Nov. 18, 1969 L. A. HOPKINS 3,478,864

APPARATUS FOR SUPPORTING STRIP MATERIAL ON A GAS CUSHION

Filed Nov. 16, 1967

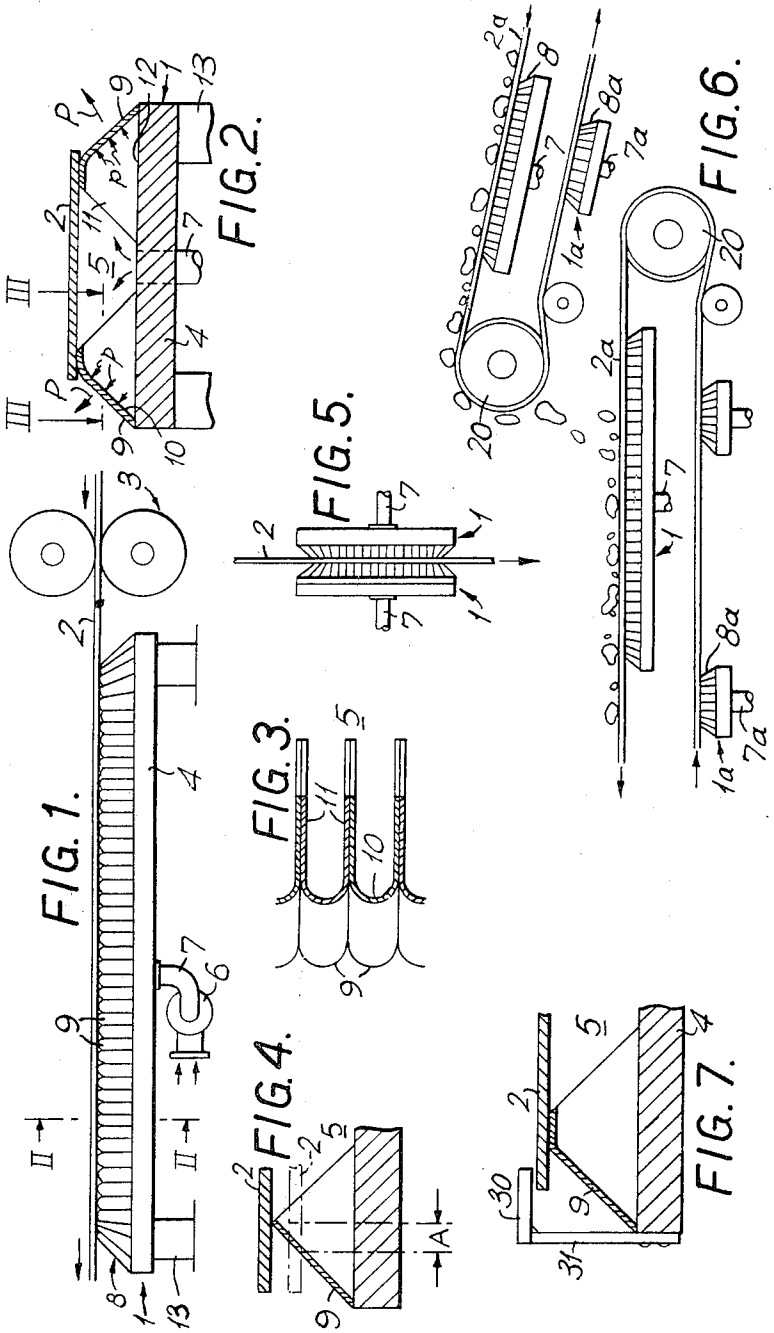


FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6.

FIG. 7.

INVENTOR

L. A. HOPKINS

BY

Cameron, Kerkam & Sutton

ATTORNEYS

United States Patent Office 3,478,864
Patented Nov. 18, 1969

3,478,864

APPARATUS FOR SUPPORTING STRIP MATERIAL ON A GAS CUSHION

Leslie Arthur Hopkins, Southampton, England, assignor to Hovercraft Development Limited, London, England, a British company

Filed Nov. 16, 1967, Ser. No. 683,541
Claims priority, application Great Britain, Nov. 24, 1966, 52,749/66
Int. Cl. B65g *15/60*
U.S. Cl. 198—204 8 Claims

ABSTRACT OF THE DISCLOSURE

An air-cushion pad for providing support to strip material for a conveyor belt using the flexible "skirt" to contain the air cushion. The skirt is attached to the base of the pad and inclines away from the base in a direction inwardly relative to the air cushion whereby movement of the strip or belt towards and away from the base results in collapse or extension respectively of the free edge of the flexible wall means so as to vary the effective area of the air cushion.

Preferably the flexible skirt is of the form disclosed in copending application Ser. No. 566,948 now Patent No. 3,420,330.

This invention relates to apparatus for supporting strip material on a gas cushion, for example, a cushion of pressurised air.

The term "strip material" is intended to include a continuous belt whereby the invention comprises a belt-type conveyor, and both vertical and lateral support are intended to be included by use of the term "support."

According to the invention, gas-cushion support apparatus for supporting strip material comprises a base structure forming a first boundary surface of the space occupied by the support cushion, means for feeding pressurised gas to said space and flexible wall means forming a peripheral boundary part of said space, said flexible wall means inclining away from said base structure and inwardly relative to said space, whereby in operation said strip material forms a second boundary surface, which second boundary surface faces said first boundary surface and whereby movement of the strip material towards and away from the base structure results in collapse or extension respectively of the flexible wall means so as to vary the effective area of the strip-supporting cushion.

Preferably, said flexible wall means comprise a succession of independently deflectable wall members each having an outer portion which extends away from said structure and which faces said space and a pair of side portions which extend inwardly from said outer portion towards said space, a side portion of each wall member being contiguous with the adjacent side portion of a neighbouring wall member, and constraining means for constraining the wall members against deflection away from said space by the pressure of gas therein, whereby inflation of said wall members by pressurised gas, which may be from said space, urges the contiguous side portions of neighbouring wall members towards each other.

The side portions of the wall members may comprise the constraining means.

At least the extremity of each outer portion furthest from the support structure may incline inwardly towards the space and the constraining means may act substantially normal to said outer portion.

The latter arrangement is particularly suitable where the strip material varies in weight or, in the case of a belt-type conveyor, when the load carried by the conveyor belt varies. When such weight or load variation does

occur, as explained hereinafter, the cushion area varies automatically so as to provide a substantially constant level of support to the belt.

Two embodiments of the invention will now be described by way of examples with reference to the accompanying drawings, wherein:

FIGURE 1 is a side view of the first embodiment,

FIGURE 2 is a section, to an enlarged scale, taken on the lines II—II of FIGURE 1,

FIGURE 3 is a section taken on the lines III—III of FIGURE 2,

FIGURE 4 is a fragmental end view, in section, which illustrates the behaviour of the invention when the load to be supported by the air cushion varies,

FIGURE 5 is a side view of a modification of the first embodiment,

FIGURE 6 is a fragmental side view of the second embodiment, and

FIGURE 7 is a fragmental end view, in section, of a modification applicable to either embodiment.

With reference to FIGURES 1 to 3, air-cushion support apparatus **1** for supporting thin metal strip **2** after passage through the nip of a roller mill **3** comprises a rigid base structure **4** forming a first or bottom boundary surface of the space **5** occupied by the support cushion, means comprising a variable-flow air pump **6** and discharge duct **7** for feeding pressurised air to the space **5** to form the support cushion and flexible wall means **8** forming the peripheral boundary of the space **5**. The flexible wall means **8** incline away from the base structure **4** and inwardly relative to the space **5**, whereby in operation, and as explained hereinafter, movement of the strip material **2** towards and away from the base structure **4** results in collapse or extension respectively of the "free" edge of the flexible wall means **8** so as to vary the effective area of the strip-supporting cushion.

The flexible wall means **8** comprise a succession of independently deflectable wall members **9** each having an outer portion **10** which extends away from the base structure **4** and which faces the space **5** and a pair of side portions **11** which extend inwardly from the outer portion **10** towards the space **5**. A side portion **11** of each wall member **9** is contiguous with the adjacent side portion **11** of a neighbouring wall member and the side portions of each wall constitute constraining means which constrain the wall member against deflection away from the space **5** by the pressure of air therein. The hollows of the wall members **9** are open to the cushion space **5** whereby cushion air urges the contiguous side portions of neighbouring wall members towards each other to provide an air seal. The strip material **2** forms a second or upper boundary surface of the space **5** which is opposite to the boundary surface defined by the base structure **4**.

The wall members **9** are attached to the base structure **4** by their lower extremities **12** and the upper extremity of each outer portion **10**, i.e., the extremity furthest from the structure **4**, inclines inwardly towards the cushion space **5** so that the constraint provided by the side portions **11** act substantially normal to the outer portion. Inflation loads p acting on the outer portion **10** have a resultant P which has an upward component of direction. This arrangement allows the use of thin, light flexible material (e.g., .020" thick, 10 oz. per square yard) to be used as the inflation forces acting on the wall members subject them to substantially tensile stresses only.

For further information concerning the design of the wall members, reference should be made to Patent No. 3,420,330.

As the metal strip **2** passes from the roller mill **3** it is supported over a substantial part of its length by the air-cushion formed in the cushion space **5**. As shown

in FIGURE 2, the weight of the strip **2** causes the upper extremities of the wall members **9** to collapse until the effective area of the air-cushion is large enough to result in the cushion applying an upward force large enough to support the strip. The weight of the strip is reacted by supports **13** beneath the base structure **4**.

FIGURE 4 illustrates how the upper extremities of the wall members collapse downwardly to automatically accommodate strip **2** of varying weight ranging from very light-weight strip (full lines) to substantially heavy strip (broken lines). The change in weight causes the peripheral boundary of the strip-supporting air-cushion to move outwardly a distance A and this increase in the effective area of the cushion results in an increase in the upward thrust exerted by the cushion.

The apparatus of the invention provides a substantially constant load support to the metal strip **2** over a substantial distance. To provide similar support by rollers a substantial number of close-spaced rollers would be required and, if the strip material is heavy or plastic, no matter how close-spaced the rollers were some sagging in the strip would be inevitable.

FIGURE 5 shows how two oppositely-facing apparatus **1** can be used to provide lateral support and thus guidance to metal strip **2** travelling in a substantially vertical plane. The base structures **4** face each other so that the strip **2** is located between the wall members **9** of the two apparatus **1** and is in contact with the wall members. It will be apparent that the strip **2** separates the cushion spaces **5** (not shown) of the apparatus. Any tendency for the strip **2** to move sideways is resisted by an increase in the lateral "thrust" as the effective cushion area of the apparatus **1** towards which the strip **2** moves is increased. Thus, the air-cushions in the cushion spaces **5** limit lateral movement of the strip **2** away from one or the other of the base structures **4**.

FIGURE 6 illustrates belt-type conveyors according to the invention. The upper, load-supporting runs of the belts **2***a* of the conveyors are supported by the large-area air-cushion support apparatus **1** and the lower, non-loaded runs of the belts by a plurality of spaced-apart small-area apparatus **1***a*. The apparatus **1***a* are supplied with cushion air by ducts **7***a*. The conveyor belts **2***a* are driven by rollers **20**.

As shown in FIGURE 6, one conveyor is conveying coal to another and, as explained above, with reference to FIGURE 4, the wall members of the apparatus **1**, **1***a* automatically vary the cushion areas so as to provide a substantially constant level of support.

FIGURE 7 illustrates an arrangement for preventing the strip **2** from being blown away from the base structure **4** should a load suddenly be removed from the strip. The figure shows stop means for limiting upward movement of the strip **2** and comprising strips **30** of metal extending above and substantially parallel to the sides of the base structure **4** and supported in this position by columns **31** bolted to the sides of the base structure. Under normal operating conditions the strip **2** is clear of the undersurfaces of the strips **30** but should the strip **2** suddenly be unloaded upward movement of the strip **2** will be limited by contact of its edges with the undersurfaces of the strips **30**.

In a (non-illustrated) modification of any of the above-described arrangements the wall members **9** are attached to each other by their side portions so as to at least limit the degree of deflection relative to each other. This arrangement provides an improved air seal. Attachment of the wall members to each other may be by stitching or by the application of adhesive.

In a further (non-illustrated) modification of any of the arrangements wherein the strip **2** comprises a conveyor belt, the belt may take the form of a plurality of contiguous slats attached to each other by a sheet or sheets of flexible material, the longitudinal axis of the slats being disposed substantially normal to the longitudinal axis of the conveyor belt.

I claim:

1. Gas-cushion support apparatus for supporting strip material comprising a base structure forming a first boundary surface of the space occupied by the support cushion, means for feeding pressurised gas to said space and flexible wall means forming a peripheral boundary part of said space, said flexible wall means inclining away from said base structure and inwardly relative to said space, whereby in operation said strip material forms a secondary boundary surface, which second boundary surface faces said first boundary surface, and whereby movement of the strip material towards and away from the base structure results in collapse or extension respectively of the flexible wall means so as to vary the effective area of the strip-supporting cushion.

2. Apparatus as claimed in claim **1** wherein said flexible wall means comprises a succession of independently deflectable wall members each having an outer portion which extends away from said structure and a pair of side portions which extend inwardly from said outer portion towards said space, a side portion of each wall member being contiguous with the adjacent side portion of a neighbouring wall member, and constraining means for constraining the wall members against deflection away from said space by the pressure of gas therein, whereby inflation of said wall members by pressurised gas, which may be from said space, urges the contiguous side portions of neighbouring wall members towards each other.

3. Apparatus as claimed in claim **2** wherein said side portions comprise said constraining means.

4. Apparatus as claimed in claim **2** wherein at least the extremities of each outer portion which is furthest from the base structure inclines inwardly towards said space and wherein said constraining means act substantially normal to said outer portion.

5. Apparatus as claimed in claim **1** provided with stop means for limiting movement of the strip material in a direction away from the base structure.

6. A belt conveyor wherein the conveyor belt is supported by apparatus as claimed in claim **1** and wherein the conveyor belt comprises said strip material.

7. An arrangement for supporting strip material comprising first and second gas-cushion apparatus each according to claim **1** and disposed so that the base structures thereof face each other and so that in operation the strip material is located between the wall members of said first and second apparatus and in contact therewith.

8. Apparatus as claimed in claim **2** wherein the wall members are attached to each other by their side portions so as to at least limit their degree of deflection relative to each other.

References Cited

UNITED STATES PATENTS

3,198,499 8/1965 Stanley ..... 226—97 X

EDWARD A. SROKA, Primary Examiner

U.S. Cl. X.R.

226—97