A screening deck is provided which includes a plurality of screening panels to form the screening surface each panel having a thickness and edge faces on the periphery of the panels; a support frame for the screening panels; fixing means to secure the panels to the support frame; wherein the fixing means consists of recesses in the edge faces and a fixing strip having complementary protrusions to mesh with said recesses on the edge faces, the fixing strip being integral with or securable to the support frame. The arrangement of the recesses and protrusions increases the open area of the panels. The recesses may alternately be in the fixing strip and the protrusions on the edge faces. Additionally a locking strip may be used having complementary recesses or protrusions in addition to the panels and fixing strips to prevent ingress of fines at the panel junctions. The protrusions or recesses on the panel generally function as a snap fit interlock characterised by a high lead in angle to provide an ease of assembly and a steeper lead out angle in combination with an undercut to realize a defined higher panel dislodgement force.
before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))
Ore Screening Panel Fixing System

This invention relates to improvements in ore screening panels used in the separation and grading of materials in the mining and quarrying industries.

Background to the invention

Australian patent 482212 proposed a modular screening panel system for ore screening decks which is now widely used by the mining industry and replaced the earlier screening cloths, and large wire screening frames. The screening panels were all of the same size [eg. 300mm] and made of reinforced polyurethane. The panels are adapted to be secured to an underlying support frame using dependent spigots which are a force fit into corresponding apertures in the support frame. Patent 517319 provided an alternative method of securing the panels to the frame using a pin expanded fastening concept.

The Australian patent 556953 disclosed the use of a hold down bar which abutted the edge flanges on the panels and had spigots passing through apertures in the edge flanges and into apertures in the underlying support frame. Australian patent 700843 disclosed a two part hold down bar the first being bolted to the frame and the second being a snap fit into the first part.

Australian patent 559443 improved on this concept by providing a channeled bar which could be bolted to the underlying support frame. The panels had dependent flanges which were a force fit into the channel of the bar. A pair of abutting panels each provided flanges to fit into one channel. Together two abutting edge flanges provided a shape complementary to the cross sectional shape of the channel.

Patent 627919 discloses a modification of that arrangement but still relying on the force fit of the dependent flange or skirt on the edge of the panel, into the channel of the hold down bar. Australian patent 742060 and application 17523/00 are improvements in the dependent flange and channel shaped hold own bar concept.
Australian patent 2003204125, Australian patent 662683 or Australian patent 2003218509 all suggest using a narrow support in the shape of an I beam. These arrangements all compromise the I beam with a fastening arrangement that extends laterally of the beam and thus compromises the available open area of the screening surface.

All of these attachment systems encroach on the margins of the panel and restrict the available screening area of the screening surface. It is an object of this invention to provide an alternative means of fastening screening panels which enables them to be easily installed and replaced while providing a high hold down force.

It is a further object of this invention to increase available open area of the screening panel.

**Brief description of the invention**

To this end the present invention provides a screening deck which includes a plurality of screening panels to form the screening surface; each panel having a thickness and edge faces on the periphery of the panels; a support frame for the screening panels; fixing means to secure the panels to the support frame;

wherein the fixing means consists of recesses in at least two of the edge faces of each panel and a fixing strip having complementary protrusions to mesh with said recesses on the edge faces, the fixing strip being integral with or securable to the support frame and the arrangement of the recesses and protrusions increases the open area of the panels.

Alternatively the recesses may be in the fixing strip and the protrusions on the edge faces.

By using a fixing strip and complementary protrusions and recesses, the open area of the panels may be increased. If the fixing strip is not integral with the panel it is preferably a snap connection onto the support frame.

Preferably a locking strip may be used in addition to the panels and fixing strips to prevent ingress of fines at the panel junctions.
This invention provides fixing of a panel to a fixing strip for high open area whilst maintaining high panel holding forces. The protrusions or recesses on the panel generally function as a snap fit interlock characterised by a high lead in angle to provide an ease of assembly and a steeper lead out angle in combination with an undercut to realize a defined higher panel dislodgement force.

This invention also provides fixing of the fixing strip to the screen media support structure, simplifying the screen deck rail design and cost, eliminating the need for steel reinforcements in the fixing strip as well as omitting the need for bolt on fixing elements such as welded bolts and nuts for attachment of the fixing strip to the rail or additional fixing pins.

The advantages of this invention include

1. Higher open area than current known fixing systems whilst maintaining a high holding force
2. The holding force may be designed to be as high as pin-fixing systems
3. Ease of assembly and disassembly of fixing strips
4. Further increased of ease of assembly and disassembly of screening media panels with introduction of locking strip
5. Adaptable to a variety of machine frame
6. Suitable fixing for wet / dry operating conditions
7. Suitable fixing for polyurethane / rubber panels and components
8. Simplification of interface: No loose small parts
9. Simplification in manufacture of components (+cost reduction)
10. Fixing strip may be injection moulded as no steel reinforcement is required as with other systems
11. Screen deck rail may be manufactured in one process step (laser-cutting). The raw material may be standard off the shelf angle iron profile, readily available
12. Panel joint line protected from dirt ingress
13. Easy change between panels with locking strip or without. Only by providing a new panel. No need to change fixing device or rail.
14. Substantial weight reduction compared to standard hold down bar systems
15. no steel reinforcement in the fixing strip is required
16. Weight reduction of support rails compared to standard angle iron rails (thinner horizontal profile)
17. The exposure of the fixing strip due to panel wear may be used as a wear indicator for the panel itself.
18. Reduction of the likelihood of material build up or pegging underneath the screen media panel due to the thin horizontal rail width.

Detailed description of the invention.
Preferred embodiments of the invention will be described with reference to the drawings in which:
Figure 1 is a view of the general assembly of this invention;
Figure 2 illustrates 3 views of the panel of this invention highlighting the edge face of the panel;
Figure 3 illustrates two views of the preferred support rail of this invention;
Figure 4 illustrates a first embodiment of the fixing strip of this invention;
Figure 5 illustrates 3 views and two detailed views of the fixing strip;
Figure 6 illustrates two views of the optional locking strip;
Figure 7 illustrates the installation of the locking strip;
Figure 8 illustrates a side view of the assembly of figure 7;
Figure 9 illustrates a panel with edge surface protrusions without the need for a locking strip;
Figure 10 illustrates a panel and fixing strip;
Figure 11 illustrates 3 views of the panel that does not require a locking strip;
Figure 12 illustrates a panel embodiment with edge surface protrusions that are used in conjunction with a locking strip and fixing strip;
Figure 3 illustrates a panel used in a further embodiment of this invention which provides an indication of panel wear;

Figure 14 illustrates the edge surface of the panel of figure 13;

Figure 15 illustrates the assembly of a support rail fixing strip and panel according to figure 13;

Figure 16 illustrates another embodiment of the invention illustrating a Bolton version of the fixing strip;

Figure 17 illustrates a further view of the fixing strip of figure 16;

Figure 18 illustrates an end view of figure 17;

Figure 19 illustrates 3 views of a panel having another embodiment of the interface design;

Figure 20 illustrates 3 views of a panel having a further embodiment of the interface design;

Figure 21 illustrates 3 views of a panel having yet another embodiment of the interface design;

Figure 22 illustrates the assembly of variants of panels of this invention mounted on a support rail comprising an L-beam rail encapsulated in polymer with and without an integral fixing strip and a locking strip;

Figure 23 is an end view of the assembly of figure 22;

Figure 24 illustrates a partly exploded view of figure 22 showing the locking strip and an edge fixing;

Figure 25 illustrates a fixing strip and support rail with a frame cover;

Figure 26 illustrates the frame cover of figure 25.

In the embodiment of figure 1 the support frame 1 is a slim angle iron rail to maximise screening open area. The fixing strip 2 is designed to interlock screen media panel 3 with deck rail 1.

The screen media panel 3 is provided with side protrusions to interlock with the complementary recesses on the fixing strip.

In the panel as further illustrated in figure 2, typically less than 5mm of panel width either side are proposed for the fixing system which cannot be utilized as
panel open area. This maximizes the utilization of the important effective
screening area of a screen media panel and is essentially superior to existing
high open area fixing systems.

In figure 2 the screen media panel is shown as a bottom view at 2.

A side view of screen media panel is shown at 3 with repetitive side protrusions
4 to interlock with the fixing strip. The panel protrusions 4 interface with the fixing
strip. The profile shape for protrusions 4 consists of a larger lead in angle to
allow assembly and an undercut in combination with a defined lead out angle to
secure the panel once installed. The undercut depth and lead out angle are
specifically designed to create a defined holding force and are chosen to suit the
specific material properties of the fixing strip and screen media panel. The
repetition of this profile and may vary to define the desired overall panel holding
force. These thin protrusions are typically <5mm to maximise open area.

In Figure 3 the rail embodiment is of a very low profile <30mm ensuring the
utilisation of the open area of the panel and reducing potential pegging or
material build-up issues.

This slim angle iron rails are easy to manufacture as only one process step is
required (laser cutting). The laser cutting is generally required for angle iron rails
to trim to the correct width. In this case the further cut-out profiles may be
accommodated for in the cutting process, which allows for cheap manufacture.

Conventional rails usually consist of holes drilled into the rail in a second
process step. The same argument applies for other existing rail fixing systems
such which require holes to be drilled into the rail.

Repetition of profiled cut out is shown at 2 in figures 1 and 3 to allow a snap
interlock of the screen deck rail with the fixing strip. A detailed view of profiled
cut out is shown at 3 where the snap fit cut out 4 allows interaction with the fixing
strip to create a defined minimal lateral holding of the fixing strip on the rail. The
cut out is designed to allow a mating of the fixing strip with the vertical portion of
the screen deck rail.

In figure 4 the fixing strip is for for a 305mm base length to suit imperial sized
screen media panels. The base length may be modified e.g. to suit metric
300mm panels. Elongated versions may be manufactured to reduce the number of fixing strips required, typically in multiples of the base length e.g. 1220mm. In figure 5 a bottom view of fixing strip is shown at 2. The lower fixing strip protrusion is shown at 3. The lower protrusion is designed to provide a secure non-releasable fixing of the strip in vertical direction.

Section view A-A shown at 4 illustrates a lateral clip on rail interface consisting of one or more elements for attachment of the fixing strip to the rail. The amount of clip on elements may vary depending on the application. A detailed view A of the snap fit shaped profile is shown at 5 of figure 5. The profile shape consists of a larger lead in angle to allow assembly and an undercut in combination with a defined lead out angle to secure the panel once installed. The undercut depth and lead out angle are specifically designed to create a defined holding force and are chosen to suit the specific material properties of the fixing strip and screen media panel. The repetition of this profile and may vary to define the desired overall panel holding force.

View B shows Lateral clip on rail detail at 7. This connects the lower portion of the fixing strip to the upper portion.

Mating of the fixing strip with the vertical portion of the screen deck rail is shown at 8. A portion of the lower protrusion (radius) is intended to mate with the vertical portion of the screen deck rail to further secure the fixing strip from dislodging by rotational torque in longitudinal direction of the screen deck rail. The shape is not of importance as long as it mates with the rail.

Snap fit lug 9 allows for a defined minimal lateral holding of the fixing strip on the rail. The shape can be varied to allow an easier assembly and higher disassembly force by introducing different lead in and lead out angle in combination with a defined undercut (similar to the snap fit profile as shown in 5). The snap fit also provides means of feedback to the person installing the strip that the fixing strip is properly installed. Once all panels in a screen deck are in place this lateral holding function is not required as the panels hold each other in place.

An end view of fixing strip is shown at 10.
Rail protection 11 is optional. The rail protection may be omitted or included as desired.

Panels may be secured to the fixing device with or without a locking strip without the need to exchange any parts other than the screen media panel protrusions which is done with the use of a modular panel tooling setup.

To ease the required effort for assembly and disassembly of a panel during replacement an optional locking strip is introduced. This locking strip shown in two views in figure 6 replaces some of the protrusions on the panel to interlock directly with the fixing device. Thus the holding force of the panel is reduced after disengaging the locking strip, allowing an easier and quicker panel replacement.

The overall holding force with installed locking strip is unchanged. The locking strip may be as long as a panel or longer in length to fix multiple panels at the same time to the fixing device. Part of the locking strip may be elevated above the screen panel to function as a rider bar if material tracking is desirable for the screening application.

- Locking strip can have deflectors
- Locking strip can cover the fixing region on top of the panel to provide further protection against dirt ingress or exposure of the fixing system to the ore
- Locking strip can be flush with top of panel w/without deflectors

The Panel joint line is protected from dirt ingress due the locking strip due to the double T-shaped intersection between panel, fixing device and locking strip.

Figure 7 shows a view of the assembly with locking strip and poly encapsulated rail showing the intersection of panel, locking strip and fixing device to prevent dirt ingress at the panel joint. Here the fixing strip is shown in combination with a poly encapsulated I beam rail.

Figure 8 is a side view of the assembly of figure 7.

Figure 9 illustrates a panel with protrusions that function in the same manner as the locking strip of figure 6.

Figure 10 illustrates a panel and fixing strip.

Figure 11 illustrates 3 views of the panel that does not require a locking strip.
Figure 12 illustrates a panel embodiment with edge surface protrusions that are used in conjunction with a locking strip and fixing strip.

Figures 13 to 15 illustrate an embodiment that also functions to indicate panel wear. The exposure of the fixing strip due to panel wear can be used as a wear indicator for the panel itself. The panel will have an appropriate impression to suit. This impression is leveled to a certain panel height which is deemed as the maximum panel wear depth. To protect the actual fixing strip from wear the indicator can be realized by slightly raising a specific portion on one or more of the profiles on the fixing strip.

The fixing device may be designed to be bolted onto or spigot onto an angle rail. This method is known from patents 2009101091 and 662683. The fixing device may be designed as disclosed by patent 2009200159 and as indicated in figures 16 to 18.

Figures 19 to 21 illustrate other protrusions that may be used in the fixing and locking strips or on the panel edge faces.

The round, oval, elliptic or preferably polygonal shaped protrusions on the panel fixing side which are shown here mainly as hexagonal shapes on the screen media panel interlock onto a plastic fixing strip. The panel may alternatively interlock onto the fixing strip with additional preferably hook-like shaped protrusions (as specifically shown in the locking strip version).

The protrusions are slightly oversized to enable secure fixing and induce a force between the fixing device and the polygonal shapes thus increasing the interlock between the screen media panel and the fixing device. This force increases as the panel is pushed/pulled out.

Assembly of selected variants also disclosing the option of polyencapsulating the screen deck rail in combination of an I-beam rail is shown in figure 22.

To prevent exposure and corrosion of the screen media support structure the fixing device may be manufactured to fully encapsulate the rail as shown in figures 23 and 24.
As further protection for the support rail a cover strip as shown in figures 25 and 26 may be used. The angle on the cover strip can be 90deg (facing straight down) or any other inclination, typically 30deg.

Those skilled in the art will appreciate that the present invention provides a unique means of securing screening panels to the support frame and increasing the available open area without compromising the hold down forces.

Those skilled in the art will also realize that the invention may be put into practice in other embodiments than those disclosed without departing from the core teachings of this invention.
CLAIMS

1. A screening deck which includes
   a plurality of screening panels to form the screening surface
   each panel having a thickness and edge faces on the periphery of the
   a support frame for the screening panels
   fixing means to secure the panels to the support frame
   wherein the fixing means consists of recesses in at least two of the edge
   faces of each panel and a fixing strip having complementary protrusions
   to mesh with said recesses on the edge faces, the fixing strip being integral
   with or securable to the support frame and the arrangement of the
   recesses and protrusions increases the open area of the panels.

2. A screening deck as claimed in claim 1 wherein the recesses are in the
   fixing strip and the protrusions on the edge faces.

3. A screening deck as claimed in claim 1 or 2 which additionally uses
   a locking strip in addition to the panels and fixing strips to prevent ingress of
   fines at the panel junctions.

4. A screening deck as claimed in any one of claims 1 to 3 wherein the
   protrusions or recesses on the panel generally function as a snap fit
   interlock characterised by a high lead in angle to provide an ease of
   assembly and a steeper lead out angle in combination with an undercut to
   realize a defined higher panel dislodgement force.

5. A screening deck as claimed in any one of claims 1 to 4 in which the fixing
   strip is separate from the panels and is securable to the support frame by a
   snap connection.
6. A screening panel with a high open area for use in the screening deck as claimed in any one of claims 1 to 5 wherein the panel has a thickness and edge faces on the periphery of the panels incorporating recesses to mesh with the complementary protrusions of said fixing strip.

5

7. A screening panel as claimed in claim 6 wherein protrusions are provided on the edge faces and the complementary recesses are in the fixing strip.

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8. A fixing strip for use in the screen deck of any one of claims 1 to 5 having complementary protrusions to mesh with said recesses on the edge faces, the fixing strip being securable to the support frame by a snap connection and the arrangement of the recesses and protrusions increases the open area of the panels.

15

9. A fixing strip as claimed in claim 8 wherein recesses are provided in the fixing strip and the complementary protrusions are on the edge faces of the panels.
INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2015/000009

A. CLASSIFICATION OF SUBJECT MATTER

B07B 1/30 (2006.01) B07B 1/46 (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)

Epdoc & WPI: IPC & CPC: B07B1 and (((SCREEN or SIEVE) 5d (PANEL+ or DECK+ or MODUL+ or PORTION? or PIECE?)) and (FIX+ or ATTACH+ or SECUR+ or INTERLOCK+ or FIT+ or SNAP+ or CLIP+ or CLICK+ or CONNECT+ or FAST+ or JOIN+ or CLASP+)) and (FRAM+ or EDG+ or SUPPORT+ or BASE? or SUB_FRAM+) and (RECESS+ or GAP? or OPEN+ or HOLE? or MOUTH? or REBATE? or GROOV+ or SLOT+ or FEMALE) and (PROTRU+ or PROJECT+ or MALE or JUT+ or TONGU+ or TAB?)

Applicant(s) and Inventor(s) names searched in internal databases provided by IP Australia.

Google Patents search completed using keywords: screen, sieve, panel, deck, module, portion, piece and the like.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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<td>Documents are listed in the continuation of Box C</td>
<td>X Further documents are listed in the continuation of Box C</td>
<td>See patent family annex</td>
</tr>
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- * Special categories of cited documents:
  - "A" document defining the general state of the art which is not considered to be of particular relevance
  - "E" earlier application or patent but published on or after the international filing date
  - "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)
  - "O" document referring to an oral disclosure, use, exhibition or other means
  - "P" document published prior to the international filing date but later than the priority date claimed

- "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

- "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

- "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

- "K" document member of the same patent family

Date of the actual completion of the international search
27 May 2015

Date of mailing of the international search report
27 May 2015

Name and mailing address of the ISA/AU

AUSTRALIAN PATENT OFFICE
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Authorised officer

David T Bell
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Telephone No. 0262832309

Form PCT/ISA/210 (fifth sheet) (July 2009)
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<td>WO 2008/014552 A1 (Ludowici Mineral Processing Equipment Pty. Ltd.) 07 February 2008 Abstract, page 4 line 20 to page 13 line 2, page 14 line 13 to page 18 line 15, Figures, claims</td>
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<td>US 5112475 A (Henry Jr.) 12 May 1992 Abstract, column 1 line 49 to column 2 line 60, column 3 line 24 to column 6 line 11, claims, figures</td>
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Continuation of Box II
Claim 1 (and claims 6 and 8) specifically requires that the ‘fixing means consists of recesses in at least two of the edge faces of each panel and a fixing strip having complementary protrusions’. An alternative method of securing the panels to the frame does not fall within the scope of the present claims. Claims 2, 7 and 9 specify a contrary arrangement where the recesses are in the fixing strip and the protrusions on the edge faces. This is the opposite of what is claimed in claim 1 (and claims 6 and 8) and therefore cast doubt on the scope of these claims. As a result, the scope of claims 2, 7 and 9 lacks clarity since as claim 1 currently stands no other scope is possible. Opinion regarding the Novelty, Inventive Step and Industrial Applicability of claims 2, 7 and 9 is therefore reserved.
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:
     - the subject matter listed in Rule 39 on which, under Article 17(2)(a)(i), an international search is not required to be carried out, including

2. **Claims Nos.: 2, 7 and 9**
   - 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:
     - See Supplemental Box

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.**
This Annex lists known 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.

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End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.
This Annex lists known 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.

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Form PCT/ISA/210 (Family Annex)(July 2009)