ABSTRACT: A vacuum belt conveyor is provided comprising an endless belt or carrier formed of a plurality of hinged or linked together plate members and adapted to be driven by suitably powered sprocket wheels in engagement therewith. Each plate member supports a vacuum or suction applying means including an outer cuplike member and an inner extensible bellows or flexible diaphragm member, the latter having a plunger rod and roller mechanism attached to its free end for actuation by a common cam track cooperatively engageable therewith. The cam track is operable to expand each bellows or diaphragm causing it to form a vacuum or suction plenum communicating with the outer cup member through a common aperture provided therebetween for such purpose. Thus, when a flat plate or object is placed on the endless carrier belt in air tight sealing engagement with a plurality of outer cup members and the bellows means associated with each outer cup member is actuated by the cam track means, a plurality of vacuum or suction forces are applied to the underside of the flat plate or object thereby firmly and securely holding it against the endless belt carrier for movement therewith. The cam track means is designed to actuate the bellows units at a predetermined location relative to the path of travel of the belt and to release the bellows units or deactuate them at a different predetermined location along the path of belt movement.
VACUUM BELT CONVEYORS

This application is a continuation-in-part of my earlier copending application, Ser. No. 860,283, filed on Sept. 23, 1969, now abandoned for Improvements in Vacuum Belt Conveyors.

BRIEF SUMMARY OF THE INVENTION

The present invention relates generally to improvements in conveyor belt systems and more particularly, to an improved fully self-contained vacuum belt conveyor having self-actuatable suction applying means, such means being effective to obviate the herefore required external vacuum source or suction pump presently employed in prior art vacuum belt conveyors.

Vacuum belt conveyor systems are well known and understood, one such system being fully described, for example, in my previous U.S. Pat. No. 2,877,607, entitled "Belts for Conveying and Supporting Flat Plates in Grinding and Polishing Machines." This patented vacuum belt conveyor which is fairly representative of the present state of the art, briefly comprises an endless rubber belt or the like driven by a pair of longitudinally spaced rollers or other drive means over the upper surface of a suction box or plenum, the latter having suitable slots or sets therein for registering respectively with a series of corresponding apertured rubber suction chambers in the endless belt. Coupled to the suction box through a duct or nozzle is an external vacuum producing means such as a suction pump, for example, for exhausting the air from the box and for thereby applying a suitable suction through the communicating holes in the plenum box and belt to the underside of a flat plate or glass or similar object placed on the belt. The flat plate thus may be firmly and securely held to the surface of the belt while being carried along therewith at a predetermined speed and for a preselected distance past a work station, for example, which may typically, though not necessarily, comprise a series of grinding or polishing wheels adapted for engagement with the upper surface of the plate.

And, although the prior art vacuum belt conveyor system has proven to be quite generally successful, it has certain disadvantages. For example, it is advantageous to provide the external vacuum source means or suction pump for exhausting the air from the suction box or plenum. Such external vacuum pump devices aside from increasing the original fixed cost of the conveyor belt system, continuously consume power and therefore increase the overall operating expense of the system as well.

Furthermore, the external vacuum source tends to comprise a rather complex and bulky arrangement of pumps, air hoses, couplings, valves and so on, all of which require additional factory space and whatnot, often lead to even further maintenance costs due to the increased probability of breakdown and the longer "down-time" cycles for repairs necessitated thereby.

Therefore, it is a broad object of the present invention to provide an effective and efficient vacuum belt conveyor system that is completely self-contained and automatic, and does not require an external vacuum producing source or pump means.

It is another object of the present invention to provide an improved vacuum belt or carrier apparatus that is relatively inexpensive to operate and maintain, that is compact and rugged in construction, and that is characterized by the inclusion of means for applying a suitable suction force to the surface of a flat plate or similar sheet object whereby said plate or sheet may be securely moved from one predetermined location to the next without marring its surface.

Toward the accomplishment of the aforementioned objects, means, and advantages, one preferred embodiment of the vacuum belt conveyor apparatus according to the present invention comprises, in brief, an endless web or belt of hinged or otherwise linked together flat plate members adapted to be driven by two longitudinally spaced pairs of sprocket wheels or the like which, in turn, are driven by suitable motive power means. Each plate has fixedly attached thereto on its upper or outer surface a suction cup of rubber or similar material and has fixed to its inner or lower surface an extensible rubber bellows unit communicating with the suction cup through a common central aperture in the plate. The lower terminal portion of each bellows unit is sealed and has integrally fixed thereto one end of a plunger or rod member while the other end of the plunger carries a pair of roller members adapted for continuousriding engagement with an endless cam track means or channel member disposed substantially within a plane passing longitudinally through the center of the endless belt. In addition, the cam track is fixedly supported so that at differing points along the longitudinal extent thereof, it is spaced at predetermined varying distances from the inner surface of the endless belt. For example, at a predetermined location along the path of travel of the endless belt, the spacing between the cam track and the underside of the endless belt is caused to diverge or increase. Accordingly, at this point, the various roller members riding on the cam track displace each plunger causing it to extend its corresponding bellows unit and to apply a suction through each corresponding suction cup associated therewith provided the underside of a flat plate of glass or similar object is placed on the outer surface of the endless belt and is covering the open end of the suction cup. Thereafter, at a second location spaced longitudinally along the direction of travel of the endless belt, the spacing between the common cam track and the undersurface of the endless belt is purposely made to decrease or converge causing each plunger member to again displace, only this time to compress or fold it's corresponding bellows unit thereby removing the suction force from the underside of the flat plate. In an alternate preferred form of the invention, each suction cup and its corresponding bellows unit is replaced by a one-piece, integral, molded cup element having an extensible downwardly extending diaphragm portion connected to each plunger member respectively.

Additional objects and advantages as well as a complete and thorough understanding of the present invention will be made more apparent from a study of the following detailed description of the present invention in connection with the accompanying drawings.

BRIEF SUMMARY OF DRAWINGS

FIG. 1 is an elevation in section of one preferred embodiment of the apparatus according to the present invention;
FIG. 2 is sectional view taken along line 2--2 in FIG. 1;
FIG. 3 is a plan view of a portion of the apparatus of FIGS. 1 and 2;
FIG. 4 is an elevation in section of an alternate preferred form of a portion of the invention;
FIG. 5 is a plan view of the portion of the invention illustrated in FIG. 4; and,
FIG. 6 is an elevation in section taken along line 6--6 of FIG. 4.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIGS. 1-3, there is shown one preferred form of the vacuum belt conveyor according to the present invention, including an endless belt or carrier generally indicated by reference numeral 10 being supported on a stationary frame means 12 and being adapted for continuous movement along a closed loop path by spaced apart pairs of sprocket wheels 14 and 16 cooperating therewith. The endless belt or carrier also includes a plurality of self-actuatable suction applying members generally indicated by reference numeral 17 which are adapted to firmly and securely engage a flat, nonporous support 19 and transport the same from a position marked A to a position marked B as shown in FIG. 1 and as will be explained in considerably more detail below.

Preferably speaking, an endless carrier belt 10 is fashioned of a juxtaposed plurality of similarly shaped, substantially rectangular, essentially flat plate members 18 fabricated from steel,
aluminum or the like. Each plate member is connected, hinged, or otherwise linked on opposite transverse sides thereof to a neighboring adjacent plate member by a corresponding pair of longitudinally displaced hinge units 20 (see FIG. 3). The hinge units 20, which are constructed in the usual manner, are designed to permit relative pivoting movement between any two adjacent plates and to serve the dual function of permitting movement of the respective elements toward one another. Toward this latter end, the recesses 22 and 24 in each of the sprocket wheels 14 and 16 are spaced sufficiently apart to engage each consecutive hinge unit substantially as shown in FIG. 1. In addition, as further indicated in FIG. 2, each pair of sprocket wheels is fixedly supported in spaced axial relation along a respective common shaft 26 and 28 so as to be in simultaneous engagement respectively with each of the hinge units corresponding to a common pair, respectively. Shaft 26 and 28 are adapted to be rotatably supported respectively by a pair of journal bearings (not shown) carried by frame means 12 and may be driven at a predetermined angular velocity by any suitable motive power means, such as for example, the electric motor and bevel gear set, indicated generally by reference numeral 30 in FIG. 2.

In order to provide additional movable support to the endless carrier belt 10, each rectangular plate member 18 further includes a pair of longitudinally opposed, laterally extending rollers 32 integrally attached thereto by suitable respective axle means 33 and antifriction bearing means (not shown) whereby the rollers are adapted for cooperative engagement with a corresponding pair of laterally opposed track means or channels 34 each having a substantially U-shaped cross section as seen to best advantage in FIG. 2. Inasmuch as each U-shaped track or channel 34 is rigidly supported by the frame 12 and extends in a continuous, endless loop parallel to and immediately adjacent each corresponding opposed lateral edge of the endless belt carrier 10 as indicated in FIG. 3, the action of rollers 32 traveling in the U-shaped track 34 assures that the endless belt 10 is adequately supported for movement and the continuous closed loop indicated in FIG. 3 and furthermore prevents lateral shifting of the belt during such movement.

As most clearly illustrated in Figs. 2 and 3 each plate member 18 of endless carrier belt 10 is adapted to support a suction applying member 17 comprising an outer suction cup element 36 and an inner extensible bellows unit 38 communicatively coupled with a central common aperture opening 40 provided for this purpose in plate member 18. The outer suction cup element which may be fabricated from a suitable elastomeric material such as rubber, for example, integrally includes a flared outer lip portion 42, a substantially horizontally disposed intermediate web portion 44, and a generally tubular shaped central neck portion 46 adapted to be snugly seated within aperture 40. The contiguous under surface common to intermediate web portion 44 and tubular neck portion 46 is preferably fixedly fastened to the corresponding plate member surface in contact therewith as by applying a suitable cement thereto or by vulcanizing an uncured rubber suction cup element directly to each plate member before the latter are assembled together to form the endless belt carrier 10. As viewed in FIG. 3, the suction cup element has a generally rectangular shape conforming to that of plate member 18 and therefore coextensively overlies substantially the entire outer surface of the plate member. This arrangement is preferred so that the endless belt 10 provides a bearing surface that is essentially completely covered by rubber and therefore prevents marring of the surface of any objects or materials placed in contact therewith. However, it is also to be understood in this regard that the shape of the suction cup element is a matter of design convenience and is changeable to suit various and different carrier belt arrangements; thus, for example, the geometric character of the suction cup element may be elliptical, or even circular if desired, without departing from the principles of the present invention.

Extensible bellows unit 38, which in its preferred form is also fabricated from an elastomeric material and has a generally rectangular cross-sectional shape size to conform substantially to that of central common aperture 40, has an opening at one end defined by a lip portion 48 and is closed or sealed at its other end by a terminal end portion 50. The lip portion 48 is suitably fixedly fastened to plate member 18 and extending the entire length of the endless belt carrier 10 (see FIG. 2) so as to provide an essentially airtight seal between the aperture and the underside of the plate member. With this arrangement bellows unit 38 defines a vacuum or suction plenum interiorly thereof when the bellows unit is in its extended or protracted position, wherein the suction plenum communicates directly with the upper suction cup unit through the latter's tubular neck opening and/or common plate aperture 40.

A substantially rigid, rodlike member or plunger 52 is integrally connected or otherwise fixedly fastened at one end by suitable means to the closed end terminal portion 50 of extensible bellows unit 38 and has its remotely extending other end integral with or fastened to an axle member 54 which, in turn, has a pair of roller members 56 fastened at either end thereof respectively via suitable antifriction bearings (not shown). As best observed in FIG. 2, rollers 56, axle 54, and plunger rod 52 are designed to function as a "cam roller" mechanism in continuous cooperative engagement with a common cam track means comprising a pair of opposed, slightly spaced-apart channels or tracks 58 and 60. The common cam tracks 58 and 60 which are disposed substantially within the central longitudinal plane of frame means 12 and which may be fixedly supported thereon as by welding same to crossrail members 62 and 64, for example, in an endless or continuous, closed loop path which later is spaced generally inwardly and concentrically with respect to the closed loop path of travel corresponding to the endless carrier belt 10 as represented most clearly in FIG. 1. In accordance with the present invention, however, the cam track spacing relative to the endless carrier belt 10 is purposely made to vary in a predetermined manner along various portions of its closed loop path. Thus, as shown by way of example in FIG. 1, the spacing between the cam track and the carrier belt is made to be substantially constant along the length of travel running from point B to point A, but diverges at point A to a greater distance and runs substantially constant at this greater spacing along the distance of travel extending from point A to point B whereupon the spacing between the cam track and the endless carrier belt once more converges to that originally existing between points B and A.

By virtue of this diverging-converging construction, the common cam track means of the present invention may be made to engage the roller member and plunger mechanism corresponding to each extensible bellows unit at a predetermined point along the path of travel of the endless carrier belt thereby actuating each bellows unit to an extended condition or alternatively, to a compressed or folded condition as the case may be. For example, consider a single bellows unit traveling between points B and A as viewed in FIG. 1. Because the spacing between the carrier belt and the cam track is at a constant minimum, the cam track will maintain the bellows unit in its folded or inactivated condition due to the camlike action of track means 58, 60 against roller members 56 and plunger member 52. Now when the bellows unit in question passes point A, the diverging cam track begins to exert a downward bias against the rollers and/or plunger member gradually expanding the bellows unit until the latter reaches its fully protracted or extended condition coinciding with maximum constant spacing between the cam track and the endless carrier belt. The extended bellows unit will be maintained in this actuated condition until point B is reached, at which juncture and the camlike action of the converging cam track means will urge the roller and plunger mechanism upwardly thereby compressing or folding the bellows unit into its deactivated condition. The contrast between the extended, fully
protracted condition of the bellows unit and the compressed or folded condition of the latter may be clearly viewed in FIG. 2.

Thus, in the operation of the embodiment of FIGS. 1–3, motive power means 30 is initially turned on to rotate either one or both of shafts 28 thereby driving endless belt carrier 10 at a predetermined speed through the action of sprocket wheels 14 and 16. With reference to FIG. 1, suppose now that motion of the belt carrier is clockwise, i.e., moving from point A to point B and that a flat, nonporous object 19 which may comprise a plate of glass or similar sheet of like material is placed on the endless belt carrier at or near the position marked A. The flat plate bears down against the resilient flared outer lip portions 42 of a plurality of adjacent outer suction cup elements 36 and effectively provides an airtight seal for each suction cup completely covered thereby. As the endless belt moves toward point B, each successive extensible bellows unit underlying the flat glass plate is engaged one-by-one and actuated by the diverging surface of the common cam track 58, 60 to thereby extend each successive bellows unit to its corresponding protracted, fully engaged position as described hereinabove. Inasmuch as each bellows unit is sealed off from the outside atmosphere by the overlying plate 19, the extension of each bellows unit creates a vacuum within the suddenly enlarged interior volume or plenum defined by the extended bellows unit 38 which vacuum extends throughout the commonly apertured plate member 18 and the suction cup member 36 to the overlying plate 19. The vacuum produced within each extended bellows unit provides accordingly, a suction force effective to firmly and securely grip the underside of the flat plate object thereby holding the latter tightly against the endless belt carrier as it travels from point A to point B. As the flat plate approaches point B, the cam track begins to converge thereby collapsing each extended bellows unit in succession through the previously described action of rollers 56 and plungers 52 and thus releases the suction grip on the underside of the flat plate which latter may then be removed from the endless belt carrier shortly after passing beyond point B.

It is anticipated that various modifications and alterations may be made to the preferred embodiment of FIGS. 1–3 without, however, departing from the spirit and scope of the present invention. Thus, for example, instead of employing a suction applying member 17 comprising an outer suction cup 36 and an inner extensible bellows unit 38, each of which must be separately assembled to the plate member 18, the modified one-piece construction shown in FIGS. 4 and 5 may be used wherein like numerals refer to similar parts. As indicated in FIG. 4, the modified alternately preferred suction applying member 68 is supported by a substantially rectangularly shaped plate member 18 having a centrally disposed rectangularly shaped aperture or opening 70 in its upper surface 71. Aperture 70 has tapered sidewalls 72 which terminate in a smaller, similarly shaped opening 74 in the lower surface 76 of the plate substantially as shown.

The suction applying member 68 which is preferably of one-piece molded rubber construction has an upper cuplike section that is also substantially rectangularly shaped so as to conform to the general shape of plate member 18 whereby it coextensively overlies the plate’s upper surface as viewed in FIG. 5. The upper cuplike section of suction applying member 68 includes an upwardly flared outer lip portion 78 integral with an intermediate substantially horizontal web portion 80 which latter terminates in a centrally disposed, rectangularly shaped aperture or similar opening 82 approximately equal in size to opening 74 in the lower surface 76 of plate 18.

Suction applying member 68 which may be suitably fixedly fastened to the plate member 18 by cementing the underside of intermediate web portion 80 to the plate’s upper surface 71, for example, also includes a substantially rectangularly shaped, flexible, cuplike diaphragm section 76 integrally attached to the underside of the horizontally disposed intermediate web portion 80 and which extends downwardly into the recess formed by tapered walls 72 for providing an airtight seal between aperture 82 and the underside of plate member 18. As indicated, the flexible diaphragm 76 is securely fastened to one end of a plunger or rod 52 which latter is adapted to flex the diaphragm between a deactuated condition wherein the diaphragm essentially occupies the recess formed by the tapered walls 72 in plate 18, and an actuated condition represented by the broken lines in FIG. 4 wherein the diaphragm forms a vacuum or suction plenum 84 communicating with the cuplike upper portion of the suction applying member through aperture 82. Of course, it will be appreciated that plunger or rod 52 is connected to suitable rollers 56 for cooperatively engaging the cam track means 58, 60 described above in connection with FIGS. 1–3 and therefore is adapted to be displaced along the direction indicated by arrow 86 in FIG. 4 depending upon its position along the path of the cam track.

In this connection, it may sometimes be desirable to drive the endless carrier belt 10 by a conventional sprocket chain drive means instead of using the cooperating sprocket wheel and hinge arrangement disclosed above relative to the embodiment of FIGS. 1–3. When this is done, it is recommended that the individual plate member 18 be linked directly to a pair of spaced apart sprocket chains 88, 90 via corresponding pairs of bracket means 92, 94 bolted or otherwise fixedly fastened to the undersurface of each plate member 18 as shown in FIGS. 4 and 6. The sprocket chains 88 and 90 are driven in the usual manner by suitably powered sprocket wheels engageable therewith as is well known in the art.

Alternatively, it may be preferable to dispense with a linked belt construction altogether and to substitute therefor a one-piece endless belt member fabricated from a suitable flexible and durable material such as rubber or canvas. With this modified arrangement, the individual suction applying members may be suitably supported within a corresponding series of apertures in the one-piece endless belt and securely and integrally affixed thereto by a conventional vulcanizing process. In addition, the drive sprocket wheels may be suitably modified to frictionally engage the inner surface of the one-piece endless belt for the purpose of imparting positive driving motion thereto.

Finally, it is to be understood that although the vacuum belt conveyor apparatus according to the present invention has been disclosed herein in the form of an endless belt or carrier adapted to horizontally support a series of flat plates or similar objects placed thereon, it is within the contemplation of the present invention to mount the conveying apparatus in any suitably convenient manner as for example, on a vertical wall or on overhead ceiling supports wherein the flat plate objects being conveyed may be supported vertically or horizontally from above, respectively.

Also, it should be appreciated that although the vacuum belt conveyor apparatus disclosed hereinabove includes only a single suction applying device on each flat-plate-supporting member, this was done only to illustrate a preferred form of the invention. Obviously, more than one suction applying member may be supported by each flat plate 18 depending upon the width dimension of the carrier belt being employed.

Many additional modifications within the spirit and scope of the present invention will obviously occur to those skilled in the art.

claim:
1. A conveyor belt apparatus comprising, a frame means for supporting a movable belt thereon, said belt including at least one portion having two oppositely disposed surfaces, said portion having an aperture centrally disposed therein, extensible bellows means fixed to one surface of said belt portion, said extensible bellows means having an open end in communication with said aperture and a sealed other end remotely extending therefrom, said plunger means connected to said bellows means remotely extending other end, and means supported on said frame means for engaging said plunger means and for extending said bellows means.
2. The apparatus of claim 1, wherein suction cup means are provided on the other surface of said belt portion, said suction cup means having an opening in registry with said aperture and said bellows means open end, whereby said suction cup means provides bearing surface for a flat object in gripping contact therewith when said bellows means is extended.

3. The apparatus of claim 1, wherein said engaging means comprises cam means fixed to said frame means and adapted to actuate said plunger means at different positions in the movement of said belt relative to said frame means.

4. A vacuum belt conveyor apparatus comprising a frame, a plurality of supporting members connected together to form a movable belt on said frame, each of said supporting members having a vacuum producing element thereon, and means mounted on said frame for selectively actuating said vacuum producing elements, wherein the improvement comprises a vacuum producing element including a flexible plenum chamber extensible between a collapsible condition and a protracted condition capable of producing a suction force, said flexible plenum chamber including means engageable by said selectively actuating means for extending said plenum chamber to its protracted condition.

5. A vacuum belt conveyor apparatus comprising a frame, an endless belt supported for movement on said frame in a continuous closed loop path including at least a portion thereof which substantially spans a linear distance between two separated points, said belt being formed of a plurality of flat plate members being pivotally connected together, each of said flat plate members having a through-hole opening substantially centrally disposed therein and supporting a suction applying member extending through said opening, each of said suction applying members including an upper suction cup member and a lower extensible member communicating therewith through said flat plate opening, said lower extensible member and said upper suction cup member defining a sealed vacuum producing chamber when said lower extensible member is fully extended, and a plunger connected at one end to said lower extensible member and having its other end engageable by an actuating means fixedly supported by said frame in variable spaced relation to said endless belt whereby each said lower extensible member may be fully extended at least during linear movement of its corresponding plate member between said two separated points.

6. The apparatus of claim 5, wherein said lower extensible member comprises a flexible diaphragm integral with said upper suction cup member.

7. The apparatus of claim 5, wherein said lower extensible member comprises an expandable hollow bellows having one end fixedly attached to the underside of said plate member in airtight sealing arrangement with said opening and having its other end terminate in an end closure portion whereby the latter is connected to said plunger member one end.

8. The apparatus of claim 5, wherein said actuating means comprises a continuous track member spaced from said endless belt by a predetermined constant amount, said track member having a diverging portion adjacent said linear distance between said two separated points for exceeding said constant distance by a predetermined increment, and said plunger member includes a roller member connected to it’s said other end for engaging said track member.

9. The apparatus of claim 5, wherein each of said flat plate members is substantially rectangularly shaped and each of said upper suction cup members includes a flared outer lip portion and an integral intermediate web portion surrounding said opening, said lip portion and said web portion substantially coextensively overlying the outer facing surface of said rectangularly shaped plate member.

10. The apparatus of claim 9, wherein said upper suction cup is formed of an elastomeric material.

11. The apparatus of claim 5, wherein each of said flat plate member through-hole openings is substantially rectangularly shaped, and said lower extensible member has a cross-sectional shape substantially conforming to that of said opening.

12. The apparatus of claim 11, wherein said lower extensible member is formed of an elastomeric material.

13. The apparatus of claim 5, wherein said upper suction cup and said lower extensible member are of integral one-piece construction extending through said opening in said flat plate member and having a common aperture therebetween concentric with said plate opening, said lower extensible member comprising a flexible cuplike diaphragm for defining said sealed vacuum chamber.

14. A vacuum belt conveyor apparatus comprising in combination; a stationary frame having a pair of longitudinally spaced axes supported for rotation thereon, said axes each carrying at least one sprocket wheel for rotation relative to said frame, a plurality of flat plates, linked together to form an endless conveyor belt, said belt being engaged by said spaced sprocket wheels for continuous longitudinal movement of the closed path defined by said spaced sprocket wheels, said frame further including a pair of continuous supporting tracks laterally disposed on either transverse side of said belt and being substantially immediately adjacent thereto respectively, each of said plates having a pair of axially opposed frictionless bearing means for continuous engagement with said laterally disposed tracks respectively, said bearing means thereby supporting said endless belt on said frame for movement relative thereto, each of said flat plates supporting an actuable suction applying device comprising an upper suction cup and a lower extensible member communicative with each other respectively, through a common aperture centrally disposed in said plate, said lower extensible member being adapted to create a vacuum plenum for said upper suction cup when actuated to a fully protracted condition, each of said extensible members having a plunger rod fixedly connected thereto at one end, the other end of said plunger rod terminating in an antifriction roller member, and a continuous cam track fixedly supported on said frame interiorly of said endless belt and extending at a predetermined constant spaced distance therefrom, said cam track having a portion extending intermediate between said spaced sprocket wheels which diverges to a greater constant spacing and then converges back to said original constant spacing relative to said endless belt, said plunger rod antifriction roller member serving as a cam follower in continuous rolling engagement with said cam track.

15. In a vacuum belt conveyor, a self-actuable suction producing device comprising; a supporting member having at least two opposed substantially flat surfaces, and including an aperture for forming an opening common to said opposed flat surfaces, a suction cup supported on one of said surfaces and substantially coextensively overlying same, said suction cup having an opening therein in registry with said aperture in said supporting member, an extensible hollow bellows member supported on the other of said surfaces having one end thereof in registry with said aperture in said supporting member and having its other end sealed to form a vacuum chamber when said bellows member is fully extended, and a member connected to said sealed end of said bellows member for selectively actuating said bellows member to its fully extended condition to thereby form said vacuum chamber.

16. The device defined in claim 15, wherein said suction cup and said extensible bellows member are formed of an elastomeric material.
17. The device claimed in claim 15 wherein said supporting member comprises a one-piece flexible endless belt.

18. In a vacuum belt conveyor, a self-actuatable vacuum producing device comprising:
   a supporting member having at least two opposed substantially flat surfaces, and including an aperture for forming an opening common to said opposed flat surface.
   a suction cup supported on one of said surfaces and substantially coextensively overlying same, said suction cup having an opening in registry with said aperture in said supporting member and having a flexible diaphragm cup portion integrally attached thereto and adapted for extensible movement through said opening in said supporting member toward said other opposed surface, whereby said extended diaphragm cup forms a vacuum chamber communicating with said suction cup, and
   a member connected to said extensible diaphragm cup portion for selectively extending same to form said vacuum chamber.

19. The device defined in claim 18 wherein said suction cup and said integral extensible diaphragm cup are formed of a single piece of elastomeric material.

20. The device claimed in claim 18 wherein said supporting member comprises a one-piece flexible endless belt.