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PROCESS OF MAKING NEGATIVES IN METAL
OF METAL OBJECTS OF SUBSTANTIALLY
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lizing Engineering Company, Inc., New York,
N. Y., a corporation of New JerseyNo Drawing. Application September 7, 1937,
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2 Claims. (Cl. 22—200)

This invention relates to a new and useful process of making negatives in metal of metal objects of substantially smooth surface.

It is old to apply a coating of metal to objects of metal by the use of a metal spray gun, i. e., a device by which metal particles are directed against the surface of the object by a blast of air or other gas. In a type of spray gun commonly used for this purpose a rod or wire of solid metal is fed progressively into a melting zone and as rapidly as it melts is propelled against the surface to be sprayed by a suitably directed blast of air or other gas. Another form of gun which may be so employed feeds particles of powdered metals to the heating zone and these are propelled upon the surface by a suitably directed blast of air or other gas. In still another form of gun which may be employed molten metal is sprayed and is subdivided and propelled against the surface by a suitably directed blast of air or other gas.

Generally speaking, unless the surface of the metal base against which the spray is directed is relatively rough or porous, the sprayed metal will not adhere and accumulate on the base and no coherent coating will build up. For this reason in the commercial application of the spraying process, unless the metal base to be sprayed has a substantially rough or porous surface, the surface must be roughened or rendered porous by suitable means such as sand blasting, grit blasting, machining, acid etching or the like.

If the coating could be so applied to a rough or porous surface so as to be removable, the removed surface would carry the irregular and roughened surface of the base to which it was applied and it is for this reason impossible starting with such a base to make negatives characterized by a smooth surface and accuracy and detail of impressions.

It is desirable to make accurate negatives or molds and reproductions or replicas in metal of metal objects of substantially smooth surface and I have discovered how this may be accomplished and herein describe certain useful applications of my discovery.

The initial step in the application of my process is the formation upon the smooth surface of the metal article of which a negative is desired of a coherent detachable coating by spraying metal thereon. This is accomplished by applying the sprayed metal to the metal base while maintaining the base within a suitable temperature range. The lowest temperature at which the sprayed metal shows definite adhesion to the base with the formation of a coherent coating thereon is

designated for the purposes of this application as the "temperature of incipient adhesion". At lower temperatures the sprayed metal does not so adhere to the base and is either blown off by the force of the blast from the spray gun or if it forms flakes upon the metal base these flakes curl and show the absence of any firm attachment to the metal base.

At the temperature of incipient adhesion and within the temperature range somewhat above the temperature of incipient adhesion the sprayed metal will accumulate upon the metal surface to which it is applied and form a coherent coating thereon. This coating is, however, detachable and may be removed intact by thermo or mechanical means for example it may detach itself on cooling or if the base to which it is applied is of a character which will not be injured or destroyed by quenching, the applied coating may be loosened by rapid cooling as for example by quenching and the applied coating thereafter removed. The upper limit of the permissible temperature range is the temperature at which inseparable adhesion between the base and applied metal occurs and at which the applied coating cannot be removed intact by thermo or mechanical means. Between the temperature of incipient adhesion and the temperature of inseparable adhesion any intermediate degree of adhesion may be obtained by appropriate regulation of the temperature. The metal base must be at the desired temperature until a coherent coating has been formed although as soon as the surface has become entirely coated by the sprayed metal the deposition of the metal may be continued until a desired thickness has been obtained without regard to the temperature of the metal base while continuing the spraying.

In the practical application of my process the metal base to be covered is pre-heated to a point within this permissible range in any suitable way and then sprayed. In the time required to coat the surface the piece will not ordinarily drop below this range but if the surface is extensive it is advisable to maintain the temperature by heating the piece in some manner during the spraying operation.

The temperature of incipient adhesion and the temperature of inseparable adhesion are dependent upon the composition of the sprayed metal, the composition of the metal base and upon the degree of smoothness of the surface of the metal base. These temperatures may, however, for practical purposes be determined in the following manner. Test specimens of the base metal

are placed in a suitable furnace in which the temperature is accurately measured and in which the temperature is gradually rising. Test specimens are taken from the furnace at intervals and may conveniently be taken whenever the temperature has risen an increment of 25° F. When a test specimen is taken the spray gun is passed immediately over the specimen spraying onto the specimen the metal to be applied by spraying. As the temperature of the furnace rises, a point will be reached at which the sprayed metal shows a definite adhesion to the test specimens and the formation of a coherent coating thereon. Each test piece should be sprayed immediately on removal from the furnace so that no appreciable drop in temperature has occurred before the spraying operation and the specimen is substantially at the indicated furnace temperature. The temperature of the test piece at which the sprayed metal first shows definite adhesion and formation of coherent coating, may for practical purposes be taken as the temperature of incipient adhesion and the process may be carried out at this temperature. The temperature at which inseparable adhesion occurs can of course be determined in the same manner by continuing the testing at higher temperatures until a point is reached at which the coating applied to the test piece by spraying is not removable therefrom intact by thermo or mechanical means. In the practical application of my process it is, however, sufficient to carry out the practical spraying operation at or slightly above the temperature of the test piece at which the sprayed metal first showed definite adhesion and coherent coat formation.

In the following tabulation are set forth examples of pre-determined temperatures of incipient adhesion for certain given metal bases and certain given spray metals.

Spray metal	Base	Temperature of incipient adhesion
		° F.
Aluminum.....	Brass (satin finish).....	620
Do.....	Polished brass (mirror finish).....	720
Do.....	Aluminum (satin finish).....	600
Tobin bronze.....	do.....	640
Aluminum.....	Polished tool steel (mirror finish).....	760
Do.....	Polished cast iron (mirror finish).....	780

The foregoing examples are intended merely as illustrations since in each case the temperature of incipient adhesion should be determined by test for the specific conditions under which the process is applied unless this temperature has been indicated by previous experience with similar materials.

One application of the discovery resides in making molds for the manufacture of smooth moldable articles, such as articles of rubber, plaster and formaldehyde resins and permanent molds for use in casting metals. In this case I take in the first instance a metal master or pattern having substantially the dimensions of the article to be reproduced from which any number of molds may be obtained by the application of my process, i. e., by spraying metal against said master or pattern to form a coherent detachable coating of metal and thereafter detaching and removing the coating so formed. The mold so obtained is an exact negative of said master or pattern and its surface will bear the same degree of smoothness and finish as the original.

The method may, of course, be applied to the manufacture of a finished article of manufacture since in this case starting with a metal mold of the article the article itself may be built up by spraying metal against the surface of the mold to form a structure of the desired thickness. The finished article may be formed in this manner or, alternatively, by first forming a shell having the external shape of the finished article and thereafter completing the article by pouring a backing of metal or other suitable material into the shell.

Articles of manufacture so produced may have a surface of one metal and a backing of a different metal. Such articles may, for example, be made having a surface of a relatively inert metal or one taking a high polish, such as brass, chromium, or stainless steel.

Mandrels or chucks for spinning may be formed by my method. These may conveniently be formed starting with the duplicate of the article to be spun and building against this by spraying a shape of spray metal substantially in the form of the desired chuck or mandrel and thereafter detaching the same.

When making molds, articles of manufacture, etc., whenever the form from which the mold or article is made has reverse drafts, it will of course be understood that the mold or article of manufacture will be made in sections, each of which can be drawn. In cases where this is not convenient or practicable the sprayed metal may be applied upon a shape of metal, the melting point of which is lower than that of the sprayed metal and the shape thereafter removed from the applied metal by melting it away.

The process is applicable to the production of negatives of metal surfaces of all kinds including metal surfaces themselves formed of sprayed metal.

Another application of my process is in the printing art. Metal type can be made by the application of my process by spraying upon a metal matrix and thereafter detaching and removing the sprayed metal. If desired I may in the first instance assemble a block of type and form the matrix itself by spraying thereon, whereupon the matrix may be used for any desired number of reproductions of the type either by the application of my process or by pouring metal into the matrix. In either case both the type and the matrix can be formed of metals harder than those at present generally available for this purpose in the printing industry.

It will of course be understood that dies may be formed by the process hereinabove described for the manufacture of molds, i. e., by taking a suitable master and thereafter forming the dies by spraying against the master.

It will also be understood that after I have formed a coherent coating of sprayed metal by following the method hereinabove described I may proceed to apply a backing to this coating by either spraying or pouring a metal of different composition.

The foregoing description is furnished by way of illustration and not of limitation and it is, therefore, my intention that the invention be limited only by the appended claims or their equivalents wherein I have endeavored to claim broadly all inherent novelty.

I claim—

1. Process of making metal negatives of smooth surfaced metal objects comprising spraying such a metal object with a metal, which object is at least at the temperature of incipient adhesion for

said object and said applied metal, and below the temperature at which inseparable adhesion occurs, at least until the surface is covered with applied metal, thereby forming a coherent coating of said applied metal, adhering to said metal object and thereafter removing said coating from said object.

2. Process of making metal negatives of smooth surfaced metal objects comprising spraying such

a metal object with metal, which object is substantially at the temperature of incipient adhesion for said object and said applied metal, at least until the surface is covered with applied metal, thereby forming a coherent coating of said applied metal, adhering to said metal object and thereafter removing said coating from said object.

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