United States Patent

Davies et al.

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[54] PRODUCTION OF STRIP FROM POWDERED METAL

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.** **B22f 1/00**

[58] **Field of Search** 75/200, 214; 156/289; 264/213

[56] **References Cited**

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[57] **ABSTRACT**

A process is provided for rolling metal strip particularly iron or iron alloy strip, directly from powdered metal using a technique in which a self-supporting metal powder/binder strip is formed on a support surface from a slurry containing the metal and binder composition, the support surface being precoated with a release agent. Typical release agents are mono-basic fatty acids, such as steric and oleic acids.

11 Claims, No Drawings

PRODUCTION OF STRIP FROM POWDERED METAL

CROSS REFERENCES TO RELATED APPLICATIONS

U.S. Application 683,983, filed 17th Nov. 1967.
U.S. Application 807,101, filed 13th Mar. 1969.

BACKGROUND OF THE INVENTION

This invention relates to a process for the production of metal strip from powdered metal which is particularly, but not exclusively, applicable to the production of steel strip.

In our co-pending application Ser. No. 683,983 filed 17th Nov. 1967 there is described a process for the production of strip from powdered metal which comprises depositing a layer of powdered metal onto a support surface, removing the layer from the support surface and then rolling the layer to effect compaction and sintering the compacted layer at a temperature below the melting poing of the metal. In accordance with one embodiment of the process described in our abovementioned application, the powdered metal is initially deposited onto the support surface as a coating in the form of a slurry comprising a suspension of metal powder in a binder composition, one example of a suitable binder composition being an aqueous methyl cellulose solution.

After drying, the resulting metal powder binder strip is removed from the substrate and then subjected to rolling to effect compaction of the powdered metal and the compacted strip is then sintered. Provided that the slurry formed from the binder and the powdered metal is sufficiently viscous, little difficulty is normally experienced in cleanly stripping the dried film from a smooth substrate, such as a stainless steel band. It is, however, desirable in order to increase the line speed of the process to reduce the viscosity of the slurry to the minimum consistent with maintaining good metal powder/binder strip formation and adequate suspension of the powdered metal. It is found, however, that reduction of the viscosity of the slurry below about 50,000 centipoises tends to give a more brittle and less easily handled metal powder/binder strip which is more difficult to remove cleanly from the substrate as a result of a tendency to adhere to the substrate. While we have found that the addition of a hygroscopic substance, e.g., glycerol, to the suspension plasticises the resultant dried film and results in a strip which exhibits increased flexibility and cohesion, the dried strip may still exhibit a tendency to adhere to the substrate. The addition of hygroscopic substances to metal powder/binder slurries is the subject of our co-pending application Ser. No. 807,101 filed 13th Mar., 1969 which also refers to the beneficial effect of the hygroscopic substance in improving the physical properties of the final metal strip.

Preferably, the hygroscopic substance is a water-soluble polyhydroxy compound, such as glycerol, low moleculor weight polyalkylene glycols, e.g., trimethylene glycol, polyhydric alcohols, e.g., sorbitol, mannitol, and sugars, e.g., invert sugar. Inorganic hydroscopic materials may also be employed, such as calcium chloride. The hydroscopic substance is preferably present in an amount up to 1.0 percent by weight of the suspension employed. It has been noted that if a substantially larger portion of the hydroscopic substance is employed, too much water tends to be retained in the cellulose derivative during the slurry drying which leads to difficulties in the subsequent processing steps.

SUMMARY OF THE INVENTION

The present application is concerned with a solution to the problem of undesirable adhesion to the substrate of dried films formed from powdered metal/binder compositions. We have now discovered, that this difficulty can be overcome by coating the substrate with a thin film of a release agent prior to the deposition of the slurry of powdered metal and binder composition.

Examples of suitable release agents are fatty acids, e.g., mono-basic acids such as oleic and stearic acids fluorinated hydrocarbons, particularly fluorinated hydrocarbon polymers,

e.g., polytetrafluoroethylene and silicones. In the case of fluorinated hydrocarbons and silicones a permanent release film is obtained on the support surface, the films being applied by methods known in the art.

The release agent is desirably coated in a thin film onto the support surface and in the case of mono-basic fatty acid, this may be achieved directly (i.e. alone without the agency of a solvent or dispersant) or in the form of a solution or dispersion with subsequent removal of the continuous phase of the solution or dispersion. Convenient solvents for fatty acids are, for example, trichloroethylene or ethanol. The solution or dispersion (when used) may be applied to the support surface by any convenient method, such as roller coating, spraying or using a rotating lambswool coated roller impregnated with the solution. The continuous phase may be evaporated or allowed to evaporate before the suspension of powdered metal and binder composition is applied to the support surface.

It has been found that a 1 percent solution of a mono-basic fatty acid, such as oleic or stearic acid, in trichloroethylene or ethanol is extremely satisfactory, (although other concentrations may be used). By rotating the application roller in contact with the substrate, a very thin film of oleic acid or stearic acid can be applied to the surface and this ensures that the deposited, dried metal powder/binder strip film can be readily removed from the substrate. Preferably the fatty acid is applied continuously to the support surface. Generally where the slurry is coated continuously onto an endless belt or drum, as described in our co-pending application Ser. No. 683,983 the fatty acid is conveniently applied continuously to the belt or drum at a point upstream of the slurry coating station.

Apart from the use of the release agent the process of the present invention is carried out in the manner described in our co-pending patent application Ser. No. 683,983.

What we claim is:

1. A process for the production of a strip from powdered metal which comprises:
   a. Forming on a support surface a thin film of a release agent;
   b. Depositing on said film a coating of slurry comprising a suspension of powdered metal in an aqueous solution of a film-forming cellulose derivative, said slurry having a viscosity of less than 50,000 centipoises;
   c. Drying said coating on said support surface;
   d. Removing the resultant dried coating from the support surface;
   e. Rolling the dried coating to effect compaction; and
   f. Sintering the compacted coating at a temperature below the melting point of the metal.

2. A process according to claim 1 in which the cellulose derivative is a cellulose ether containing methyl groups.

3. A process according to claim 1 in which the release agent is a fatty acid.

4. A process according to claim 4 in which the fatty acid is oleic or stearic acid.

5. A process according to claim 1 in which the support surface is a drum or an endless metal belt onto which the slurry is continuously coated and from which the dried coating is continuously removed.

6. A process according to claim 5 in which the release agent is a fatty acid and is coated continuously onto the belt or drum at a point upstream of a slurry coating station.

7. A process according to claim 1 in which the release agent is a fluorinated hydrocarbon or a silicone.

8. A process according to claim 1 in which the release agent is a fatty acid and is deposited on the support surface from a solution or dispersion.

9. A process according to claim 1 in which the slurry includes a hygroscopic substance selected from the group consisting of, low molecular weight polyalkylene glycols, polyhydric alcohols, sugars, and calcium chloride.

10. A process according to claim 9 wherein said polyhydric alcohol is glycerol.

11. A process for the production of a strip from powdered metal which comprises:

a. Forming on a support surface a thin film of a fatty acid release agent;

b. Depositing on said film a coating of slurry comprising a suspension of powdered metal in an aqueous solution of a film-forming cellulose derivative, said slurry having a viscosity of less than 50,000 centipoises;

c. Drying said coating on said support surface;

d. Removing the resultant dried coating from the support surface;

e. Rolling the dried coating to effect compaction; and

f. Sintering the compacted coating at a temperature below the melting point of the metal.

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