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[54] **HARDFACED MEMBER AND METHOD OF ATTACHING HARDFACING ELEMENT THERETO**

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[52] **U.S. Cl.** **219/77;** 29/498; 219/85; 219/94; 219/106; 219/107; 219/150

[51] **Int. Cl.** **B23k 9/04**

[58] **Field of Search** ..... 219/85, 94, 150 V, 77, 219/107, 106; 29/498

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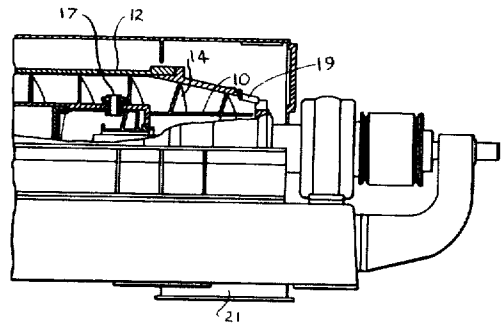
[57] **ABSTRACT**

A hardfaced support member and a method of applying a hardfacing element thereto in which the support member to receive the hardfacing element and the hardfacing element have different coefficients of thermal expansion. The invention discloses a method of attaching the hardfacing element by brazing while reducing the area thereof that is subjected to thermal stress thereby eliminating breaking of the hardfacing element when it is attached to the support member.

16 Claims, 4 Drawing Figures



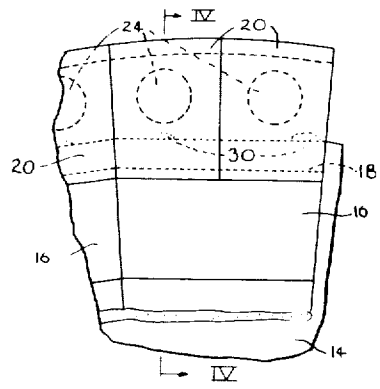


FIG. 1

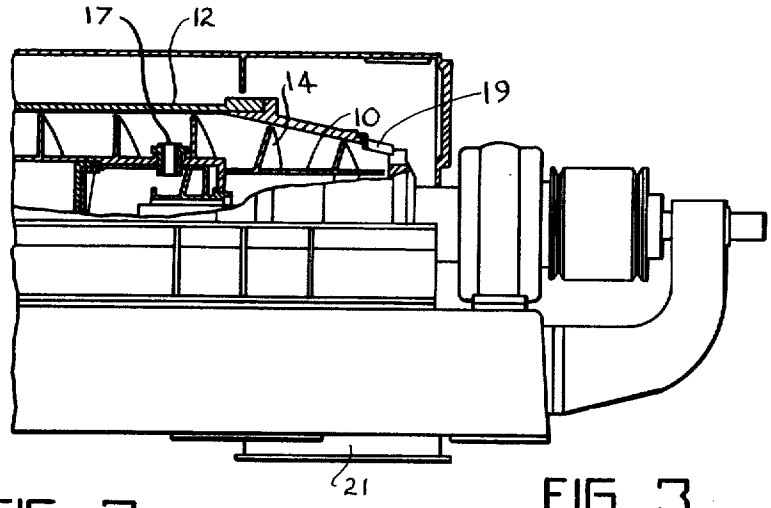


FIG. 2

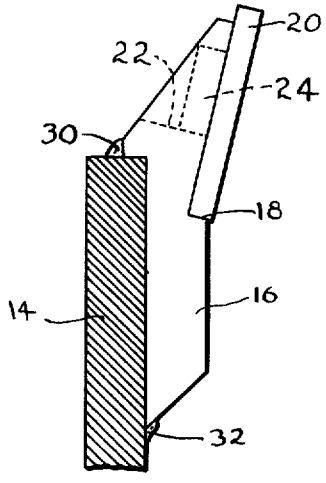


FIG. 3

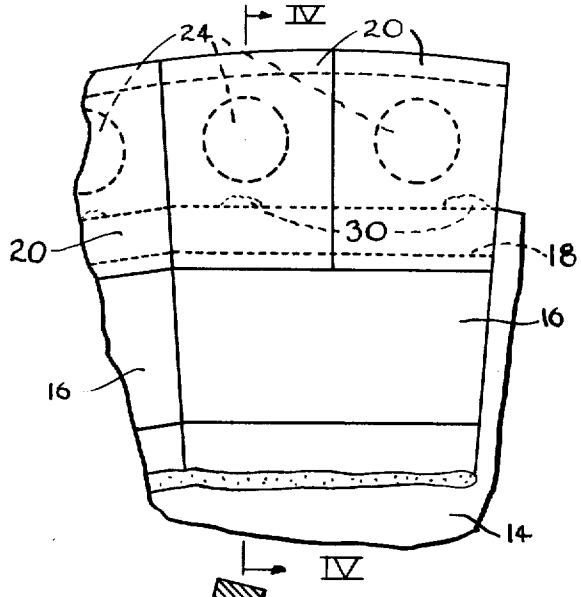
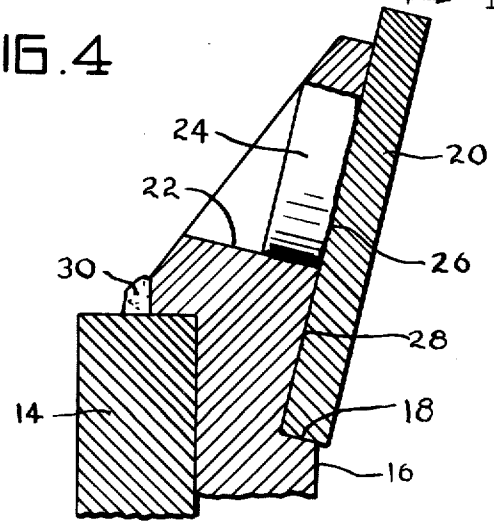


FIG. 4



HARDFACED MEMBER AND METHOD OF ATTACHING HARDFACING ELEMENT THERETO

The present invention relates to a work member having hardfacing in the form of plate elements applied thereto and to a method of applying the hardfacing elements to the work member.

Many work members are subjected to abrasion in use, and in order to impart satisfactory life to such members, they are often provided with hardfacing materials in those areas that wear away rapidly in use. When the abrasive conditions encountered are severe, an extremely hard hardfacing material, such as a cemented hard metal carbide, tungsten carbide, for example, or the like, is applied to the areas which will be exposed to the greatest abrasion.

Materials bearing hard metal carbide in particulate form can be applied by depositing the material in a molten state on the member to be hardfaced, but such deposits are defective for imparting the ultimate in wear resistance to the member. The ultimate wear resistance can be achieved only by making the hard metal carbide hardfacing material in the form of plates or blocks of cemented hard metal carbide and attaching the plates or blocks to the member to be hard surfaced.

The member supporting the carbide elements is generally some sort of steel and the connection of the cemented carbide articles thereto presents problems because of the difference in the coefficients of thermal expansion of the cemented carbide and the steel. When such a cemented carbide element is brazed to a steel element, cracking of the cemented carbide element is likely to occur, particularly where the element is exposed on one side and is brazed to the support on the other side.

The present invention has as its primary object the provision of a novel method for applying hardfacing material in the form of cemented hard metal carbide plates to a work member so as to eliminate the particular problem referred to above.

Another object is the provision of a work member provided with hardfacing in the form of cemented hard metal carbide elements in which the construction of the hardfaced member is relatively simple and inexpensive.

BRIEF SUMMARY OF THE INVENTION

According to the present invention, a support member has a surface to be hardfaced and arranged on the surface in side by side relation are plates of a cemented hard metallic carbide, such as tungsten carbide. The plates are relatively thin and will, thus, crack easily if subjected to stresses during the brazing of the elements to the support member.

According to the present invention, the support member for receiving a cemented carbide plate is provided with a hole substantially smaller in area than the plate and the plate is connected to the member by means of a plug secured to the side of the plate facing the member and extending into the hole with brazing material disposed between the end of the plug and the carbide plate and between the periphery of the plug and the hole in the support member.

A stop-off material is interposed between the carbide plate and the support member around the plug and the brazing material is, thus, confined to the region immediately at the end of the plug and along the sides of the plug where the plug is disposed in the hole in the support member. By so reducing the area of the carbide plate that is exposed to stresses during the brazing operation and the cooling down period, any tendency for the carbide plate to crack when the braze joint cools down is eliminated. At the same time, the plate is firmly held on the support member and performs adequately for protecting the member beneath the carbide plate from wear.

In one form of the invention, the carbide plate either alone or together with another plate at the side thereof is mounted in a small steel support member which is thereafter secured to a steel work member as by welding.

The objects referred to above, as well as still other objects and advantages of the present invention, will become more apparent upon reference to the following detailed specification taken in connection with the accompanying drawings in which:

FIG. 1 is a fragmentary view showing a machine having a work member therein adapted to be hardfaced in conformity with the present invention.

FIG. 2 is a sectional view through the hardfaced region of the work member.

FIG. 3 is a view looking in toward the right side of FIG. 2 showing the hardfacing cemented carbide plates applied according to the present invention.

FIG. 4 is a vertical sectional view indicated by line IV—IV on FIG. 3.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings more in detail, the device shown in FIG. 1 comprises a rotor **10** rotating inside a nonrotatable stator **12.** The rotor **10** is provided with a helical rib **14** on the outer periphery, the radially outer edge of which runs fairly closely inside the stator **12.**

Material is introduced to the outside of the rotor via feed nozzles **17** and as the rotor rotates the solid part of the material moves rightwardly along the rotor and is discharged through openings **19** into a housing and then drops from the housing from a solids discharge **21.** The liquid in the material moves leftwardly along the rotor and is discharged through a liquids discharge near the opposite end of the machine and which is not shown in FIG. **1.**

A section through the radially outer region of the rib **14** is shown in FIG. **2.**

The rib **14** is formed of steel, and is advantageously formed of stainless steel, and has mounted on the outer edge a plurality of support members, or tiles, **16** which are disposed in side by side relation preferably along the entire length of rib **14.**

Each support member, or tile, **16** is also advantageously formed of stainless steel and has a rather shallow notch **18** formed therein in the radially outer region on the forwardly facing side. In notch **18** there is seated one or two plates **20** formed of a cemented hard carbide material such as tungsten carbide.

Behind each plate **20** the support member **16** is provided with a hole **22** and disposed in each hole **22** is a steel plug **24** fitting the hole freely but relatively closely. For example, up to about .008 of an inch difference in diameter between the plug and the hole can be tolerated, the critical thing being that the plug should fit the hole closely enough to provide for capillary flow of brazing material therebetween.

As will be seen in FIG. 4, one end of plug 24 engages the back of the respective plate 20 and brazing material is disposed at 26 between the end of the plug and the back of the plate and at 28 between the periphery of the plug 24 and the periphery of the hole 22 in support member 16.

In making the assembly, that area of the side of plate 20 which faces support member 16 and which is disposed radially outwardly from the region to be engaged by plug 24 is coated with a stop-off material of a known type which will prevent braze material from adhering thereto. Only the area directly opposed to plug 24 is free of the stop-off material.

The assembly is then made by placing a disc of brazing material between the plug and the plate and applying pressure between the plug and the plate while developing brazing temperature in the region of the surfaces to be brazed together and which will cause the disc of brazing material to soften and to flow upwardly about the periphery of the plug between the plug and the surface of hole 22. The brazing material is subject to considerable variation in composition, but a satisfactory material has been found to be about 0.005 inches of copper with about 0.0025 inches of silver on each side.

Upon cooling, the braze material firmly connects plug 24 to plate 20 and also firmly connects plug 24 to support member 16. At the same time, the plate 20 is free to expand and contract in its plane relative to support member 16 radially outwardly from plug 24 and there are, thus, no high stresses developed in the plate that might cause it to fracture when the assembly cools down after brazing.

It is possible to connect plug 24 to plate 20 before assembly and thereafter to assemble the plate and the connected plug with support member 16 and braze the plug to the support member, for example, from the rearward side of support member 16. This last mentioned procedure could be followed if, for example, a carbide plate were broken or lost from the rib of the device after the rotor had been completely manufactured.

In the normal course of events, the carbide plates will be joined to the support members 16 and thereafter the support members 16 are put in place along the edge of rib 14 and are connected thereto as by welding indicated at 30 and 32. The welding at 30 can consist of a couple of tack welds for each one of the support members 16 while the welding at 32 is preferably in the form of a continuous bead of welding.

The welding does not interfere with the already made braze joints nor does it create any undesirably high temperatures in the region of the carbide plates so that there is no deterioration of either the carbide plates or the braze joints during such a welding operation nor are any stresses developed in the carbide plates that might cause cracking thereof.

The present invention has been illustrated and described in connection with the applying of hardfacing to the flight of an extrusion screw, but it will be apparent that hardfacing material could be applied in conformity with the present invention to other types of work members as well. The important thing about the invention is that the hardfacing plates are firmly connected to a support member by brazing while, at the same time, cracking of the hardfacing plates is prevented.

The holes 22 are shown as extending completely through the support member 16, but the holes could be in the form of blind recesses of ample size to receive the plugs 24 and the same beneficial results would be obtained.

While a cemented carbide material has been referred to as the hard facing material, other brittle wear resistant materials, such as ceramics, could be applied to a support member according to the present invention and the same advantages would be had.

Modifications may be made within the purview of the appended claims.

What is claimed is:

1. A method of securing a first member to a second member with said members having parallel opposed faces of substantial area in engagement, said first member being steel and said second member being a cemented hard metal carbide, said second member being in the form of a plate having a thickness which is a fractional part of any lateral dimension thereof, said method comprising; forming recess means in the first member through said one face thereof, placing said faces of the members together, placing plug means on said face of the second member with the plug means extending into said recess means in said first member, and brazing the plug means to the face of said second member and to the periphery of the said recess means in said first member.

2. A method according to claim 1 which includes interposing stop-off material between the said faces of said members except in the region of said recess means.

3. A method according to claim 1 in which said recess means comprises at least two recesses in spaced relation, said plug means comprising a plug in each recess, said second member overlying both of said recesses.

4. A method according to claim 1 in which said recess means comprises at least one hole extending through said first member, said plug means comprising a plug loosely receivable in said hole.

5. A method according to claim 4 which includes interposing a body of brazing material between said plug and said face of said second member, and applying pressure to the end of said plug which faces away from said second member while developing brazing temperature in the plug to cause said braze material to melt and extrude into the space between the peripheries of said plug and hole.

6. A method according to claim 5 which includes applying flux to the regions to be joined by the braze material and applying stop-off material between said faces of said members outside the range of said hole.

7. A method according to claim 1 in which said recess means comprises at least two holes in said first member, placing a plug in each hole, placing brazing material between each plug and the said one face of said second member, applying stop-off material between said faces in at least the region surrounding each said hole, and developing heat in said plugs while pressing said plugs toward said second member to cause said brazing material to melt and extrude into the space between the peripheries of the plugs and holes thereby to fix said plugs to both of said members while preventing the establishment of permanent stresses in said members due to differential thermal expansion and contraction.

8. A method according to claim 1 in which the plug fits the recess with capillary clearance, placing a disc of braze material between the end of the plug and the op-

posed face of said second member, and developing brazing temperature in at least said plug to cause the braze material to melt and connect the plug to the second member and to flow along the plug and thereby connect the plug to the first member.

9. In combination; a steel support member having an area exposed to abrasion in use and hardfacing material on said area, said hardfacing material comprising at least one plate formed of a cemented hard metal carbide, said plate being of substantial area relative to the thickness thereof and disposed in face to face engagement with said area, a hole in said support member open toward said plate and of substantially smaller area than said plate, a plug in said recess and having one end engaging said plate, and braze material connecting the plate to the plug and the plug to the support member and confined to the region of said one end of the plug and the periphery thereof.

10. A combination according to claim **9** which includes stop-off material between said support member and said plate over the region of said plate which surrounds said one end of the plug.

11. A combination according to claim **9** in which said support member has a notch formed in one face thereof and in which said plate is seated, said hole having the axis disposed a substantial distance from each edge of a plate in said notch.

12. A combination according to claim **9** in which said plate has a thickness which is a fraction of any lateral dimension thereof, said plate being seated in said notch and having a planar face engaging said planar bottom surface of the notch, said support member having a second notch therein at the side opposite said plate for receiving the edge of a work member to which the support member is connected.

13. In combination; an elongate rib-like work member having a free outer edge, a plurality of like support members fixed to said edge in side by side relation, said support members on one side each having a surface, said surfaces when taken together being continuous, each support member having hole means in the form of at least one hole extending therein through the said surface, plate means in the form of at least one plate of a hard wear resistant hardfacing material in face to face engagement with each surface and extending a substantial distance radially outwardly beyond the respective hole, a plug freely fitting each hole and having one end engaging the respective plate, and braze material connecting each plate to the respective plug and each plug to the respective support member and confined to the immediate region of the plug.

14. A combination according to claim **13** in which each support member has two of the said plates thereon in side by side relation, said plate in the lateral direction being coextensive with the respective support member, said support member having a said hole for each plate and a said plug for each hole.

15. A combination according to claim **13** in which each support member has a single said plate thereon and which is coextensive with the said support member in the lateral direction.

16. A combination according to claim **15** in which each said support member has two holes therein and a plug in each hole, each plug being connected to the same said plate.

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