Aug. 3, 1965 H. T. MARTIN ETAL 3,197,831

LIGATURE JOINT AND SEAL THEREFOR

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Fig. 5.

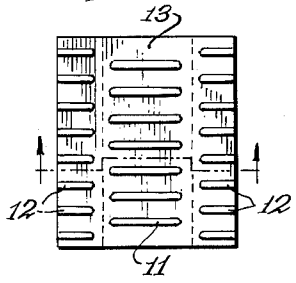


Fig. 7.

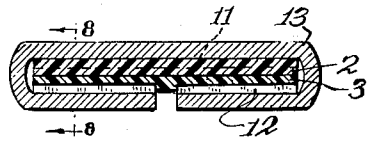


Fig. 6.

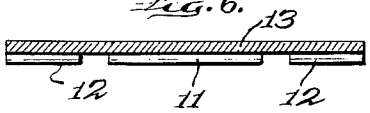


Fig. 8.

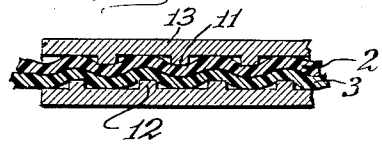


Fig. 9.

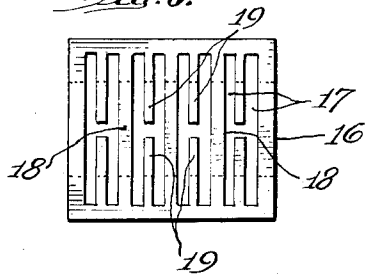


Fig. 10.

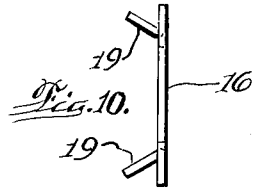


Fig. 11.

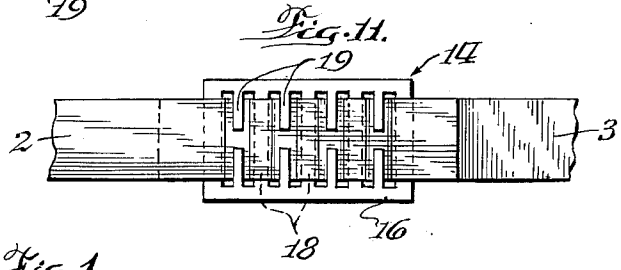
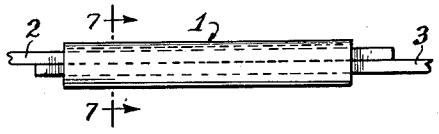


Fig. 1.



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LIGATURE JOINT AND SEAL THEREFOR

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Fig. 12.

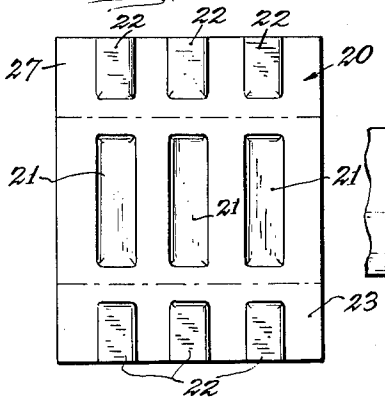
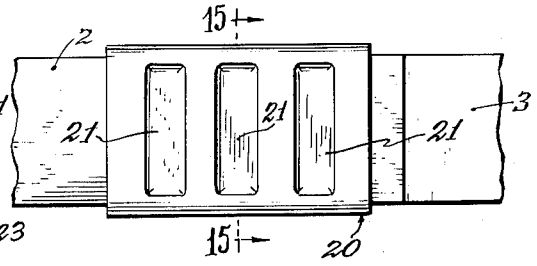


Fig. 14



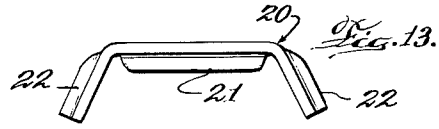


Fig. 13.

Fig. 15.

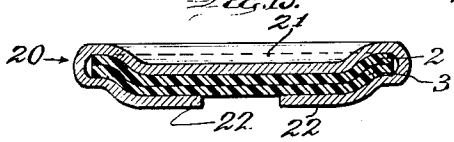
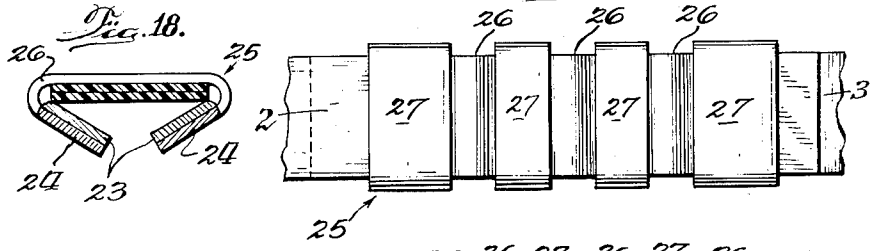


Fig. 16.

Fig. 18.



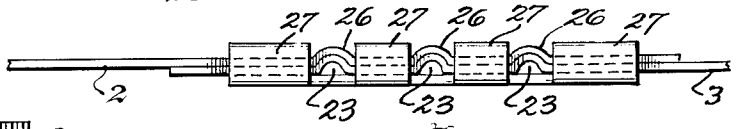


Fig. 17.

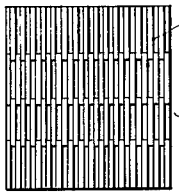


Fig. 2.

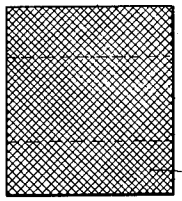


Fig. 4

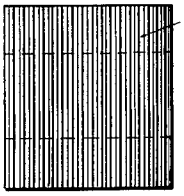


Fig. 3.

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LIGATURE JOINT AND SEAL THEREFOR

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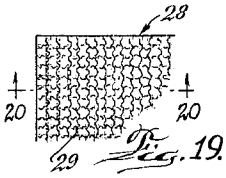

Fig. 19.

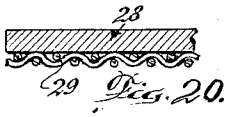

Fig. 20.

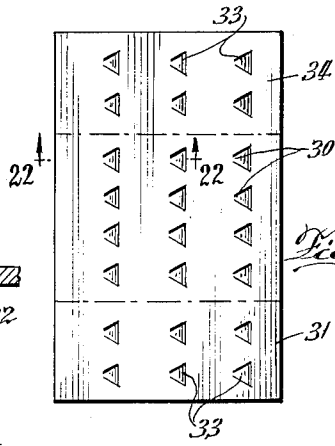

Fig. 21.

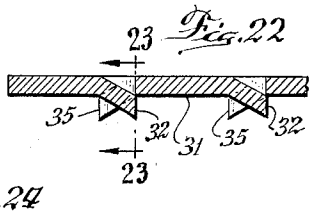

Fig. 22.

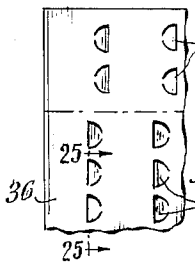

Fig. 24.

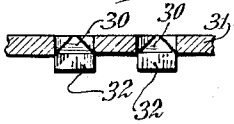

Fig. 23.

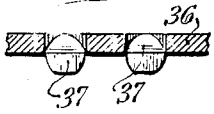

Fig. 25.

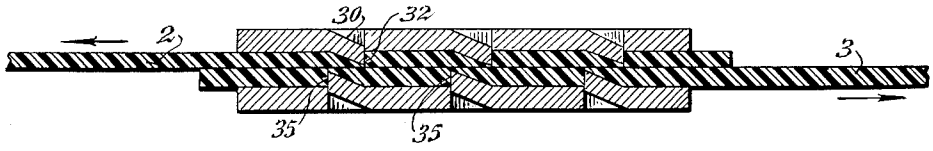

Fig. 26.

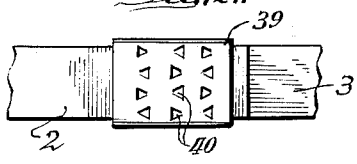

Fig. 27.

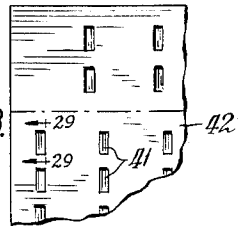

Fig. 28.

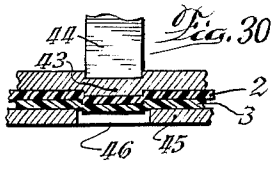

Fig. 30.

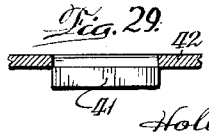

Fig. 29.

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United States Patent Office 3,197,831 Patented Aug. 3, 1965

3,197,831

LIGATURE JOINT AND SEAL THEREFOR

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Filed June 4, 1962, Ser. No. 199,847
13 Claims. (Cl. 24—16)

The present invention relates to ligature joints and seals therefor and more particularly to seals and joints made with such seals surrounding overlapping portions of ligatures such as strap. As used in the specification and claims hereof, the term "strap" and "strapping" are used and intended to be generic to ligature elements substantially independent of the configuration thereof.

The type of ligature with which the present invention is concerned is referred to herein as "plastic." As used, "plastic" refers to materials, natural or synthetic, which may be formed into an elongated ligature, which are readily deformable under pressures of the same order of magnitude as those ordinarily employed in sealing or forming joints in steel strapping, which are relatively soft compared to steel, which have good elastic and resilience properties, and which tend to conform to the shape of objects forced thereagainst, at room or normal atmospheric temperatures.

It has been found that in certain situations the elasticity or "stretchability" of the steel now used in strapping is less than that desired. This difficulty is particularly apparent where the package is a compressible or expansible one which may have a tendency to swell or cause the strap to be subject to substantial shock loads. Swelling packages may burst straps that are not sufficiently stretchable or elastic, or create serious distortion in the package if the strap is too strong. These and other related problems such as the problem of disposing of removed or scrap strap have brought about a desire for the use of plastic strap. If the plastic strap is of a combustible material such as a nylon, it will be most easily disposed of in an incinerator.

Plastic materials were not effectively held when overlapping portions were secured together with known forms of seals used for steel strap. This was due to several features including those such as the slipperiness of the plastic and the transverse reduction in the dimensions thereof when the strap was subjected to substantial tensile forces. These problems were further multiplied when it was found that plastic strap had a tendency for cuts or tears therein to run until the strap shredded or separated.

In accordance with the present invention, most of these problems have been overcome and there is provided a new seal arrangement and joint arrangement which is highly effective with plastic strap to grip and hold the strap. In general, embodiments of this invention provide for gripping distortion of the strap by deformation by the strap engaging surface of the seal and the provision of a seal which is substantially harder than the strap.

There are illustrated in the accompanying drawings and described hereinbelow in this specification several illustrative embodiments of the invention. In each of these, a seal of steel or other material harder than the plastic strap has a surface character or deformation of such character or configuration that when the seal is firmly pressed or squeezed into the overlapping portions of the strap there will be deformation of the strap to interlock the same with the seal and provide a rigid mechanical connection formed between the strap and the seal.

The hardness and strength of the seal are responsible for at least two important functions. First, when the seal is pressed firmly into engagement with the strap, the strap will be deformed to conform to the surface structure or

character of the seal rather than the seal surfaces being smoothed or flattened out. Second, since a strap in tension has a tendency to open the seal and pull the folded or bent parts or sections apart the character of the seal will result in the strap biting into the seal and thereby reduce the tendency of the seal to open and release the strap.

It should be understood, of course, that the foregoing statements as to the reasons for the advantages of a harder seal over a softer seal should not be considered as placing any limitations on the scope or substance of the invention. It has been found that a seal which is substantially harder than the plastic strap deforms the strap within the seal and provides an effective joint.

It has been found also, in accordance with this invention, that in order to effect a secure joint between the seal and the overlapping portions of the strap, that the irregular strap contacting surfaces of the seal should be such that they do not create a condition in the strap which would cause the strap to tear or shred.

The irregular configurations or character of the strap contacting surfaces of the seal may be provided in a number of different ways. The important aspect, however, is that they create a positive deformation of the strap without tearing the strap. This may be in the form of metallic weldments or punch press die deformations. In the latter category, the deformations may appear as serrations, knurls, teeth, wire mesh, drawn burrs or complementary rises and recesses or rises and apertures in or on the contacting surfaces.

There are several illustrative embodiments of the present invention shown in the accompanying drawings in which like reference numerals refer to like parts, in which each and every detail shown is included as a part of this specification, and in which:

FIGURE 1 is an elevational view of a plastic strap and seal joint embodying this invention;

FIGURES 2, 3 and 4 are illustrative planned views of the interior, strap engaging surfaces of seal blanks showing various surface deformations;

FIGURE 5 is a plan view of a seal blank having transversely arranged bar deformations on the strap contacting surfaces thereof;

FIGURE 6 is a transverse sectional view of the seal of FIGURE 5 taken substantially along the line **6—6** of FIGURE 5;

FIGURE 7 is a transverse sectional view of the seal of FIGURES 5 and 6;

FIGURE 8 is a fragmental longitudinal sectional view of the joint of FIGURE 7 taken substantially along the line **8—8** of FIGURE 7;

FIGURE 9 is a plan view of a seal blank having strap deforming and gripping ears or tabs formed therein;

FIGURE 10 is an end view of the seal of FIGURE 9 with the tabs or ears bent outwardly to receive overlapped plastic strap portions;

FIGURE 11 is a bottom plan view of a joint formed with the seal of FIGURES 9 and 10;

FIGURE 12 is a plan view of a seal blank having complementary recesses and projections formed in the body and flange portions thereof;

FIGURE 13 is an end view of the seal of FIGURE 12 with the flanges bent downwardly to receive strap therebetween;

FIGURE 14 is a plan view of a joint formed with the seal of FIGURES 12 and 13;

FIGURE 15 is a transverse sectional view of the joint of FIGURE 14 taken substantially along the line **15—15** of FIGURE 14;

FIGURE 16 is a plan view of the joint of FIGURE 18;

FIGURE 17 is a side elevational view of the joint of FIGURE 16;

FIGURE 18 is a transverse sectional view of a partially formed joint wherein projections formed in the flanges are arranged for distortion of the strap into apertures formed complementary therewith in the back or body of the strap;

FIGURE 19 is a fragmental plan view of the interior surface of a seal blank having wire mesh secured to such surface;

FIGURE 20 is a fragmental sectional view of the seal of FIGURE 19;

FIGURE 21 is also a plan view of the interior surface of a seal blank provided with punched or die formed teeth thereon;

FIGURE 22 is a fragmental sectional view taken substantially along the line **22—22** of FIGURE 21;

FIGURE 23 is a fragmental sectional view taken substantially along the line **23—23** of FIGURE 22;

FIGURE 24 is a fragmental plan view of a seal having teeth punched therein;

FIGURE 25 is a fragmental sectional view similar to FIGURE 23, but taken substantially along the line **25—25** of FIGURE 24;

FIGURE 26 is a longitudinal sectional view of a joint formed with the seal of FIGURE 21;

FIGURE 27 is a plan view of a joint having a seal similar to the seal of FIGURE 21, but with the teeth therein alternately arranged;

FIGURE 28 is a fragmental plan view of a seal blank having teeth formed on the strap contacting surfaces thereof;

FIGURE 29 is a fragmental sectional view of the seal of FIGURE 28 taken substantially along the line **29—29** of FIGURE 28; and

FIGURE 30 is a fragmental transverse sectional view of a joint with teeth similar to those in the seal of FIGURES 28 and 29 formed therein after the seal is disposed about the plastic strap.

As noted above, there are illustrated in the drawings a number of illustrative embodiments of this invention having in common numerous features of the invention including, without any attempt to list all such features nor place any limitation on the scope of the invention, seal formations which in the completion of a joint of a seal with plastic strapping provide for positive gripping and deformation of the plastic strap as by biting into the strap.

The strap engaging surfaces of the seal are configurated to grip the strap. Also, the seals are formed of a harder material than the plastic strap so that when the seal is closed and the joint is formed with the seal disposed about the overlapping portions of the strap, the irregular surface construction will not be flattened or smooth, but will bite into the plastic strap and positively grip and hold the same.

Tests conducted with various embodiments of this invention have shown that the joints formed have high efficiencies wherein the joint strength approaches the tensile strength of the plastic strap. Tests conducted utilizing plastic strap and ordinary steel seals and crimping techniques demonstrated extremely low efficiencies. In the embodiment of FIGURE 1, the overlapping portions **2** and **3** of the strap secured in the joint construction indicated generally at **1** are firmly secured together by a seal **13**.

The interior surfaces or strap contacting surfaces of the seal have irregular formations thereon. The configuration of the formations on the interior face of the seal may take any form which will be effective to bite into the strap. Three of such forms are in FIGURES 2, 3 and 4 which show, respectively, alternate square-faced, rack-like teeth **7** arranged for an inter-fitting or complementary deformation and biting of the strap, full width serration **8** and crossed serration **9** of a knurled configuration.

Another toothed seal and joint arrangement is shown in FIGURES 5–8 in which transversely arranged bars

11 and **12** are formed on the contacting or engaging surfaces of the seal **13**. The bars **11** formed on the inner face of the seal back or body are longitudinally spaced and alternately arranged or staggered with respect to the fragmental bars on the inner faces of the flange portions of the seal. These bars may be formed by punching or by welding separate parts onto the seal as desired.

A joint formed with the seal **13** closed about overlapped strap ends **2** and **3** is shown in transverse section in FIGURE 7 and longitudinal section in FIGURE 8. There it will be seen that the bars form a complementary strap biting and gripping arrangement which also serves to undulate the strap whereby tensile forces on the strap tend to cause the strap to bite more tightly on the teeth.

An undulated strap configuration coupled with biting of teeth elements into the strap ends in a joint **14** is effected in the joint of FIGURE 11 which utilizes the seal **16** of FIGURES 9 and 10. The seal blank shown in FIGURE 9 is a series of H shaped punchings **17** taken therefrom so that the seal is provided with a plurality of transversely extending crossbars **18** and a plurality of transversely extending, half length biting and distorting fingers **19**. The fingers **19** of the seal blank are bent outwardly from the inner face of the seal to provide a receiving space for the overlapped strap end portions of plastic strap. When the strap ends are received between the fingers **19**, the fingers **19** are then bent back to a position close to their original position whereby the strap is wound about the fingers and the transversely extending crossbars as shown in FIGURE 11. This causes undulation of the strap and by proper proportioning of the seal segments, the fingers and crossbars bite into the upper and lower strap end portions.

The seal arrangements of FIGURES 12–18 also provide for undulating the strap within the seal and are equipped with tooth or barlike portions which are effective to grip the strap portions to provide a secure joint construction. In the particular arrangement of FIGURES 12–15 deep, barlike and cavitylike deformations are provided in the seal. The seal blank **20** is shown in FIGURE 12 with deep, barlike deformations **21** formed in the back or body portion of the seal and projecting inwardly thereof. These deformations extend substantially fully transversely of the back portion. Half length receiving, transversely extending recesses **22** complementary with the barlike deformations **21** are formed in the flange portions **23** of the seal. The deformations including both the bar portions **21** and the recess portions **22** have a depth in this arrangement greater than the thickness of the seal material, although lesser depths may be employed.

The complementary configurations of these deformations provide for effective gripping and undulation holding of the strap ends **2** and **3** as shown in the joint drawings of FIGURES 14 and 15.

The joint and seal of FIGURES 16–18 are similar to many of the above described joints and seals wherein bar deformations were formed complementary to recesses or apertures. In this arrangement, barlike deformations **23** similar to the recessed deformations **22** in the arrangement of FIGURES 12–15 are formed in the flange portions **24** of the seal **25**. These barlike deformations are arranged to extend transversely of the flanges and are disposed in complementary spacing with transversely extending slots **26** in the back or body portion of the seal **25**. When the seal is closed and squeezed about the overlapped strap portions **2** and **3**, the barlike portions **23** undulate the strap and squeeze the same into the slots **26** to cause undulated configuration of the strap in the joint and positive gripping of the strap on the faces of the crossbars **27** which remain in the back or body portion of the seal when the slots **26** are cut therein.

FIGURES 19 and 20 illustrate a surface distortion form of strap seal **28** which employs a wire mesh **29**

secured as by welding or soldering to the inner or strap contacting faces of the seal. The effect of the wire mesh is similar to the effect of the knurls **9** in the seal of FIGURE 4 and the serrations or teeth of seals such as those shown in FIGURES 2 and 3 to bite into the strap and securely grip the same when the seal is squeezed about the strap.

The seals and joints illustrated in FIGURES 21–30 use a plurality of relatively small individual teeth to grip the straps disposed within the seals and about which the seals are squeezed. These teeth may take any one of a number of different forms and have a wide variety of configurations. The significant aspects of the teeth of the seals in these arrangements are that they present a flat face in a direction opposite to the direction of the tensile force in the strap. This provides a greater gripping and biting effect and tends to reduce the effectiveness of forces which tend to open the seal to release the strap from the seal. The various teeth are formed integrally with the seal and are arranged to minimize any tendency to create or permit tearing or shredding of the strap.

The seal of FIGURES 21, 22, and 23 utilizes pyramid or triangularly shaped teeth **30**. These teeth are formed in the seal **31** by being partially punched inwardly from the outer surface of the seal in such a manner that the teeth remain integral with the seal. It is clearly seen in FIGURES 22 and 23 that the projecting faces **32** of the teeth formed in the back or body portion of the seal are flat and all face in a direction opposite to the tensile direction of the upper or outer strap **2** as seen in FIGURE 26. The teeth **33** in the flange portions **34** of the seal have flat faces **35** which face in the opposite direction from the faces **32** on the teeth **30** so that they are arranged to bite into the lower or inner strap **3** and face in the opposite direction to the tensile force on that strap portion under weld conditions.

The seal **36** of FIGURES 24 and 25 is quite similar to the seal of FIGURES 21–23 and 26, except that the teeth **37** thereof are substantially semi-circular in plan view and are more or less configurated to resemble the teeth of a rasp. These teeth **37** and the complementary, oppositely facing teeth **38** on the flange portions of the seal **36** are integral with the material of the seal and arranged to face in opposite directions to the directions of the tensile forces to which the straps will be subjected.

The arrangement of FIGURE 27 is also similar to the arrangement of FIGURES 21–23 and 26, except that the teeth are generally alternately arranged so that adjacent or nearly adjacent teeth face in opposite directions. The seal **39** of FIGURE 27 with its oppositely arranged adjacent teeth **40** is a bi-direction seal. That is, it may be placed on the overlapped strap portions in either direction and will form an effective seal or joint with the plastic strap.

The seal of FIGURES 28 and 29 is also similar to the seals of FIGURE 21, et seq., hereinafter described, but in this arrangement, the integral teeth **41** in the seal **42** are relatively broad, flat-faced chisel-like teeth, rather than semi-circular, or pyramid, or diamond shaped. As in the arrangement of FIGURE 21, the teeth **41** of the seal **42** of FIGURES 28 and 29 present flat faces in the direction opposite to the direction of the tensile force on the strap which are gripped by the teeth.

The joint construction of FIGURE 30 is essentially the same as the joint formed by the seal **42** of FIGURES 28 and 29, except that the teeth **43** therein are formed by a punch device **44** during or after compression of the seal **45** and the seal **45** may be provided with receiving, strap locking apertures **46** under the area wherein the teeth **43** are to be punched.

The features, structural configurations and arrangements of the various strap, joint and seal arrangements described hereinabove are, generally speaking, interchangeable and widely variable within the scope of the concepts and principles of this invention. Examples of such variations are numerous, but it should be appreciated that the invention should not be limited to the specific arrangements shown. Tooth bars as well as deep segmented serrations may be used with recesses and slots as well as various other deformation configurations all within the scope of this invention, so long as there is a strong biting of the surface irregularity into the plastic strap and the seal and deformation portions thereof are of greater hardness than the strap to effect such biting and deformation of the strap.

We claim:

1. A seal for joining and securing a pair of overlapping straps of plastic material which comprises: a body of sheet material having a hardness which exceeds the hardness of the plastic strap to be secured thereby, said body including a center wall and a pair of flange walls located on the same side of said center wall, said center wall and said flange walls being interconnected by a pair of longitudinally extending substantially parallel bends, said center wall having an irregular formation provided by said body on its strap contacting surface and both of said flange walls having irregular formations on their strap contacting surfaces, said formations on said strap contacting surfaces of said body being of a depth and hardness effective to deform and securely grip the plastic strap when the seal is closed thereabout and pressed into firm engagement therewith.

2. A seal for joining and securing a pair of overlapping straps of plastic material, as set forth in claim **1** in which said irregular formations are provided by projections integral with and extending inwardly from the ligature contacting surfaces of the seal.

3. A seal for joining and securing a pair of overlapping straps of plastic material, as set forth in claim **2** in which said projections are disposed in complementary relationship so that ligature portions secured thereby are distorted to a corrugated configuration within said seal when said seal is closed thereabout and pressed into firm engagement therewith.

4. A seal for joining and securing a pair of overlapping straps of plastic material, as set forth in claim **2** in which said projections are formed by complementary arranged transversely extending barlike members.

5. A seal for joining and securing a pair of overlapping straps of plastic material, as set forth in claim **2** in which said projections are formed of bar like portions arranged complementary with transversely extending slots in said body.

6. A seal for joining and securing a pair of overlapping straps of plastic material, as set forth in claim **1** in which said irregular formations are provided by transversely extending serrations formed in the ligature contacting surfaces of the seal.

7. A seal for joining and securing a pair of overlapping straps of plastic material, as set forth in claim **1** in which said irregular formations are provided by displacement of portions of the material of the seal on the ligature contacting surfaces thereof to provide projections extending inwardly from said surfaces.

8. A seal for joining and securing a pair of overlapping straps of plastic material, as set forth in claim **1** in which said irregular formations are formed by elongated projecting burrs formed adjacent apertures in said body and extending inwardly from the ligature contacting faces thereof.

9. A seal for joining and securing a pair of overlapping straps of plastic material, as set forth in claim **8** in which said body has additional apertures therein disposed complementary with the burrs to receive the burrs and plastic material displaced thereby when the seal is closed about the strap and pressed into firm engagement therewith.

10. A seal for joining and securing a pair of overlapping straps of plastic material, as set forth in claim **1** in which said irregular formations are provided by project-

ing elements secured to the ligature contacting surfaces of the seal.

11. A seal for joining and securing a pair of overlapping straps of plastic material, as set forth in claim **1** in which said irregular formations are provided by teeth elements projecting inwardly from the ligature contacting surfaces of the seal and formed integrally therewith.

12. A seal for joining and securing a pair of overlapping straps of plastic materials, as set forth in claim **8** in which said teeth have substantially flat faces at least some of which face in a direction opposite to the direction in which ligature secured thereby is tensioned.

13. A seal for joining and securing a pair of overlaplaping straps of plastic material, as set forth in claim **6**, in which said serrations extend across the entire width of the seal.

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