

"APPARATUS FOR TRANSMITTING POWER
BY MEANS OF A CHAIN"

The present invention relates to chain power
5 transmitting apparatus, and more particularly, to chain
power transmitting apparatus in which the chain is contacted
with or wound on a sprocket over an angle not more than 180
degrees.

Apparatus for transmitting power by means of a
10 chain have been widely used as power transmitting apparatus
in various industrial fields primarily because no slippage
occurs between a chain and the associated sprockets. Such a
chain drive is equipped with a chain tensioning device which
applies a suitable magnitude of tension to the stretched
15 chain and absorbs the slackness thereof.

The chain tensioning device of the type described
above utilizes the force of a spring to put the chain in a
suitably taut condition and to absorb its slackness at times
when the degree of slackness is small. To cope with the
20 slackness of the chain which is caused by its elongation
with age, the magnitude of tension applied to the chain is
adjusted so that it remains constant by periodically
changing the position at which the chain tensioning device
is installed. The operation of shifting the position at
25 which the chain tensioning device is installed includes
removal of a cover and disassembly of the parts arranged on
the periphery of the power transmitting apparatus. This is
a troublesome but necessary operation because without it a

close engagement between the chain and the associated sprockets cannot be maintained and damage of the chain or the teeth of the sprockets will result if this work is neglected.

5 It is an object of the present invention to provide a chain power transmitting apparatus which enables the frequency at which chain tension adjusting work has to be carried out to be reduced.

 According to the present invention there is
10 provided chain power transmitting apparatus including: a first sprocket arranged to be driven and rotated; a second sprocket arranged at a location spaced apart from said first sprocket; and a chain wound on said first sprocket in such a manner that it extends from upside toward said first
15 sprocket and is returned therefrom toward the upside for transmission of power to said second sprocket; wherein said chain is wound on an area of said first sprocket located below an axis of said first sprocket, and a retaining member is arranged at a location within said area for maintaining
20 engagement between said chain and said first sprocket.

 With this structure, it is capable of maintaining a proper engagement between the chain and the sprocket, preventing the portion of the chain which is to be engaged with the sprocket from becoming separated therefrom. Even
25 if the chain becomes loose owing to its elongation with age, no slippage will occur when an operation of the chain is started, thereby allowing the frequency at which the adjustment of the looseness of the chain is performed to be

reduced.

The present invention will now be described in greater detail by way of examples with reference to the accompanying drawings, wherein:-

5 Fig. 1 is a side elevational view, with parts broken away, of an escalator provided with a handrail drive incorporating an apparatus of an embodiment of the present invention;

10 Fig. 2 is an enlarged view of the handrail drive shown in Fig. 1;

 Fig. 3 is a sectional view of the handrail drive taken along the line III - III of Fig. 2;

 Fig. 4 is an enlarged view which illustrates a chain and a sprocket in their engaged state;

15 Fig. 5 is a cross-section taken along the line V - V of Fig. 4; and

 Fig. 6 and 7 are schematic views of other embodiments of the invention.

20 An embodiment of the present invention will be described below with reference to Figs. 1 to 5, in which the chain power transmitting apparatus according to the embodiment of the present invention is applied to an escalator. Referring first to Fig. 1, a pair of balustrade panels 2 extend substantially over the entire length of a
25 frame 1 laid between two floors F of a building. A plurality of

1 moving steps are disposed between the pair of balustrade
panels 2, although they are not shown. Each of the
balustrade panels 2 guides a moving handrail 3 on its
periphery. Each of the moving handrails 3 is driven
5 by a handrail drive 4 disposed below the upper curved
portion of each balustrade panel 2, i.e., the portion
thereof where its upper horizontal portion meets its
inclined portions. Each handrail drive 4, which is
located on the lower side of each moving handrail 3,
10 includes a fixed frame 5 fixed to the frame 1, and a
movable frame 7 supported on the fixed frame 5 in such
a manner as to be movable solely in the thicknesswise
direction of the moving handrail 3. The fixed frame 5
is elongated in the longitudinal direction of the moving
15 handrail 3, and rotatably supports four driven rollers
6a to 6d which guide the movement of the moving handrail
3. The movable frame 7 is a plate which is formed
substantially in the shape of an inverted triangle.
The movable frame 7 rotatably supports four driving
20 rollers 8a to 8d above the handrail 3 in such a manner
that they face the four driven rollers 6a to 6d through
the handrail 3. The driving sprockets 9a to 9d are
fixed on the shafts of the driving rollers 8a to 8d,
respectively, on the sides thereof which are closer to
25 the movable frame 7. A guide pin 10, which is elongated
in the thicknesswise direction of the moving handrail 3,
is mounted on the side of the fixed frame 5 which is
closer to the movable frame 7. The movable frame 7

1 has bosses 11a, 11b attached thereto, and the guide pin
10 which passes through the bosses 11a, 11b is slidable
therethrough solely in the longitudinal direction of
the guide pin 10. A tongue 12 extends downward from
5 the side of the fixed frame 5 which is closer to the
movable frame 7, and an idler sprocket 13 is mounted on
the tongue 12 through a position adjusting device 14.
The position adjusting device 14 includes an L-shaped
adjusting plate 14a which fixes the end of the shaft
10 of the idler sprocket 13 which passes through a slot
formed on the tongue 12, and an adjusting bolt 14b
having a leading end which passes through the lower
side of the adjusting plate 14a from below and which
opposes the end of tongue 12. The lower portion of
15 the movable frame 7 that is formed in the shape of an
inverted triangle rotatably supports two coaxial idler
sprockets 15, 16.

A chain 17 extends over the sprockets, being
contacted with or wound on the idler sprocket 15, the
20 driving sprocket 9d, the driving sprocket 9c, the idler
sprocket 13, the driving sprocket 9b and the driving
sprocket 9a in that order, then returning to the idler
sprocket 15. The chain 17 is wound on the idler sprocket
15 in such a manner that it extends upwardly and
25 divergingly from the idler sprocket 15, as shown in
Fig. 2. This means that the chain 17 is wound on the
sprocket 15 over an angle not more than 180°, and that
the chain 17 makes contact with the portion of the idler

sprocket 15 which is below the axis of the latter. Adjacent to the portion of the chain 17 which contacts the idler sprocket 15 and at positions at which the contact of the chain 17 with the sprocket 15 begins and ends (on the tension side and slack side of the chain) are disposed two chain retaining members 18A, 18B. Each of the chain retaining members 18A, 18B, which are mounted on the movable frame 7, includes a retaining plate 19 having a length substantially corresponding to or spanning three chain rollers 17b, as well as a thickness which is slightly less than the width of the chain roller 17b, a spacing member 20 which determines the spacing between the retaining plate 19 and the movable frame 7, and fixing bolts 21. The unit of the chain 17 comprises two chain rollers 17b, two roller pins 17a which rotatably support the two chain rollers 17b, respectively, a pair of link plates 17c which support the two roller pins 17a at the same pitch as a pitch P of teeth 15c of the idler sprocket 15 in such a manner that the plates 17c do not interfere with the rotation of the chain rollers 17b, and connecting link plates 17d which connect the adjacent link plates 17c at the same pitch as the pitch P. The connecting link plates 17d pass the roller pins 17a therethrough and rotatably support them.

The retaining plate 19 is disposed such that a gap G exists between the chain rollers 17b and the retaining plate 19 when the chain rollers 17b engage

1 with grooves 15b of the idler sprocket 15.

Below the idler sprocket 16 of the thus-
arranged handrail drive 4, the frame 1 rotatably supports
idler sprockets 22a, 22b. The frame 1 houses a driving
5 device 23, and a reduction sprocket 24 driven by the
driving device 23. A chain 25 extends over the sprockets,
contacting with or wound on the reduction sprocket 24,
the idler sprocket 22b, the idler sprocket 16 and the
idler sprocket 22a in that order and then returning
10 to the reduction sprocket 24, by means of which the
handrail drive 4 is operated.

In the thus-arranged escalator, the moving
steps (not shown) and the moving handrails 3 are driven
simultaneously, ready for carrying passengers, by the
15 operation of the driving device 23. Each of the moving
handrails 3 is driven in the following manner: when
the chain 25 engaging the reduction sprocket 24 is
driven in the direction shown by an arrow A by the
operation of the driving device 23, the idler sprocket
20 15 which is coaxial with the idler sprocket 16 is
rotated so as to rotate the chain 17 in the direction
shown by an arrow B. The rotation of the chain 17 in
turn rotates the driving sprockets 9a to 9d. When the
chain 25 is rotated, the tension thereof moves the
25 movable frame 7 downward, pressing the driving rollers
8a to 8d against the moving handrail 3 on the driven
rollers 6a to 6d. The moving handrail 3 is driven in
the direction shown by an arrow C by the rotation of

1 the driving rollers 8a to 8d and by the press thereof
against the moving handrail 3.

In the thus-arranged escalator handrail drive
4, the chain 17 becomes slack due to its elongation
5 with age when used for a long period of time. Such
slackness is eliminated by adjusting the position
adjusting device 14 and thereby shifting the idler
sprocket 13 downward. However, adjustment of the
position adjusting device 14 involves removal of the
10 surface cover members of the escalator, and is therefore
a troublesome operation.

In this embodiment, it is not necessary to
immediately adjust the position adjusting device 14
when the chain 17 becomes loose, allowing safe operation
15 of the escalator to continue. More specifically,
ordinarily, the loose chain 17 tends to be separated
from the idler sprocket 15, as shown by a dotted line
17' of Fig. 4, when its rotation is stopped, preventing
power from being transmitted by means of the chain 17
20 when the chain is restarted. In this embodiment,
however, the chain retaining members 18A, 18B located
at positions at which contact of the chain 17 with the
idler sprocket 15 begins and ends hold the chain 17
to be not separated from the idler sprocket 15 while
25 the rotation of the chain is being suspended. The
portion of the chain 17 which is located between the
two chain retaining members 18A, 18B is not positively
held or retained. However, it is kept engaged with

1 the idler sprocket 15 so long as the portions of the
chain 17 which face the chain retaining members 18A,
18B do not become disengaged from the idler sprocket 15.

In consequence, the loose chain 17 can be
5 driven smoothly without any trouble when its rotation
is started. Further, it is not necessary to adjust
the looseness of the chain 17 by removing the surface
cover members of the escalator. It is therefore possible
to reduce the frequency at which chain tension (slackness)
10 adjusting work has to be carried out.

The chain 17 which has become loose owing to
elongation with age causes no problems in practice if
the slackness of the chain 17 is within 2% of the pitch P
of the roller pins 17a. Thus, it is preferable that
15 the gap G between the chain rollers 17b and the retaining
plate 19 is maintained within a range which allows the
diameter D of a pitch circle to be increased by 2%.

The retaining plate 19 of each of the chain
retaining members 18A and 18B which is on the slack
20 side of the chain 17 (on the side of the portion of the
chain 17 at which the engagement thereof with the sprocket
terminates) is always in contact with the chain 17.
Therefore, it is preferable that at least that portion
of the retaining plate 19 which makes contact with
25 the chain 17 is made of a highly wear-resistant polymer
such as a plastic to reduce the level of noise or degree
of wear. The retaining plate 19 must be replaced if
it becomes worn. However, if it is shaped into a

1 symmetrical form, as shown in Fig. 4, the retaining
plate 19, a portion or one lateral edge of which has
been worn, may be re-used economically by re-arranging
the same retaining plate 19 in such a manner that the
5 other portion or lateral edge which has not been in
contact with the chain 17 comes into contact therewith.

In this embodiment, the retaining plate 19 is
constituted from a plate disposed in such a manner that
it faces the chain rollers 17b which extend between
10 the pair of link plates 17c. However, it may face the
outer edges of the pair of link plates 17c and the
connecting link plates 17d. Further, the retaining
plate 19 need not be a plate.

In this embodiment, the chain retaining members
15 18A, 18B are mounted at positions where the engagement
of the chain 17 with the idler sprocket 15 begins and
ends. However, any number of the chain retaining member
may be provided at any position between the start and
end points of the engagement. For example, more than
20 two chain retaining members may be mounted successively
at positions between the start and end points of the
engagement. Also it is possible to provide a single
chain retaining member at a position between the start
and end points of the engagement, as will be further
25 described hereunder. In the latter case, it is effective
that the single chain retaining member is provided at
either the start point or the end point of the engagement.
Further, it is possible to provide a single chain

1 retaining member of arcuate form extending from the
start point of the engagement to the end point thereof.

In this embodiment, the chain retaining members
18A, 18B are provided at positions at which the engagement
5 of the chain 17 with the idler sprocket 15 begins and
ends, respectively. However, it is possible to provide
a single chain retaining member 26 at that portion of
the chain 17 which engages with the idler sprocket 15,
as shown in Figs. 6 and 7. Fig. 6 illustrates the chain
10 retaining member 26 disposed at the position at which
the engagement of the chain 17 with the idler sprocket
15 terminates, for maintaining the engagement between
the chain 17 and the idler sprocket 15 while the rotation
of the idler sprocket 15 is suspended. More specifi-
15 cally, even if the loosened chain 17 engages with
the idler sprocket 15 while the sprocket is being
rotated in the direction shown by the arrow, it hangs
below the idler sprocket 15, as the chain 17' shown by
the broken lines, while the rotation of the idler sprocket
20 15 is suspended. However, the chain retaining member
26 maintains a portion of the chain 17' which is located
on the side of the chain retaining member 26 engaged
with the idler sprocket 15. As a result, when the
idler sprocket 15 is rotated again, the chain 17'
25 becomes engaged with the teeth of the idler sprocket
15, the engagement starting from the portion thereof
which is on the side of the chain retaining member 26,
and eventually the chain 17' reaches the state corre-

sponding to the chain 17 by means of which power is transmitted.

Fig. 7 illustrates the chain retaining member 26 which is disposed substantially at the bottom of the idler sprocket 15. If the chain 17 is loose, it hangs below the idler sprocket 15, as the chain 17' shown by the broken lines, while the idler sprocket 15 is not being rotated. However, the chain retaining member 26 maintains a portion of the chain 17' engaged with the idler sprocket 15. As a result, when the rotation of the idler sprocket 15 is started, the chain 17' becomes engaged with the idler sprocket 15, the engagement starting from the portion of the chain 17' which is on the side of the chain retaining member 26, and spreading sequentially toward the start point of the engagement of the chain with the idler sprocket, and eventually the chain 17' reaches the state corresponding to the chain 17 by means of which power is transmitted. Thus, the disengagement of the chain 17 from the idler sprocket 15 can be eliminated, preventing the slippage of the chain 17, regardless of whether adjustment of the slackness by the position adjusting device 14 (see Fig. 2) is performed.

As will be understood from the foregoing description, the apparatus for transmitting power by means of a chain according to this invention incorporates a chain retaining member at a position where a chain engages with a sprocket. It is therefore possible to continue to drive the chain without any problems, even if the chain becomes slack due to elongation with age. This enables a reduction in the

frequency at which the chain tension must be adjusted.



CLAIMS:-

1. A chain power transmitting apparatus including: a first sprocket arranged to be driven and rotated; a second sprocket arranged at a location spaced apart from said sprocket; and a chain wound on said first sprocket in such a manner than it extends from upside toward said first sprocket and is returned therefrom toward the upside for transmission of power to said second sprocket; wherein said chain is wound on an area of said first sprocket located below an axis of said first sprocket, and a retaining member is arranged at a location within said area for maintaining engagement between said chain and said first sprocket.
2. A chain power transmitting apparatus according to claim 1, wherein said chain retaining member is arranged at a position at which the engagement of said chain with said first sprocket terminates.
3. A chain power transmitting apparatus according to claim 1, wherein there are provided two chain retaining members respectively located at positions at which the engagement of said chain with said first sprocket starts and terminates.
4. A chain power transmitting apparatus according to claim 1, wherein said chain retaining member is arranged between a pair of link plates of said chain in such a manner



as to oppose a roller of said chain.

5. A chain power transmitting apparatus according to claim 1, wherein said chain retaining member includes a plate which is made of a highly wear resistant polymer.

6. A chain power transmitting apparatus constructed substantially as herein described with reference to and as illustrated in Figs. 1 to 5, or Fig. 6, or Fig. 7 of the accompanying drawings.