United States Patent Office

3,510,366

Patented May 5, 1970





3,510,366

# METHOD FOR BLACKENING APERTURE MASKS FOR COLORED TV PICTURE TUBES

Norman B. Mears, St. Paul, Minn., assignor to Buckbee-Mears Company, St. Paul, Minn., a corporation of Minnesota

No Drawing. Filed Feb. 6, 1967, Ser. No. 613,992
Int. Cl. C23f 7/02
U.S. Cl. 148—6.35 6 Claims

## ABSTRACT OF THE DISCLOSURE

Thin sheets of cold-rolled steel containing a multitude of tiny apertures are subjected to a nitrogen gas atmosphere at controlled temperatures to a maximum in the order of 1200° F. to form a non-reflective coating on the metal without affecting the size of the tiny apertures.

## BACKGROUND OF THE INVENTION

### Field of the invention

Although the invention may have some general application to the treating and processing of cold-rolled steel sheets, it is particularly directed toward the field of making and processing aperture masks for colored TV picture tubes which are made out of cold-rolled steel in the order of .006 inch thickness and having hundreds of thousands of very miniature apertures.

### Description of the prior art

The prior art has been effective to produce a blackening coating on the TV aperture masks by subjecting the mask to controlled temperature in gaseous environmental conditions. However, it has been found that the present day blackening tends to easily flake off when the mask is handled. This presents a two-fold problem. One is that a break in the protective coating makes the mask susceptible to corrosion and the other is that the flakes may fall into the picture tube thereby contaminating it and making it unusable. Whenever the coating starts to flake off it usually becomes necessary to discard the mask onto the scrap pile. This can be quite costly because of the investment that has gone into producing the mask to that point. The present invention provides a non-reflective coating which is uniform and non-flakey and adheres strongly to the metal sheet without affecting the size of the tiny holes in the mask.

## SUMMARY

The essence of this invention lies in taking a thoroughly cleansed cold-rolled steel aperture mask and inserting it in a nitrogen gas atmosphere under certain temperature conditions within prescribed limitations and ranges to form a dull, soft gray appearing coating on the metal which will not flake off even under the roughest type of handling conditions that a mask may experience.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Aperture masks are located in virtually every color TV picture tube between the electron gun inside the glass bulb and the phosphor screen on the front inner face of the bulb. The electron beams of the three-color guns pass through the tiny apertures which are formed in the aperture mask on their way to the phosphor screen. The mask prevents overlapping or shadowing of the three colors. It is important that the mask surfaces be non-reflective so as not to interfere with the viewing. It is also important that the mask not oxidize or otherwise corrode because once it is inserted in the picture tube it cannot be removed without destroying the tube. Therefore it has been found necessary to subject the mask to a "blackening" process prior to inserting it in the picture tube. It is mandatory, of course, that the blackening process not change the size of the small apertures in the mask. Once this coating is formed it must be stable and not flake off otherwise if the mask is inserted in the tube and the coating flakes off thereafter, it will destroy the usefulness of the tube.

To accomplish the blackening process the present invention requires that the mask be inserted in an atmosphere consisting solely of nitrogen gas. This is done by introducing nitrogen gas into a suitable oven to purge the oven to assure that substantially all traces of other gases or other contaminants are removed. While continually keeping the nitrogen gas flowing into the oven, a mask is inserted into the oven, preferably on a suitable holder or rack. It is axiomatic that the mask must be positioned so that it is located in an area where the surrounding gas is uniform. The oven can be preheated to a temperature in the order of 500° to 600° F. but should not be preheated above 800° F. It has been found that preheating is not necessary but does save time. The same end results are obtained even when starting the process from room temperature. With the oven closed, the temperature in the oven is elevated from either room temperature or the preheat temperature toward 1200° F. It usually takes in the order of ten minutes to go from approximately 500° F. to 1200° F. At all times sufficient nitrogen gas must be introduced into the oven to compensate for any that might escape through leaks in the oven. As soon as a peak temperature, in the order of 1200° F., is reached the heat in the oven is turned off and the interior of the oven is allowed to cool downward. It has been found that when the temperature has dropped down to approximately 800° F. the nitrogen gas no longer has to be continually fed into the oven to compensate for any leakage of the gas inserted earlier. The oven, along with the mask, temperature is allowed to continue to drop down to the order of 600° F. This may take in the order of forty minutes although it is contemplated that the cooling can be accomplished more rapidly by using some cooling elements or other cooling means. The length of cooling time does not appear to be critical. After the mask has been cooled down to approximately 600° F. it can be removed from the oven. It is then found to have a soft appearing, dull-gray, ductile or non-flakey coating which is uniform throughout the mask which provides the non-reflective surface that is desired. Although to date it has not been completely analyzed, it is thought that the coating is either ferric or ferrous oxide. The theory is that a minute quantity of oxygen is entrapped on the surface of the metal as it is fed into the oven and it is this oxygen which reacts to form the coating on the metal.

Samples of masks coated in this manner have been kinked, bent and otherwise severely handled in an effort to flake off some of the coating but the coating has withstood all tests. Because no foreign masses are added to form this coating it appears to be merely a change in form of the top surface of the metal sheet. Therefore, it should in no way and appears not to interfere with or change the dimensions of the tiny apertures in the mask.

Although the invention has been described heretofore as involving the step of placing individual masks in the oven and varying the temperature while controlling the gas atmosphere, it is contemplated that the masks can be carried in strip form and be fed into and through the oven continually in this manner. For this purpose the oven will contain the suitable nitrogen gas atmosphere but will have various temperature zones through which the masks will pass when traveling between the input and output ends of an elongated oven. In this way the process can be expedited for mass production purposes.

I claim:

1. A process for forming a surface coating on a sheet of cold-rolled steel having a multitude of miniature apertures in a prearranged pattern, comprising the steps of:

(a) inserting the sheet of cold-rolled steel containing a myriad of apertures into an atmosphere consisting essentially of nitrogen gas;

(b) raising the temperature of the atmosphere consisting essentially of nitrogen gas up to a peak temperature in the order of 1200° F. while maintaining the atmosphere in a condition consisting essentially of nitrogen gas;

(c) reducing the temperature of the atmosphere consisting essentially of nitrogen gas as soon as the peak temperature is reached;

(d) allowing the temperature of the atmosphere consisting essentially of nitrogen gas to decrease down to the range of 600° F.; and

(e) removing the sheet from the atmosphere.

2. The invention as in claim 1 wherein the atmosphere is maintained exclusively nitrogen gas through step (d) in the process.

3. The invention as in claim 2 wherein the temperature of the nitrogen gas atmosphere surrounding the steel sheet is uniform.



4. The invention as in claim 1 further including the step of preheating the nitrogen gas atmosphere consisting essentially of nitrogen gas to the range of 500° F. but less than 800° F. prior to inserting the steel sheet into the nitrogen gas atmosphere.

5. The invention as in claim 4 wherein the temperature of the nitrogen gas atmosphere consisting essentially of nitrogen gas is raised from about 500° F. to a peak temperature over a period of time in the order of 10 minutes after the steel sheet is inserted in the nitrogen gas atmosphere.

6. The invention as in claim 1 including cleaning the sheet by removing all contaminants and foreign substances from the steel sheet prior to inserting it in the nitrogen gas atmosphere.

**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 2,340,461 | 2/1944 | Gage et al. | 148—6.35 |
| 2,625,734 | 1/1953 | Law | 117—33.5 X |


RALPH S. KENDALL, Primary Examiner

U.S. Cl. X.R.

148—12.1; 118—504