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LINK STRUCTURE FOR CUTTER CHAINS

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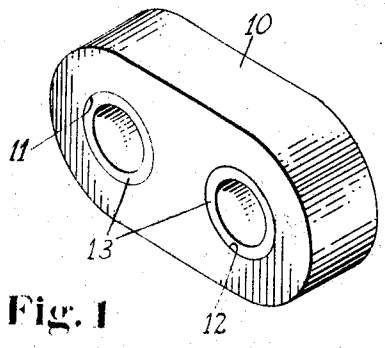


Fig. 1

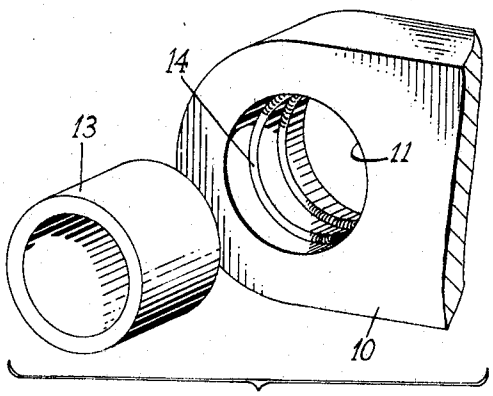


Fig. 2

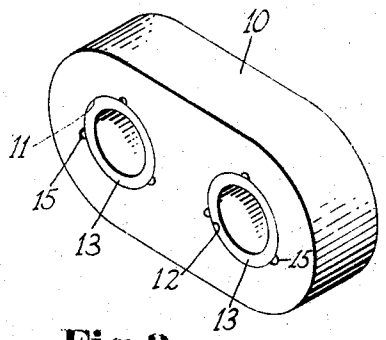


Fig. 3

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LINK STRUCTURE FOR CUTTER CHAINS

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ABSTRACT OF THE DISCLOSURE

An improved link member and insert combination for the chains of mining machines and the like, and method of making it. The combination comprises a link member and an insert, the link member having a perforation to receive the insert. The insert is located within the link member perforation and is joined to the link member by brazing means.

This invention resides in a novel link member and insert combination, and method of making same, of a type particularly suitable for use in mining operations, as will be set forth more fully below.

In mining machinery, as is well known, cutting means are frequently mounted on chains which run over a driven sprocket so that the cutting means are brought against the work, e.g. a seam of coal. In conventional undercutting machines, by way of example, the chain runs around a cutter bar which is swingably mounted on the body of the machine so that a seam of coal may be cut and, after removal of the mining machine, the coal in the seam may be blasted and then removed.

There are other types of mining machinery which employ cutter chains. For example, in one type a plurality of cutter chains run around sprockets on a boom on the front of the machine, forming a cutting mechanism which can be advanced against the face of a seam of coal. Such machines usually embody mechanisms for transporting the cut coal over the machine itself and onto a conveyor or shuttle car which will carry the cut coal out of the mine entry. With such machines the operations of cutting and transporting the coal occur concurrently. Yet other machines employ rotary heads upon which cutting means may be mounted so as to be advanced against the face of a seam of coal. Even these machines, however, usually employ one or more chains (cutting or trimming) so as to complete a cut of given transverse dimensions.

The cutting means usually comprise cutter bits which are held in members forming part of the chains, which members are egnerally called lugs or socket members. The combination of a lug and one or more link members is generally referred to as a block, and this terminology will be followed in the present application. The chains themselves may take various forms. In some types, the lugs are attached to single link members, and the single link members are connected together by means of a pair of link members, the ends of which lie outside the ends of the first mentioned link member and are held thereto by pintles. In another type of chain the lug has two spaced link members or cheeks attached to it, and these structures are held together by single link members, the ends of which lie between the ends of the cheeks aforesaid. In still another type of chain the lug is attached to a structure which presents a single link portion at one end, and double spaced link portions at the other end. These last mentioned structures may be attached directly together by means of pintles.

The specific arrangement of the lugs or socket members and the link members (a block) in a cutter chain does not constitute a limitation on the invention; and it will hereafter be apparent to one skilled in the art that the

principles of the invention are applicable to any portion of a cutter chain which is to be connected by a pintle to another portion thereof. However, it will be most convenient in describing the invention to disclose it in connection with a single simple link member having a pintle hole at each end, as illustrated in the drawings hereof.

Cutter chains are subjected to great stresses in use, and to avoid undue breakage, it is necessary that the links or link portions be made of a steel which is very tough and strong. Thus in the manufacture of the link portions of cutter chains, they are fabricated from a heat treatable material so that after the link is machined to size as to external surfaces, it can be heat treated to a very tough and strong condition.

The links will be perforated for the reception of pintles, whereby they may be hinged to adjacent link members or blocks. Due to the flexing of the chain in use, there arises here a problem of wear so that it has been the practice in the past to line the pintle holes in the link members with an insert or bushing in the form of a hollow cylinder. The bushing is made of a different metal such as a steel which is susceptible to case hardening. The case hardening operation is preferably so carried on that the inside diameter of the bushing acquires an extremely hard and wear resistant condition, while the portions of the bushing lying adjacent its outside diameter retain a relatively soft and relatively ductile condition to support the hardened inside surfaces. The selective case hardening of bushing members is well known in the art; and in prior practice the bushing is press-fitted into the pintle hole.

In the prior manufacture of link members, it has been a practice to electroplate the outer surfaces of the inserts with a noble metal, or a metal which is softer than the steel of the link body and is also resistant to corrosion, before press-fitting the insert into the pintle holes of the link member. The purpose of this expedient is an attempt to exclude mine waters of corrosive character from the joint between the bushing and the link body. The attempt has not been completely successful. Despite the press-fitting itself, and despite the presence of a thin layer of noble metal between the insert and the link body, corrosive attack still occurs. It will be understood that if the tough body of the link member fails to support the insert in a given area by reason of corrosive attack at the interface, failure of the structure will be likely. If the insert were hardened throughout its thickness so as to be wear resistant in the desired degree, failure would occur even sooner. In fact, in the manufacture of link members in accordance with the techniques hitherto current in the art, the hardened interior surface or "case" of the insert must be held to a minimum to insure against premature breakage.

It is the primary object of this invention to provide an improved link structure as above defined which will give greatly enhanced service life because the problem which has just been outlined is solved.

More specifically it is an object of this invention to provide a link member and insert combination such that the link member has good toughness and strength against shock while the insert has excellent wear resistance, the total strength of the combination being greater than that heretofore obtainable.

A further specific object of this invention is to provide a link member and insert combination in which corrosion between the outer face of the insert, and that face of the link member defined by the perforation which receives the insert, is prevented by brazing the insert within the perforation.

These and other objects of the invention which will be set forth hereinafter or will be apparent to one skilled in the art upon reading these specifications, are accom-

plished by that procedure and in that structure of which the aforesaid exemplary embodiment will now be described. Reference is made to the accompanying drawings wherein:

FIG. 1 is an isometric view of the exemplary embodiment of a link member chosen for purposes of disclosure in this case.

FIG. 2 is a partial exploded view of a link member and a primary insert showing a mode of applying brazing material.

FIG. 3 is an isometric view of a link member showing another way in which a brazing material may be applied.

It will be understood by the skilled worker that the link members to which this invention is addressed will be held together by pintles. Pintles are generally cylindrical members of fairly large diameter, and since the ends of the pintles should not ordinarily project beyond the outer link members of a chain structure, prior workers in the art have devised various ways for holding the pintles against endwise or axial movement. These various means do not form a limitation on the present invention; but it may be pointed out that many of them operate in such a way as additionally to hold the pintle against rotational movement with respect to the outer cheeks or link portions of a cutter chain. Where this is done, there will be no opportunity for wear between the pintle ends and the pintle holes in the outer cheek members because there will be no relative rotary or other movement between the pintle and these outer cheek members.

The principles of this invention are primarily applicable to link members where, when the chain flexes, there will be relative rotary movement between the body of the pintle and the insert or bushing which has been described above. In many structures the pintle hole in a link member which is designed to lie between outside link members will be made oversize, and a hardened bushing will be placed over the central portion of the pintle. It is usual in such instances to provide against relative rotation of the last mentioned bushing and the pintle itself, as may be done by keying the last mentioned bushing to the pintle by providing a non-circular portion on the body of the pintle and a matching non-circular configuration on the interior surface of the last mentioned bushing. The ends of the pintle are received in appropriate openings in the outside link members while the central portion of the pintle, having the hardened bushing keyed thereto, is received in the over-sized pintle hole of the inside link member; in this invention such over-sized pintle hole will have an insert brazed therein which will just nicely receive the pintle bushing. This expedient (the use of a hardened pintle bushing), which is also well known in the art, does not constitute a limitation upon this invention. Because of the stresses to which mining machine cutter chains are subjected, it is advisable to form a pintle of a tough steel devoid of brittleness and hence having greater toughness and shock resistance. It will be noted that in the structure just described the relative rotary movement, and consequently the wear, will be localized between the interior surface of the first mentioned insert or bushing and the exterior surface of the second mentioned, hardened pintle bushing. It is cheaper to replace the second mentioned bushing than it is to replace a broken pintle. Even the use of the second mentioned bushing, however, still leaves the problem to which this invention is addressed, namely, that of providing an improved link member and insert combination.

In the practice of the present invention as applied to the exemplary embodiment, a link member is made as shown in FIG. 1. It has a body **10** characterized by a pintle receiving hole **11** or **12** at either end. The body of the link member **10** will be made from a suitable tough steel or a steel which can be heat treated to an extremely strong condition. There are many steels which will serve the purpose; and mention may be made of those steels or "grades" of steels characterized by the A.I.S.I. or S.A.E.

(see S.A.E. Handbook for 1963) by the following numerical notations: C1027 through C1045; C1125 through C1145; 1330 through 1345; 3130 through 3140; 4027 through 4047; 4130 through 4145; 4337 and 4340, 4427, 5046, 5130 through 5145; 8627 through 8645; 8735 through 8742; 9840, TS4140, TS14B35, 50B40 through 50B46; 81B45, 86B45, and many others.

The body of the link member may be fabricated in any suitable way as by forging or cutting from a rolled blank; but it will be usual to machine the external surfaces of the link member and to finish the holes **11** and **12** (whether or not the holes have been partially formed as in a punching or forging operation) in a machining operation. As will later be pointed out in variants of the procedure, the body of the link member may be left in a soft, i.e., un-heat treated, annealed condition (as opposed to heat treated) until after the installation of the primary bushing or inserts as hereinafter set forth, or it may be subjected first to the conventional heat treatments which will cause it to assume the desired tough and strong condition.

The inserts or bushing **13** may be fabricated in any suitable way as by forging or the like, or they may be cut from tubular blanks such as may be produced from pierced billets. The primary insert will again be press-fitted into the pintle hole of the link body.

A difference between the procedure of this invention and prior procedures is that the primary insert or bushing (13 in the figures) will be brazed in position by means of a brazing material which will wet the surfaces of the two steel elements and enter any spaces between the surfaces by capillarity in a high temperature heat treatment. The brazing materials can be any of the known brazing materials, typical of which are copper and copper alloys, silver and silver alloys, gold and gold alloys, and even in some instances lead and lead alloys.

The surfaces which are to be joined together during the brazing operation may be prepared in any suitable fashion, as by the removal of foreign materials, oxides and the like. They may be plated with a noble metal as in the old art; but this is not generally necessary. The brazing is done at temperatures suitable for use with the particular brazing material chosen, and flux will be employed as understood in the art. If a high temperature brazing material is used, such for example as copper, it will be the usual practice to braze the primary bushing (insert) or bushings to the link body and then subsequently to subject the composite article to such heat treatment as will temper the body to a tough and strong condition and will harden the primary bushing at least as to its inner surface. In other instances, as where a lower temperature brazing material is used such as silver alloy, it will be found possible to accomplish the brazing and the heat treatment simultaneously.

The interior surface of the primary bushing or insert may be case hardened as above described, leaving the body and outer surface of the primary bushing in a softer condition. Commercially available case hardening steels suitable for the manufacture of bushings include the steels or "grades" of steel characterized by the A.I.S.I. or S.A.E. (see S.A.E. Handbook for 1963) by the following numerical notations 1020 through 1035; 1120 through 1132; 1330 and 1335; 4012 through 4037; 4118 through 4135; 4320 through 4337; 4422 and 4427; 4520, 4615 through 4621; 4718 and 4720; 4815 through 4820; 5115 through 5135; 6118 and 6120; 8115, 8615 through 8637; 8720 and 8735; 8822, and many others.

It is an advantage of the present invention, however, that the external surface of the primary bushings or inserts will be fully backed by the metal of the link member itself, so that it becomes possible to harden the primary bushing throughout. Commercially available steels capable of being hardened throughout the thickness of the bushing and suitable for the manufacture of primary bushings for use in the cutter chains of this invention include those steels or "grades" of steel characterized by the

A.I.S.I. or S.A.E. (see S.A.E. Handbook for 1963) by the following numerical notations: E50100, E52100, E51100, 9763, 1080, 1084, 1085, 1090, 1095, and many others.

It is necessary in the manufacture of the improved link structures of this invention that the brazing material fill up preferably all of the interstices between the insert and the link member body, or at least all of the interstices within that area of juxtaposition to which stresses will be applied during the operation of the cutter chain. There are various ways in which the brazing material may be applied. It could be applied by electroplating, or tumble plating, or by vacuum deposition directly to the parts. However, it is well to have present an excess of the brazing material which will flow during the brazing operation and fill up all of the interstices. This in turn may be accomplished in various ways. It is possible to use a ring or other appropriately shaped mass of the brazing material juxtaposed to the annular line demarking the meeting surfaces of the parts on one or both sides. In FIG. 2 the perforation **11** in the link member **10** is shown as having interior grooves **14** which may be filled with the brazing material before the parts are press-fitted together. In FIG. 3, the link member **10** having the perforations **11** and **12** is shown as provided with axial grooves **15** in the walls of the perforations. These grooves may be filled with the brazing material; but they also serve as channels whereby additional brazing material from an outside source may be fed into the interspace between the insert and the link member.

The brazing itself may be carried on in accordance with known techniques including, but without limitation, hydrogen brazing. In the ideal product of the invention all openings between the outer surfaces of the inserts and the inner surfaces of the link member, as defined by the perforations **11** and **12**, will be solidly filled with the brazing metal. This provides a number of important advantages. For one thing, corrosive mine waters cannot enter the space between the insert and the link member, so that no corrosion can occur which will ultimately impair the support given to the outer surfaces of these inserts or primary bushings. For another thing, it has been found that no electrolytic action occurs which would impair the supporting action. Yet again the primary bushings, being fully supported by the body of the link member are not subjected to bending strains or such distortions as would tend to form cracks or fissures in the hardened portion of the bushings. By the same token the bushings may be hardened throughout their thickness, which has hitherto not been feasible. Thus the bushings in the structure of this invention provide a substantially longer wear life for the same thickness, and in some instances where the bushings are hardened throughout thinner bushings may be used. The link structures are stronger and remain stronger because the bushings and link member bodies function as an integral unit.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An improved link member and insert combination for the chains of mining machines and the like, said combination comprising a link member, and an insert, said link member having a perforation to receive said insert, and brazing means joining said link member and said insert, said insert being in said perforation, said brazing means including an excess of brazing material which will flow during a brazing operation and fill up substantially all the interstices between the said link member and the said insert.

2. The combination of claim **1** in which said link member, in a face defined by said perforation, is provided with at least one annular groove to receive brazing material.

3. The combination of claim **1** in which said link member, in a face defined by said perforation, is provided with at least one axial groove to receive brazing material.

4. The combination of claim **1** in which said link member, said insert and said brazing means constitute an integral unit, the brazing means filling all of the interstices within that area of juxtaposition of the said link member and said insert to which stresses will be applied when the said combination is in use.

5. A method of making an improved link member and insert combination for the chains of a mining machine and the like, which includes the steps of providing a link member with a perforation to receive an insert, positioning said insert in said perforation, and brazing said insert to said link member, and including the step of using an excess of brazing material so that substantially all of the openings between the outer surface of the insert and the inner surface of the link member, as defined by the perforation, will be solidly filled with the brazing material.

6. A method of making an improved link member and insert combination for the chains of a mining machine and the like, which includes the steps of providing a link member with a perforation to receive an insert, positioning said insert in said perforation, and brazing said insert to said link member, and including the step of subjecting the said combination to a single heat treatment to bring out the tough quality of the said link member and the wear resistance of the said insert.

7. The method of claim **6** in which the brazing step and the heat treatment step are carried on simultaneously.

8. The method of claim **6** in which the brazing step is performed before the heat treatment step, and the heat treatment step is carried on without destroying the bond resulting from the brazing step.

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