METHOD OF MAKING COMPOSITE STOCK

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Fig. 1

Fig. 2

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METHOD OF MAKING COMPOSITE STOCK

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This invention relates to composite stock and a method for making such stock and is particularly directed to a method for making composite stock including a relatively hard metal supporting member having a more ductile metal overlay thereon.

In application Serial No. 601,764, filed June 27, 1945, we have disclosed a method for making composite stock wherein metallic material of suitable frictional qualities is attached to a steel support through the medium of a porous metal layer and wherein said suitable material is sprayed onto the porous metal. This invention is directed to another method for making said steel wherein the spraying of the suitable material is eliminated.

In the present invention, it is a primary object thereof to form composite stock wherein a metallic material such as aluminum, babbitt, or other suitable metal is applied to the surface of a porous metal on steel stock through a rolling operation whereby the applied metal is mechanically worked into the pores of the porous metal and thereby interlocked to the steel through the medium of the porous metal layer.

It is a further object of the invention to continuously apply metal strip to porous metal on steel strip.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein preferred embodiments of the present invention are clearly shown.

In the drawings:

Fig. 1 illustrates one method for applying a metal strip to steel wherein the apparatus is shown diagrammatically and includes pressure rolls positioned externally of an annealing furnace.

Fig. 2 is another embodiment showing diagrammatically apparatus for applying metal strip to porous metal on steel wherein the pressure rolls are positioned within the annealing furnace and Fig. 3 is a view on a greatly enlarged scale of a cross section of the composite stock formed showing the penetration of the rolled metal into the porous metal layer.

Referring particularly to Fig. 1, one embodiment of the invention is shown wherein a metal strip 20 is fed simultaneously with a porous metal on steel strip 22 to a pair of rolls 24 wherein the metal of strip 20 is mechanically worked into the porous metal whereupon the composite strip 26 preferably passes into an annealing furnace 28, wherein the composite strip is annealed for relieving strains therein and for alloying the metal of strip 20 with the porous metal layer when said metals are alloyable. Fig. 2 shows another embodiment of the invention wherein the strip 20 and the porous metal on steel strip 22 are fed directly into an annealing furnace 28, which furnace 28 includes pressure rolls 24. In this embodiment, the pressure required for rolling the metal of strip 20 into the porous metal is less than in the embodiment shown in Fig. 1 since the strip 20 is hot and is more ductile and, therefore, flows more readily into the pores of the porous metal. In both instances the metal of strip 20 is mechanically worked into the pores of the porous metal. It is desirable that the porous metal layer is formed of a metal strong in compression such as, copper-nickel alloy, copper-iron alloy or some other strong metal or alloy thereof since the rolling step tends to deform the porous metal and if a weak structure is provided, deformation thereof occurs prior to the time that the metal of strip 20 is thoroughly worked into the pores thereof.

The porous metal is applied to the steel by sintering and may be made from non-compacted metal powder as disclosed in Kochring Patents 2,198,265 and 2,198,264, or it may be formed from compressed metal powder which has been sintered with void forming compounds wherein whereby the porosity of the layer is at least 40%.

In each case, the porous metal layer is metallurgically bonded to the steel support and has a minimum thickness equal to the diameter of one particle of powder used in the porous metal layer. Any metal strip 20 may be used, such as; aluminum, or alloys thereof, silver, alloys thereof, babbitts, lead, alloys thereof or in fact any metal which can be rolled into the porous metal layer. In this connection, any metal which has greater ductility than the porous metal at the temperature of rolling can be used.

We have found that pressure rolls 24 and 30 should be so set that the metal of strip 20 is thoroughly worked into the pores of the porous metal without appreciately deforming the porous metal. Thus, for the best results, trial runs should be made with different settings of the pressure rolls after which cross sections of the stock should be examined metallographically. After rolling, the strip is preferably annealed to relieve strains and/or cause metallic diffusion, if possible, between the juxtaposed layers. The annealing furnace is heated, as is well known in the art, to a temperature sufficient to properly anneal the rolled in metal depending upon the time of annealing.

The primary factors being that the rolled in
metal becomes alloyed with the porous metal at its boundary line and that the strains set up by the rolling step are relieved. In some cases, it may be desirable to melt the rolled in layer, particularly in the case of babbitts. In this instance, side rolls may be provided for the strip to prevent the molten metal from being lost. Obviously the temperature of heat treatment must be below the melting point and the dissolution temperature of the porous metal layer.

In the embodiment, shown in Fig. 2, the rolls 30 are positioned at a point within the annealing furnace sufficiently remote from the entrance to permit preheating of the strip 20. In this instance, it is desirable that the strip attains a temperature sufficient to soften the strip 20 so as to reduce the pressure necessary for the rolling in operation prior to rolling. Obviously this temperature is not limiting since the rolls may be placed external of the furnace as shown in Fig. 1 but to gain any substantial benefit over the externally placed rolls, the strip should be preheated. Also the preheating will provide a better bond between the metal of the strip 20 and porous metal since the strips in passing through the annealing furnace are fluxed to a certain extent by the atmosphere within the furnace which is a non-oxidizing atmosphere and preferably a reducing atmosphere. Obviously a reducing atmosphere will increase the fluxing by removing certain oxides from the surface of the metals.

It has been found that rolled metal actually flows under rolling either hot or cold and is mechanically forced into the pores of the porous metal to completely fill the pores whereby satisfactory interlock is obtained.

While the embodiments of the present invention as herein disclosed, constitute preferred forms, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In a method of making composite stock the steps comprising; providing a highly porous metal layer metallurgically bonded to a strong non-porous metal, said highly porous metal layer being formed by sintering loose, substantially non-compacted metal powder onto the surface of the non-porous metal for forming a layer having pores which inherently include reentrant angles therein, and then rolling a sheet of lead alloy material of continuous extent and more ductile than the porous metal layer onto the surface of the porous metal whereby portions of the alloy are forced into the pores of the porous metal.

2. The method defined in claim 1 with the added step of heating the composite stock for improving the bond of the more ductile metal rolled in metal.

3. In the method for forming composite stock, the steps comprising; providing a porous metal layer on steel stock, said porous metal layer being formed by sintering loose, substantially non-compacted metal powder onto the surface of the steel for forming a layer having pores which inherently include reentrant angles therein, providing a sheet of metal of continuous extent and more ductile than the porous metal layer, heating said sheets, at a temperature below the melting point of either said stocks and under reducing conditions for fluxing the surfaces of said stocks, superimposing the more ductile stock upon the porous metal layer under controlled atmospheric conditions, and finally hot rolling the superimposed stocks for forcing portions of the more ductile metal into the porous metal layer without melting, and attaching the more ductile stock mechanically and metallurgically to the steel through the medium of the porous metal layer.

4. In the method of making composite stock, the steps comprising; providing a highly porous metal layer metallurgically bonded to a strong non-porous metal, said highly porous metal layer being formed by sintering loose, substantially non-compacted metal powder onto the surface of the non-porous metal for forming a layer having pores which inherently include reentrant angles therein, and then rolling a sheet of lead alloy material of continuous extent and more ductile than the porous metal layer onto the surface of the porous metal whereby portions of the lead alloy are forced into the pores of the porous metal.

5. In the method of making composite stock, the steps comprising; providing a highly porous metal layer metallurgically bonded to a strong non-porous metal, said highly porous metal layer being formed by sintering loose, substantially non-compacted metal powder onto the surface of the non-porous metal for forming a layer having pores which inherently include reentrant angles therein, and then rolling a sheet of aluminum material of continuous extent and more ductile than the porous metal layer onto the surface of the porous metal whereby portions of the aluminum are forced into the pores of the porous metal.

6. In the method of making composite stock, the steps comprising; providing a highly porous metal layer metallurgically bonded to a strong non-porous metal, said highly porous metal layer being formed by sintering loose, substantially non-compacted metal powder onto the surface of the non-porous metal for forming a layer having pores which inherently include reentrant angles therein, and then rolling a sheet of aluminum material of continuous extent and more ductile than the porous metal layer onto the surface of the porous metal whereby portions of the aluminum are forced into the pores of the porous metal.

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