The present invention relates to the manufacture of mirrors and more particularly to a process of silvering glass sheets.

One object of the invention is the provision of a process in which metallic silver deposited from a silvering solution may be confined to a single surface of a glass sheet.

A second object of the invention is the provision of a process in which the metallic silver deposited from a silvering solution may be prevented from adhering to the face of a glass sheet undergoing the silvering operation.

Other objects and advantages of the invention will become more apparent from the following detailed description of certain preferred embodiments thereof.

Mirrors are ordinarily prepared by pouring a silvering solution over the upper surface of a glass sheet maintained substantially in a horizontal position. This process has been followed, with only slight variation, for many years. An excess of the silvering solution is employed, however, to insure complete coverage of the glass surface and the deposition of a silver film of adequate thickness. This excess of solution flows over the edges of the sheet and is drawn onto the under surface of the sheet where some silver is also deposited. Removal of the silver partially covering what is to be the face of the mirror is essential and this entails an additional operation which increases production costs. Furthermore there is a danger of permanently impairing the glass surface and destroying the reflecting film on the mirrored surface.

Various attempts have been made to prevent the silvering solution from flowing onto the under glass surface, but these have not been uniformly successful. For example, it has been proposed to form a rim of rubber or putty about the margins of the glass sheet in order to confine the silvering solutions to a single surface thereof. Obviously these rims must be fitted by hand to sheets of varying sizes. A provision of this type can be used only in an intermittent process and is not adaptable to a continuous line operation in which the glass sheets are handled on a conveyor. Other attempts to protect the mirror face embody the application thereto of paint and resin coatings. These will prevent the deposition of silver but the removal of the protective coating is as difficult and laborious as the removal of the silver itself.

Briefly stated, the present invention contemplates the application of an acidulated solution of a dichromate or a permanganate to the surface of a glass sheet opposite the surface upon which silver is to be precipitated to mask that surface in order to prevent adherence of silver thereto.

In preparing mirrors, sheets of glass are cleaned to remove any grease and alkalies and are then placed in a horizontal position upon a table or conveyor system. The upper surfaces of the sheets are sensitized by treatment with a solution of sodium chloride prior to the application of a silvering solution comprising a mixture of a silver salt and a reducing agent from which metallic silver is deposited on the glass. During the silvering operation, the excess of the silvering solution flows over the edges of the sheets and is drawn back onto the under surface of the sheet where metallic silver is also deposited.

I have discovered that by applying an acidulated solution of a dichromate or a permanganate to the under surface of the glass, prior to the silvering operation, it is possible to prevent any silver deposited from the silvering solution from adhering to the treated surface. It is believed that the coating forms a masking film over the glass surface to the extent that no silver nucleus attach to the glass. It is possible, however, that the coating alters directly the chemical nature of the silver reduced from solution for both the dichromates and permanganates act as strong oxidizing agents. The coating does free the glass surface of the objectionable silver films which are ordinarily formed thereon.

$K_2CrO_7$, $Na_2CrO_4$, and $(NH_4)_2CrO_4$ in concentrations of from 0.1 to 5 percent by weight in an aqueous solution acidulated with from 1 to 10 percent by weight of nitric or sulfuric acid will form satisfactory treating solutions. Optimum protection has been obtained by using a solution containing approximately 5 percent by weight of $K_2CrO_4$ and 1 percent by weight of sulfuric acid.

$Na_2MnO_4$ and $K_2MnO_4$ in similar concentrations in acidulated solutions may also be used successfully.

The solution may be sprayed, rolled or otherwise applied to the surface of the glass which is to be protected. The coating remains effective even after it is dry and glass sheets may be treated for some time prior to being silvered. When the protection is no longer required, the coating is easily removed by washing and the glass surface is restored to its original condition.

It will be understood that various modifications in the concentrations of the solutions and their manner of application are possible without
departing from the spirit of the invention or the scope of the appended claims.

What I claim is:

1. In the process of manufacturing mirrors which includes the deposition of metallic silver from a solution of a silver salt and a reducing agent upon the upper surface of a glass sheet maintained substantially in a horizontal position, the steps which comprise applying an acidulated solution of a compound selected from the group consisting of $\text{K}_2\text{Cr}_2\text{O}_7$, $\text{Na}_2\text{Cr}_2\text{O}_7$, $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$, $\text{NaMnO}_4$, and $\text{KMnO}_4$ to the under surface of the glass sheet to prevent adherence thereon of silver from the silvering solution overflowing the upper surface and contacting the under surface of the glass, depositing the metallic silver upon the upper surface while the under surface is covered with the compound, then washing away the compound.

2. In the process of manufacturing mirrors which includes the deposition of metallic silver from a solution of a silver salt and a reducing agent upon the upper surface of a glass sheet maintained substantially in a horizontal position, the steps which comprise applying an aqueous solution of a compound selected from the group consisting of $\text{K}_2\text{Cr}_2\text{O}_7$, $\text{Na}_2\text{Cr}_2\text{O}_7$, $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$, $\text{NaMnO}_4$, and $\text{KMnO}_4$ and containing from 1 to 10 percent by weight of sulfuric acid to the under surface of the glass sheet to prevent adherence thereon of silver from the silvering solution overflowing the upper surface and contacting the under surface of the glass, depositing the metallic silver upon the upper surface while the under surface is covered with the compound, then washing away the compound.

3. In the process of manufacturing mirrors which includes the deposition of metallic silver from a solution of a silver salt and a reducing agent upon the upper surface of a glass sheet maintained substantially in a horizontal position, the steps which comprise applying an aqueous solution containing from 0.1 to 5 percent by weight of a compound selected from the group consisting of $\text{K}_2\text{Cr}_2\text{O}_7$, $\text{Na}_2\text{Cr}_2\text{O}_7$, $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$, $\text{NaMnO}_4$, and $\text{KMnO}_4$ and from 1 to 10 percent by weight of sulfuric acid to the under surface of the glass sheet to prevent adherence thereon of silver from the silvering solution overflowing the upper surface and contacting the under surface of the glass, depositing the metallic silver upon the upper surface while the under surface is covered with the compound, then washing away the compound.

4. In the process of manufacturing mirrors which includes the deposition of metallic silver from a solution of a silver salt and a reducing agent upon the upper surface of a glass sheet maintained substantially in a horizontal position, the steps which comprise applying an aqueous solution containing approximately 5 percent by weight of $\text{K}_2\text{Cr}_2\text{O}_7$ and 1 percent by weight of sulfuric acid to the under surface of the glass sheet to prevent adherence thereon of silver from the silvering solution overflowing the upper surface and contacting the under surface of the glass, depositing the metallic silver upon the upper surface while the under surface is covered with the compound, then washing away the compound.

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