Feb. 11, 1969 A. J. STRENG ET AL 3,426,412

FASTENING FLEXIBLE SHEET MATERIAL

Filed Sept. 20, 1966 Sheet 1 of 3

Fig. 1

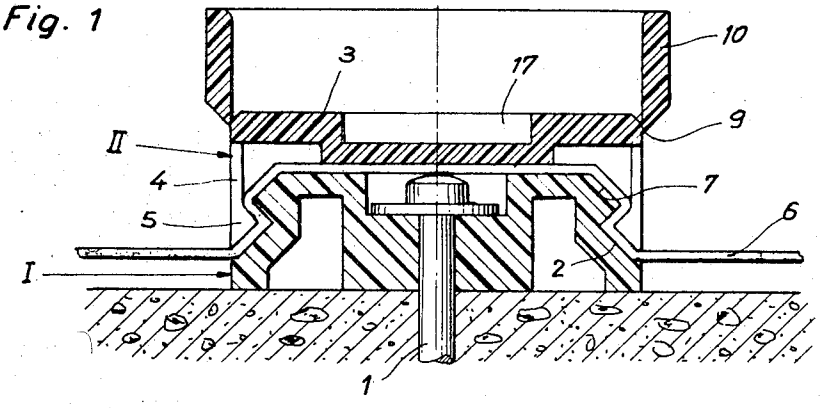


Fig. 2

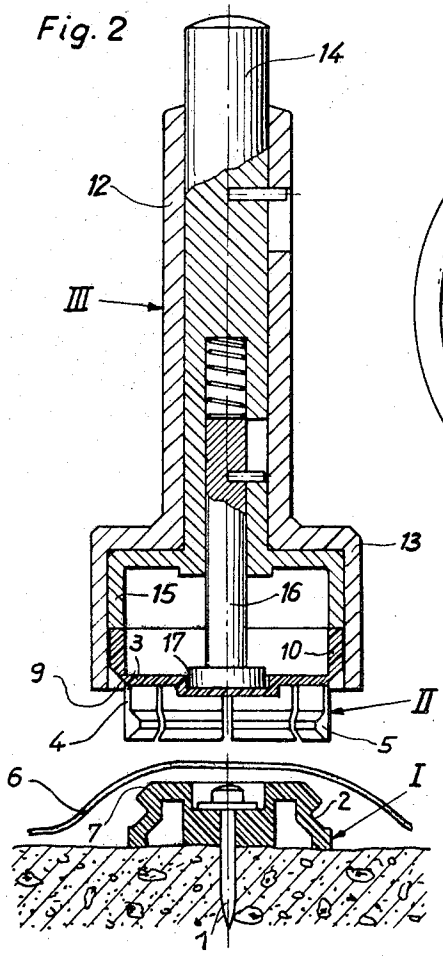


Fig. 4

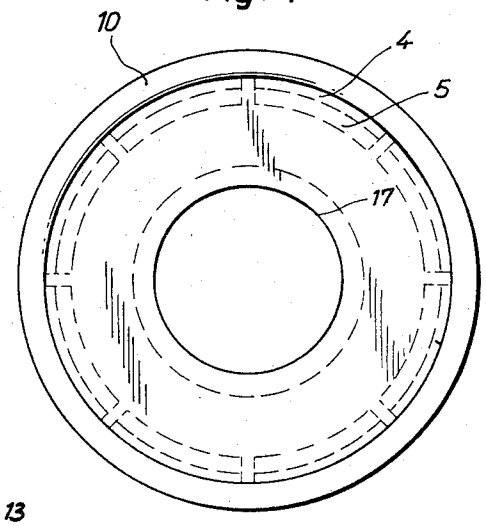
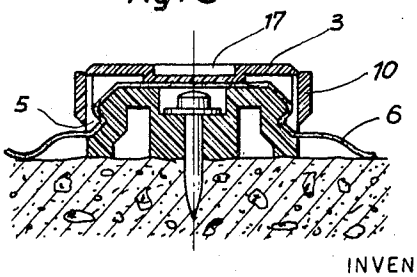


Fig. 3



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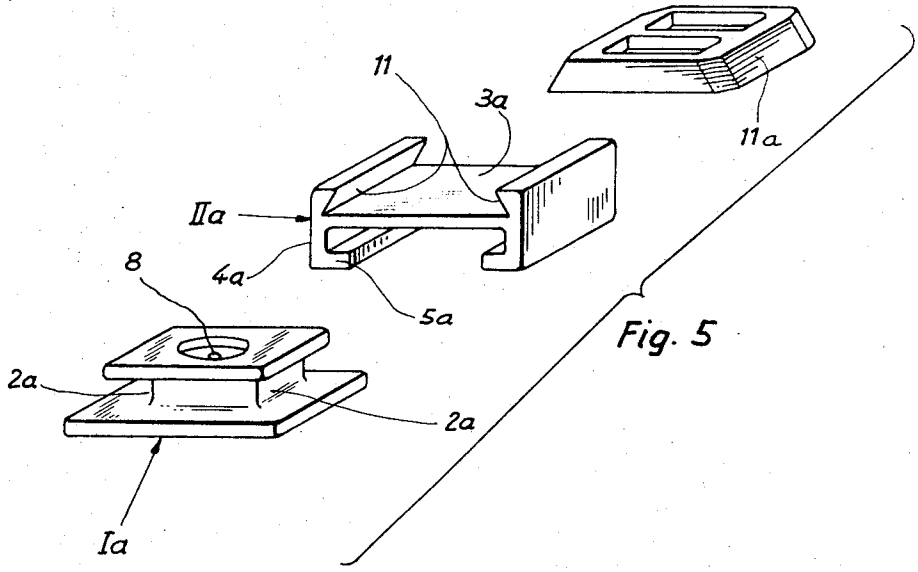


Fig. 5

Fig. 7

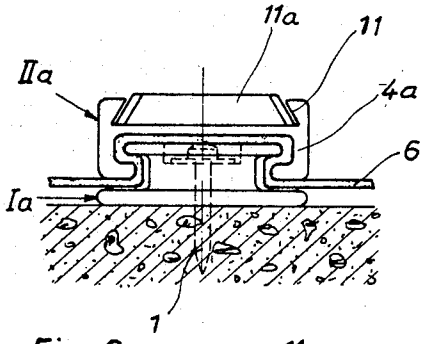


Fig. 8

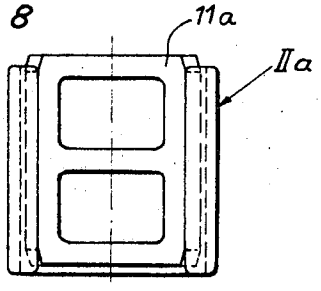
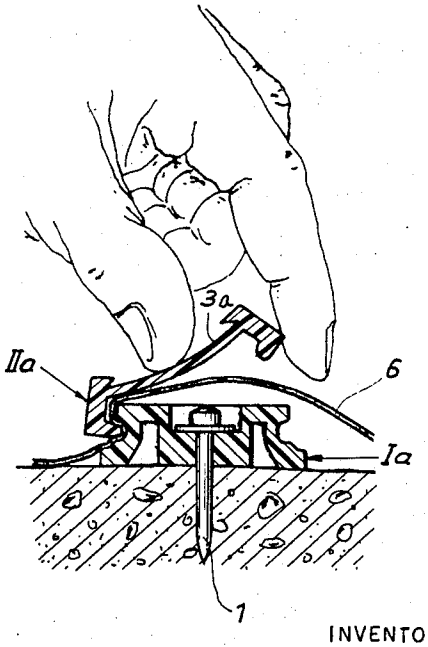


Fig. 6



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Filed Sept. 20, 1966 Sheet 3 of 3

Fig. 11

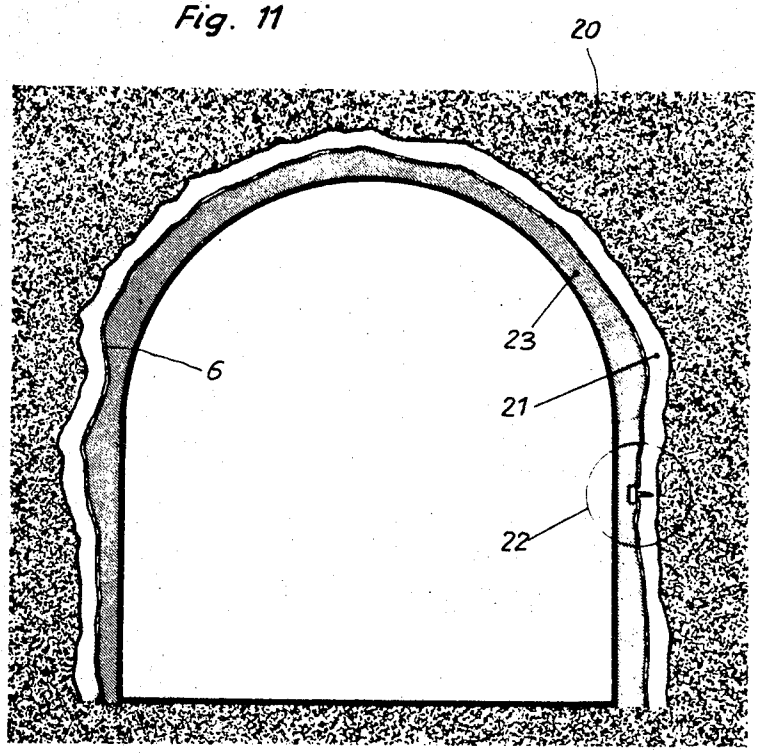


Fig. 10

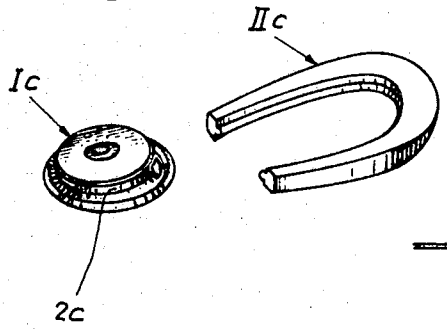
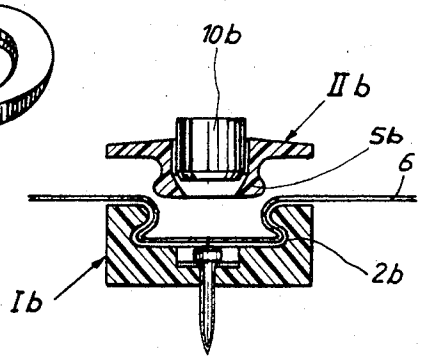


Fig. 9



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3,426,412

FASTENING FLEXIBLE SHEET MATERIAL

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Claims priority, application Germany, Mar. 9, 1966, H 58,755
U.S. Cl. 24—243 6 Claims
Int. Cl. B23p 11/00; E21d 11/14, 21/00

ABSTRACT OF THE DISCLOSURE

A fastener for securing sheet material to a foundation or backing wall includes a first part which may be made substantially cylindrical or rectangular box-shaped and a second part complementary to the first part which is adapted to be engaged over the first part. The sheet material is secured in position by first securing the first part to the foundation such as by driving a stud or securing nail through this part and into the foundation. Thereafter, the sheet is positioned over and around the first part and the second part is engaged over the sheet and over the first part and locked with the first part by means of interlocking resilient elements which in one embodiment comprise a plurality of spaced tines having protuberances which engage in recesses defined around the periphery of the first part. The tines are locked in position by an interlocking element which resiliently holds and deforms the tines into engagement in the recess of the first part. In another embodiment, the second part is interlocked with the first part by sliding it over projecting flanges of the first part after the first part has been covered with the sheet material and to cause locking engagement of inwardly directed flanges of the second part over the sheet material and the flanges of the first part. The second part is made resilient and it is locked in a holding engagement with the first part by means of a locking plate which is inserted between upstanding extensions of the side edges of the second part.

Summary of the invention

This invention relates to a method of and fasteners for fastening flexible sheet material to surfaces such as, for example, plastics sheeting to a foundation of rock, or to plaster, concrete, or the like, applied to rock.

Flexible sheet material, and more particularly plastic sheets have heretofore been attached to the walls in tunnel constructions for the purpose of sealing the wall against water seepage. However, the fastening of such sheets to a wall have presented a number of problems. If such sheeting is simply fastened by driving nails or rivets therethrough into the tunnel or gallery wall by use of a driving tool actuated by a cartridge containing an explosive, the head of the nail or rivet attaches the sheeting tightly against the wall and, in theory, seals it thereto in the region surrounding the hole produced by the shank of the nail or rivet. In practice, however, the sheeting is apt to tear in the region of the hole even when subjected to slight stress, which results in leaks and impairs the function of the sheeting. Also, folds should be avoided when attaching a sheet to a wall and the fastener should not hold the sheeting away from the wall to any consequential extent because it is often desired to pour concrete against the sheeting in tunnel construction.

An object of this invention is to provide a method of and a suitable form of fastener for fastening a plastic or other flexible sheet to a wall without piercing or otherwise damaging the sheet so as to avoid the possibility of leaks.

In accordance with the method of the present invention sheet material such as, for example, plastic sheeting is attached to a wall with the aid of a two-part fastener having complementary grooves and protuberences. One of the parts having the groove is attached to the wall, the sheet loosely applied over the attached part and the other part is then applied over the sheet and into engagement with the attached part to clamp the sheet material therebetween. After the parts of the fastener are engaged they may be locked in engagement with each other.

The method is useful for attaching sheets of plastic to any wall and particularly adapted for attaching such sheets to rock walls of excavations or tunnels or to plaster or concrete surfaces on such walls. Advantageously, the one of the fastener parts attached to the wall is so secured thereto by driving a stud, such as a bolt, nail or the like, therethrough and into the wall, preferably using a hammer-actuated or a cartridge-actuated tool.

The method of the invention provides the advantage of attaching the flexible sheet material to a wall without forming any hole therein or destroying the integrity of the material in any way. Only a minimal spacing between the sheet material and the wall in the region of the fastening results which can be easily accomplished by using a cartridge-powered driving tool for securing the one fastener part to the wall. Also the fasteners can be so spaced as to reduce the loading on each fastener and eliminate the possibility of tearing the sheet.

The invention also provides an improved form of fastener for fastening flexible sheet material to a wall comprising two parts having complementary interengaging formations and which can be brough into mutual engagement with sheet material disposed therebetween. A preferred form of fastener has one of said parts of generally circular form with a groove around its periphery and the other part has a plurality of catches of a shape to engage the groove and grip the sheet material therebetween. The catches are conveniently provided on resilient tines which extend generally parallel to one another.

An annular interlocking element is provided for interlocking the two fastener parts against separation by tension applied by the flexible sheet material. Said interlocking element has an internal diameter corresponding to the outer diameter of one of the parts of the fastener and is moved to a position to overlie and surround the catches and prevent disengagement thereof from the groove.

The parts of the fastener are preferably made of a plastic material and the interlocking element may conveniently be moulded (e.g. by injection moulding) integrally with one of the fastener parts with a frangible section therebetween at places which can readily be broken.

The invention also provides alternative forms of the fastener, which in all instances comprise two parts having complementary interengaging formations which can be brought into mutual engagement with sheet material disposed therebetween. In one of such modified constructions, one of said parts is of generally rectangular configuration having grooves in two opposite lateral faces thereof and the other part comprising inwardly-directed tongues for engagement into said grooves, the tongues being connected by a resiliently-deformable web. The web may be conveniently provided with ribs at the side remote from the tongues, which have aligned slots therein for the reception of a locking plate to limit deformation of the web.

The invention will be described further, by way of

example, with reference to the accompanying drawings, wherein:

FIG. 1 is a sectional side elevational view of a fastener for attaching sheet material to a wall in accordance with the invention and showing one part of the fastener secured to a wall and other part engaged therewith to fasten a flexible sheet therebetween;

FIG. 2 is a sectional side elevational view showing the tool for driving the separate parts of the fastener into engagement and applying the interlocking element thereon;

FIG. 3 is a view similar to FIG. 1 on a reduced scale and showing the interlocking element driven to its operative position;

FIG. 4 is a plan view of the fastener shown in FIG. 1;

FIG. 5 is an exploded perspective view of another form of fastener for attaching sheet material to a wall in accordance with the invention;

FIG. 6 is a diagrammatic view of the fastener in side elevation and showing the manner in which the two fastener parts are engaged with a flexible sheet therebetween;

FIG. 7 is a sectional side elevational view of the fastener shown in FIGS. 5 and 6 and showing the parts fully assembled;

FIG. 8 is a plan view of the fastener shown in FIG. 7;

FIG. 9 is a sectional side elevational view showing another embodiment of fastener which may be used to attach sheet material in accordance with the invention;

FIG. 10 is an exploded perspective view showing a still further embodiment of fastener adapted for use with the present invention; and

FIG. 11 is a diagrammatic sectional view showing how the invention may be applied to secure a flexible sheet to a wall in a tunnel construction.

Referring to FIGS. 1 to 4 of the drawings, a fastener for applying sheets to a wall in accordance with the present invention comprises two complementary parts generally designated I and II. Both of these parts are of a generally circular configuration. Part I is secured to a wall by an appropriate securing element, such as a nail **1** driven by a manually-actuated or cartridge-actuated tool (not shown). The wall may be formed of rock at the side of an excavation or tunnel or may be formed of concrete or mortar. Part I of the fastener has a groove **2** around its curved peripheral surface.

The part II which is complementary to the part I, and is brought into engagement with the latter has a disc-like bearing part **3**. At intervals around the periphery of such bearing part **3** are depending tines **4** which extend perpendicularly to the plane of the disc and generally parallel to the axis thereof in a circular pattern. Each tine **4** has a lug or catch **5** formed thereon at its lower end and directed radially inward to engage the groove **2**. The dimensions of the two parts I and II are so chosen, with particular reference to the tines **4**, catch **5** and groove **2**, that when the two parts are assembled together there is a small clearance therebetween for accommodating flexible sheet material such as a sheeting **6** of plastic material as shown in FIGS. 1 to 3. The tines **4** are resilient so that upon assembly of the fastener part II onto the part I with the sheeting **6** therebetween, as illustrated sequentially by FIGS. 2 and 1, the catches **5** snap into the groove **2** after being deflected radially outwards by a peripheral chamfer **7** around part I. The two fastener parts I and II are preferably made of a low-pressure polyethylene, such as that marketed under the trade name "Hostalen" which has the properties of being corrosion-resistant, tough yet resilient, and coherent, which properties are particularly suitable in relation to the present invention.

Formed integral with the disc **3** of the fastener part **2** is an annular interlocking element **10**. The interlocking element **10** is initially disposed so as to project upwardly from the disc **3** at its outer periphery from the side opposite from the tines **4**. The connection of the interlocking element **10** with the periphery of the disc **3** is by way of a thin, frangible ring of material **9**. This interlocking element **10** serves, after assembly of the fastener part II onto the part I, to interlock the two parts by displacement from the position shown in FIG. 1 wherein it is clear of the tines **4** to the position shown in FIG. 3 where it surrounds the tines and prevents outward movement to disengage the catches **5** from the groove **2**. The actual engagement of the fastener part II with tre part I and the subsequent displacement of the annular interlocking element **10** may be effected by a tool, such as that designated III in FIG. 2, for breaking the frangible ring **9**. Thus, the sequence of fastening a flexible sheet to a foundation, according to FIGS. 1 to 4 is as follows:

First, the fastener part I is secured to the foundation by means of a nail **1** or other similar device, as discussed above. The sheet material **6** then is positioned to extend over the fastener part I as shown in FIG. 2. Thereupon, the fastener part II is applied over the part I, using a tool III such as that illustrated at III in FIG. 2. As can be seen, the tool III comprises a tubular body **12** having a cup-like end **13** having an inside diameter which corresponds to the outside diameter of the interlocking element **10** of the fastener part I. Slidable axially in the body **12** is a driver **14** having an enlarged head **15** corresponding in shape to the interlocking element **10**, and fitted to slide in the end **13** so that when the fastener part II is in the position shown in FIGURE 2, the interlocking element **10** underlies a corresponding annular face of the driving head **15**. A spring-loaded mandrel **16**, in turn, is mounted for a limited axial sliding movement in the head **15** and has an end which projects into the end **13** to engage with a depression **17** in the disc-like bearing part **3** of the fastener part II at the center of the latter.

After introduction of the fastener part II into the tool III, the latter is applied over the fastener part I, as shown in FIG. 2 so that the catches **5** overlie the peripheral chamfer **7** on the fastener part I with the flexible sheet **6** therebetween. Tool III is then actuated by a hammer blow applied to that end of the driver **14** which protrudes from the tubular body **12**. The head **15** acts upon the annular interlocking element **10** to first force the fastener part II down over that part of the flexible sheet **6** which overlies the fastener part I and then over the latter at which time the chamfer **7** serves to ensure the spreading of the resilient tines **4** so that the catches **5** slide over the circular shoulder on the part I. When the part II is driven into full engagement with the part I, the catches **5** snap into the peripheral groove **2**, as shown in FIG. 1 and the disc **3**, tines **4** and catches **5** come to rest. Continued movement of the head **15** then serves to shear the connecting ring **9** between the disc **3** and interlocking element **10** to displace the latter axially relative to the fastener part II, from the position shown in FIG. 2 to that shown in FIG. 3. Interlocking element **10** separated from the ring **3** is shifted from its inoperative position of FIG. 1 (wherein it is clear of and does not obstruct the tines **4** and catches **5**) to its operative position of FIG. 3 wherein it snugly surrounds such tines and effectively prevents outward movement thereof so that the tines are prevented from deforming sufficiently to permit fastener part II to be separated from the fastener part I, and thereby hold the flexible sheet **6** securely across the part I.

Referring now to FIGS. 5 to 8 of the drawings wherein a second embodiment of the fastener of the present invention is shown which comprises two fastener parts I*a* and II*a* of generally rectangular configuration. The fastener part I*a* is provided, at least on two opposed faces (and preferably on two pairs of such opposed faces, as shown) with grooves **2***a*, and such part is intended to be secured to a wall in any suitable manner, such as by means of a nail or rivet **1** (FIGS. 6 and 7) driven through an aperture **8**, see FIG. 5 and into the wall, the aperture **8** serving to assist in centering of the nail or rivet **1**. The fastener part II*a* comprises a resiliently deformable plate or web **3***a* formed integrally with two flanges **4***a* which

are provided along two opposite edges of the web 3*a* and shaped to provide inwardly-directed tongues 5*a* projecting towards one another from opposite edges of the web. As can be seen from FIGS. 6 and 7, the spacing of the tongues 5*a* is such that they can be engaged into the opposed grooves 2*a* in the fastener part I*a* by engaging one of the tongues 5*a* into one of the grooves 2*a*, and then deforming the web 3*a*, as shown in FIG. 3, to enable the other tongue 5*a* to be sprung into engagement with the other groove 2*a*. This can be done manually and without the need for any tools.

To enable the part II*a* to be firmly interlocked with the part I*a*, and thereby obviate unintentional separation of the two parts, the part II*a*, is formed on the side of the web 3*a* opposite the tongues 5*a* with upstanding ribs, constituting extensions of the flanges 4*a* and having inclined inner faces 11 effectively defining a dove-tail slot above the web 3. Complementary to this slot is a slidable locking plate 11*a* which, when introduced into the dovetailed slot, serves to prevent flexing of the web 3 and thereby prevents unintentional separation of the two fastener parts I*a* and II*a*. FIGS. 7 and 8 show the locking plate II*a* in its locking position.

FIG. 9 shows a third embodiment of the fastener for mounting sheets in accordance with the present invention which comprises a part I*b* for attachment to a wall and a complementary part II*b* for interengagement with the part I*b* after interposition of the flexible sheet material 6. Both parts I*b* and II*b* are of generally circular shape with the part I*b* having an undercut circular recess 2*b*, therein, into which recess the sheet material 6 is clamped, instead of being gripped around the periphery of the respective part as in the preceding embodiments. The part II*b* has a bulbous nose 5*b* complementary to and engageable with the recess 2*b*. The projecting part of such nose portion 5*b* projecting radially-outward may be either continuous or discontinuous, (i.e. interrupted at intervals) around the periphery of the nose portion. The part II*b* has a central bore, which tapers inwardly at the interior of the nose portion 5*b*, for the reception of an interlocking plug 10*b* which is intended to be driven home into the bore after the fastener parts have been assembled and then serves to prevent inward deformation of the nose portion 5*b* and, thus, to prevent separation of the two fastener parts.

Another embodiment of fastener in accordance with the invention is shown in FIG. 10. In this embodiment the fastener part I*c* secured to the wall is in the form of a flanged disc having a circumferential groove 2*c*. The other part of the fastener being in the form of a horse-shoe-shaped element II*c*, the arms of which are shaped for sliding engagement into the groove 2*c* at two diametrically opposed points on the latter.

FIG. 11 illustrates the preferred application of the method and the fastener of the invention, namely in tunnel construction. The passage blasted into rock or the like 20 is firstly lined with wire netting, expanded metal or the like, and a layer of mortar 21 is applied thereon as, for example, by spraying which is then allowed to set. Such mortar layer 21 is required to be sealed against seeping water, or other fluid, and this is done by lining the same with the flexible lastic sheeting 6, referred to above, so as to lie snugly against the surface of the mortar. The sheeting 6 is fastened to the mortar without perforating the sheeting in any one of the ways already described. One such fastening is indicated at 22. The interior of the passageway of the tunnel can then be finished by applying a finish layer 23 of concrete against the lastic sheeting 6.

It will be understood that the tunnel construction constitutes only one application of this invention which can be used in other locations wherein it is desired to secure a flexible sheet material to the surface of a wall. Other possible uses are in construction of underground railway shafts, mine shafts, and the like, and in fastening protective sheeting across the window openings of building shells during various stages of the erection.

What is claimed is:

1. A fastener for fastening a flexible sheet to a wall, comprising two parts having complementary interengaging formations, one of said parts located at one side of the sheet being of generally circular form and having a groove around its periphery, the other part located at the opposite side of the sheet having a plurality of catches adapted to engage the groove in said one part and grip the sheet material therebetween, an interlocking element surrounding the tines to lock the protuberances thereon in the recess in said one part, the interlocking elements being formed integrally with the said other part of the fastener at a location outside said tines and connected to the said other part by a frangible bridge to permit the interlocking element to be moved to its position surrounding the tines.

2. A fastener for fastening flexible sheet material to the wall of an excavation comprising two parts having complementary interengaging formations which can be brought into mutual engagement with sheet material disposed therebetween, one of said parts being of a generally rectangular configuration having outwardly directed grooves in two opposite lateral faces thereof, the other part comprising inwardly directed tongues for engagement into said grooves, and said tongues being connected by a resiliently deformable web, the web being provided with ribs at the side remote from the tongues and having aligned slots therein, and a locking plate which serves to limit deformation of the web.

3. A fastener for fastening a flexible sheet to a wall comprising a first part of substantially cylindrical configuration having a central portion adapted to receive a fastening device such as a nail which is to be driven into a foundation, said first part having an exterior side wall with a recess, a second part having a central web adapted to overlie the flexible sheet and the first part and including a plurality of tines extending downwardly from said central web around the periphery thereof and engaging in the recess of said first part, and an interlocking member connected to said web and being deformable into resilient inward biasing engagement with said tines to hold said tines in said recess.

4. A fastener for fastening a flexible sheet to a wall comprising two parts having complementary interengaging formations, a first one of said parts having a top wall with overhanging sides and a recess defined on each side of said first part between the top and bottom and located below the overhanging sides of said top wall on at least two opposite sides thereof, and a second part of resiliently deformable material engaged on said first part over the sheet material and having a holding flange on each side extending upwardly and an engagement flange having a central web and spaced apart walls extending downwardly from each side of said web, each including inwardly extending projections formed thereon adapted ot engage over the overhanging sides of said top wall in the recess on respective opposite sides of said first part, and a locking plate engageable between said holding flanges of said second part and locking said second part in an engaging position to hold the sheet material on said first part.

5. A fastener for fastening a flexible sheet to a wall comprising first and second parts having complementary interengaging formations, said first part having a top wall with overhanging sides and a recess defined on each side of said first part between the top and bottom thereof and located below the overhanging sides of said top wall on at least two opposite sides thereof, said second part being generaly horse-shoe shaped and including a web portion and a leg portion on each side of said web, said leg portions being resiliently biased against said first part when slidably inserted over the sheet material and into the corresponding recesses of said first part.

6. A fastener for fastening flexible sheet material to

the wall of an excavation comprising two parts having complementary interengaging formations which can be brought into mutual engagement with sheet material disposed therebetween, one of said parts being of a generally rectangular configuration having outwardly-directed grooves in two opposite lateral faces thereof, the other part comprising inwardly-directed tongues for engagement into said grooves, said tongues being connected by a resiliently deformable web, means above said web defining a dovetail slot, and a locking plate slidably engageable in said slot over said web to prevent flexing of said web and to prevent separation of said two parts.

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