wire cable or the like 76 which can be brought into contact with the trolley by being spring triggered by a cam or the like mechanism 77.

Alternatively, we may use a chain rather than the wire 76 and the interconnection could be by teeth associated with the trolley which could engage the chain to provide driving connection.

This arrangement, as will be described, permits the trolley, and thus the hand rail portion, to move at four different speeds depending upon the required speed at any particular place.

It will be appreciated that, in the particular embodiment of beltway previously described, we have used nine beltway sections prior to the main section, and of the four different speeds for the hand rail three are associated with groups of three beltway sections at the commencement and intermediate portion and the fourth speed is related to the main beltway section.

We have found that, if, over the length of each approximately three intermediate beltway sections, approximately 1200 mm, the speed of the hand rail is approximately that of the centre section, then the hand rail, whilst apparently moving a short distance behind and ahead of a neutral position, will remain in a position relative to a passenger for the passenger to retain his or her grip on the hand rail without discomfort.

The actual arrangement of the connections adjacent to each end of the beltway is that, at any time, one of the three flexible belts 75 is compressed between a pulley 74 and the underside of the plate 62, which is preferably roughened, the trolley is carried forward by the frictional engagement between the belts 75 and the plate.

Referring to Fig. 14, it can be seen that there are effectively three horizontal runs of belt in the lower three parts of the Figure, runs 81, 82 and 83 and it is these that drive the trolley.

It will also be seen that these effectively extend from the first beltway section and for the length of the intermediate beltway sections to the point at which the main beltway section commences.

These belt runs, as can be seen from examination of Fig. 14 together with Fig. 11 are arranged so that each is driven from a shaft 84 and are on pulleys of different sizes, 85, 86 and 87, so that the speed of the hand rail varies from a flow speed, in the second portion of Fig. 14, to higher speeds in the third and fourth portions.

Shown on each of these Figures there are idler rollers which have not been specifically described, but they provide the desired engagement of the belts with the plate 62. The number of such rollers will depend on the length of the horizontal runs of the belts.

Referring to Fig. 13 it will be seen that run 82 is that which is horizontal, and with which the plate 62 is in connection, and the run 88 of the belt having the horizontal portion 83 can also be seen.

The arrangement of the pulley 74 is such that the belt run 82 is compressed between the pulley and the plate 62 so that the drive obtained to the trolley and thus the hand rail, is achieved from this belt.

It will be seen that a trolley will be picked up by the

run 90 of the end belt at approximately the position shown at 91 and will be carried around the end roller 92 at this speed and will retain this speed as it runs along the upper run 81 of the belt.

As it reaches the end of this belt, the next adjacent run 82 shall come into driving contact with the plate 62 and the belt 81 will come out of such contact and the trolley will travel faster until it comes into contact with the run 83 of the third belt, at which time it will travel faster again.

Shown at 94 there is an accumulation of trolleys and their hand rail members and these can be released sequentially by a device, not shown, so that the trolleys are effectively equally spaced as they proceed on the upper run.

On the lower run there is no necessity for this and the trolleys can travel at their maximum speed, which will be described hereafter, until they come into the accumulator position.

The fourth belt 76 may be a wire cable or chain and may extend the whole length of the hand rail, effectively as illustrated in the first view of Fig. 14, or it could terminate earlier than this, but it must extend beyond the end of the run 83.

The cable or chain 76 operates at the speed of the main portion of the beltway and, as indicated, can be drawn into frictional engagement with the underside of the plate 62 by a spring or the like so that, over the main portion of the length of the beltway, the trolley, and thus the hand rail 65 associated therewith, travels at the same speed as the beltway associated with the hand rail.

The trolley remains connected to the cable 76 along the whole of the central run of the main beltway but becomes disengaged at the other end of the beltway, where there is a belt arrangement which is the mirror image of that shown in Fig. 14 so that the speed of the hand rail trolleys is reduced in steps associated with the slowing down of the intermediate sections of the beltway at the "off" end.

Where the beltway is associated with a hand rail of the type described, it will be seen that at the entrance end of the beltway a passenger simply steps onto the initial beltway section 1 and can grasp the hand rail which at this position will be moving at the speed of the beltway.

The passenger moves onto succeeding belt segments, each at an incremental speed higher than the preceding one. The points at which the speed of the hand rail changes are located so that, while the speed of the hand rail may at times slightly exceed and then fall below the speed of the passenger's body, the relative position of the two does not vary by more than 150 mm.

When the end of the beltway is reached, complementary movements occur and firstly, the passenger starts to travel slower as he or she moves across the junctions of the beltway sections and, at the same time, the hand rail is sometimes slightly slower, then the same speed as, and then slightly faster than the beltway so that, at all times, the hand rail can comfortably be maintained in position relative to the passenger until, finally, the passenger steps off the last beltway section which is travelling at the same speed as the first section.

Whilst we have described herein one particular arrangement of beltway made in accordance with the invention and have made comments as to possible areas of variation, it will be understood that there can be substantial changes in the engineering of the beltway without any departure from the concept of the invention.

The important aspects of the invention which cannot be departed from are that the junctions between adjacent beltway sections must be sufficiently narrow for a passenger to be carried thereacross without having to step across a junction and it is also preferred that the whole beltway arrangement be driven from a single source so that should there be any form of breakdown, then it shall come to a stop evenly without any likelihood of damage. It is not essential that the hand rail, if provided, be driven from the same source.

It will be seen that using relatively thin belts and small rollers, extremely close tolerances can be achieved, so that any gap between, say, a comb or a scraper plate and its associated belt will be very small so a shoe or article being carried by a passenger, or even such things as clothing from a sitting passenger, will not be pulled into the mechanism, with the possibility of injury or even death of the passenger.

At the same time, the arrangement is such that the depth of the construction is minimal so that it can be readily post fitted and the arrangement of the intermediate sections is such that the belts on these, which will tend to suffer maximum wear, can be readily and simple replaced.

The construction, at the same time, gives the very substantial advantage of being able to move a large number of passengers over very substantial distances in relatively short times and this will permit the beltway to become a very valuable transit system.

Depending upon the number of intermediate modules provided, the final speed of the main section, and the cost of providing it, can vary according to the circumstances and the overall distance to be travelled.

This is in contrast to present beltways which move at approximately half walking pace, and thus take a long period to transfer passengers over any distances.

Claims

1. A moving beltway which comprises a main moving support belt (50) which passes over main rollers (52) at each end thereof and a secondary moving support belt (51) which, over most of the length of the beltway, is in abutting relationship with the main support belt (50) but which, at each end thereof, passes over a secondary roller (53) of relatively small diameter which is spaced from the adjacent main roller (52) about which the main support belt passes, the secondary roller (53) being located to retain the secondary support belt substantially tan-

gential to the main roller and a further moving support belt (20) which is in close longitudinal abutment with the secondary support belt (51), the main support belt and the associated secondary support belt being driven at a first speed and the further support belt being driven at a second speed and means (10) between the secondary support belt and the further support belt over which a passenger can pass whilst being in contact with either the secondary support belt or the further support belt.

2. A beltway as claimed in claim 1 wherein there is at least one intermediate beltway section (2) which has a support member which passes over rollers (15) to provide a length on which a passenger can stand, the rollers (15) at each end being closely adjacent to similar rollers (15) of an adjacent intermediate member or the secondary roller (53) of the secondary support member (51).

3. A beltway as claimed in claim 2 wherein there is a plurality of intermediate beltway sections (2).

4. A beltway as claimed in either claim 2 or claim 3 wherein the or each intermediate beltway section is/are driven from the drive for the main support member and wherein each has a speed different from the immediately adjacent intermediate beltway section.

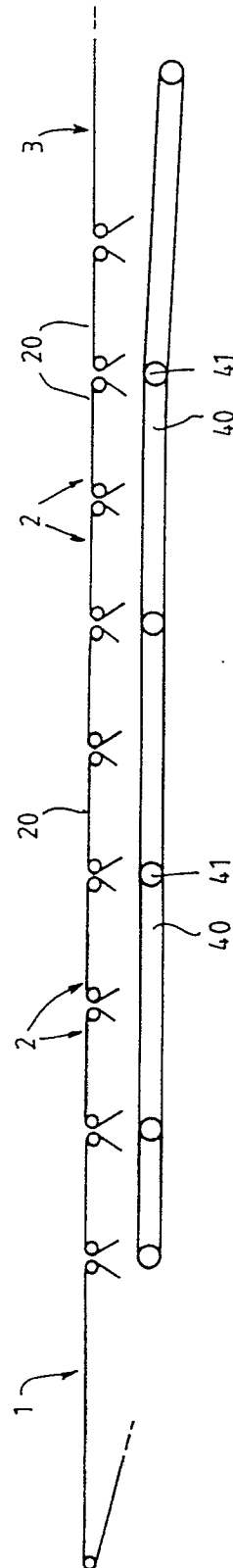
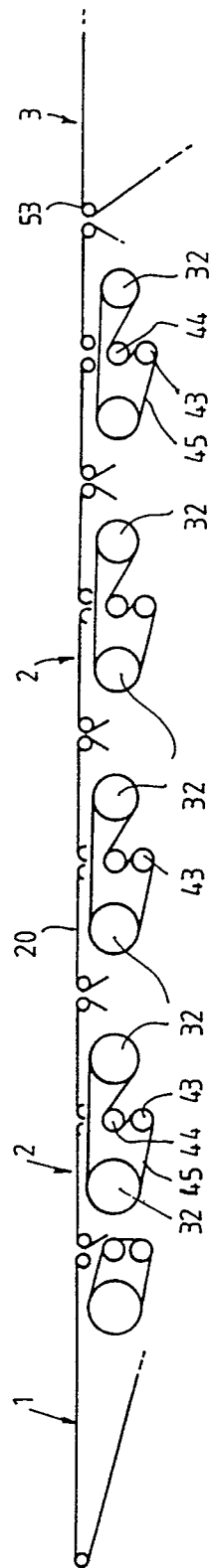
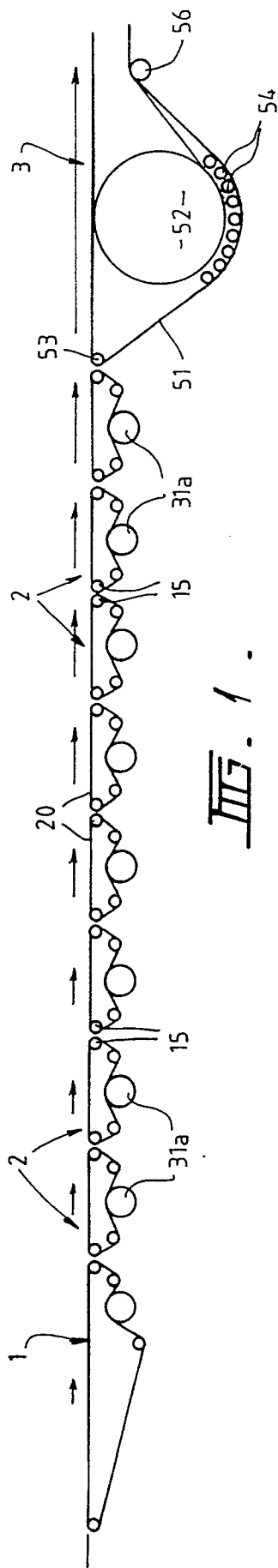
5. A beltway as claimed in any preceding claim wherein the means (10) between the secondary support belt and the further support belt is a shaped member located across and between the belts, the upper surface (11) of which member is a low friction surface.

6. In or for a beltway, a hand rail comprising a plurality of trolleys (60), each of which having on its upper surface a hand-grip member (65) at least one moving belt (82) passing adjacent a plate (62) being part of the trolley and means (74) to bring the belt into contact with the plate to cause the trolley to move at the speed of the belt.

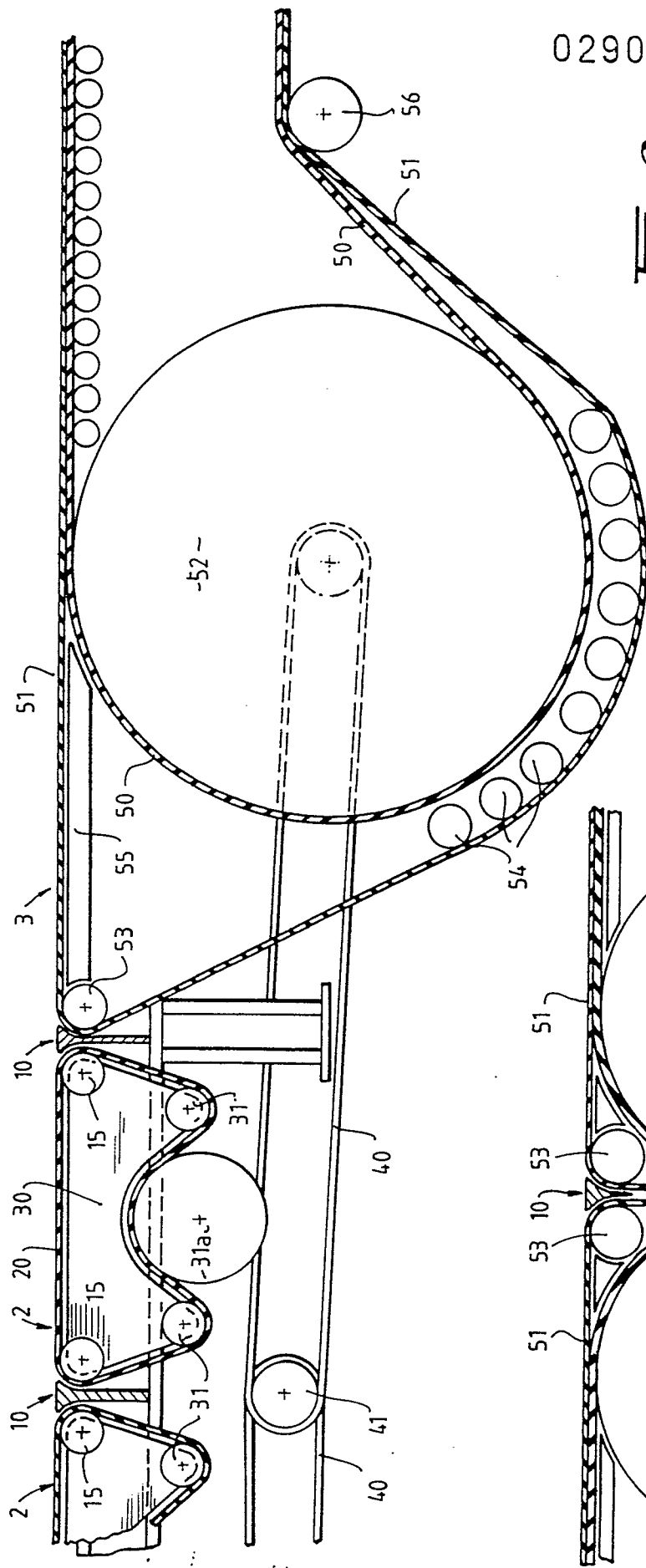
7. A hand rail as claimed in claim 6 wherein the moving belt (82) is resilient and wherein the means to bring the belt into contact with the plate includes at least one pulley (74) located adjacent the plate and at a distance therefrom less than the diameter of the belt whereby the belt is compressed against the plate.

8. A hand rail as claimed in claim 7 wherein the moving belt (76) is solid and wherein the means to bring the belt into contact with the plate comprises a grip (77) which is actuated to physically draw the belt to the plate.

9. A hand rail as claimed in claim 8 wherein the actuating means (76) comprises a cam activated member including a loop which passes beneath the belt and which can be actuated to draw the loop towards the plate.



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Fig. 2.

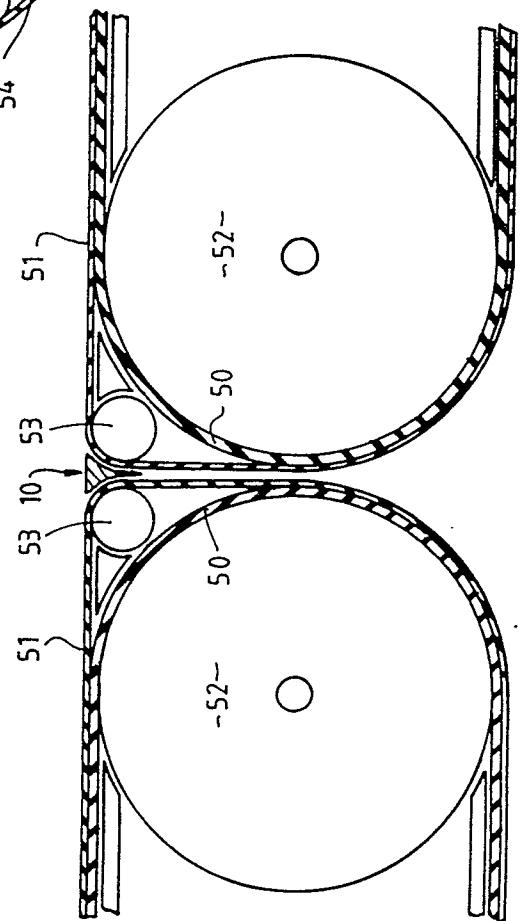
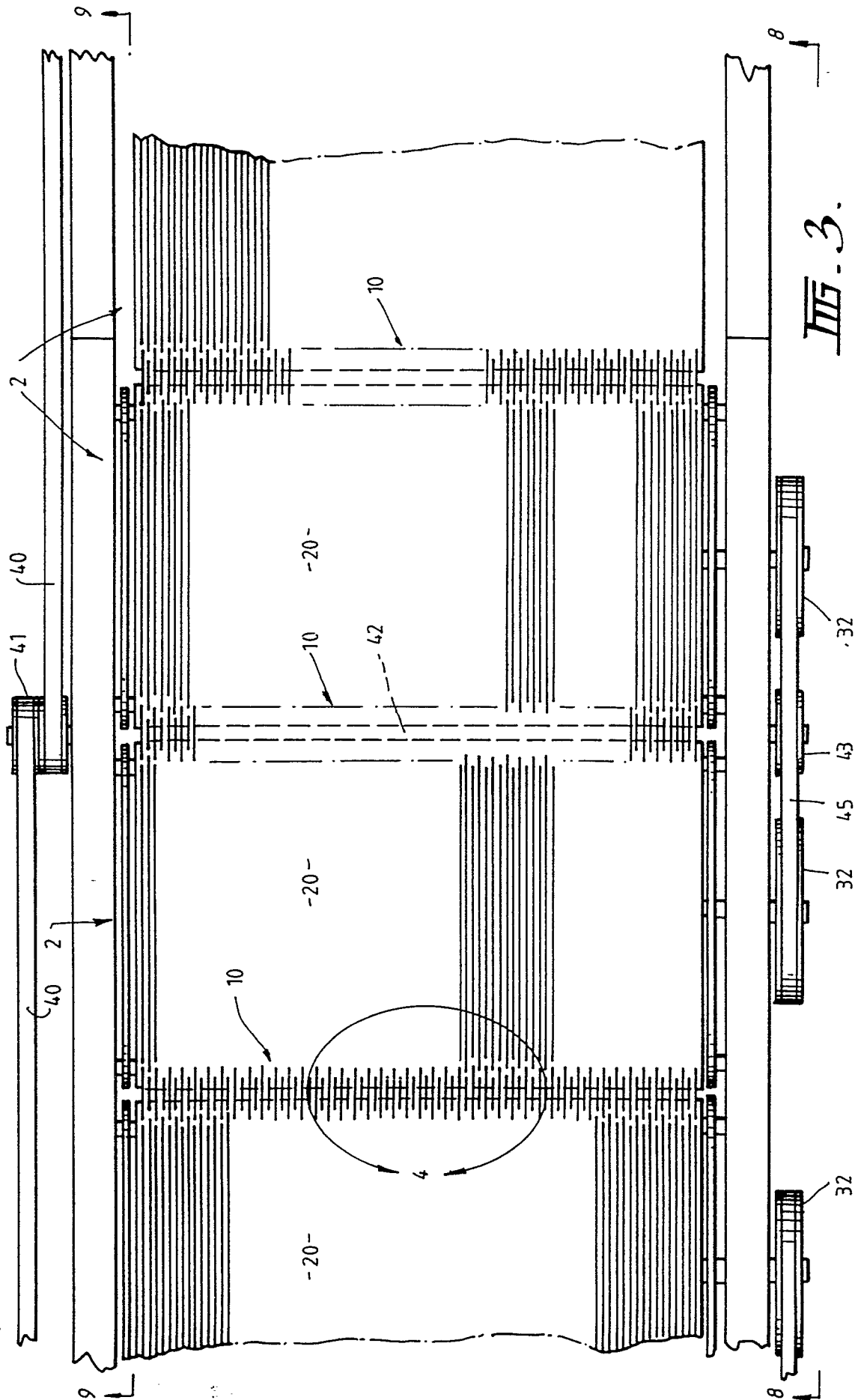


Fig. 10.

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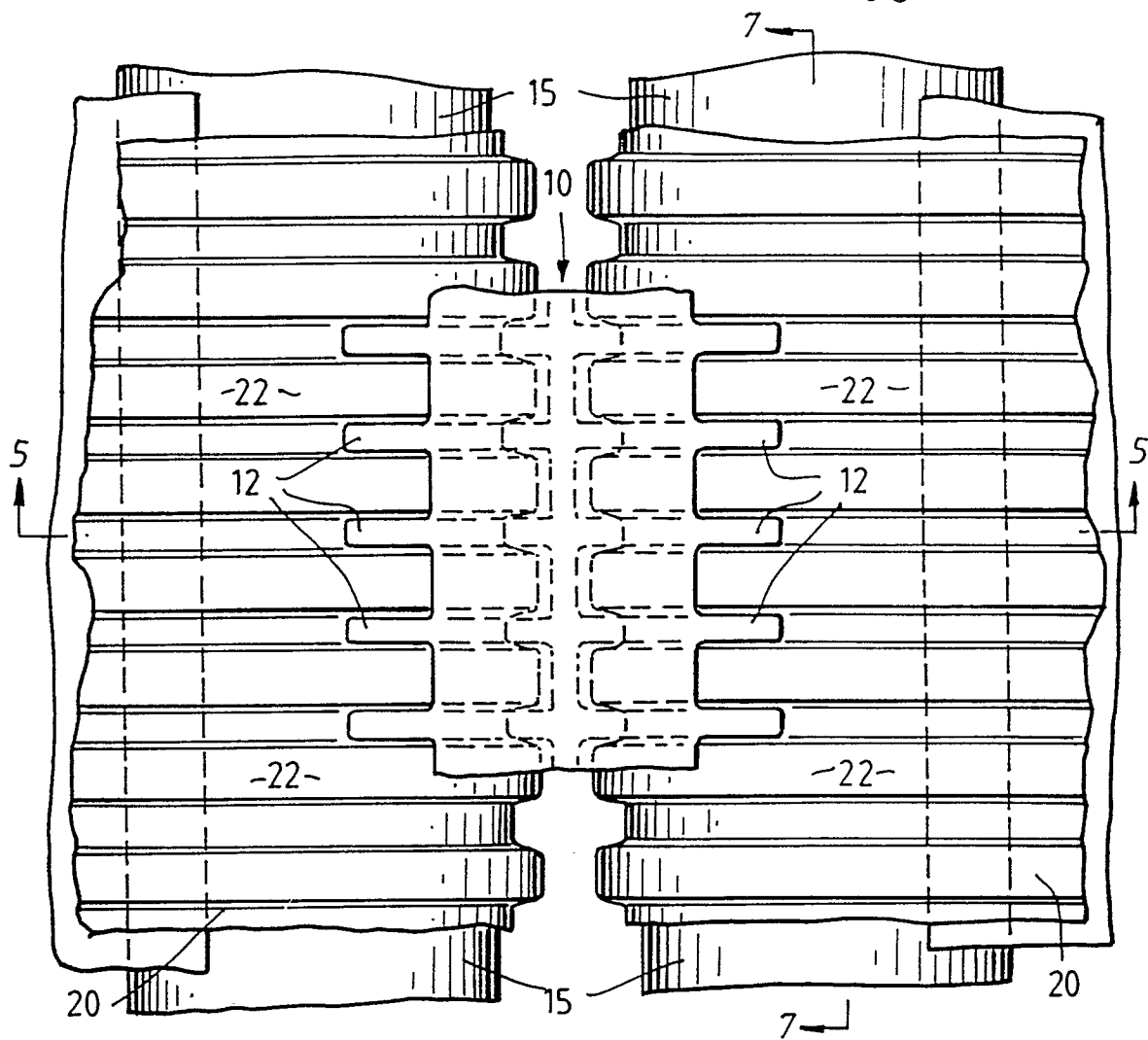


FIG. 4.

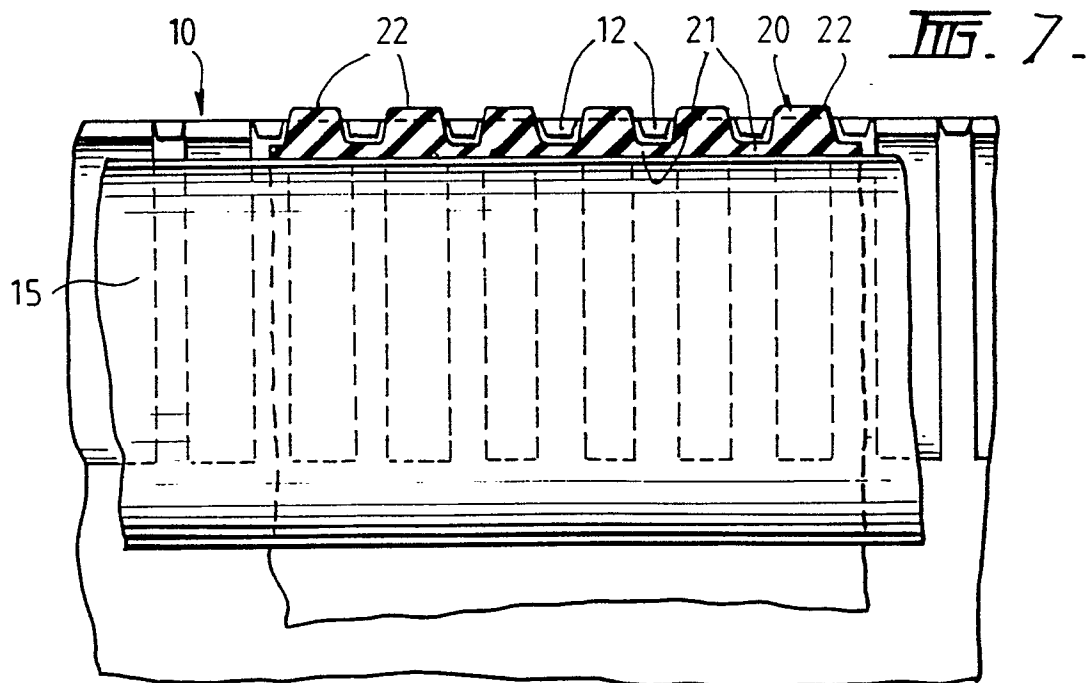
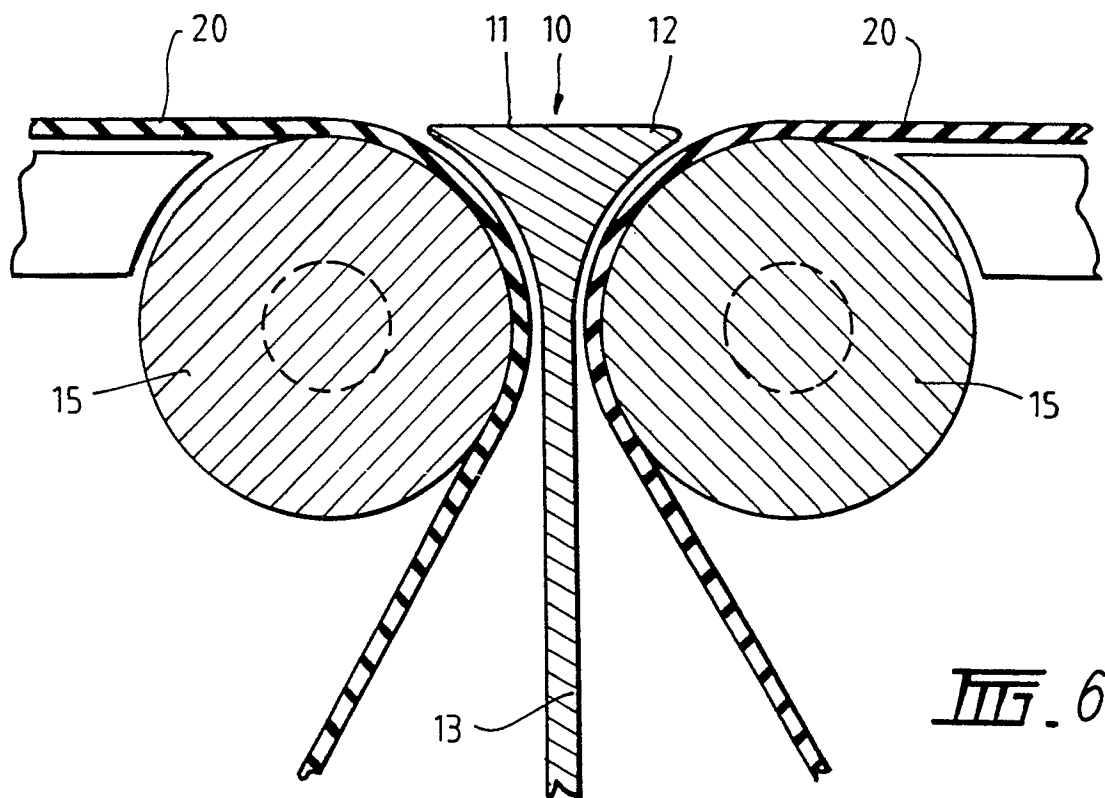
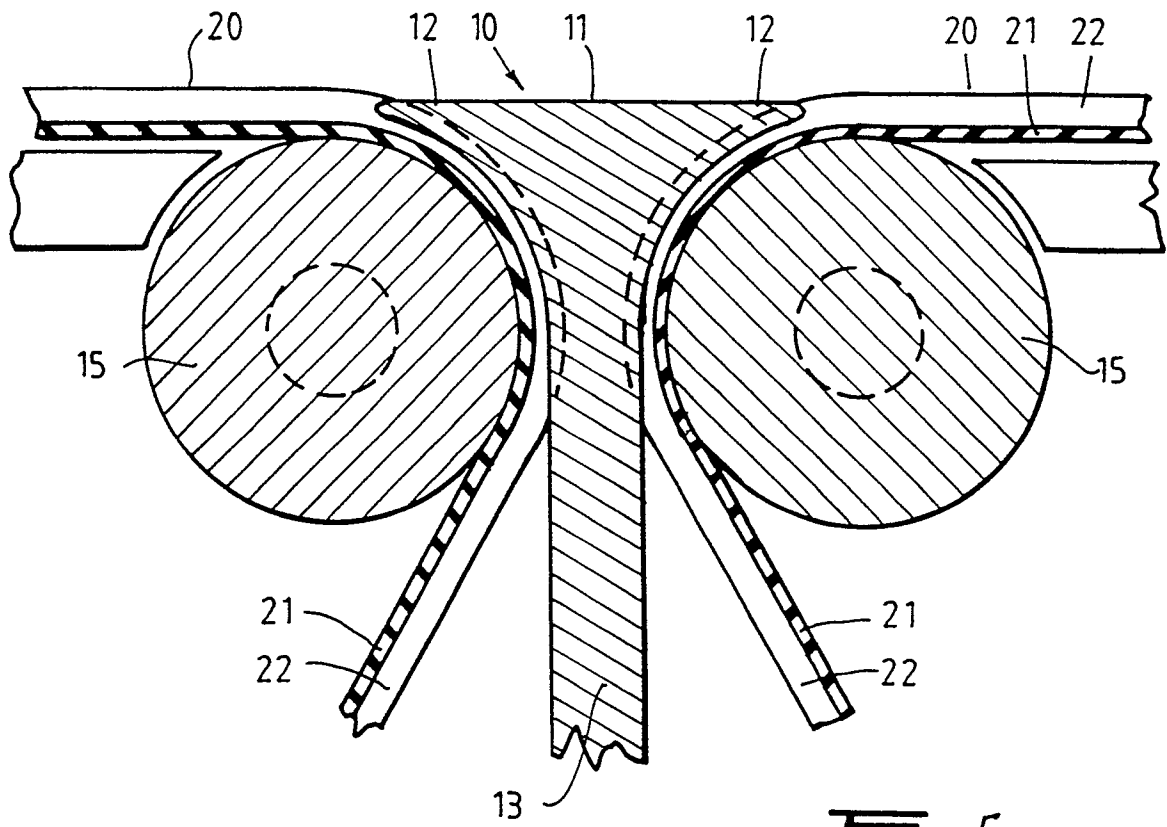
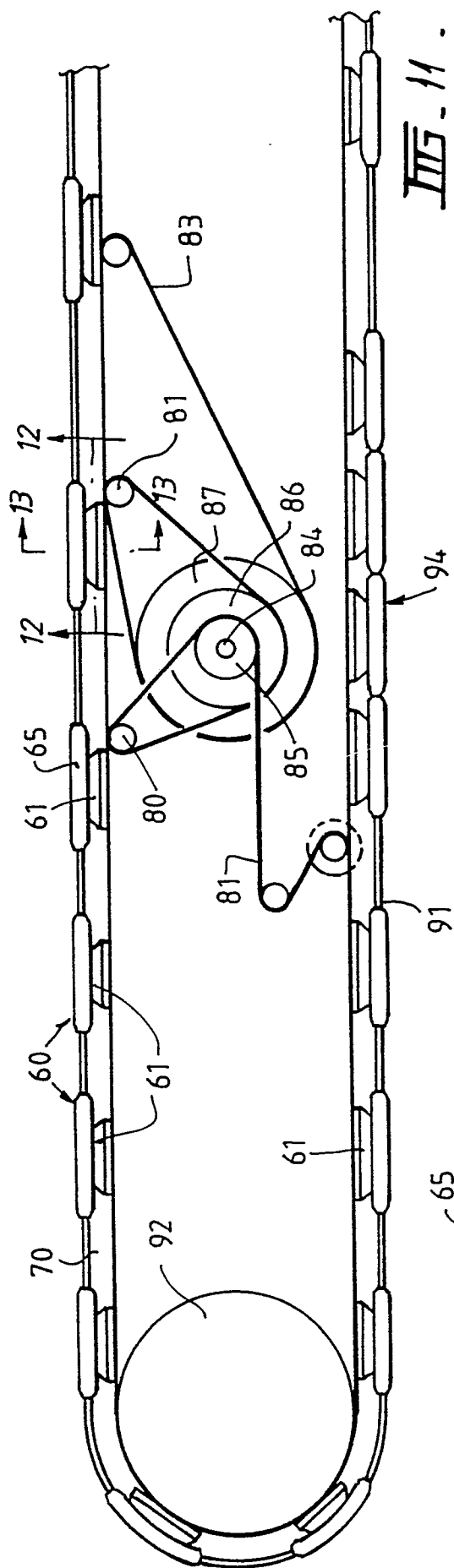


FIG. 7.

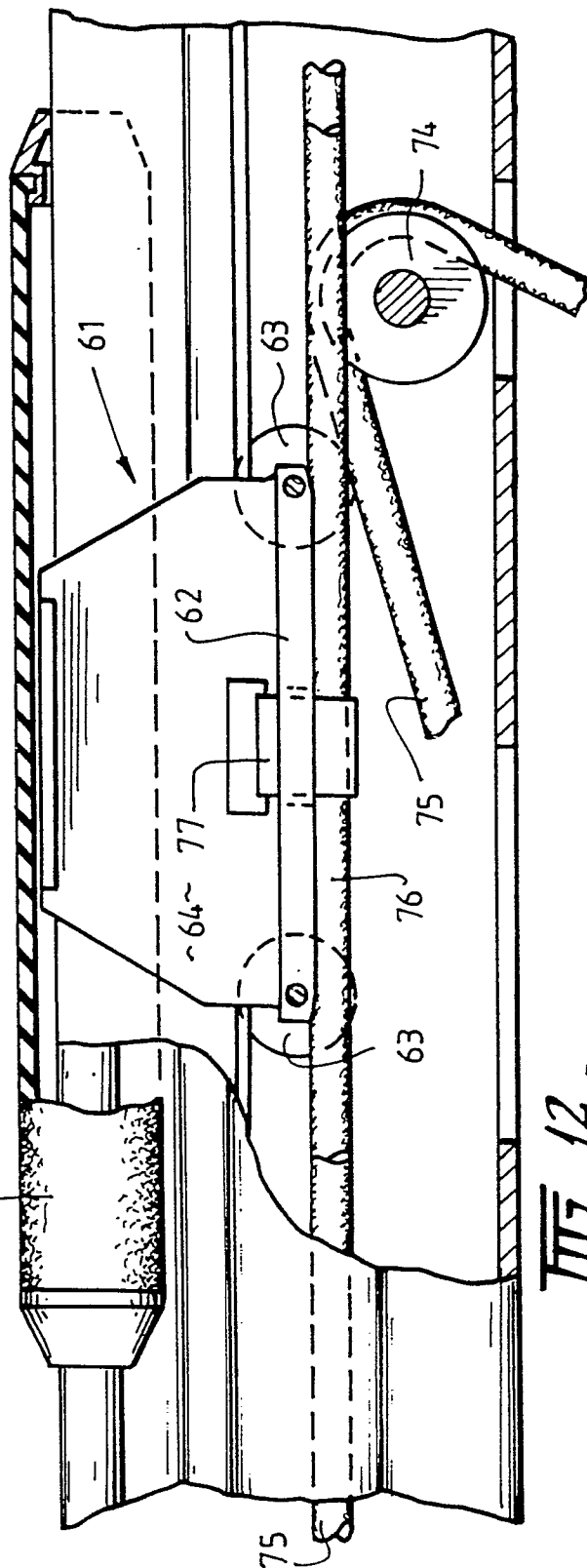
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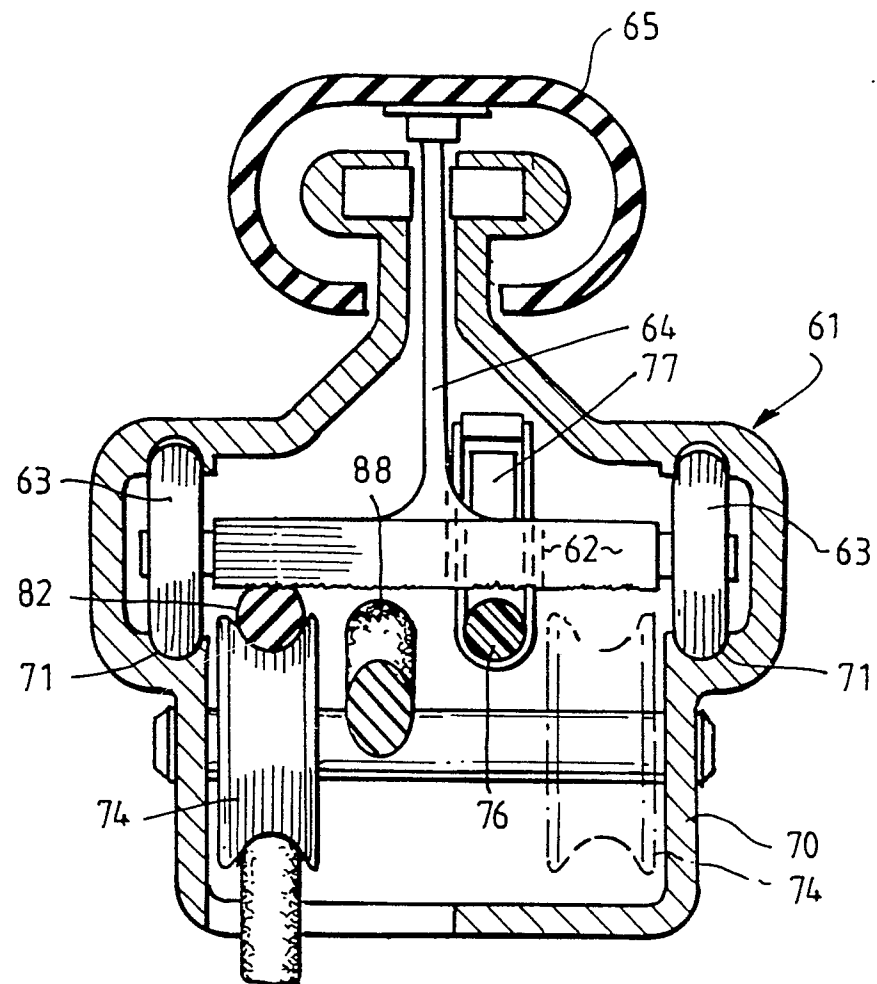
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III-12.

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III. 13.

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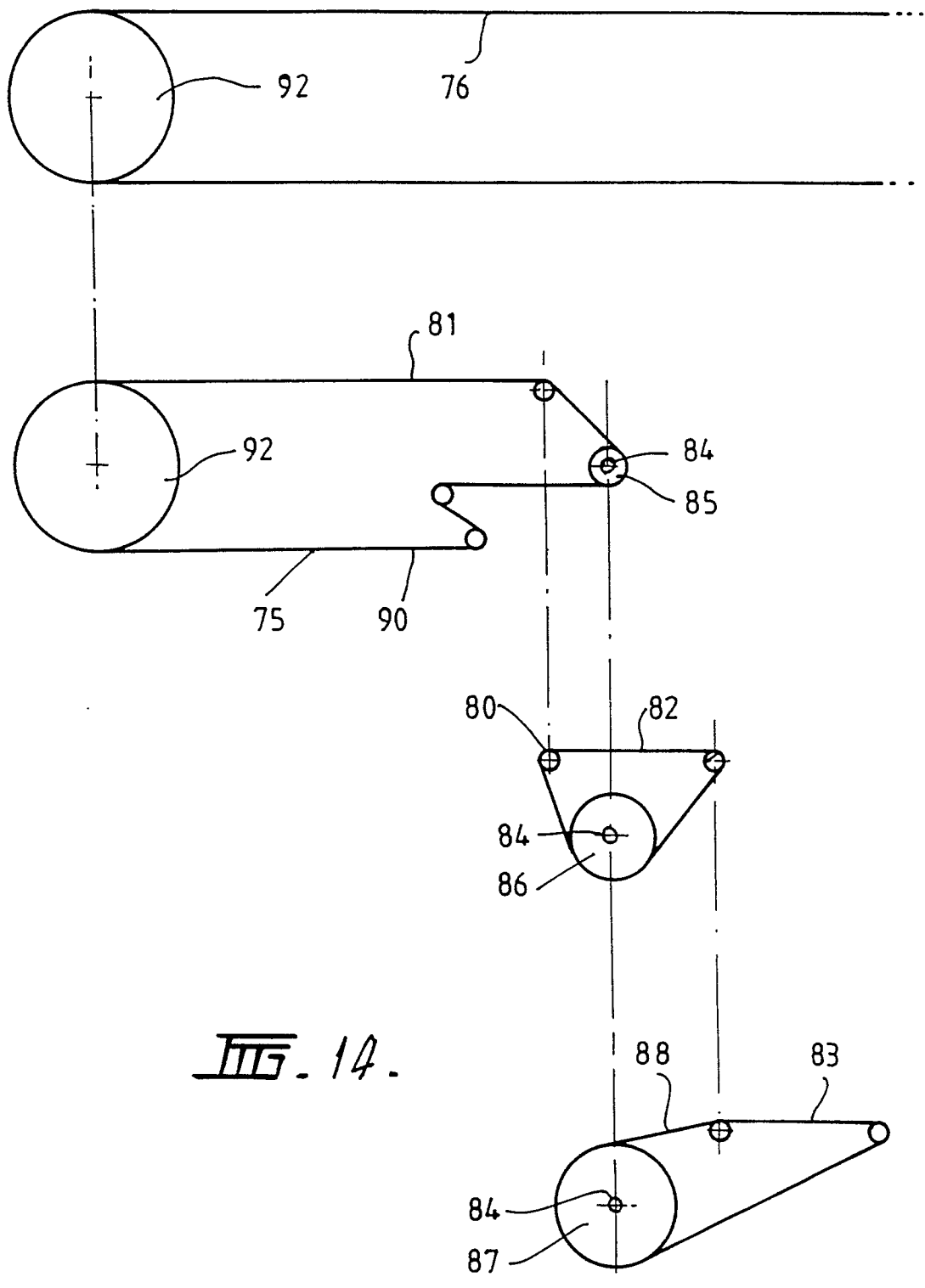


FIG. 14.