Wire Meshes

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Mesh types, crimp/weaving patterns, applications data, suggestions about fitting wire meshes in screens, fastening/tension systems.

This article will treat mainly wire mesh types, manufacturing methods, applications and implementations.

Wire screens or meshes are the oldest and most efficient means of aggregates separation in terms of open area. They are irreplaceable in small as well as mobile screens having restricted screening surfaces.

People involved in the separation of aggregates have been using for some time other screening medias as wire meshes that can be classified as:

- Rubber mats mainly used in mines and quarries on primary and secondary decks where the feed rate and size are too important for wire meshes. These mats are provided with tapered openings to reduce the phenomenon of openings blocked (pegging) by the crushed material
- PUR (polyurethane) molded or injection mats or modules mainly used in sand and gravel pits, and lately in quarries as well.

Both of these outlast by several fold wire screens, yet reduce considerably the open area, less production.

Nature of Various Wires Used

HT wire is a high-carbon (0.5% and above) steel (see **Table 1**). LT wire is a low-carbon grade wire with low abrasion resistance quality. Piano wire for tough abrasion-factor applications and "self-cleaning" meshes (tensile strength from 1980/2200 to 1400/1580 N/mm^2 of wires from 1 to 6 mm diameter).

Oil-tempered steel wire has tensile strength slightly lower than HT wires. The full range of SST (stainless steel) wires overcomes binding with sticky materials (lime stone, fertilizers, etc.) and the full range of refractory steel wires is for hot applications.

Copper, bronze, aluminum, etc., wires are for special applications. Composite spring steel wire is precoated with PUR prior to weaving.

Table 1. Tensile strength of HT (high tensile) wire used to produce meshes for use in mines, quarries, sand and gravel pits (Rm = tensile strength of metals, MpA = Megapascal = 1 N/mm^2).

Ø (mm)	Tol Ø (mm)	Rm
1,00 mm	+/-0,010	R 1520/1720 Mpa
1,20 mm	+/-0,020	R 1520/1720 Mpa
1,50 mm	+/-0,020	R 1470/1670 Mpa
2,00 mm	+/-0,020	R 1370/1570 Mpa
2,50 mm	+/-0,030	R 1320/1520 Mpa
3,50 mm	+/-0,030	R 1170/1370 Mpa
4,00 mm	+/-0,030	R 1130/1330 Mpa
4,50 mm	+/-0,030	R 1080/1280 Mpa
5,00 mm	+/-0,030	R 1030/1230 Mpa
6,00 mm	+/-0,030	R 980/1180 Mpa
7,00 mm	+/-0,040	R 980/1180 Mpa
8,00 mm	+/-0,040	R 980/1180 Mpa
9,00 mm	+/-0,045	R 980/1180 Mpa
10,00 mm	+/-0,045	R 980/1180 Mpa

Mesh Types

The choice of mesh type is entirely dependent on the type of aggregates to separate, the problem to solve, thus to obtain the necessary output, cleanliness of the aggregates, proper sizing, to overcome screening area shortage, to climate clogging/pegging, etc.

The common point of meshes as per **Figure 3** and **Figure 4** is that the precision of the undersize cannot be guaranteed as the long wires that are oriented in the direction or at right angle of the material flow have the tendency of parting (due to crushed stones caught between the long wires), especially in the absence of permanent tensioning (as is the case in almost all screens).

Self-Cleaning or Nonblinding Wire Meshes

This is the latest up-to-date, state-of-the-art wire screening media. It is made up of noncrossing precrimped wires, thus in use each wire vibrates independently between the rubber or PUR (polyurethane) strips or eventually between the groups of cross wires when the screen mesh is used in hot applications (asphalt, slag, etc.).

Screen Panels

Screen panels must be tensioned at all times. If not, they will break prematurely and the wires in the panels will part.

It is extremely important that the rubber-protected bucker/camber bars and the strip spacings match so as to avoid the screen panels tapping on the bars, and again breaking prematurely.

Selecting Screen Media

The simplest and most universally used screening medium is wire mesh. It is a very low purchasing item. However, it may prove to be expensive in terms of cost price as it has to be changed relatively often meaning down time for changing and thus loss in production.

Nevertheless, wire meshes are irreplaceable on small screens having restricted screening area, when the screen is running at near capacity, or for short orders of given aggregate sizes. Therefore, the mesh sizes are frequently changed on portable screens for top and low decks, for dry or wet screening on the lower decks, in all cases where a maximum output is required in any given screen, provided that there are no clogging or binding problems. If so, refer to the self-cleaning meshes section of this article.

Figure 1 and **Figure 2** show the most widely selected patterns, and **Figure 3** is chosen to increase the open area for the highest possible output where the precision of the undersize if not a primary concern like topsoil, fertilizers, etc. **Figure 4** shows the flat top version of harp or triple shut meshes, which will not last longer than type B, but will also stop the straight wires from parting due to the near size aggregates getting cornered in the intermediate crimps, and altering the precision of the screened material.

Figure 5 shows a combined solution that associates crimped wires and PUR, just like the self-cleaning wire meshes described earlier.

As one can see, selecting the right and most efficient screening media is not something that may be qualified as an exact science. In many cases it takes some experimentation in choosing the type of mesh pattern and size to install before obtaining the expected result.

Different mesh patterns and screening media can be mixed, like fitting a PUR or rubber section at the feed end mainly on top decks to absorb the shock and load of the incoming run of the mine or pit, and then fit subsequent wire meshes for open areas, to balance the production rate.

In wet screening on a deck fitted with PUR panels or modules, the sand and gravel feeds have the tendency of running down too fast, carrying over a good deal of undersizes. To overcome this frequent phenomenon, run the screen counter-clockwise and install three to four split rubber skirts at right angles of the flow from used conveyor belts that will barely touch the panels. This very simple solution will keep the materials on the screening surface longer.

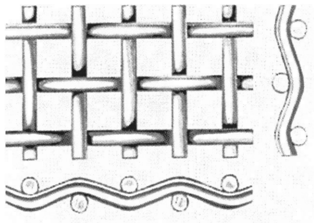


Fig. 1 — Double crimp – which is the basic, universal crimping pattern.

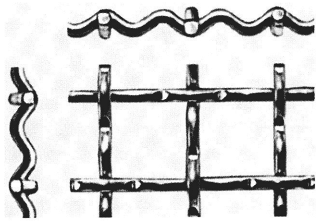


Fig. 2 — Intercrimp – when the ratio of mesh versus wire diameter is more than four.

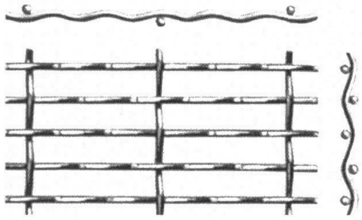


Fig. 3 — Long slot weaving pattern to increase the screening surface, cross wires spacing should not exceed more than seven crimps.

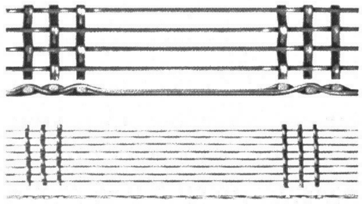


Fig. 4 — Harp or triple shut weaving pattern to overcome blinding or pegging, and to remove slivers (flats).

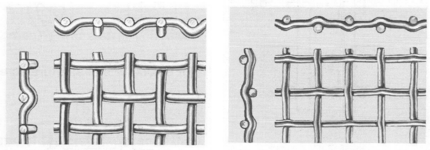
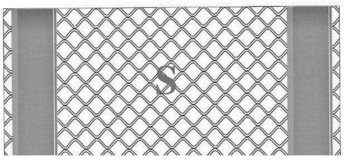


Fig. 4A — Flat top (near right) and lock crimp (far right) styles.

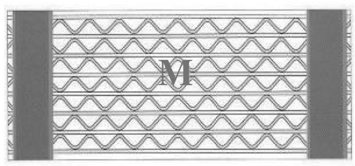
Screens & Fittings/Tensioning

There are various screen designs to suit specific applications or to overcome some acute problems. Here, we will only look at eccentric, unbalanced, inclined screens—the most widely used screens in the world. Their design is well known and appreciated for its simplicity and efficiency.

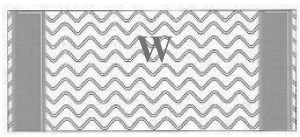
If the structure of the screen and the setting of the right unbalance/throw is very important, it is equally important to have the most appropriate frame and wire mesh tensioning/clamping device. An efficient tensioning system is shown in **Figure 6** on the next page, whereby the tension hooks of the wire mesh are suspended on the tension bars, and are not touching the camber frame's structure. The



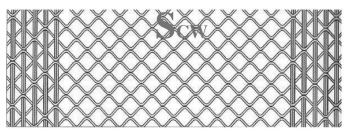
This is the most widely and universally used pattern that is suitable to solve blinding, pegging and perfect sizing applications. Each wire vibrates individually as they are not binded toge-ther. They are also a perfect solution to overcome reduced screening areas, the sizing of coal, minerals, lime stone, etc.
The phenomenon of pegging is eliminated as self-cleaning meshes have a perfectly flat surface, also flats or slivers will not go through the meshes.



This M (Mixt) type is used when the feed size off the upper deck or from the preliminary input is at least 4 times bigger than the undersize, e.g. feed size is minus 20mm for an undersize of 5mm or less.
Also used when a high precision is needed in the undersize as the wires will not part, thus the mesh will remain constant.
Both the S & M patterns are used for crushed stones to obtain cubical shaped final products.



This pattern is exclusively used for very sticky material's screening, where the absence of high precision in the undersize is not important.



This pattern is exlusively used for the screening of hot materials in cokeries, hot asphalt, etc.

Fig. 5 — Self-cleaning wire screens; different mesh patterns.

automatic tensioning is accomplished by the natural compression/decompression of the PUR rings following the load on the screening surface, with rings fitted on each tension bolt.

As opposed to the above, tension/clamp bars press and block the tension hooks on the screen's frame, resulting in a rigid assembly that can only be altered by retightening the bolts from the outside of the screen's side plates. This is the reason why so many bolts are bent and have to be cut when new panels are fitted.

On low decks where usually the fine meshes are installed, the SPT system should be used, which will also avoid the shearing of the screen cloth by the tension hook's liner edge. The use of SPT device is also recommended for medium and heavy-gauge wire meshes.

The choice of camber frame is another very important point. The higher the camber the lesser is the screening efficiency. A high camber increases the bed depth on the power points, along the tension hooks, thus a good deal of undersize will just run down without being separated. This is even more the case in wet screening, as the pressure of the water (acting as a lubricant) will accelerate the movement of the feed. The bed depth should not exceed 25-30 mm, regardless of the number of camber bars.

The best result will be obtained with an even number of bars (see **Figure 7 B – D right – E**). In any other solutions, the center bar will immediately spread the feed to the sides, leaving the center empty of barely loaded, thus resulting in poor screening efficiency.

Various Hooks & Clampings

The choice of a hook type depends mostly on the diameter of the wires the mesh is made with. Usually the fine meshes are provided with double fold hook edge, medium-diameter wires are bent in single fold liners that are spot welded to maintain the wires within, heavy-gauge wires are simply folded after having heated the wires to avoid breakage while bending, or eventually a simple thick previously bent liner is welded onto the wires.

The choice of screening media, the type of screen or the setting of the amplitude is not an easy task. A great deal of experience is an irreplaceable asset.

The choice of a screen with the number of decks depends mostly on the number of cut (product) sizes desired. However, the space available or the size of the pit is also to be taken into consideration. The number of decks will increase as the space is small.

The most important problem to solve is how to set the screen's amplitude. The difficulty is to favor either the top or lower decks. The top deck needs high amplitude to counter the feed's weight, whereas the lower decks have small amplitude to keep as long as possible the materials on the screening surface to allow

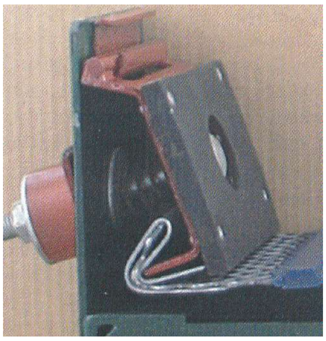


Fig. 6 — SPT (suspended pivoting tensioning) device.

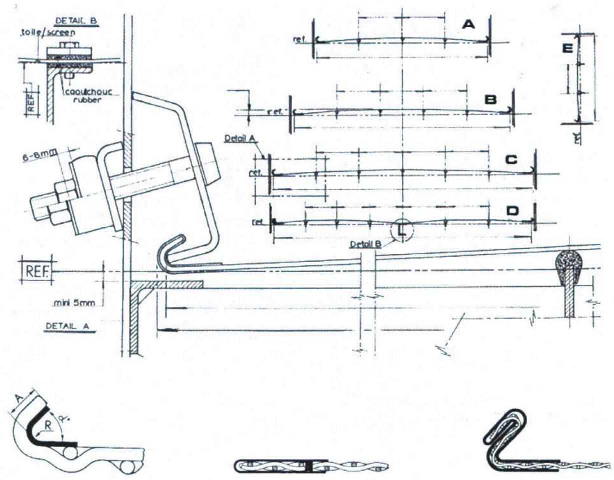


Fig. 7 — Best result is obtained with an even number of bars.

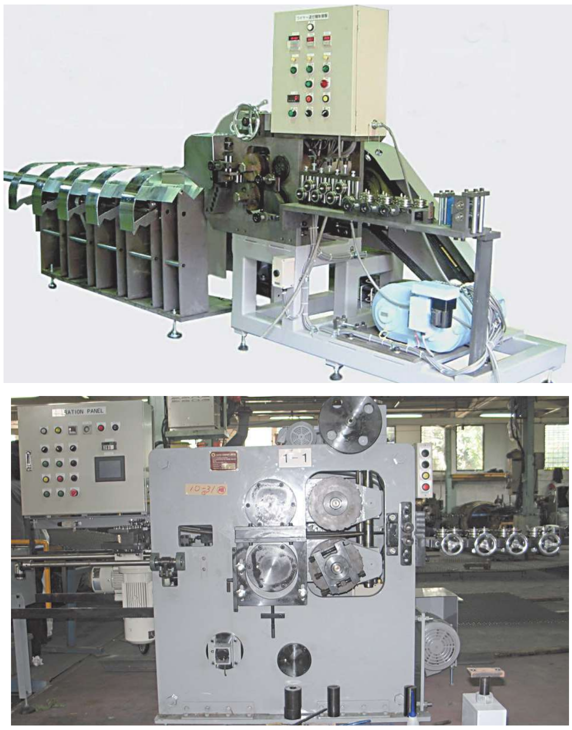


Fig. 8 — PC-1 model for wires 1 to 4 mm (top) and PC-40 model for wires 1 to 12 mm (bottom).

enough time for the fines to pass through the meshes. The solution is obviously a compromise which will yield an acceptable result on all decks, which can go as high as five.

It is highly recommended, although it may eventually mean an extra initial cost, that medium and heavy-

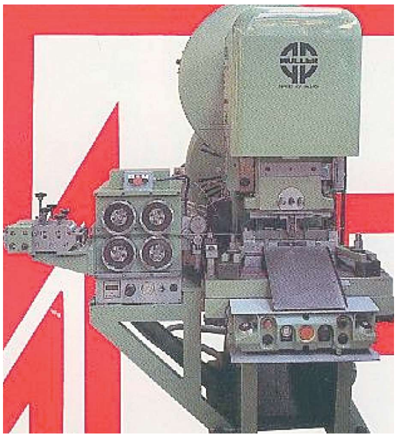


Fig. 9 — Automatic feed/stamping machine for heavy-gauge wires up to 20 mm diameter.

Fig. 10 — Fully automatic CNC type crimping /weaving line .

gauge wire screen panels be pre-bent equal to the screen frame's camber (see **Figure 7**). The change of screen panels will be shorter, a lot of time and effort saved and less strain applied on the tension bolts that should not serve as the means of bending the rigid panels.

Manufacture of Wire Meshes

To manufacture wire meshes, four basic equipment components are required.

Wire crimping/cutting machines. These machines are usually fully automatic with wire diameter capacities from 1 to 12 mm and speeds from 140 to 7 rpm (see **Figure 8**). For heavy-gauge wires up to 20 mm in diameter, we suggest the use of an automatic feed/stamping line (see **Figure 9**). This is a flexible, high-output solution, as the speed of the feed unit and the press's speed is variable, the changing of the stamping tool is fast and new tools can be set up while the line is working. The feed unit can be adapted on any existing press.

Crimping wheels. Preferably, a variable pitch or OD crimping wheel should be used. These allow the varying of the OD to crimp different wire diameters to obtain various meshes (see **Figure 10**).

Wire weaving looms. Looms are semi-automatic or automatic machines for diameter capacities up to 12 mm and widths of 1600, 2500 and 3000 mm (see **Figure 11**). For diameters above 12 mm, we suggest the use of a hydraulic loom.

USP (Urethane Strip Press). This machine for the manufacture of self-cleaning wire meshes has a standard width of 2100 mm (others on request), with a wire diameter of 6 mm maximum and an unlimited mesh size (see **Figure 12**).

The information provided in this article is based on long field experience in wire screen manufacture, equipment design and development, the solving of pertinent screening problems in various parts the world and helping screen producers to improve their working methods and technologies.

The author remains at the deposition of companies or aggregate site owners to assist them in overcoming everyday recurrent problems or shortcomings.

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Fig. 11 — All - IN - ONE semi automatic loom for wires from 1 to 12 mm.

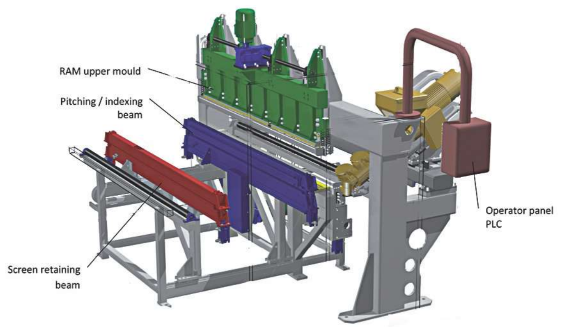
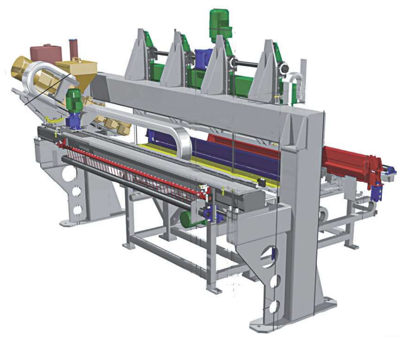


Fig. 12 — USP-2100 fully automatic machine for making self-cleaning screen panels (front view above and rear view below) showing integrated polyurethane extruder.



Author Profile...

Peter Szilvasi *is an engineer with over 40 years of experience in the design, development and use of equipment to manufacture wire meshes. He also has experience in the choice and commissioning of various screening media, mainly standard wire and self-cleaning meshes.* ***sales.wsm@orange.fr***