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PROCESS OF CHROMIZING

George A. Samuel, White Plains, N. Y., assignor to Metal Diffusions, Inc., Philadelphia, Pa., a corporation of New Jersey

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This invention relates to processes commonly known as chromizing which consists generally in producing or effecting a chromium alloy coating or layer on the surface of ferrous metal. In such processes the ferrous articles to be chromized are placed in a container provided with means for excluding oxygen therefrom, the articles being embedded in powdered material including chromium metal or ferro-chromium and a halogen, and the container together with the articles and the processing materials are placed in an oven or furnace and therein heated to certain temperatures required in the functioning of the process.

One of the principal objects of the present invention is to provide in a process of the character mentioned a more effective, self-reacting, halogen compound than has heretofore been used.

Another, and important object of this invention is to provide a halogen compound which is not only economical but will function more rapidly and provide a better finish on the chromized articles than previous compounds developed for the purpose referred to.

A still further object of the present invention is to provide in a process of the character mentioned a powdered material for the chromizing process of a mesh which will greatly facilitate the chromizing operation.

In the carrying out of my invention, I preferably use ammonium bi-fluoride as a source of halogen for the reason (1) that it will react more rapidly with chromium or ferro-chromium than the other halogens, and (2) it will effect a greater diffusion of chromium into the ferrous parts at much lower temperatures for the chromizing operation than any other halogen. In the use of ammonium bi-fluoride I have found that the coating obtained on the ferrous parts is non-porous, brighter and more ductile than can be obtained by any other method.

I have also discovered that with a processing powder comprising approximately 50 pounds of chromium metal powder, 50 pounds of chromium trioxide (Cr_2O_3) and 1/100 pound of ammonium bi-fluoride or 65 pounds of chromium metal powder, 35 pounds chromium trioxide and ¼ pound ammonium bi-fluoride very bright coatings are obtained, thus producing a surface suitable for decorative purposes. The rate of diffusion is extremely rapid, the alloy surface is entirely non-porous, and will therefore resist corroding medias to a degree that has never been achieved in parts chromized by previous methods.

Moreover, I have discovered that to obtain the most effective results, the processing powder should be more finely divided than has heretofore been done. For the most effective results the powdered material should be 100 mesh or smaller, the reason being to provide the greatest possible surface of reaction, a uniform mixture, and to minimize the possibility of air being trapped in the processing compound; also to provide a more intimate contact of the compound with the ferrous parts to insure the optimum results. Also due to its fine texture this compound can be applied to the ferrous parts when supended in a liquid neutral media by spraying or dipping, thereby effecting a substantial saving in space in the heating container and correspondingly reducing the processing cost. I have found that a coating of 10 to 20 thousandths of an inch of this compound applied by spraying or dipping is sufficient to obtain adequate diffusion of the chromium in the ferrous parts. Moreover, after processing, this compound coating does not adhere to the ferrous parts treated, but disintegrates into powder.

The following improved processing mixtures are in accordance with my invention as set forth in the foregoing description and have been found to be effective in producing the advantageous results mentioned therein:

		Pounds
(1)	Chromium metal powder	60
	Calcined alumina (or kaolin)	40
	Ammonium bi-fluoride	¼
(2)	Chromium metal powder	51
	Calcined alumina (or kaolin)	49
	Ammonium bi-fluoride	⅛
(3)	Chromium metal powder	50
	Chromium oxide (Cr_2O_3)	50
	Ammonium bi-fluoride	1/100
(4)	Chromium metal powder	65
	Chromium oxide (Cr_2O_3)	35
	Ammonium bi-fluoride	¼
(5)	Ferro-chrome powder	65
	Kaolin powder	35
	Silicon metal powder	1
	Ammonium bi-fluoride	1/10
(6)	Ferro-chrome powder	40
	Kaolin powder	60
	Silicon metal powder	2
	Ammonium bi-fluoride	1/100
(7)	Ferro-chrome powder	68
	Kaolin powder	32
	Aluminum metal powder	¾
	Ammonium bi-fluoride	2/10
(8)	Ferro-chrome powder	39
	Kaolin powder	59
	Aluminum metal powder	2
	Ammonium fluoride	3/10

With either of the processing mixtures above specified, the process is carried out at temperatures from 1650° to 1980° F. Also, as already mentioned, the powdered materials in the mixtures specified should be of a mesh not exceeding 100, but may range downward within reasonable limits.

The time of treatment should be from 4 to 12 hours.

With the above mentioned mixtures (1) and (2) the following results have been obtained. For high carbon steel and tool steels, 6 hours' treatment at 1650° F., produced an alloy coating of 1½ thousandths of an inch, which consisted mainly of chromium carbide which, upon analysis, disclosed a chromium content of approximately 65 percent, the surface hardness being of the order of 70 to 72 R. C. There was no indication of decarburization under the chromium layer. The percentage of carbon found in the coating was 6 times that of the parent material.

With mixtures (3) and (4) a mild steel part was treated for 4 hours at 1980° F. and the coating had a very bright surface, and the penetration was 2 thousandths of an inch.

Mixtures (5) and (6) produce a deep non-ductile type of coating, mainly for resistance to high temperatures.

Mixtures (7) and (8) produce a highly ductile coating at low temperatures and are mainly used for sheet

metals which are required to be formed and fabricated after chromizing. The temperatures used never exceed 1750° F. This mixture is suitable for spraying and dipping. After spraying or dipping the mixture on the articles is dried before the articles are placed in the container for heat treatment.

Various changes in the mixtures set forth in the foregoing description may be made within the spirit and scope of my invention, and it should, therefore, be understood that the examples given are intended to be illustrative only, and not limited thereto.

I claim:

1. Material for use in chromizing ferrous metal articles, comprising a heat mixture essentially composed of between 35 and 90 parts by weight of powder selected from the group consisting of ferro-chromium and chromium, between 10 and 65 parts by weight of inert refractory powder, and between $\frac{1}{100}$ and $\frac{1}{4}$ part by weight of ammonium bi-fluoride.

2. In the process of chromizing ferrous metal articles by heating the articles in intimate contact with a chemically reactive chromizing mixture in a closed container at a temperature of about 1650 to 1980° F. for a period of about 4 to 12 hours, the step which comprises reacting in intimate contact with the articles, a chromizing mixture substantially composed of between 35 and 90 parts by weight of powder selected from the group consisting of ferro-chromium and chromium, between 10 and 65 parts by weight of inert refractory powder and between $\frac{1}{100}$ and $\frac{1}{4}$ part by weight of ammonium bi-fluoride.

3. The process of claim 2, which comprises applying the chromizing mixture as a coating on the ferrous metal articles, and then drying the coating, prior to the treatment at elevated temperature.

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