



(43) International Publication Date
8 November 2012 (08.11.2012)

(51) International Patent Classification:
B65G 15/08 (2006.01)

(21) International Application Number:
PCT/AU2012/000449

(22) International Filing Date:
30 April 2012 (30.04.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2011901608 2 May 2011 (02.05.2011) AU

(71) Applicant (for all designated States except US):
LANGKILDE ENGINEERING SERVICES [AU/AU];
138 Burswood Road, Burswood, Western Australia 6100
(AU).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **LANGKILDE, Neil Robert** [AU/AU]; C/- Karnet Prison Farm, PO Box 22, Serpentine, Western Australia 6125 (AU). **MILES, Matthew James** [NZ/AU]; 8 Mandora Way, Riverton, Western Australia 6148 (AU).

(74) Agent: **WRAYS**; Ground Floor, 56 Ord Street, West Perth, Western Australia 6005 (AU).

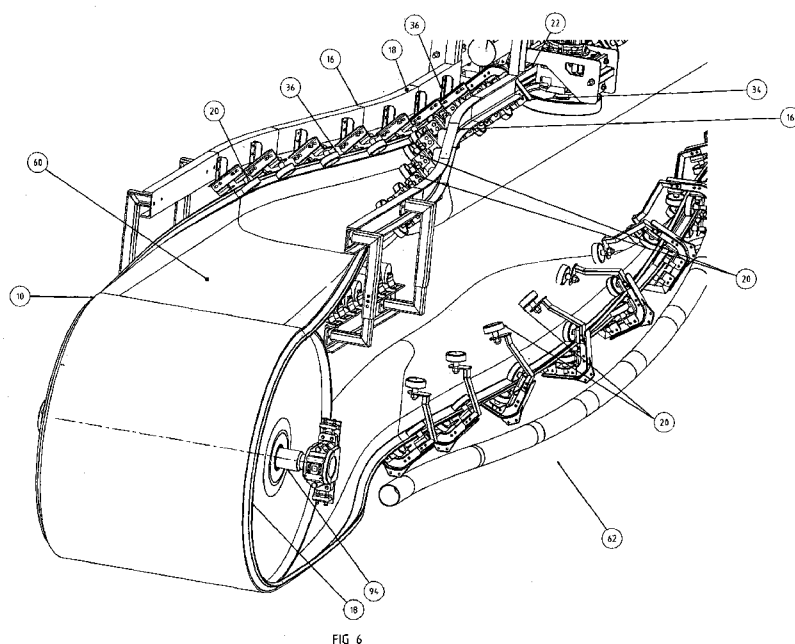
(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: A CONVEYOR BELT



(57) Abstract: A conveyor belt for transporting a material which is moveable between an open condition for loading/unloading the belt and a closed condition in which the belt is folded into a closed pouch. The belt also comprises oppositely facing surfaces, with one of the surfaces forming an inside surface of the closed pouch when the belt is in the closed condition; a central main belt section and opposite side sections extending along the length of the belt. Each side section includes a sealing portion adapted to be in abutment with a sealing portion of the other side section when the belt is in the closed condition. Each side section also comprises a support portion being provided to be gripped by pairs of rollers for supporting and guiding the belt. There is also provided a conveyor system for transporting material and a method for transporting the material.

- 1 -

A CONVEYOR BELT

Field of the Invention

5

The present invention relates to a conveyor belt for transporting a material, the conveyor belt having an open condition for loading/unloading the belt and a closed condition in which the belt is closed when viewed in transverse cross-section.

10

The present invention also relates to a conveying system that includes the conveyor belt.

The present invention has particular, although by no means exclusive, application in the mining industry.

15

Background

Conveyor belts are used in industry for conveying a wide range of materials. Conveyor belts are used in conveyor systems comprising one or more loading points at which materials are loaded onto the belt and a discharge point generally at the head of the conveyor system at which the materials are discharged from the belt.

20

With particular regard to mining applications, flat belt conveyors are used to convey a significant amount of material between locations at relatively high speeds. Such conveyor systems tend to be positioned to transport material in a straight trajectory since bends can, due to the speed of the belt and inertia of the material thereon, create points at which material is inadvertently discharged from the belt. Bends also result in movement of the material towards one side of the belt. This movement results in a greater rate of wear of one side of the conveyor belt, being that to which the material is biased when passing around bends, when compared with the other side of the conveyor belt. An additional issue inherent in flat belt conveyors is the

25

30

- 2 -

generation of dust resulting from air dislodging particles of the material as it is carried along the conveyor.

“Pouch” or “closed” conveyor belts have been proposed as an alternative to flat belt conveyors. Such belts are in an open configuration during loading of material onto the belt and move to a closed condition to contain the material in a “pouch” whilst it is conveyed.

The above description of flat belt and “pouch” conveyors is not to be taken as an admission of the common general knowledge in Australia or elsewhere.

Summary of the Invention

In accordance with the invention there is provided a conveyor belt for transporting a material, the conveyor belt being moveable between an open condition for loading/unloading the belt and a closed condition in which the belt is folded into a closed pouch when viewed in transverse cross-section, the belt comprising:

oppositely facing surfaces, with one of the surfaces forming an inside surface of the closed pouch when the belt is in the closed condition;

a central main belt section and opposite side sections extending along the length of the belt;

each side section including (a) a sealing portion adapted to be in abutment with a sealing portion of the other side section when the belt is in the closed condition and (b) a support portion having (i) oppositely facing surfaces, the support portion being provided to be gripped by pairs of rollers for supporting and guiding the belt, with each pair of rollers defining a gap that receives the support portion and sandwiches the oppositely facing surfaces therebetween, with one roller of each pair of rollers contacting one of the oppositely facing surfaces of the support portion and (ii) an enlarged tip section for preventing the support portion from pulling through the gap between the pair of rollers when the belt is operating to transport material.

- 3 -

The enlarged tip section of each support portion is outwardly of the surfaces of the support portion that can be gripped by the rollers and is provided to prevent the respective support portions from being pulled through the gap between the rollers of each pair of rollers and becoming disengaged from the rollers when the belt is in the closed condition and is operating to transport material on the belt. This is a feature that is particularly important for heavily loaded belts. More specifically, an important function of the enlarged tip section of each support portion is to re-direct a moving belt onto the surfaces of the support portion in the event that the moving belt starts to drift downwardly and inwardly in response to the load, i.e. the transported material, carried by the belt.

The enlarged tip sections of the support portions have an additional benefit of contributing to making it possible for each support portion to be supported to be moved independently of the other support portion. Consequently, one longitudinal side of the belt can be drawn away from the other longitudinal side, thereby opening the belt to enable loading and discharge of material onto and from the belt.

The enlarged tip section of each support portion may be wedge-shaped.

The enlarged tip section of each support portion may include oppositely facing surfaces that are extensions of the above-mentioned oppositely facing surfaces of the support portion that can be gripped by the rollers and diverge outwardly away from each other.

The rollers of each pair of rollers may have parallel axes of rotation.

The sealing portions may comprise sealing surfaces that are in contact with each other when the belt is in the closed condition.

The sealing surfaces may extend in a vertical plane when the belt is in the closed condition.

- 4 -

Each support portion may extend upwardly and outwardly from the sealing surfaces of the sealing portion that forms part of the same side section of the belt as the support portion, as viewed when the belt is in the closed condition and a load is applied to the belt. With this arrangement, when the belt is in the closed condition, the applied load of the material being transported on the belt results in inwardly directed forces that force the sealing portions into closer contact as the applied load increases.

Each support portion and the sealing surface of the sealing portion that forms part of the same side section of the belt as the support portion may define an included angle of 20-70° when the belt is in the closed condition.

Each support portion and the sealing surface of the sealing portion that forms part of the same side section of the belt as the support portion may define an included angle of 30-60° when the belt is in the closed condition.

Each support portion and the sealing surface of the sealing portion that forms part of the same side section of the belt as the support portion may define an included angle of 45° when the belt is in the closed condition.

The belt may be reinforced.

The belt may be reinforced in a lengthwise extending direction.

The belt may be reinforced in a transverse direction of the belt.

The belt may be reinforced in a lengthwise extending direction and a transverse direction of the belt. Similarly, the belt may be reinforced at an angle to the lengthwise extending direction and/or the transverse direction of the belt, i.e. diagonal reinforcement.

Each support portion may include a lengthwise extending reinforcing element.

- 5 -

The reinforcing element may be a chain, a bar, a rod, or the like.

The reinforcing element may be embedded within the enlarged portion and/or the sealing portion.

5

In accordance with the invention there is also provided a conveying system for transporting a material, the conveying system comprising:

10

(a) the above-described conveyor belt,

(b) a support structure for the conveyor belt, the support structure comprising a series of the above-described pairs of rollers for supporting and guiding the support portions of opposite side sections of the conveyor belt at spaced intervals along the length of the belt; and

15

(c) a drive system for driving the belt.

20

The pairs of rollers may be arranged alternately, whereby successive pairs of rollers support support portions on opposite side sections of the belt. In other words, one pair of rollers supports a support portion on one side of the belt and the next pair of rollers along the length of the belt supports a support portion on the other side of the belt.

25

The drive system may comprise a plurality of drive rollers that contact the belt and drive the belt.

30

The conveying system may be skid-mounted or wheel-mounted and be a shiftable, i.e. manually movable, system when the conveying system is not operating and transporting material on the belt.

The conveying system may be track-mounted and be a movable, i.e. drivable, system when the conveying system is operating and transporting material on the belt.

- 6 -

In accordance with the invention there is also provided a method of transporting a material comprising loading the material onto the conveyor belt of the above-described conveying system at a loading location of the system while driving the conveyor belt and transporting the material along the belt and discharging the material from a discharge location of the system.

The material may be a mined material.

The material may be a mined material that has been crushed in a crusher.

Brief Description of the Drawings

Embodiments of the conveyor belt and the conveying system of the present invention are now described by way of non-limiting example only with reference to the accompanying drawings, of which:

Figure 1 is a cross-sectional view of an embodiment of a conveyor belt in accordance with the invention in a closed condition;

Figure 2 is a cross-sectional view of the conveyor belt in an open condition;

Figure 3 is a perspective section view of the conveyor belt held in rollers;

Figure 4 is a transverse cross-section of an embodiment of a conveying system in accordance with the invention showing a particular configuration of the belt of Figure 1 during forward and return runs of the belt;

Figures 5 show a transverse cross-section of a part of the conveying system including a drive system of the belt of Figure 1;

Figure 6 is a perspective view of a tail/head end of the conveying system;

- 7 -

Figure 7 is a cross-sectional view of the conveying system showing the belt during loading;

Figure 8 is a perspective view of a loading point of the conveying system; and

Figure 9 is a perspective view of a support structure of the conveying system for supporting the belt.

Detailed Description

It is to be appreciated that the embodiments of the conveyor belt and the conveying system shown in the Figures are not the only embodiments of the present invention.

Figure 1 shows the embodiment of the conveyor belt 10 shown in the Figures in an operative closed condition of the belt as a part of a conveying system for conveying material 12, such as mined ore, that has typically been crushed, between a loading location and a discharge location (not shown). The loading location and the discharge location may be any suitable locations within and outside a mine pit.

Figure 2 shows the conveyor belt 10 in an operative open condition for unloading material from the belt 10. Figure 8 shows an example of the belt 10 in an operative open condition for loading material into the belt.

As is described in more detail below, the embodiment of the conveying system shown in the Figures supports the conveyor belt 10 so that it is moved between the open condition (see Figure 2) for unloading the conveyor belt 10 and the closed condition (see Figure 1). In the closed condition the belt forms a closed pouch shape when viewed in transverse cross-section to permit material 12 therein to be conveyed by the belt 10.

- 8 -

The conveyor belt 10 is typically made from a rubber material. It is noted that the belt may be made from any suitable material other than rubber, including elastomers, polymers, and/or the like.

- 5 The conveyor belt 10 has oppositely facing surfaces 7a, 7b, with one of the surfaces 7a forming an inside surface of the closed pouch when the belt is in the closed condition.

10 With reference to Figure 2, the conveyor belt 10 also includes a lengthwise-extending central main belt section 14 and side sections 15 on opposite sides of the main belt section 14.

15 The side sections 15 include a pair of sealing portions 16. One sealing portion 16 of the pair is part of one side section 15 of the belt and the other sealing portion 16 of the pair is part of the other side section 15 of the belt. The sealing portions 16 are each provided with a substantially flat longitudinal contact surface 19 that are in abutment when the conveyor belt 10 is in the closed condition.

20 The side sections 15 further include a pair of support portions 18. One support portion 18 of the pair is part of one side section 15 of the belt and the other support portion 18 of the pair is part of the other side section 15 of the belt.

25 Each support portion 18 includes a flat section 38 that is provided to be gripped on opposite lengthwise-extending surfaces thereof by pairs of rollers 34, 36. The rollers 34, 36 are provided to support and guide the conveyor belt 10 at spaced intervals along the length of the belt 10. The pairs of rollers 34, 36 are part of a support assembly for the conveyor belt 10. The support assembly is described in more detail in a later section of the specification.

30 Each support portion 18 also includes a lengthwise-extending enlarged tip section 22 for preventing the support portions 18 from pulling through the gaps between the pairs of rollers 34, 36 when the conveyor belt 10 is operating and transporting

- 9 -

material. The pull through force is caused by downward loading on the belt as a result of material being transported on the belt. Each enlarged tip section 22 is in the form of a wedge-shaped element that extends outwardly from the flat section 38 and has outwardly diverging surfaces that are extensions of the lengthwise-extending surfaces of the flat sections 38. The enlarged tip section 22 of each support portion 18 increases in thickness away from the flat surface 19 of that support portion. The enlarged tip sections 22 are provided to make it progressively more difficult to pull the support portions 18 through the gaps between the rollers 34, 36 in response to a downwardly applied load on the belt 10 as material is being transported on the conveyor belt 10. Specifically, the greater the pull through force that is applied to the support portions 18 as a consequence of the mass of material on the conveyor belt 10 as the belt is operating and transporting material on the belt, the greater the force applied by the enlarged tip sections 22 to re-direct the moving belt onto the oppositely facing surfaces of the flat sections 38 of the support portions and away from the enlarged tip sections 22.

With reference to Figure 1, the sealing portion 16 and the support portion 18 of each side section 15 are arranged with respect to each other so that, in the closed condition shown in the Figure, the longitudinal contact surfaces 19 of the sealing portions 16 of opposite side sections 15 are in contact with each other in a vertical plane and the support portions 18 of these side sections 15 extend upwardly and outwardly at an angle of 45° from the sealing portions 16. With reference to Figure 1, the angle is the angle between the vertical contact plane X2 of the sealing portions 16 and a central plane X1 of the support portions 18. As is discussed further below, with this arrangement, when the conveyor belt 10 is in the closed condition, an applied load generates inwardly directed forces that force the sealing portions 16 into closer contact, and the inwardly directed forces increase as the applied load increases.

In the embodiment shown in the Figures, the conveyor belt 14 is reinforced. Whilst rubber is sufficiently strong to absorb shocks from applied loads, and is sufficiently flexible to enable to conveyor belt 10 to travel along a curved trajectory, reinforcing

-10-

the conveyor belt 10 can improve both its tensile strength and compressive strength, and its resistance to stretching. This is particularly important where a single drive, such as a head pulley, is used to drive the belt. In these circumstances, the length of the conveyor belt 10 approaching the drive must have sufficient tensile strength to sustain the load required to drive the entire conveyor belt 10. However, the belt is typically driven by a number of drives positioned as required. In such an example, each drive drives a portion of the belt 10.

The reinforcement typically includes an embedded series of flat bars 24 that are spaced along the length of the belt 10 and increase the tensile strength of the support portions 18. However, it is to be appreciated that any number of different reinforcement configurations is possible, e.g. chain is embedded along the length of the support portion 18, or the like.

Similarly, the reinforcement typically includes some manner of force transfer element 28, such as a chain, embedded along the length of the belt 10, as shown.

In the present case, the force transfer elements 28 also reinforce the belt 10. The force transfer elements 28 thereby serve the dual purpose of strengthening the belt 10 to improve its load carrying capacity and structural integrity, and to more uniformly distribute the load applied to the belt 10 resulting in improved wear distribution and a consequent increase in longevity of the belt 10.

It is to be appreciated that the reinforcement, including the force transfer elements 28 and the flat bars 24, provide some manner of flexible framework or endoskeleton. These reinforcing elements are encased in rubber or the like which encloses the material carried by the belt, in use, and prevents the material from falling through the belt.

As such, the reinforcement also includes a series of embedded transverse elements 26 disposed at spaced intervals along the conveyor belt 10 and engaging each force transfer element 28. These transverse elements 26 may include wires, or the like.

-11-

The engagement means that the bars 24 and transverse elements 26 form a reinforcing structure through the conveyor belt 10, i.e. the force-carrying flexible endoskeleton.

5 As mentioned above, the reinforcement includes reinforcing force transfer elements 28 in the sealing portions 16, as shown. Since the sealing portions 16 abut each other when the conveyor belt 10 is in the closed condition, significant frictional forces can be generated between the sealing portions 16. The force transfer elements 28 help ensure that each respective sealing portion 16 remains as a unitary body, thus
10 reducing the chance of fracture of the sealing portions 16, particularly in cases where the forces applied to the respective sealing portions 16 is non-uniform.

It will be appreciated that there will be situations in which no reinforcement is required.

15

It will also be appreciated that there will be situations in which other reinforcing elements are used. For example, wires or chains may be used instead of bars 24 and a reinforcing mesh layer may be used throughout the conveyor belt 10 rather than a series of transverse elements 26.

20

The open condition of the conveyor belt 10 shown in Figure 2 is particularly useful where the conveyor belt 10 is, for example, passing around a head or tail pulley 30 (as shown in broken lines with return run 32 of the conveyor belt 10). Whilst it is possible to load the conveyor belt 10 when in this condition, other open conditions
25 (see Figure 8) are more suitable belt configurations for loading purposes.

The embodiment of the conveying system shown in the Figures comprises:

30

- (a) the conveyor belt 10,
- (b) a support structure for the conveyor belt 10, the support structure comprising a series of the above-mentioned pairs of rollers 34, 36 for

-12-

supporting the conveyor belt at spaced intervals along the length of the belt, and

(c) a drive system for driving the belt.

5

It is to be appreciated that the drive system may include a plurality of drives arranged along the length of the belt as required.

The conveying system may be skid-mounted or wheel-mounted and be a shiftable, i.e. manually movable, system. Alternatively, the conveying system may be track-mounted and be a movable, i.e. drivable, system. Alternatively, the conveying system may be a fixed system.

10

With reference to Figures 3, 4, 5, 8 and 9, the support structure of the conveying system supports the conveyor belt 10 clear of the ground in the operative closed condition shown in the Figures. More particularly, the support structure includes pairs of rollers that support the side sections 15 of the conveyor belt 10. The pairs of rollers on one side of the belt include individual pairs of rollers 34 and each pair of rollers on the other side of the belt includes individual pairs of rollers 36. The arrangement is such that each pair of rollers 34, 36 grips the oppositely facing surfaces of the flat 38 of a respective support portion 18.

15

20

The rollers in each pair of rollers 34, 36 define a gap (X-X) that is just large enough to receive the flat section 38 of the support portion 18. Therefore, when the conveyor belt 10 is heavily laden with material 12, and a large pull through force is thus applied to the support portions 18, the enlarged sections 22 are forced into abutment with the rollers of the pairs of rollers 34, 36 but cannot fit through the gap defined therebetween. Thus the enlarged sections 22 prevent pull through of the support portions 18.

25

As a further safeguard, the rollers of each pair 34, 36 are oriented such that the sides of the gap between the rollers (see broken lines X2 and Y) approach the bottom point of the abutment between the sealing portions 16. As is described above, in order to pull through the pairs of rollers 34, 36, the support portions 18

30

-13-

must pull both downwardly and inwardly. The inward pull increases the forces applied to the surfaces 19 of the sealing portions 16, thus applying forces to counter the inward pull on the support portions 18. Moreover, the downward pull of the support portions 18 increases the force applied between the top edges 39 of the surfaces 19. Again, this increased force inhibits pull through of the support portions 18.

With reference to Figure 3, the support structure of the conveying system includes a roller assembly 40 to which the pairs of rollers 34, 36 are mounted in an offset manner along the length of the conveyor belt 10, such that the rollers 36 of one pair is provided slightly upstream of the rollers 34 of the other pair. The offset allows larger rollers 34, 36 to be used than would be the case if the pairs 34, 36 were disposed side-by-side laterally across the belt. The larger rollers 34, 36 afforded by the offset also provide a large surface for engaging the support portions 18 thereby reducing wear of the support portions 18.

Each roller assembly 40 includes brackets 42 for supporting the pairs of rollers 34, 36 and a mounting bracket 44 for securing the roller assembly 40 to a steel pipe that forms a part of a support frame (not shown) of the support structure of the conveying system.

Most conveyor belts 10 will be endless (i.e. their two ends are spliced together to form a continuous loop of belt 10). As such, these conveyor belts 10 require a forward run and return run that generally extend between head and tail pulleys. The forward run conveys material to a discharge point and the return run returns the empty conveyor belt 10 to be reloaded with material 12.

With reference to Figures the conveying system includes an upper forward run 60 and a lower return run 62.

For most of the forward run 60 and the return run 62 the conveyor belt 10 will assume the closed condition as shown. However, at the head and tail ends of the

-14-

conveying system, the conveyor belt 10 must turn 180°, for example around a pulley (e.g. see pulley 94 in Figure 6). If the conveyor belt 10 remains in the closed configuration, significant compressive stresses would be placed on the lowest point 66 which would necessarily assume the inside of the curve around the pulley 64.

5 Accordingly, the conveyor belt 10 opens out into a flattened configuration (see reference numeral 68). In the flattened configuration the conveyor belt 10 can easily pass around the pulley 64.

10 While the conveyor belt 10 can remain upright during both the forward run 60 and the return run 62, the return run 62 can run upside down. In order to remain in this upside down configuration, a different roller arrangement 70 must be used. The roller arrangement 70 includes a base idler 72 for providing upward force to a flattened surface 74 of the sealing portions 16. To ensure the sealing portions 16 do not move apart, side rollers 76 are provided. Finally, in the absence of support from
15 above the belt 14 would flop to one side. However, both the support roller 78 and wire 26 serve to maintain the shape of the belt 14.

The arrangement of forward and return runs 60, 62 as shown in Figure 4 enable material to be conveyed in both directions of the belt 10. Such an arrangement
20 provides for significant flexibility in the use of the belt 10. For example, the forward run 60 may convey raw material to a processing plant whereas the return run 62 may take tailings to a tailings dump. The return run 62 may thus be opened to allow material to be discharged at some point intermediate the ends of the conveyor system.

25

In addition, the forward and return runs 60, 62 may involve a number of load and discharge operations each, such that a single conveyor belt 10 can perform multiple conveying operations along each of the forward and return runs 60, 62 as desired. Advantageously, only one drive need be provided along the length of the belt 10,
30 thus potentially reducing the upfront capital cost of the conveyor system.

-15-

The return run 62 may diverge away from the forward run 60 to discharge material, and thereafter return to the forward run 60 to progress towards the tail end of the conveyor system. Advantageously, such flexibility enables the forward and return runs 60, 62 to be of different lengths, which can assist in ensuring that the belt 10 wears consistently.

With reference to Figures 5, the conveying system includes drive rollers 80 to drive the conveyor belt 10. The drive rollers 80 are powered by geared motors 82 mounted to shock absorbing brackets 86, the motors 82 serving to impart a driving force to the drive rollers 80 to thereby drive the belt 10. In Figure 5, the motors 82, 82 are mounted opposite one another laterally across the belt 10 and apply a driving force to the flat land 84 (see also Figure 1) of the belt 10. In so arranging the motors 82, 82, the lateral force applied by one motor 82 to the respective flat land 84 of the belt 10 is counteracted by the abutment between longitudinal contact surfaces 19 and the equal and opposite lateral force applied by the other motor 82 to the opposite side of the belt 10.

Alternatively, the motors 82 may be mounted to the brackets 86 in an offset manner similar to the manner in which the roller pairs 34, 36 are mounted in the roller assembly 40 as described in relation to Figure 3.

In the embodiments shown in Figure 5, the shock absorbing brackets 86 are pivotally connected to a top bracket 88 by pivotal connections 90. The top brackets 88 are again attached to the support structure of the conveyor system (not shown).

Dampers 92, as shown in Figure 5, or damping springs 93, are provided between brackets 86, 88 to absorb shocks that might otherwise adversely affect the function of the motors 82. The bracket 86 is thus afforded a limited degree of movement to account for impulse forces applied to the roller 80.

It will be appreciated that many different shock absorbing elements may be used to absorb shocks occurring between the brackets 86, 88, and that dampers 92 and

-16-

springs 93 have been used in the present case as exemplary shock absorbing elements only.

5 An exemplary helical head or tail arrangement of the conveying system is shown in Figure 6. This embodiment demonstrates the advantages of shaping the support portions 18 to include flat sections T.B.A. to be individually gripped between pair of rollers 34, 36. In particular, the pairs of rollers 34, 36 are disposed progressively the closer they are to the pulley 94. Accordingly, the support portions 18 move progressively further apart as they approach the pulley 94, until the conveyor belt 10 is substantially flat. The enlarged sections 22 will, at all times, prevent the support portions 18 from pulling through the rollers 34, 36.

This advantage is not available in heretofore known conveying systems, since the side sections of the belt are not separately supported by pairs of rollers.

15 Accordingly, such belts are difficult to control when opening.

After the conveyor belt 10 has passed from the forward run 60 around the pulley 94 into the return run 62, it is temporarily upside down. While pairs of rollers 34, 36 are used to draw the conveyor belt 10 into an open condition, such pairs of rollers 34, 36 can be arranged to close the conveyor belt 10. In the present case, the pairs of rollers 34, 36 are positioned such that the support portions 18 immediately after the pulley 94 are taken around a generally helical path until the conveyor belt 10 is once again in an upright condition and is thus supportable using rollers assemblies 40 as described above, or take-up arrangements as is generally known in the art.

25

It will be appreciated that many head and tail pulley belt configurations can be used to achieve the same goal of progressing the conveyor belt 10 from a forward run 60 to a return run 62.

30 As discussed above, the open condition of the conveyor belt 10 as shown in Figures 2 and 6 is not ideal for loading material 12 onto the belt 10. A more appropriate loading configuration is shown in Figure 7, in which the base 96 of the conveyor belt

-17-

10 is supported by an array of support rollers 98 disposed substantially transversely across the belt 10. Moreover, the support portions 18 remain held in their respective pairs of rollers 34, 36. It is to be appreciated that the support rollers can also include any other suitable supporting means generally performing a similar function.

5

The impulse loads applied by material 12 to the conveyor belt 10 as it is loaded thereon are absorbed by the support rollers 98. Therefore, the belt 10, sealing portions 16 and support portions 18 (including enlarged sections 22) need not be made so strong as to withstand the impulse loads of the material 12, yet that material

10 12 can still be safely loaded onto the belt 10.

The conveyor belt 10 can progress from a closed configuration as shown in Figure 1, to the loading configuration as shown in Figure 7 & 8, by an appropriate arrangement of rollers of pairs of rollers 34, 36 similar to that described in relation to Figure 6. For example, at a loading point 100 of a conveyor belt 10, as shown in Figure 8, the edges of the belt 10 are drawn apart (at point 102) to open the belt 10, thereby allowing material 12 to be loaded onto the belt 10. The edges of the conveyor belt 10 are then drawn back together (at point 104) to return the belt 10 to a closed condition.

15

20

A roller assembly, as shown in Figure 9, is provided to support rollers of the pairs of rollers 34, 36 from a support frame of the support structure of the conveying system. As discussed in relation to Figure 3 each roller assembly includes brackets 42 for supporting the pairs of rollers 34, 36, and a mounting bracket 44 for securing the roller assembly to a steel pipe that forms a part of a support frame (not shown) of the support structure of the conveying system. The rollers 34, 36 are generally pre-configured according to the required gap size for the support portion at installation and is adjustable for maintenance purposes. The rollers 34, 36 may also be self-adjusting.

25

30

With further reference to Figure 9, the roller assembly also includes a plate 108 that is provided between the brackets 42, such that the rollers 36 of one pair of rollers is

-18-

disposed upstream on the plate 108 and the rollers 34 of the other pair of rollers is provided downstream on the plate 108. Since the pairs of rollers 34, 36 are disposed substantially the same distance either side of the roller assembly 40, the downward forces applied by the conveyor belt 10 to the rollers 34, 36 will be generally even across the roller assembly 40 (i.e. the downward force applied by one pair 34 of rollers will be equal to that applied by the other pair 36). Torsional forces will also be substantially evenly distributed across the roller assembly 40 since the torsional force applied by one pair 34 of rollers will substantially equal and opposite to that applied by the other pair 36 of rollers.

The above-described conveyor belt and conveyor system is capable of transporting large quantities of crushed iron ore within a mine pit and/or up a side wall of the pit and/or across a mine from the pit to a processing plant or a stockpile within the mine. It is noted that the invention is not confined to transporting mined material.

It will be understood by persons skilled in the art of the invention that many modifications may be made to the embodiments of the belt conveyor and the conveying system shown in the Figures without departing from the spirit and scope of the invention.

-19-

Claims

1. A conveyor belt for transporting a material, the belt being moveable between an open condition for loading/unloading the belt and a closed condition in which the belt is folded into a closed pouch when viewed in transverse cross-section, the belt comprising:

oppositely facing surfaces, with one of the surfaces forming an inside surface of the closed pouch when the belt is in the closed condition;

a central main belt section and opposite side sections extending along the length of the belt;

each side section including (a) a sealing portion adapted to be in abutment with a sealing portion of the other side section when the belt is in the closed condition and (b) a support portion having (i) oppositely facing surfaces, the support portion being provided to be gripped by pairs of rollers for supporting and guiding the belt, with each pair of rollers defining a gap that receives the support portion and sandwiches the oppositely facing surfaces therebetween, with one roller of each pair of rollers contacting one of the oppositely facing surfaces of the support portion and (ii) an enlarged tip section for preventing the support portion from pulling through the gap between the pair of rollers when the belt is operating to transport material.

2. The belt defined in claim 1 wherein the enlarged tip section of each support portion is wedge-shaped.

3. The belt defined in claim 1 or claim 2 wherein the enlarged tip section of each support portion includes oppositely facing surfaces that are extensions of the oppositely facing surfaces of the support portion that can be gripped by the rollers and diverge outwardly away from each other.

4. The belt defined in any one of the preceding claims wherein the rollers of each pair of rollers have parallel axes of rotation.

-20-

5. The belt defined in any one of the preceding claims wherein the sealing portions comprise sealing surfaces that are in contact with each other when the belt is in the closed condition.

5 6. The belt defined in claim 5 wherein the sealing surfaces extend in a vertical plane when the belt is in the closed condition.

7. The belt defined in claim 5 or claim 6 wherein each support portion extends upwardly and outwardly from the sealing surfaces of the sealing portion that forms
10 part of the same side section of the belt as the support portion, as viewed when the belt is in the closed condition and a load is applied to the belt.

8. The belt defined in claim 7 wherein each support portion and the sealing surface of the sealing portion that forms part of the same side section of the belt as
15 the support portion defines an included angle of 20-70° when the belt is in the closed condition.

9. A conveying system for transporting a material, the conveying system comprising:

20

(a) the conveyor belt defined in any one of the preceding claims,

25

(b) a support structure for the conveyor belt, the support structure comprising a series of the above-described pairs of rollers for supporting and guiding the support portions of opposite side sections of the conveyor belt at spaced intervals along the length of the belt; and

(c) a drive system for driving the belt.

30

10. The system defined in claim 9 wherein the pairs of rollers are arranged alternately, whereby successive pairs of rollers support the support portions on opposite side sections of the belt, such that one pair of rollers supports a support

-21-

portion on one side of the belt and the next pair of rollers along the length of the belt supports a support portion on the other side of the belt.

11. The system defined in claim 9 or claim 10 wherein the drive system comprises
5 a plurality of drive rollers that contact the belt and drive the belt.

12. The system defined in any one of claims 9 to 11 being skid-mounted or wheel-mounted and shiftable, i.e. manually movable, when the conveying system is not operating and transporting material on the belt.

10 13. The system defined in any one of claims 9 to 11 being track-mounted and movable, i.e. drivable, when the conveying system is operating and transporting material on the belt.

15 14. A method of transporting a material comprising loading the material onto the conveyor belt of the conveying system defined in any one of claims 9 to 13 at a loading location of the system while driving the conveyor belt and transporting the material along the belt and discharging the material from a discharge location of the system.

20 15. A conveyor belt as herein described with reference to the figures of the accompanying drawings.

25 16. A conveyor system as herein described with reference to the figures of the accompanying drawings.

17. A method for transporting material as herein described with reference to the figures of the accompanying drawings.

FIG 1

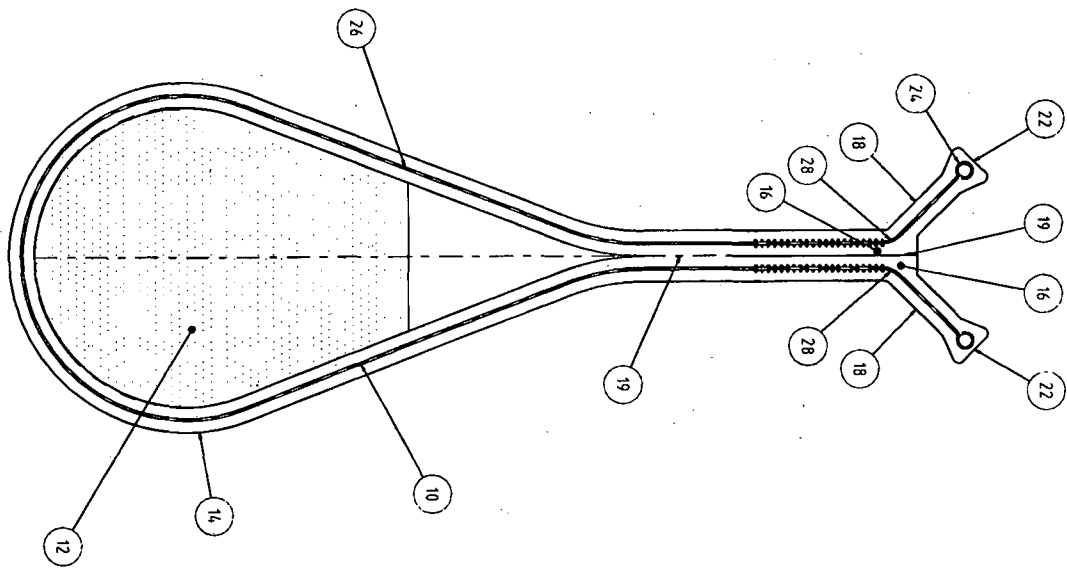
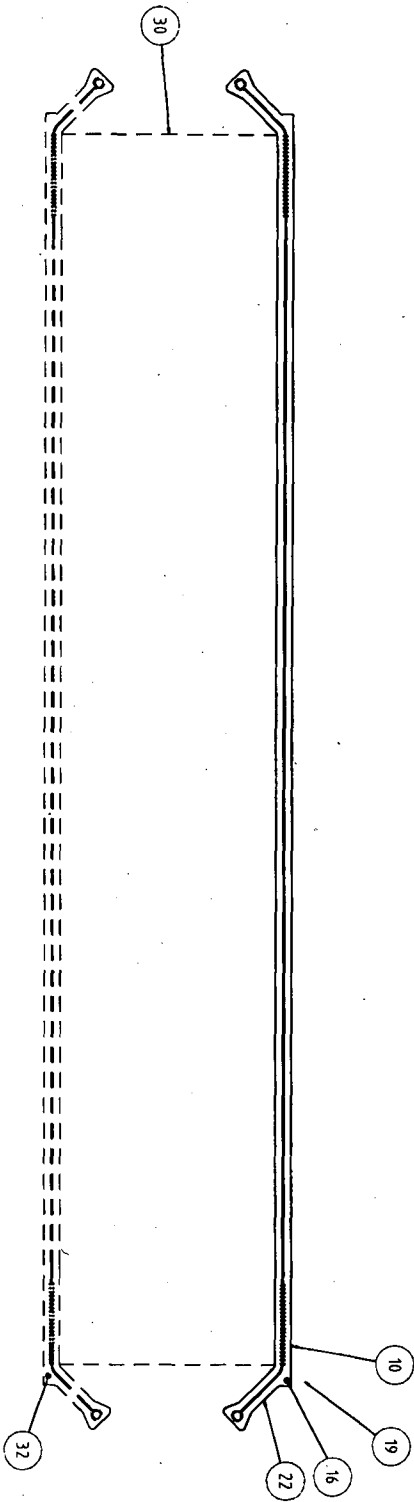


FIG 2



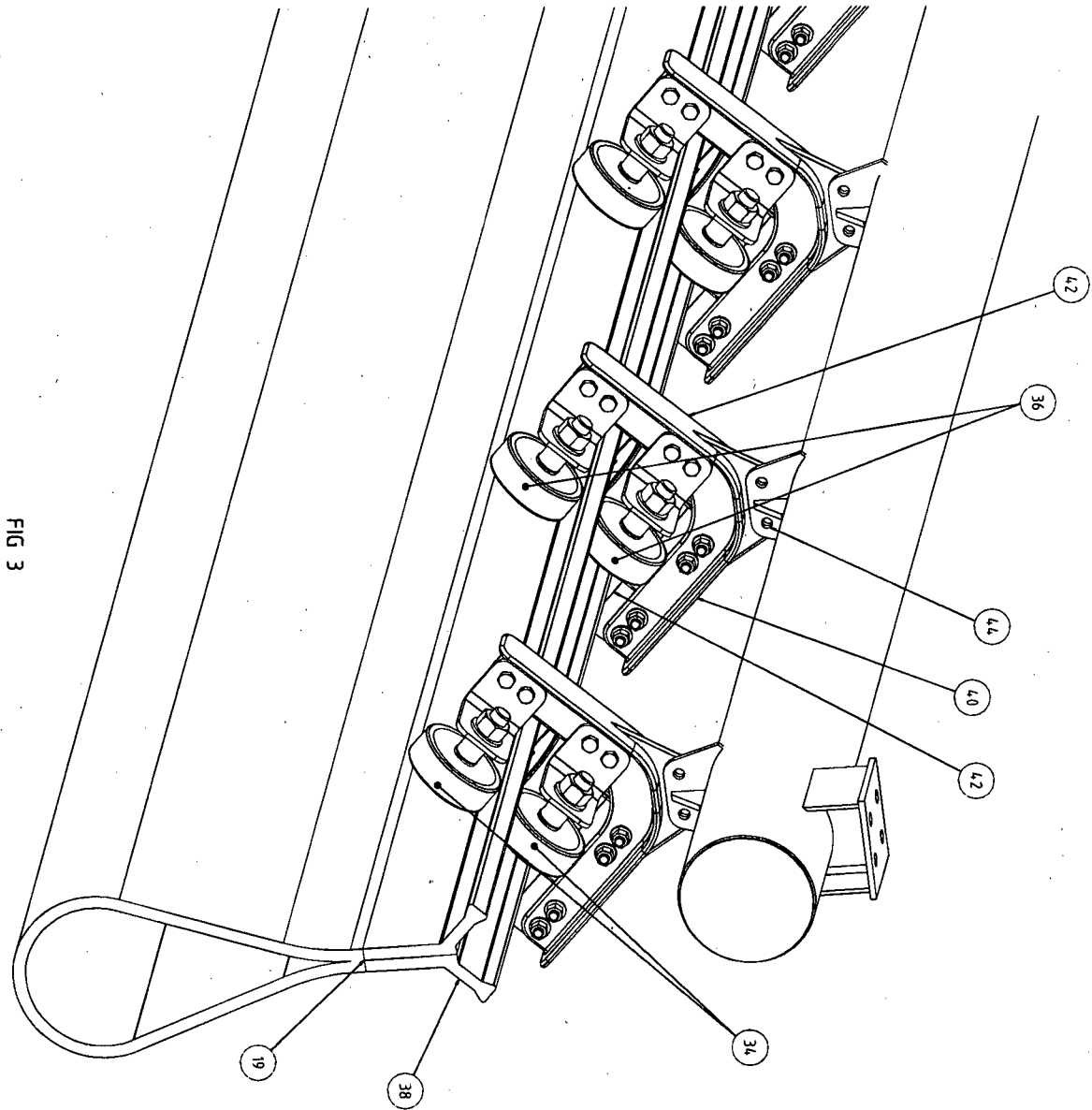
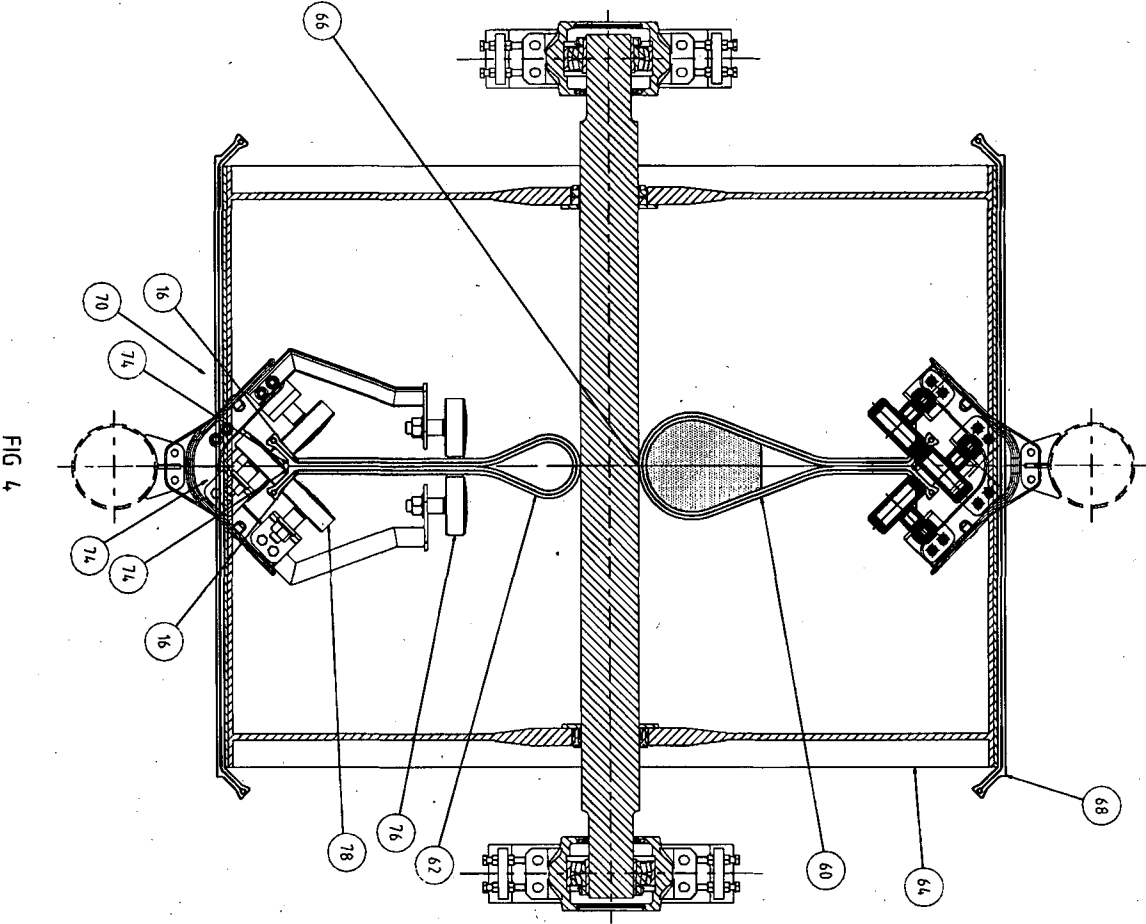
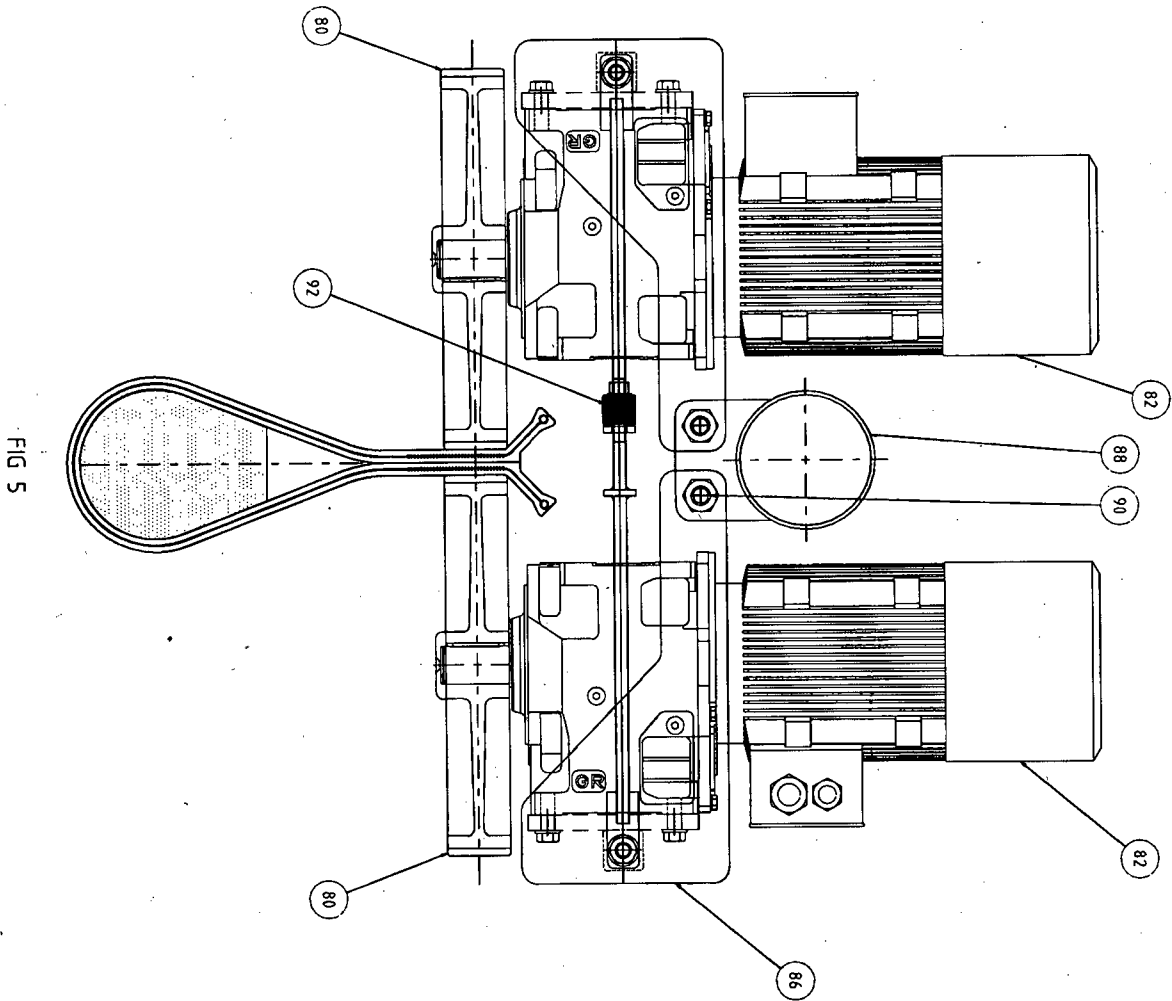
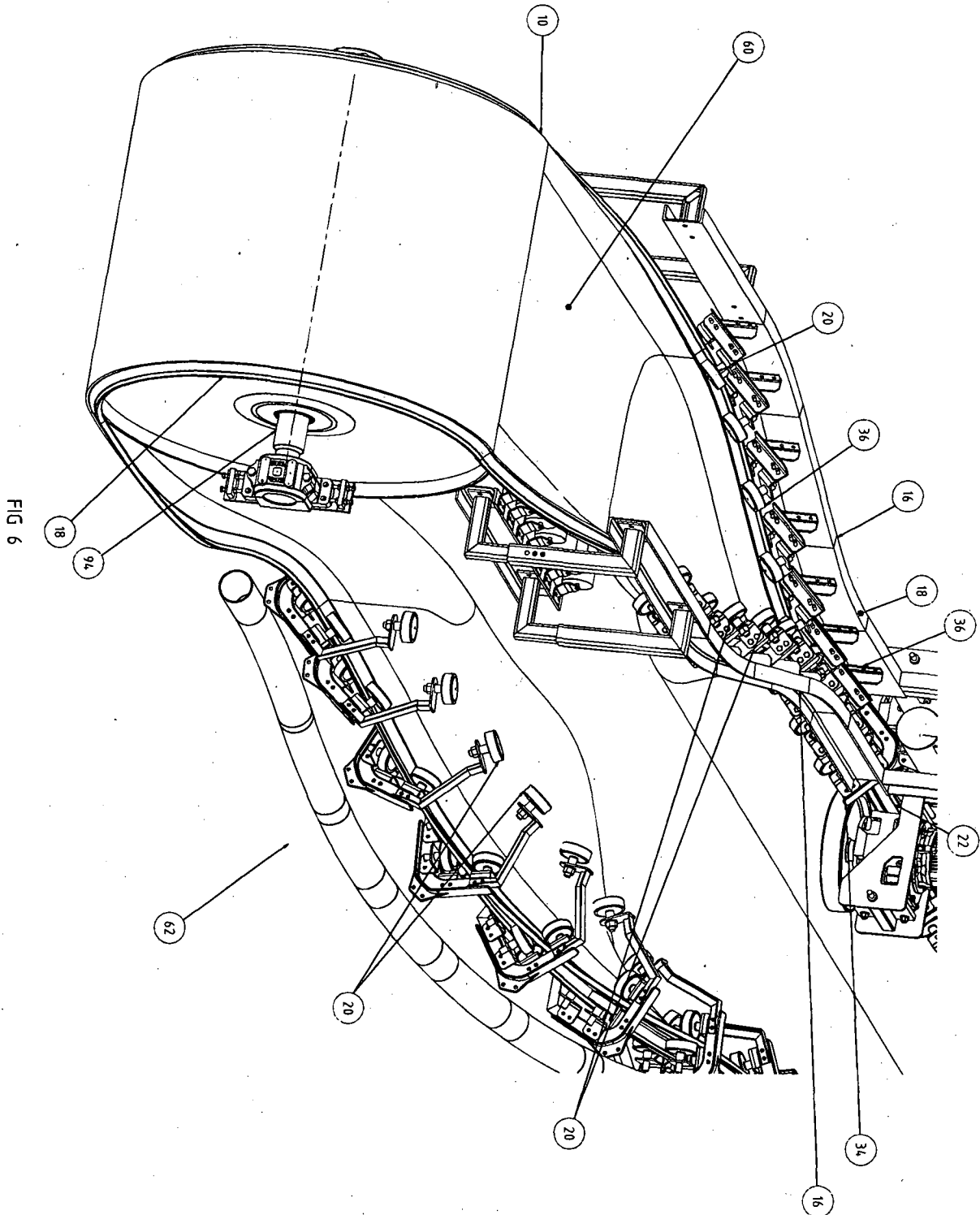
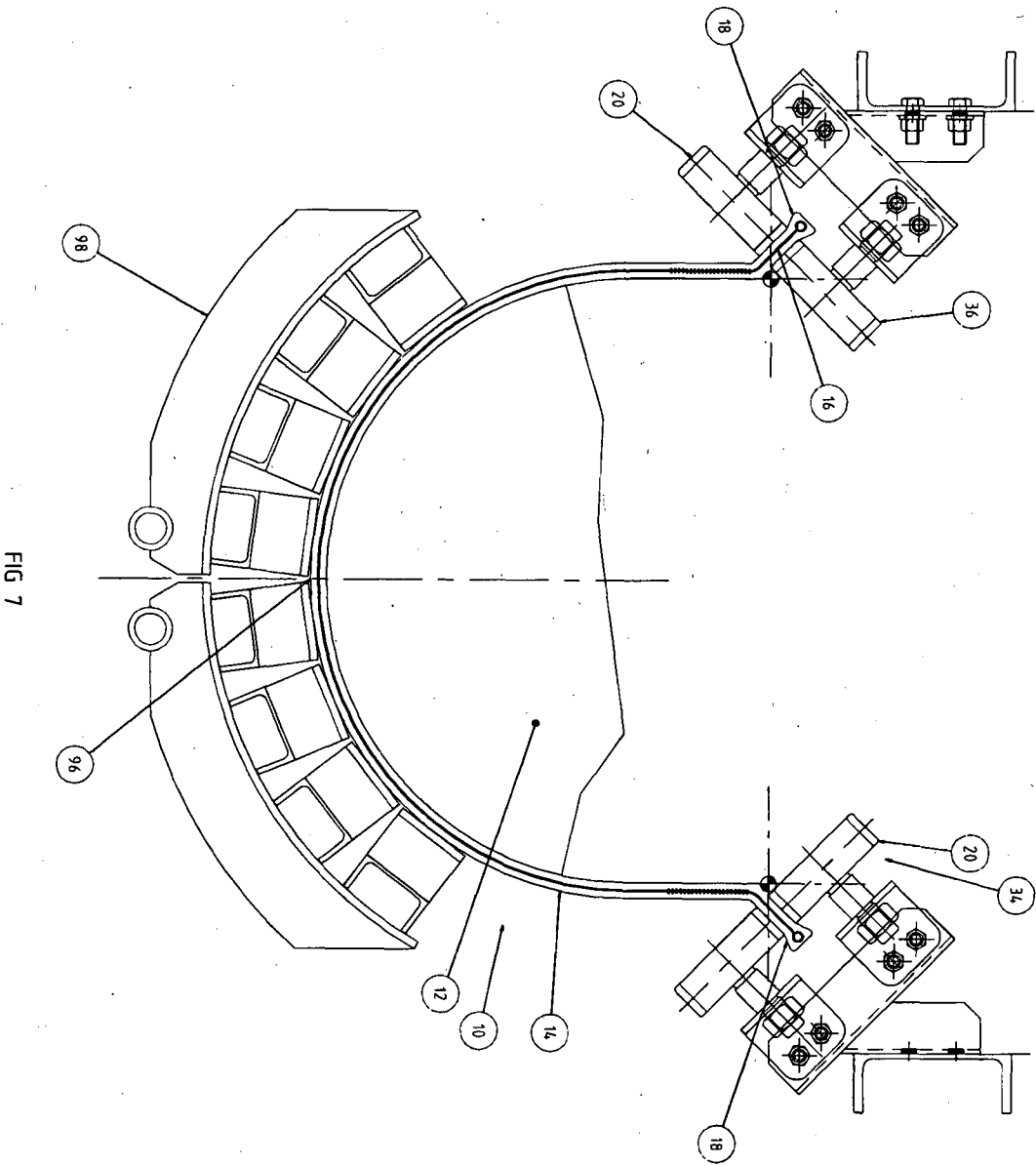


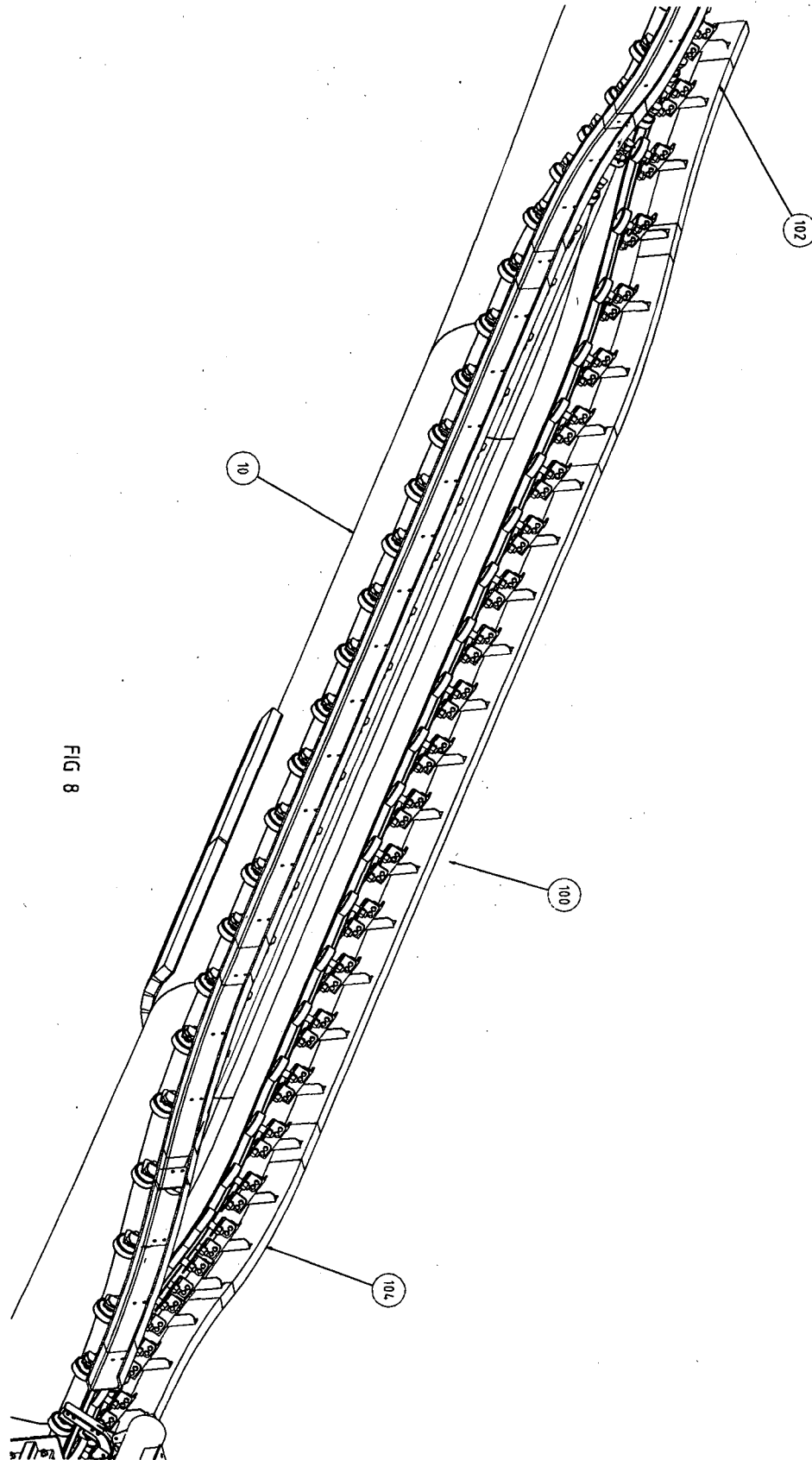
FIG 3











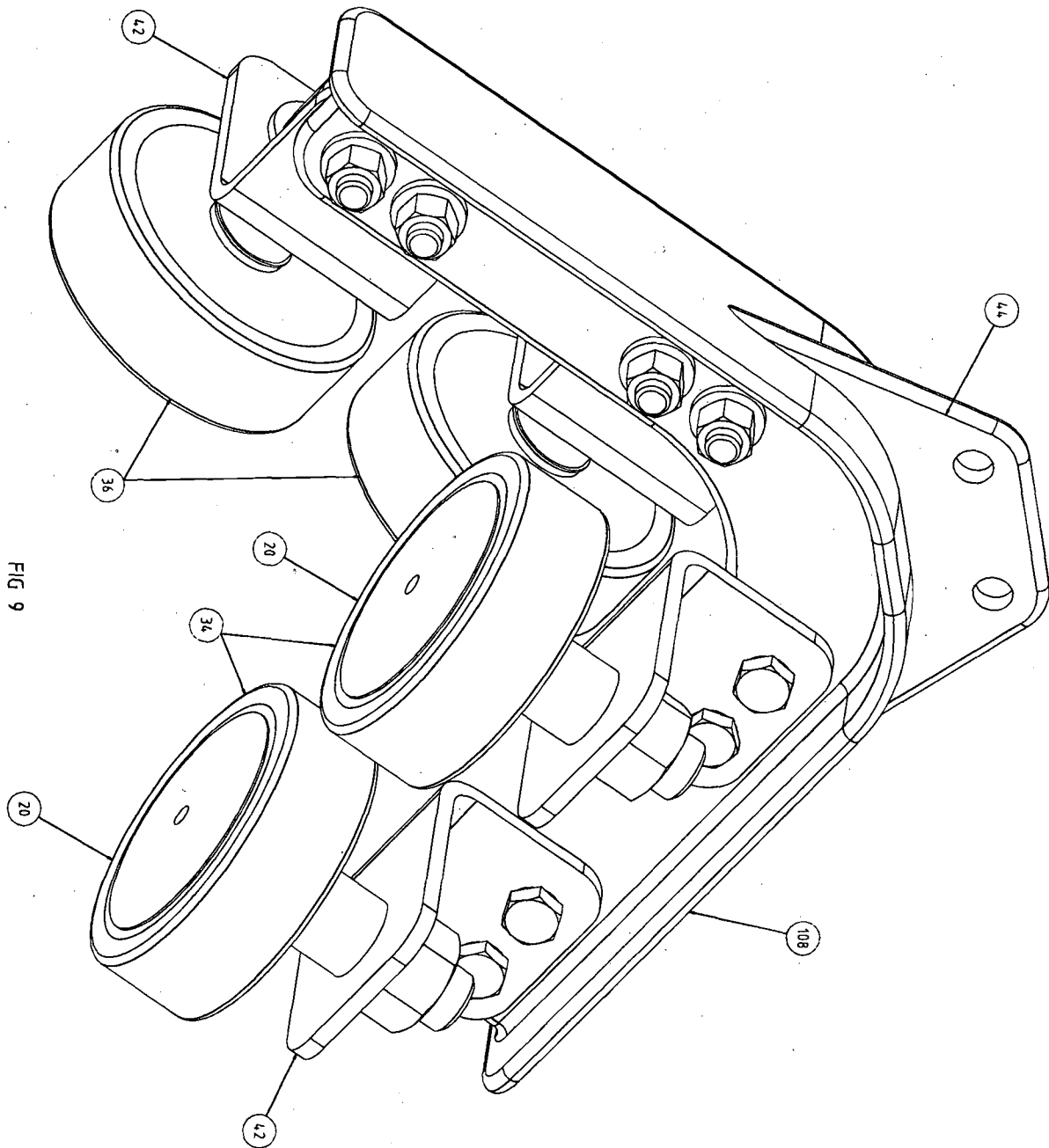


FIG 9

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2012/000449

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

B65G 15/08 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED.

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
 EPOQUENET: EPODOC, WPI - IPC Marks: B65G15/low, B65G17/low, B65G21/low, B65G35/low, B65G39/02/low, B65G41/low with Key Words: POUCH, CLOSED, WRAP+, FOLD+, CONVEYOR, ENDLESS, BELT, CARRIER, SEAL+, SECUR+, CLAMP+, CONTACT+, MAT+, ROLLER? OR GUID+, GAP?, SPAC+, MARGIN?, CLEARANCE+
 GOOGLE PATENTS: Word Search- CONVEYOR, PIPE, TUBULAR, SEAL, ROLLER

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0345193 A1 (ETUDES DE TRANSPORTS SARL) 6 December 1989 Figs 1, 3	
A	GB 2201391 A (BRIDGESTONE CORPORAION) 1 September 1988 Abstract; figs 1, 2, 4, 5, 7	
A	US 4505382 A (MAREAU) 19 March 1985 Abstract: figs 1; 2, 4	
A	GB 1351132 A (BTR INDUSTRIES LTD.) 24 April 1974 Figs 1, 2a	

☒ Further documents are listed in the continuation of Box C☒ See patent family annex

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
16 May 2012

Date of mailing of the international search report
16 May 2012

Name and mailing address of the ISA/AU
 AUSTRALIAN PATENT OFFICE
 PO BOX 200, WODEN ACT 2606, AUSTRALIA
 E-mail address: pct@ipaustalia.gov.au
 Facsimile No. +61 2 6283 7999

Authorized officer
P Fernando
 AUSTRALIAN PATENT OFFICE
 (ISO 9001 Quality Certified Service)
 Telephone No : +61 2 6283 7948

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2012/000449

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: **15-17**
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

Claims 15-17 rely on references to the description and the drawings.
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2012/000449

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2365762 A (H. S. JOHNS et al.) 26 December 1944 Figs 5, 6, 15	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2012/000449

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
EP	0345193	FR	2631942				
GB	2201391	JP	63262317				
US	4505382	CA	1201674	EP	0084511	FR	2519944
		JP	58125506	JP	H02105910U		
GB	1351132	NONE					
US	2365762	NONE					
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.							
END OF ANNEX							