

CLAMPING BAND

The present invention relates to a clamping band for tightly clamping a member to be clamped, e.g., a joint section of a transmission mechanism, a radiator pipe of a car.

Conventionally, in a universal joint of a transmission mechanism of a car, grease is applied to bearings and joint members as a lubricant. The joint members are covered with a rubber or plastic cover, and the cover is tightly clamped by clamping bands. And the radiator pipe is connected with a radiator and water-tightly clamped by the clamping band so as to prevent water leakage.

The applicant of the present invention invented a clamping band having a clamping ear, which is capable of securely clamping without spring back (see Japanese Patent Kokai Gazette No. 3-163294). The clamping band consists of two parts: a band member and a clamping member. The band member is a looped metallic band, and there is formed an engaging claw at one end of the band member. The clamping member has the clamping ear in the center part. And one end of the clamping member is spot-welded on the band member; an engaging hole is bored on the other side of the clamping ear.

In the case of, for example, clamping a member to be clamped, e.g., a hose, which has been connected with a pipe, firstly the member is inserted through the looped clamping band, then the clamping band is placed on a connecting section of the member and the pipe. To clamp the member to fix, the clamping ear is compressed in the circumferential direction of the band member to reduce diameter thereof. By reducing the

diameter of the band member, the engaging claw can be engaged with the engaging hole. By engaging the engaging claw with the engaging hole, the diameter-reduced state of the band member can be tightly kept even if the elasticity of the member to be clamped or the spring back of the compressed clamping ear works to enlarge the diameter of the band member.

However, since said conventional clamping band consists of the two parts: the band member and the clamping member, it is difficult to correctly weld the clamping members at prescribed points on the band members, so that manufacturing efficiency cannot be raised. When the diameter of the band member is reduced, a step section is formed in an overlapped part, in which the band member and the clamping member are overlapped, on an inner face of the looped band member, and the clamping member is apt to shift in the transverse direction of the band member. The step section and the shift can be absorbed if the member to be clamped is made of an elastic material, e.g., rubber. But recently the joint members of the universal joint are covered with a plastic cover, so grease in the cover will be leaked by the step section or the shift. Further, in the case of clamping, for example, a long hose, the hose must be inserted through the clamping band, which has been welded to form into the looped shape, prior to connecting the hose with another member. Namely, it is troublesome to attach the clamping band on a long member after the long member is connected.

An object of the present invention is to provide a clamping band having a simple structure, which can be

manufactured efficiently.

Another object is to provide a clamping band, which is capable of securely clamping and easily attaching.

To achieve the objects, the clamping band of the present invention comprises: a metallic band section having a first end and a second end;

a clamping ear having a gate shape, the clamping ear being disposed at a position on the band section overlapping the first end when the band section is formed into a loop, the clamping ear being compressible in the circumferential direction of the loop to permit reducing a diameter of the loop;

a Y-shaped fork being formed in the first end of the band section, the Y-shaped fork including a pair of fork pieces; and

a pair of concave sections being formed in each side edge margin of the band section, the concave sections being capable of respectively accommodating the fork pieces of the Y-shaped fork when the band section is formed into the loop with the first end being overlapped by the band section and the concave sections facing inwardly.

In the clamping band, the concave sections may be disposed to accommodate the fork pieces of the Y-shaped fork when the clamping ear is compressed in the circumferential direction of the loop such that an inner face of the loop is stepless.

The clamping band may further comprise:

an engaging piece disposed proximate the Y-shaped fork of the band section; and

a first engaging hole for engageably accepting the engaging piece, the first engaging hole being disposed proximate the second end of the band section whereby the band section is formed into the loop when the first engaging hole is engaged with the engaging piece.

In the clamping band, the first engaging hole may be a long hole elongated in the longitudinal direction of the band section, and the engaging piece is longitudinally displaceable within the first engaging hole when the clamping ear is compressed in the circumferential direction of the loop.

The clamping band may further comprise:

a second engaging hole disposed proximate the first end of the band section; and

an engaging section disposed proximate the second end of the band section for engaging the second engaging hole permitting to be formed into the loop by engaging the engaging piece with the first engaging hole on one side of the clamping ear and engaging the engaging section with the second engaging hole on another side of the clamping ear opposite the one side.

In the clamping band, the second engaging hole may be formed by cutting the band section to make a cutting hole and embossing an edge of the cutting hole, and

the engaging section may be a tongue piece insertable into the second engaging hole.

In the clamping band, the engaging piece may be formed by cutting the band section to make a tongue piece and bending the tongue piece to form into an L-shape capable of engaging with the first engaging hole.

In the clamping band, the concave sections may be disposed to accommodate the fork pieces of the Y-shaped fork when the clamping ear is compressed in the circumferential direction of the loop such that an inner face of the loop is stepless.

In the clamping band of the present invention, since the clamping band can consist of only one member, number of parts and number of manufacturing steps can be reduced, so that manufacturing cost of the clamping bands can be reduced, and manufacturing accuracy can be raised.

When the clamping ear is compressed in the circumferential direction, the fork pieces of the Y-shaped fork are fitted and accommodated in the concave sections, so that the inner face of the looped band section can be formed stepless. By forming the stepless flat inner face, the clamping band is capable of securely and tightly clamping. Thus, the safety and reliability of the clamping band can be raised.

If the first engaging hole is the long hole in which the engaging piece is guided its movement when the clamping ear is compressed in the circumferential direction of the looped band section, a part of an overlapped section of the band section can be prevented from shifting in the transverse direction.

In the case of forming the band section into the loop by engaging the engaging piece with the first engaging hole on the one side of the clamping ear and engaging the engaging section with the second engaging hole on the other side thereof, the clamping band can be easily attached to and detached from the any members to be clamped.

Embodiments of the present invention will now be described by way of examples and with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of a clamping band of a first embodiment of the present invention;

Fig. 2A is a plan view of a band section of the first embodiment;

Fig. 2B is a front view of the band section;

Fig. 2C is a partial front view of a second end section of the band section in which a clamping ear is formed;

Fig. 2D is a front view of the clamping band, which has been formed into a loop shape;

Fig. 2E is a partial plan view showing an engaging state of an engaging piece and a first engaging hole;

Fig. 2F is a partial sectional view showing the engaging state of the engaging piece and the first engaging hole;

Fig. 2G is a partial plan view showing the engaging hole of the band section;

Fig. 2H is a partial plan view showing a first end section of the band section;

Fig. 3A is a perspective view of the clamping band, which has been formed into a loop shape;

Fig. 3B is a perspective view of the clamping band whose clamping ear is compressed in the circumferential direction of the band section;

Fig. 4 is a front view of the clamping band whose clamping ear is compressed in the circumferential direction of the band section;

Fig. 5 is a plan view of a tool for compressing the

clamping ear;

Fig. 6 is a perspective view of the clamping band of a second embodiment;

Fig. 7A is a front view of w of the clamping band of the second embodiment;

Fig. 7B is a partial perspective view of the first end section of the band section of the second embodiment;

Fig. 7C is a partial perspective view of the second end section of the band section of the second embodiment;

Fig. 8 is a perspective view of the clamping band of a third embodiment;

Fig. 9A is a front view of w of the clamping band of the third embodiment;

Fig. 9B is a partial perspective view of the first end section of the band section of the third embodiment; and

Fig. 9C is a partial perspective view of the second end section of the band section of the third embodiment.

Preferred embodiments of the present invention will now be described in detail with reference to the accompanying drawings.

A first embodiment will be explained.

In Fig. 1, a metallic band section 2 of the clamping band 1 has a first end 2a, which is in an inner portion A of the band section 2, and a second end 2b, which is in an outer portion B of the band section 2. The first end section 2a of the band section 1 is formed into a Y-shaped fork having a pair of fork pieces as shown in Fig. 2A. The band section 2

has a pair of concave sections 8, which has been formed in each side edge of the band section 2 by bending a part of each side edge outward, and the concave sections 8 are capable of respectively accommodating the fork pieces of the Y-shaped fork 2a. The concave sections 8 are located at positions at which the fork pieces of the Y-shaped fork 2a are respectively accommodated when the clamping band 1 is in a clamping state (see Fig. 4). In the present embodiment, the band section is made of a relatively soft stainless steel, e.g., SUS 430 (JIS), which has width of 6 mm; thickness of 0.8 mm; and length of 236 mm.

A clamping ear 3 is formed at a position corresponding to a part in which the looped band section is overlapped. The clamping ear 3 is formed into a gate shape by bending the band section outward. The clamping ear 3 is a so-called Oetiker's ear, so it is compressed in the circumferential direction of the looped band section by a tool 7 (see Fig. 5). By compressing the clamping ear 3, the diameter of the looped band section 2 can be reduced to clamp.

In the vicinity of the Y-shaped fork 2a, an engaging piece 4 is projected outward. The engaging piece 4 is capable of engaging with a first engaging hole 5, which is bored at a position corresponding to the Y-shaped fork 2a when the band section 2 is formed into the loop shape (see Figs. 2E and 2F). The first engaging hole 5 is a long hole bored in the longitudinal direction of the band section 2. With this structure, the band section can be formed in the loop shape by engaging the engaging piece 4 with the first engaging hole 5.

The second end section 2b is fixed on an outer face of

the band section 2 at a position 6 by resistance welding. By welding the second end section 2b, the band section 2 can be tightly kept in the loop shape. The welding position 6 can be correctly defined at prescribed position by engaging the engaging piece 4 with the first engaging hole 5, so that the welding positions 6 of the clamping bands 1 can be located at the prescribed position with high positioning accuracy.

Next, manufacturing steps of the clamping band 1 will be explained with reference to Figs. 2A-2H.

In the band section 2, the engaging piece 4, the concave sections 8, the long first engaging hole 5, the clamping ear 3 and the welding point 6 are arranged from the first end or the Y-shaped fork 2a to the second end 2b.

The Y-shaped fork 2a is formed in the first end section so as to make the narrow fork pieces. By having the narrow fork pieces, the fork piece of the Y-shaped fork 2a are apt to bend radially outward when the clamping ear 3 is compressed to reduce the diameter of the band section 2.

The concave sections 8 are formed by bending the part of each side edge of the band section 2 radially outward with a die-punch machine. As described above, the concave sections 8 are located to accommodate the fork pieces of the Y-shaped fork 2a when the clamping ear 3 is compressed. The depth of the concave sections 8 is designed that the fork pieces, which have been bent radially outward by compressing the clamping ear 3, of the Y-shaped fork 2a can be fitted and accommodated in the concave sections and an inner face of the looped band section 2 is formed flat without a step section (see Fig. 4).

The engaging piece 4 is formed by: cutting the band

section 2 to make a tongue piece; and bending the tongue piece outward to form into an L-shape (see Fig. 2B).

The long first engaging hole 5 is bored at a position corresponding to the Y-shaped fork 2a when the band section 2 is formed into the loop shape (see Fig. 2E). Initially, the engaging piece 4 is located at one end of the first engaging hole 5, which is the end on the first end 2a side, by elasticity of the band section 2. In this initial state, the distance between the engaging piece 4 and the second end 2b is always fixed, so the welding position 6 can be easily located at the prescribed position with high positioning accuracy (see Fig. 2D).

The clamping ear 3 has a dimple 3a in a top face. The dimple 3a has been formed in the flat band section 2 before forming the clamping ear 3 into the gate shape (see Fig. 2A). When the clamping ear is compressed to reduce the diameter of the looped band section 2, stress in the clamping ear 3 is absorbed by the dimple 3a, so that the top face of the clamping ear 3 is prevented from deforming outward. Further the clamping ear 3 is able to resist the spring back and the diameter increment of the band section 2 can be securely prevented by forming the dimple 3a.

To effectively execute resistance welding at the welding point 6, there is formed a recess 6a in the vicinity of the second end 2a corresponding to the welding point 6. A bottom face of the recess 6a is capable of contacting an outer face of the band section 2, which is located below the recess 6a (see Fig. 2A). When electric current for the resistance welding is passed between the most inner face at the welding

point 6 and the most outer face thereat, the recess 6a is heated and melted, so that the welding point 6 is formed flat.

The band section 2 is formed into the loop shape by the steps of: locating the engaging piece 4 at the initial position in the first engaging hole 5; and resistance-welding the second end section 2a at the welding point 6. In the present embodiment, the clamping band 1 consists of only one part, and no complex machining is required, so that manufacturing efficiency can be raised, and manufacturing cost can be reduced. Further, the clamping band 1 is capable of clamping tightly and securely.

To clamp a member to be clamped, firstly the member to be clamped is inserted through the looped clamping band 1, whose clamping ear 3 is not compressed as shown in Fig. 3A, to set the clamping band 1 on a clamping position of the member to be clamped. Then, the clamping ear 3 is compressed in the circumferential direction of the band section 2 by the tool 7 (see Fig. 5) so as to reduce the diameter of the looped band section 2. The diameter reduced state of the clamping band 1 is shown in Fig. 3B.

The tool 7 has a pair of arms 7a and 7b, which are mutually crossed and rotatably connected at the cross point, as well as a pair of pliers (see Fig. 5).

When the clamping ear 3 is compressed by the tool 7, the Y-shaped fork 2a is moved in the direction of the diameter reduction. And the fork pieces of the Y-shaped fork 2a are apt to bend radially outward by force F_a , which works to reduce the diameter of the band section 2, and counter force F_b from the member to be clamped, which works to enlarge the

diameter thereof. By the outward bending of the fork pieces, the fork pieces are fitted and accommodated in the concave sections 8, so that the inner face of the looped band section 2 is formed flat without said step section (see Fig. 4), so that the clamping band 1 is capable of uniformly clamping the member to be clamped. With the uniform clamping, the clamping band 1 is capable of tightly and securely clamping the member, so that the safety and the reliability of the clamping band 1 can be raised.

After compressing the clamping ear 3, the diameter increment of the band section 2, which is caused by the elasticity of the member to be clamped, can be limited by the dimple 3a and the welding.

When the clamping ear 3 is compressed by the tool 7, firstly the Y-shaped fork 2a is moved in the direction of the force F_a (see Fig. 3B) to reduce the diameter of the band section 2 and the engaging piece 4 is guided by the long first hole 5 to move in the same direction; then the Y-shaped fork 2a is moved a little in the direction of the force F_b (see Fig. 3B) to enlarge the diameter of the band section 2, so that the engaging piece 4 is engaged with the first hole 5 to completely clamp the member to be clamped. In this case, mutual shift of the parts of the band section 2, which are mutually overlapped, in the transverse direction can be prevented because the engaging piece 4 is guided in the circumferential direction of the band section 2 by the long first hole 5.

Successively, a second embodiment of the clamping band of

the present invention will be explained with reference to Fig. 6 and Figs. 7A-7C. Note that, elements shown in the first embodiment are assigned same numeric symbols and explanation will be omitted.

In the first embodiment, the band section 2 of the clamping band 1 is formed into the loop shape by welding at the point 6 before attaching to the member to be clamped. To easily handle the clamping band, the clamping band 1 of the second embodiment is capable of attaching to and detaching from the member to be clamped, which has been already connected to another member, without disconnecting the members. The band section 2 is detachably engaged to form into the loop shape instead of the resistance welding (see Fig. 6).

As clearly shown in Figs. 7A-7C, there are formed two second engaging holes 2c in the vicinity of the Y-shaped fork 2a. The second engaging holes 2c are formed by the steps of: cutting the band section 2 to make two cutting holes; and embossing edge of the cutting holes to form like domes (see Figs. 7A and 7B). On the other hand, there are formed two engaging sections 2f in the vicinity of the second end 2b. The engaging sections 2f are formed by the steps of: boring holes 2e having tongue pieces 2f; and bending the tongue pieces 2f inward to form into L-shapes (see Figs. 7A and 7C). The engaging sections 2f are capable of respectively inserting into the dome-formed second engaging holes 2c to engage one another when the band section 2 is formed into the loop shape.

The clamping band 1 is formed in the loop shape by the steps of: forming the band section into the loop shape; engaging the engaging piece 4 with the first hole 5; and

engaging the engaging sections 2f with the second engaging holes 2c. The band section 2 is engaged on both sides of the clamping ear 3.

With this structure, the clamping band 1 can be easily attached to and detached from the member to be clamped after the member is connected to another member.

As described above, since the clamping band consists of only one part, number of parts and number of manufacturing steps can be reduced, so that manufacturing cost can be reduced; manufacturing accuracy can be raised.

When the clamping ear is compressed, the fork pieces of the Y-shaped fork are fitted and accommodated in the concave sections, so that no step section is formed in the inner face of the looped band section. By forming the flat inner face with no step section, the clamping band is capable of securely and tightly clamping. Thus, the safety and reliability of the clamping band can be raised.

In the case of having the long first engaging hole in which the engaging piece is guided its movement when the clamping ear is compressed, the part of the overlapped section of the band section can be prevented from shifting in the transverse direction.

In the case of forming the band section into the loop by engaging the engaging piece with the first engaging hole on the one side of the clamping ear and engaging the engaging section with the second engage hole on the other side thereof, the clamping band can be easily attached to and detached from the any members to be clamped.

In the case of having the dimple in the top face of the

clamping ear, stress in the clamping ear is absorbed when the clamping ear is compressed, so that the clamping ear is able to resist the spring back and the diameter increment of the band section can be securely prevented.

In the case of having the recess for resistance welding in the vicinity of the second end of the band section, the resistance welding to fix the second end can be executed effectively.

A third embodiment of the clamping band of the present invention will be explained with reference to Fig.8 and Figs. 9A-9C. Note that, elements shown in the first and the second embodiments are assigned same numeric symbols and explanation will be omitted.

In the first and the second embodiments, there is formed the engaging piece 4 in the first end section 2a of the band section 2; there is formed the long hole 5 in the position, which corresponds to the engaging piece 4 when the band section 2 is formed in the loop. With this structure, the engaging piece 4 is guided by the lone hole when the clamping ear 3 is compressed. The engaging piece 4 and the long hole 5 are not required in the present embodiment.

As clearly shown in Figs. 8 and 9A-9C, there are formed two second engaging holes 2c in the vicinity of the Y-shaped fork 2a. The second engaging holes 2c are formed by the steps of: cutting the band section 2 to make two cutting holes; and embossing edges of the cutting holes to form like domes (see Fig. 9B). On the other hand, there are formed two engaging sections 2f in the vicinity of the second end 2b. The engaging

sections 2f are formed by the steps of: boring holes 2e having tongue pieces 2f; and bending the tongue pieces 2f inward to form into L-shapes (see Figs. 9A and 9C). The engaging sections 2f are capable of respectively inserting into the dome-formed second engaging holes 2c to engage one another when the band section 2 is formed into the loop shape.

The clamping band 1 is formed in the loop shape by the steps of: forming the band section into the loop shape; engaging the engaging piece 4 with the first hole 5; and engaging the engaging sections 2f with the second engaging holes 2c.

In the present embodiment, the band section 2 is preferably made of a stainless steel: SUS 304 (JIS), and whose thickness is about 0.6 mm. The thickness of the band section 2 of the present embodiment (about 0.6 mm) is thinner than that of the band made of SUS 430 (about 0.8-1.0 mm), so the sealing ability which is influenced by the step section in the overlapped part of the band section 2 can be improved. And the band section 2 of the present embodiment has greater malleability, so the clamping band 1 can clamp a member to be clamped with greater force. Even in the case of clamping a member having lower elasticity, the sealing ability can be kept higher by clamping with the greater force.

Without the engaging piece 4 and the long hole 5 in the band section 2, the band section 2 can be formed into the loop shape by engaging the engaging sections 2f with the second engaging holes 2c, so the manufacturing cost of the clamping band 1 can be reduced.

When the diameter of the looped clamping band 1 is

reduced by compressing the clamping ear 3, the overlapped portions A and B of the band section 2 are prevented to shift in the transverse direction of the band section 2. By employing the thin band section 2, the fork pieces of the Y-shaped fork 2a are apt to warp or curve radially outward, so that the fork pieces can be easily accommodated in the concave sections 8 with no step section. Further, the clamping band 1 is easily attached to and detached from the member to be clamped, so that working efficiency can be improved.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

CLAIMS



1. In a clamping band (1), comprising:
 - a metallic band section (2) having a first end (2a) and a second end (2b); and
 - a clamping ear (3) having a gate shape, said clamping ear (3) being disposed at a position on said band section (2) overlapping said first end (2a) when said band section (2) is formed into a loop, said clamping ear (3) being compressible in the circumferential direction of said loop to permit reducing a diameter of said loop, wherein the improved comprises:
 - a Y-shaped fork (2a) being formed in the first end of said band section (2), said Y-shaped fork (2a) including a pair of fork pieces; and
 - a pair of concave sections (8) being formed in each side edge margin of said band section (2), said concave sections (8) being capable of respectively accommodating the fork pieces of the Y-shaped fork (2a) when said band section (2) is formed into the loop with said first end (2a) being overlapped by said band section (2) and said concave sections (8) facing inwardly.
2. The clamping band (1) according to Claim 1, wherein said concave sections (8) are disposed to accommodate the fork pieces of the Y-shaped fork (2a) when said clamping ear (3) is compressed in the circumferential direction of said loop such that an inner face of said loop is stepless.



3. The clamping band (1) according to Claim 1 or 2,
further comprising:
an engaging piece (4) disposed proximate the Y-shaped
fork (2a) of said band section (2); and
a first engaging hole (5) for engageably accepting
said engaging piece (4), said first engaging hole (5)
being disposed proximate the second end (2b) of said band
section (2) whereby said band section (2) is formed into
the loop when said first engaging hole (5) is engaged with
said engaging piece (4).
4. The clamping band (1) according to Claim 3,
wherein said first engaging hole (5) is a long hole
elongated in the longitudinal direction of said band
section (2), and said engaging piece (4) is longitudinally
displaceable within said first engaging hole (5) when
said clamping ear (3) is compressed in the circumferential
direction of said loop.
5. The clamping band (1) according to Claim 3,
further comprising:
a second engaging hole (2c) disposed proximate the
first end (2a) of said band section (2); and
an engaging section (2f) disposed proximate the
second end (2b) of said band section (2) for engaging said
second engaging hole (2c) permitting to be formed into the
loop by engaging said engaging piece (4) with said first
engaging hole (5) on one side of said clamping ear (3)
and engaging said engaging section (2f) with said second



engaging hole (2c) on another side of said clamping ear
(3) opposite said one side.

6. The clamping band (1) according to Claim 5,
 wherein said second engaging hole (2c) is formed by
 cutting said band section (2) to make a cutting hole and
 embossing an edge of the cutting hole, and
 wherein said engaging section (2f) is a tongue piece
 insertable into said second engaging hole (2c).
7. The clamping band (1) according to Claim 3,
 wherein said engaging piece (4) is formed by cutting
 said band section (2) to make a tongue piece and bending
 the tongue piece to form into an L-shape capable of
 engaging with said first engaging hole (5).