Dec. 29, 1959 D. S. PORTER 2,918,846

CONNECTOR FOR CARTRIDGE BELT LINK

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Fig. 1.

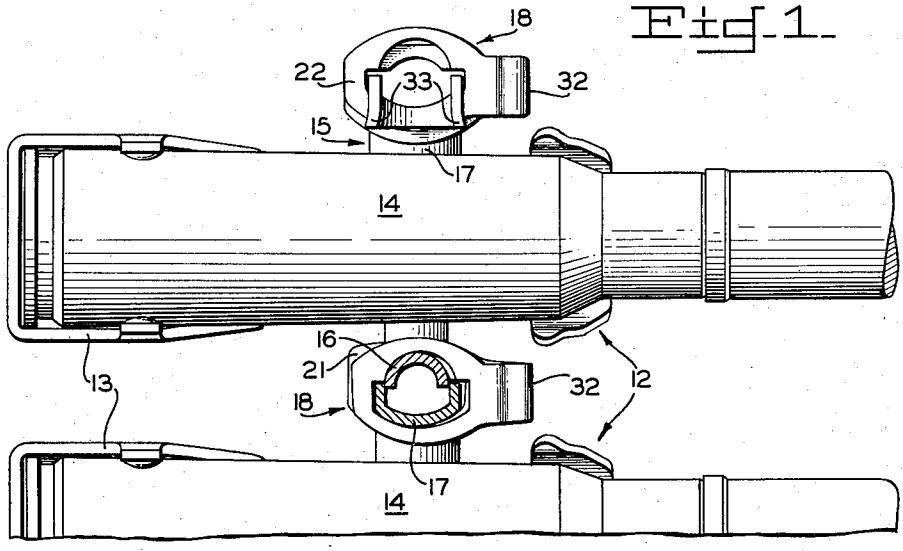


Fig. 2.

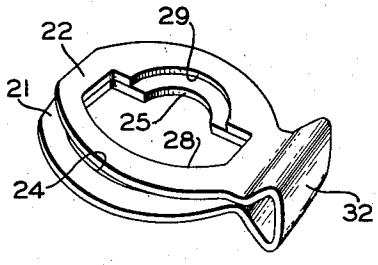


Fig. 3.

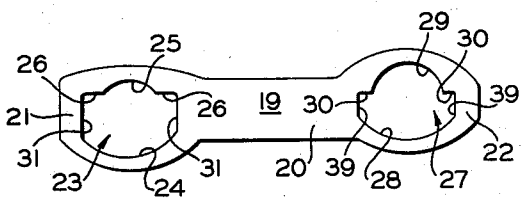
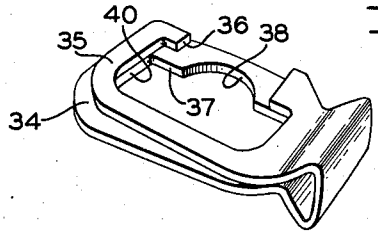


Fig. 4.



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CONNECTOR FOR CARTRIDGE BELT LINK

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8 Claims. (Cl. 89—35)

This invention relates to ammunition links for high-speed automatic guns and is more particularly directed to an improved connector for joining adjacent links of the type from which the cartridges are adapted to be stripped substantially at right angles to the longitudinal axis thereof.

One of the many problems encountered in the feeding of ammunition into high-speed guns is the difficulty of providing sufficient strength in the cartridge belt links and the connections therebetween to resist the peak loads developed under the intermittent accelerations imparted to the belt. While link constructions have been developed to provide the necessary high strength and resistance to deflection under load, the same degree of success has not as yet been achieved in regard to the members employed to connect adjoining links. For one thing, it has been extremely difficult to provide a connector having the proper combination of strength and flexibility under load. If the section modulus of the connector is designed to provide sufficient strength to resist the peak loads developed during the maximum acceleration of the ammunition belt, the resulting degree of flexibility in the connector is usually insufficient to exert any appreciable damping effect on the surging action induced in the belt by the intermittent starting and stopping of the gun operation. Without some degree of extensibility in the connector to absorb the slack between adjacent links whenever operation of the gun is initiated, the resultant waves produced in the portion of the ammunition belt suspended between the gun and the stationary ammunition box cause a considerable increase in the maximum load imparted to the links during the normal acceleration of the belt. On the other hand, too much extensibility between adjoining links is also undesirable because of the resulting difficulty in maintaining a substantially constant pitch throughout the entire belt. It is readily apparent that if the pitch distance between adjacent linked cartridges were to increase during the initial engagement between the link and the teeth of the sprocket in the feed unit of the gun, the resulting variation in belt acceleration would be extremely detrimental to the smooth ammunition feed so essential in high rate of fire guns.

It is, therefore, an object of this invention to provide an ammunition belt capable of yielding a relatively high rate of initial extension between adjacent links without a concurrent decrease in the ability to resist subsequent peak belt loads.

A further object of the present invention is to provide an ammunition belt wherein the adjacent links are joined by a separate one-piece connector having a resilient construction adapted to absorb the tensile forces encountered during any increase in the pitch distance between adjacent cartridges and thereafter adapted to transmit the developed belt load to the tension members of the link itself.

Still another object of the present invention resides in the provision of a cartridge belt link connector wherein the periphery of the link-receiving opening can be resiliently expanded to absorb the initial accelerations imparted to each link during intermittent gun operation and yet is of such construction that the expansion can be limited to prevent too great an increase in the pitch distance between adjacent links.

In many gun installations, the path which the ammunition belt is required to follow from the fixed ammunition box to the feed throat of the gun frequently involves several changes in direction each of which may be as much as 90 degrees. It has been found that if a separate connector is utilized to join adjacent links, the helical forces imparted thereto by the turning and twisting movements of the ammunition belt combine with the tensile forces produced by the normal transverse feeding movements thereof into the gun to cause frequent breakage of the connector. This condition has been successfully alleviated by providing a link structure, as shown in U.S. Patent No. 2,794,369, wherein a relatively narrow channel-shaped arm of arcuate contour projects outwardly and downwardly from one side of the link body to nest in a similar but wider channel-shaped arm projecting from the opposite side of the body portion of the adjacent link. As a result of such construction, the free helical movement between adjacent links is limited by contact between the channel-shaped arms which thereupon absorb any subsequent helical forces which would otherwise have been transmitted to the connector. Heretofore, the aforesaid nesting relationship between adjacent links has been maintained by connectors of rectangular or circular configuration. While such connectors are functionally satisfactory, they require a relatively thick cross-section to withstand the stresses which tend to become localized at the relatively small area of contact between the connector and the transverse arcuate contour of each of the channel-shaped link arms inserted therethrough.

Accordingly, it is another object of this invention to provide a unitary connector for joining adjacent cartridge belt links wherein the interior contour of the link-receiving opening corresponds to the contour of the portions of the links extending therethrough.

Still a further object of the invention is to provide a connector for joining adjacent cartridge belt links wherein the distance along the longitudinal axis of the link-receiving opening in the connector is of greater length than the distance along the transverse axis thereof.

Another object of this invention is to provide a one-piece connector for joining adjacent cartridge belt links wherein the link receiving opening therein is formed with means for preventing rotational movement of the connector about the link portions extending therethrough.

It is a specific object of this invention to provide a one-piece cartridge belt link connector of high-load capacity wherein the configuration thereof is particularly adapted to retain the channel-shaped arms of adjacent links in nested relation during the feeding of the belt into the gun without interfering with the subsequent disintegration of the belt during the exit thereof from the gun.

In one form of the invention, the connector essentially comprises an elongated member having an enlarged leaf portion at either end thereof provided with an opening therethrough which is formed by a rectangular area disposed between a pair of circular segments of unequal radii. The exterior peripheries of the leaf portions are such that doubling of the elongated member about an arched portion in the center thereof will bring the enlarged ends into offset but parallel adjacency. Each of the links in the ammunition belt is formed with a cartridge-encircling loop of channeled construction wherein substantially half thereof is of greater width than the remaining half so that upon the joining of adjacent links, the narrower loop end on one link will nest within the wider loop end of the adjacent link. When the connec-

tor is properly assembled over the nested loop ends of adjacent links, the periphery of the smaller circular segment in the lower leaf portion thereof is arranged for mating contact with the arcuate contour transversely across the inner periphery of the narrower channel-shaped arm while the periphery of the larger circular segment in the upper leaf portions will be in similar contact with the corresponding arcuate contour of the wider channel-shaped arm. As a result of the foregoing construction, the connector possesses a relatively high rate of extension as the openings in the offset leaf portions move into alignment with each other. However, once such alignment is attained the connector becomes a relatively rigid member capable of resisting the high tensile forces imparted thereto by the pull between adjacent links during the feeding movement of the belt.

The specific nature of the invention as well as other objects and advantages thereof will clearly appear from a description of a preferred embodiment as shown in the accompanying drawings in which:

Fig. 1 is a fragmentary view of the underside of an ammunition belt in which the connectors of the present invention are utilized;

Fig. 2 is an enlarged perspective view of one of the connectors;

Fig. 3 is a developed view of the blank from which the connector of Fig. 2 is formed; and

Fig. 4 is a view similar to Fig. 2 but showing a modification in the construction of the connector.

As shown in Fig. 1, the cartridge belt links **12** to be connected into an ammunition belt are preferably of one-piece construction having a rearwardly-disposed resilient structure **13** for releasably gripping a cartridge **14**. A substantially C-shaped, cartridge-encircling loop **15** is arranged to project from opposite sides of link **12** substantially closer to the forward end thereof than to the rear end. While loop **15** is of channeled construction throughout, the projecting arms thereof are of unequal width as shown at **16** and **17**. Thus, when adjacent links **12** are connected, the narrower arm **16** of one link is arranged to be nested within the wider arm **17** of the adjacent link. As a result of such construction, the free helical twisting movement between adjacent links is limited by the resulting contact between the vertical walls of arms **16** and **17**.

Cartridge belt links **12** are joined by a connector **18** which is formed by bending the blank **19**, depicted in Fig. 3, into the configuration shown in Fig. 2. Blank **19** is preferably stamped from sheet stock and essentially comprises an elongated rectangular body **20** terminating at either end thereof in an enlarged leaf portion **21** and **22** of substantially oval configuration.

Leaf portion **21** is provided with an opening **23** whose exterior periphery is produced by the inclusion of a substantially-rectangular area between opposed circular segments of unequal radii. The larger segmental area forms an arc **24** which connects the opposing sides **31** of the rectangular area while the smaller segmental area forms an arc **25** which constitutes a major portion of the side of the rectangular area opposite arc **24**. The junction of the side containing arc **25** with the sides **31** of the rectangular area form a pair of spaced-apart shoulders **26** for a purpose to be disclosed. While the center of arc **25** lies on a vertical axis normal to the longitudinal centerline of body **20**, the center of arc **24** is located slightly to one side of such axis thereby tilting arc **24** relative to sides **31** of the rectangular area, as shown in Fig. 3, by the difference in the length of such sides.

Leaf portion **22** is similarly provided with an opening **27** whose exterior periphery is formed by opposing arcs **28** and **29** in the same manner as described for leaf portion **21** except that the centers of both arcs lie on the same transverse axis. However, the rectangular area in leaf portion **22** is not as wide as that in leaf portion **21** as indicated by the shorter length of the opposite sides **39**. Thus, while arc **29** has a radius equal to that of arc **25**, the peripheral extent of the former is considerably greater than that of the latter and, consequently, occupies a greater portion of the side of the rectangular area opposite arc **28**. As a result, the junction between sides **39** and the ends of the side containing arc **29** form shoulders **30** which are appreciably shorter than shoulders **26** but lie along the same longitudinal axis. In addition, the centers of arcs **28** and **29** are laterally displaced relative to the corresponding centers of arcs **24** and **25** so that the greater portion of opening **27** lies above the longitudinal centerline of body **20** while the greater portion of opening **23** lies below such centerline.

Thus, when body **20** is folded back on itself, leaf portions **21** and **22** will be brought into parallel adjacency with shoulders **26** in alignment with shoulders **30**. In such position the exterior periphery of leaf portion **22** will project beyond leaf portion **21** and the consequent offset relationship between openings **23** and **27** will reduce the area of the space adapted to receive arms **16** and **17** of adjacent links **12**. The periphery of this space is, therefore, formed by the smaller arc **25** and the shoulder **26** of leaf portion **21**, the larger arc **28** and the opposed linear sides **39** of leaf portion **22**. It should be understood that the curvature of arc **28** is arranged to correspond to the transverse curvature of arm **17** while the curvature of arc **29** corresponds to that of the transverse curvature of arm **16**. Accordingly, when each connector **18** is assembled over the nested arms **16** and **17** of adjacent links **12**, shoulders **26** and **30** are arranged to contact the upright walls of link arm **17** and thereby limit the rotational movement of connector **18** thereabout.

In order to provide the necessary resiliency in connector **18**, the central section of elongated body **20** is arched above the transverse axis thereof and enlarged ends **21** and **22** are then folded from the ends of the resulting arched portion. After such folding, the arched portion is flattened to form a substantially closed loop section **32** which provides the torsion necessary to resist the scissors-like movement of leaf portions **21** and **22** in opposite directions. Such resistance serves to cushion the loads developed as the slack between adjacent links **12** is taken up and the belt begins to accelerate. During such cushioning movement, leaf portions **21** and **22** will be forced to move in opposite directions until arc **29** contacts the transversely-arcuate periphery of arm **16** and arc **24** contacts the transversely-arcuate periphery of arm **17** of the adjacent link. In such position, arc **25** becomes aligned with arc **29** while arc **24** becomes aligned with arc **28** and, as a result, connector **18** becomes a fixed unitary member which no longer absorbs the belt pull developed between adjacent links but instead transmits the load to arms **16** and **17** of the links themselves. The alignment of the corresponding arcs of leaf portions **21** and **22** is attained at the completion of the opposite movements thereof since the lateral displacement beween the centers of arcs **24** and **25** compensates for the slight arcuate paths thereof about the vertical axis of torsion section **32**.

Once connector **18** has been assembled onto the wider arm **17** of each link **12**, the extreme ends of such arm are turned outwardly in opposite directions to form ears or lugs **33** which are spaced apart to a slightly greater extent than the maximum dimension along the longitudinal axis of the link-receiving openings **23** and **27**. As a result, each link **12** is provided with a loosely but permanently attached connector **18**. Instead of spreading apart the end of channel-shaped arm **17**, lugs **33** may be formed by the welding or brazing of additional metal thereto. However, connector **18** is readily separable from the link adjacent the one on which such connector is permanently retained once cartridge **14** has been stripped therefrom. Such separation is readily assured

by the fact that the width of arm 16 is substantially less than the maximum dimension along the longitudinal axis of the link-receiving openings 23 and 27. Thus, arm 16 is free to move out of engagement with connector 18 and effect disintegration of the belt as soon as the empty link moves out from the restraining influence of the feed mechanism in the gun.

Instead of the oval configuration of leaf portions 21 and 22, the connector may be formed, as shown in Fig. 4, wherein the juxtaposed leaf portions 34 and 35 are substantially rectangular with rounded corners. It has been found that such construction avoids the possibility of interference between the central portion of the exterior periphery of the connector and the side of the cartridge case when the linked cartridge belt is folded in successsive, overlapping layers. As a result, each layer of the belt will lie in a substantially straight line in contiguous relation to the adjacent layer which, of course, permits the storage of a maximum number of cartridges in a given area.

It has been found that in order to successfully align arcs 24 and 28 simultaneously with the alignment of arcs 25 and 29, both the link and the connector must be formed to extremely close tolerances. However, such tolerance requirement is obviously extremely costly insofar as mass production is concerned. Accordingly, it has been suggested that the required simultaneous alignment of the corresponding, oppositely-disposed arcs in the link-receiving openings 23 and 27 be eliminated. This concept has been carried out, as shown in the connector of Fig. 4, by removing a substantial portion along one side of leaf portion 35 as indicated at 36 to provide a substantially C-shaped outline. Leaf portion 34 is, of course, provided with an opening 37 for receiving nested arms 16 and 17 of adjacentl inks. One side of opening 37 is formed with a centrally-disposed arcuate portion 38 corresponding to the transversely arcuate contour of arm 16 while the side opposite arcuate portion 38 is linearly formed but at a predetermined inclination relative to the other pair of opposite sides 40. Thus, when adjacent links are pulled apart in opposite directions, the scissors-like movement of rectangular leaf portions 34 and 35 terminates upon the alignment of the inclined side of the former with the corresponding linear portion of the C-shaped outline. Since the existence of cutout portion 36 permits unobstructed movement of leaf portion 35, any variation in the dimensions thereof relative to the corresponding dimensions of leaf portion 34 does not affect the eventual alignment therebetween. Although this construction presents only a single thickness of material to resist the belt load imparted to the connector by the narrower arm 16 of link 12, it has been found that with the proper heat treatment, the connector can be made strong enough to withstand the peak belt loads which may develop during the maximum feed rate of the gun.

It is, therefore, apparent that connectors of the present invention are particularly well suited for the task of joining adjacent cartridge belt links of the type wherein an arcuately-projecting arm of one link fits within a similar but wider projecting arm of the other link. The arcuate contours of the openings in the oval-shaped or rectangular leaf portions of the connector through which the channel-shaped arms project are selected to correspond to the transverse curvatures of such arms so that the forces transmitted thereto by the belt loads between adjacent links are evenly distributed along the entire connector instead of being concentrated in relatively small areas thereof. Such construction will, of course, provide a significant improvement in the strength of the connector in comparison to those of the prior art which merely contact a small fraction of the entire load-transmitting surface of the link.

Furthermore, while the section modulus of the connector is sufficiently small to impart considerable resiliency to each of the leaf portions, the strength thereof is virtually doubled once the resilient movement has been terminated and the interior peripheries of the leaf portions are brought into circumferential alignment. The high rate of extensibility of the connector is extremely important in effecting a desirable reduction in the acceleration of the belt upon initial engagement with the feeding sprocket which draws the belt into the gun. Extensive experimentation has shown that if the connectors in a cartridge belt did not permit any appreciable increase in the belt pitch upon engagement with the feeding sprocket, the abrupt change in direction to which the belt is subjected as a result of the relatively steep circular path of the sprocket teeth would accelerate the belt so severely that the resulting loads on the links as well as on the connectors would cause jam-producing breakages in the ammunition belt. However, at the same time, this increase in belt pitch is limited in order to ensure that the maximum distance between adjacent links does not exceed the pitch distance between the adjacent sprocket teeth which serve to feed the ammunition belt into the gun.

Another advantage of the connectors of the present invention lies in the fact that the portion which contacts the narrower arcuate arm of one of the adjacent links is considerably smaller than the maximum longitudinal dimension of the link receiving opening and, consequently, permits a relatively easy disengagement therebetween as the empty links emerge from the feedway in the gun and are free to rotate about the engagement thereof with the connector. Such disintegration of the belt is a highly desirable feature where the gun is mounted in a relatively-confined area.

Although a particular embodiment of the invention has been described in detail herein, it is evident that many variations may be devised within the spirit and scope thereof and the following claims are intended to include such variations.

I claim:

1. In a cartridge belt, the combination of a plurality of cartridge carrying links and a one-piece connector for joining each link to the one adjacent thereto, said connector comprising a torsion section and a pair of parallel leaf portions extending from opposite ends of said torsion section, each pair of said leaf portions having juxtaposed openings therethrough for loosely receiving projecting portions of said adjacent links, said leaf portions being normally disposed with the central longitudinal axis of one of said juxtaposed openings laterally offset from the corresponding axis of the other of said openings prior to the completion of the increase in the pitch distance between adjacent links produced by the initial loading of the cartridge belt whereby said torsion section resiliently opposes the scissorslike movement imparted to said leaf portions as said openings therein are brought into peripheral alignment during the feeding movement of the cartridge belt.

2. In a cartridge belt, the combination of a plurality of cartridge carrying links of the type wherein an arcuately projecting arm on one link nests within a similarly projecting but wider arm on the link adjacent thereto for limiting helical twisting movement therebetween, and a one-piece connector for joining each link to the one adjacent thereto comprising a looped torsion section at the forward end thereof and a pair of parallel leaf portions extending rearwardly from opposite ends of said torsion section, each pair of said leaf portions having juxtaposed openings therethrough for loosely receiving said nested arms of adjacent links, said leaf portions being normally disposed with the central longitudinal axes of said openings being laterally offset to limit the unobstructed separation between said nested arms whereby the subsequent increase in the pitch distance between said adjacent links during the initial load-

ing of the cartridge belt is resiliently opposed by said torsion section as said openings are brought into peripheral alignment during the feeding movement of the cartridge belt.

3. A one-piece connector for joining adjacent cartridge link members into belt form comprising a torsion section and a pair of leaf portions extending longitudinally therefrom in substantially parallel juxtaposition, each of said leaf portions having an opening therethrough for receiving the projecting arm portions of adjacent link members, said openings being formed by the inclusion of a substantially-rectangular area between oppositely-disposed circular segments of unequal radii, said leaf portions being offset in relation to each other whereby the misalignment of said openings therein reduces the original pitch distance between adjacent links, said torsion section being thereby disposed to resiliently resist the subsequent increase in pitch distance produced by the scissorslike movement imparted to said leaf portions during the transmittal of belt load between adjacent link members, the increase in the pitch distance between adjacent links being terminated when said openings in said leaf portions move into axial alignment with each other.

4. The combination defined in claim 3 wherein the centers of said oppositely-disposed circular segments in one of said leaf portions lie on the same transverse axis thereof while the corresponding centers of said circular segments in the other of said leaf portions are laterally offset to compensate for the arcuate paths of each of said leaf portions during the scissorslike movement thereof and thereby permit a substantially complete peripheral alignment between each of said link-receiving openings upon axial alignment thereof.

5. A one-piece connector for releasably joining adjacent cartridge belt links of the type wherein an arcuately-projecting channel-shaped arm on one link nests in a similarly-projecting but wider channel-shaped arm on the adjacent link to limit the degree of helical twisting movement therebetween, said connector comprising a vertically-disposed, loop-shaped torsion section at the forward end thereof and a flat leaf portion extending rearwardly from each end of said torsion section in substantially parallel juxtaposition, each of said leaf portions having an opening therethrough for loosely receiving the nested arms of adjacent links, each of said openings being formed by the inclusion of a substantially-rectangular area between oppositely-disposed circular segments of unequal radii, said circular segments having peripheries conforming in part to the transverse configuration of the nested arms of adjacent links, each of said leaf portions having a larger area on one side of the longitudinal axis thereof than on the other, said larger areas being disposed on respectively-opposite sides of said juxtaposed leaf portions whereby the peripheries of said openings therein are offset from each other, said torsion section being thereby adapted to resiliently oppose the increased pitch produced by the separation of the nested relationship between the projecting arms of adjacent links until said openings move into peripheral alignment with each other whereupon said leaf portions rigidly oppose any further increase in the pitch distance between adjacent links.

6. The combination defined in claim 5 wherein the periphery of each of said openings includes a stepped shoulder between the ends of one of said circular segments and the sides of said rectangular area whereby rotation of said leaf portions about the nested arms of adjacent links is limited by contact between said stepped shoulders and the larger of the nested link arms.

7. A one-piece connector for joining adjacent cartridge belt links of the type wherein an arcuately-projecting arm on one link cooperates with a similarly-projecting arm of greater width on the adjacent link to limit helical twisting movement therebetween, said connector comprising a vertically-disposed, loop-shaped torsion section at the forward end thereof and a substantially-rectangular leaf portion extending rearwardly from each end of said torsion section in substantially parallel juxtaposition, each of said leaf portions having similar rectangular openings therethrough for loosely receiving the cooperating arms of adjacent links, at least one of said openings including an arcuate section centrally disposed in the periphery of one side thereof, said leaf portions being disposed in offset relation whereby said openings therein combine to reduce the area through which the arms of adjacent links extend, said torsion section being thereby adapted to resiliently resist the scissorslike movement imparted to said leaf portions by the increase in the pitch distance between adjacent links produced by the loading of the belt, said increase in pitch distance being terminated when said openings in said leaf portions move into axial alignment with each other.

8. A one-piece connector for joining adjacent cartridge belt links of the type wherein an arcuately-projecting channel-shaped arm on one link nests in a similarly-projecting but wider channel-shaped arm on the adjacent link to limit the degree of helical twisting movement therebetween, said connector comprising a vertically-disposed, loop-shaped torsion section at the forward end thereof, first and second leaf portions extending rearwardly from opposite ends of said torsion section to lie in substantially horizontal parallel juxtaposition, said first leaf portion having an opening therethrough for receiving the nested arms of adjacent links, said opening being bounded by a substantially rectangular periphery including an arcuate section centrally disposed in one of the longer sides thereof, the shorter sides of said opening being parallel and of unequal length whereby the side opposite said arcuate section is inclined relative thereto, said second leaf portion being of C-shaped outline corresponding to the rectangular portion of said opening in said first leaf portion but disposed in offset relation thereto, said first and second leaf portions being thereby arranged to resiliently resist separation between the nested arms of adjacent links until said C-shaped outline of said first leaf portion is forced into correspondence with said link-receiving opening in said second leaf portion whereupon said connector is converted to a rigid nonexpandible member.

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