The instant invention relates to an improved metal casting process. More specifically, the present invention is concerned with a method of increasing the life of mold bottoms used to cast ingots, and prevent adhesion of these mold bases to subsequently formed solidified ingots which must be removed from within the mold walls.

All metal ingots are cast from molds. One popular type is a "big end down" mold. These molds rest on bases known as "stools." The stools are merely large, normally rectangular, flat slabs of metal, commonly made of cast iron, which are used as support for the mold sides and also, of course, form the bottom portion of the mold. The mold sides generally taper up in diameter from bottom to top. Another type of mold is known as the "big end up" mold. These are ladle-like receivers for the molten metal, the bottom portion of which molds are integral, nonremovable parts of the entire mold.

Various problems commonly occur in use of these molds and particularly with respect to the surface of their base portions. First, the unprotected metal surface quickly erodes and pits in the presence of molten metals which are cascaded upon their surface. Large gouges in the base portions are produced due to the force and high temperature developed by the flowing molten metal which contacts the surface of the stool. Since many mold bases are generally approximately 5-10 feet in height, the metal must be poured from a height at least equal to that distance and quite often is poured from even greater heights. A considerable pressure head is thereby developed. Thus, the hot molten metal easily gouges gaping depressions in the base members under such force and at a temperature of at least the liquefaction temperature of the molten metal. Moreover, the problem of creation of pits or gouges in the base portions of the molds, caused by the above factors is aggravated due to the fact that the molten metal, especially near the bottom of the mold, remains in its erosive hot liquid state for a considerable amount of time subsequent to pouring.

The molten metal upon solidification to an ingot thereby has a bottom form conforming to the undesirable eroded surface configuration of the stool or base member of the mold. Thus, a considerable amount of the ingot, when withdrawn from the mold and subsequently processed into slabs or blooms, is lost through a cropping of the irregularly formed end of the slab. This, of course, is highly undesirable, since it results in undue loss of usable metal and increase in scrap, which must be subsequently reprocessed.

Another extremely serious and costly problem results after the ingot in the mold has solidified to a point where it can be removed from both the mold sides and its base platform member or stool. In many cases, if the surface of the stool is unprotected, or inadequately protected, and erosion occurs as described above, the ingot has a greater tendency to remain tightly adherent to the stool. Thus, after the mold sides are removed from around the ingot, which process can normally be efficiently achieved with a minimal film of coating selected from a variety of coating agents, the ingot must be forcibly removed from the stool. This is normally achieved by raising both ingot and adherent stool, and thrusting them against some other larger object whereby the ingot is jarred loose. In many cases the stool and ingot are merely dropped on the floor from some suitable height. In such a situation, the ingot is often broken into two or more smaller pieces and cannot be subsequently reused in casting other ingots. Again, replacement cost of these stools is high, making this aspect of the overall casting process somewhat disadvantageous. The same problem exists with respect to big end up molds wherein sticking of ingots particularly occurs at their base portion. New molds of this type are especially vulnerable to sticking due to their smooth surface unprotected by any layers of metal oxides or scale. A tight metal-to-metal bond between mold bottoms and ingots then occurs.

Cracking of molds and particularly their base portions due to the above discussed rough handling occasioned by "stickers" between the base portions and ingots, is also enhanced by thermal shock during ingot formation. Unprotected or inadequately protected bottom surfaces of mold are especially susceptible to such destructive shock.

Many prior art coating materials have failed to give adequate protection to the mold base members, and in some cases caused ancillary process difficulties. For example, some inferior coatings were washed off the surface of the base portion of the mold and were thereby included as an unwanted impurity in the ingots. Such inclusion oftentimes deleteriously affected desirable metal properties.

The above described problem is a particularly arduous one, which prior art coating materials have not been able to cope with to any substantial degree. It would therefore be of benefit to the art if a method were discovered whereby the surfaces of the above described stools of big end down molds or base members of big end up molds, could be protected from erosion from cascading molten metal. If such erosion could be substantially prevented and, in addition, the problem of adherence between the base member and subsequently formed ingot could also be overcome, considerable advantages would accrue. For example, the overall casting process would be materially benefited since the separation between the mold base member and ingot would be accomplished in a more facile operation.

It therefore becomes an object of the invention to provide a method of casting metal ingots into metal molds whereby adherence of the base member of the mold to the formed ingot and erosion of the same base member during ingot formation are substantially prevented.

A specific object of the invention is to inhibit such erosion and adherence by applying a film of coating material to the surface of the base member whereby these problems are overcome.

Yet another object is to provide improved metal molds used for casting metal ingots which have at least the base member of the mold protected by a film of material so that the above described problems of erosion of the base member and adherence of same to metal ingots no longer exist to any appreciable degree.

Other objects will appear hereinafter.

In accordance with the invention a method of casting metal objects from metal molds has been discovered, whereby adherence of the base member of the mold to ingots formed therefrom, and erosion of these same base members during such ingot formation are substantially inhibited.

In its broadest aspects, the invention comprises the steps of applying a slurry consisting of an aqueous alkali metal silicate binder and a refractory to the surface of the base member of a metal mold. Preferred binders include sodium silicate and potassium silicate. Among
these, the most preferred by virtue of its availability and low cost is sodium silicate.

In order to best achieve dual purposes of prevention of erosion of base member and non-adherence to formed ingots, the slurry should consist of at least one refractory of the following types: vitreous silica, crystalline silica, magnesium silicate, aluminum silicate, alumina, graphite, zirconium silicate and clay. These materials are all well-known substances and are all commercially available. Typical aluminum silicates, for example, may include a laminated type of aluminum silicate, and mullite, an orthorhombic aluminum silicate available from the Island of Mull or artificially made by heating andalusite, sillimanite or cyanite. Excellent magnesium silicates are forsterite or talc, while a useful zirconium silicate is zircon. The most preferred refractories, discussed in more detail hereinafter, are vitreous and crystalline silicas.

The slurry is provided in an amount adequate to form a coating of sufficient thickness to prevent the above mentioned adherence and erosion from occurring. After the slurry is allowed to dry, with or without application of heat, whereby the liquid phase is driven from the surface of the base member, leaving a thin film of solid refractory coating, the molten metal is thereafter poured into the mold and on top of the now coated base member. The liquid metal is allowed to solidify into an ingot and then removed from the coated base member and mold sides.

The slurry coating reagent is simply applied to the mold or the sides of the mold by a wide variety of methods. For example, the slurry may be applied by flowing it over the mold, by spray techniques, by coating the mold with some type of applicator, etc. Spray application is believed to be the most efficient and practical way of slurry application. The slurry is best applied to the mold portion of big end down molds before the metal mold sides are placed thereon.

Effecting removal of the liquid phase of the slurry from the solid refractory material may likewise be carried out in a variety of methods. For example, the bottom portion of the mold may be coated with the slurry and allowed to dry gradually. Another method of laying down a thin protective coating is to apply the slurry to an already heated scout or mold having an integral base portion. This is particularly preferred in that the tongues and their metal mold sides or big end up molds are generally already hot before introduction of the molten metal due to the residual heat from the previous casting run, and in such a method drying time is a very minimum period.

Another way of applying the protective film is to coat the base member, and then heat it as slowly or rapidly as desired to drive off the liquid portion of the slurry. In any event all that is necessary is that the coating be laid down in some manner after contact of the base member with the slurry.

In the most preferred method the coating slurry is applied to stools or mold base members having a temperature ranging from that of room temperature to 1000°F, and more preferably from 200° F to 800° F. Best adherence of solid coating to stools is achieved by slurry application to the stools at a temperature range of 200–500° F. For best results, it has been determined that films should measure in thickness from 0.01” to 3” and most preferably from 0.1” to ½”.

It is believed that the excellent coating success achieved by use of the above described slurries is their ability to form a strong ceramic coating even when affixed to the base members of the mold at relatively low temperatures, at least under foundry conditions, of say about 500° F or even lower. The coating becomes completely resistant to subsequent contact with water and stays tightly adherent to the base portions of the mold even under such washings. After the coating has been formed preparation for cast-
ing is complete except when big end down molds are used. In those cases the mold sides should be placed on the base member following coating, if not already present during coating.

After coating operations, molten metal is flowed into the mold, allowed to solidify into an ingot and the ingot is then separated from mold surfaces. The invention is not limited to use with specific mold sides or any particular metal mold bottom or to use with any particular molten metal. However, it has found specially preferred use in coating cast iron mold base members for molds which are used in forming ingots of steel.

As mentioned above, two refractories have shown extreme promise for coating. Both of these materials are well-known and need little further elaboration. The first is a crystalline silica refractory. Representative types include sand, crystalline silica flour, crystalline silica grains, etc.

Other preferred refractory materials are those generally referred to as vitreous silicas. These are glassy modifications of silica, obtained by the fusion of selected low-temperature crystalline forms, and are frequently referred to as fused silica and glass. Specific vitreous silicas include those particles made from fused quartz glasses, silicate glasses, silica glasses such as the well-known "Vycor" materials and fused silica glasses. With respect to all of these materials their thermal coefficients of expansion are relatively small in proportion to expansion properties of other refractories such as those of the soda-lime and lead glass types. Generally, the above preferred refractories have thermal expansion coefficients smaller than $5 \times 10^{-6}$ cm./cm.$/^{°}$ C. Also, the silica content of these granular siliceous refractory materials is generally greater than 96% silica expressed as SiO$_2$ and may range as high as 99.8% SiO$_2$. Thus, by the term "vitreous silica" is meant a refractory comprising a silica glass having a thermal coefficient of expansion and SiO$_2$ content within the above ranges.

It has been determined that for best results in coating stools the refractory used in the silica slurry should be able to withstand severe heat shocks. Due to the extreme hot temperature of the molten metal as compared to that of the stool even when the latter is heated, an exceedingly abrupt change in temperature occurs when the metal contacts the stool. The coating must itself be able to withstand this heat shock to impart necessary protection to the stool itself. It has been theorized that failure of some prior art materials was due, at least in part, to their inability to withstand this sudden increase in heat, thereby resulting in cracking of the coating and subsequent exposure of the metal surface to the cascading molten metal poured into the mold.

In view of the above it is generally thought that the most preferred silica-type refractories are those which have the highest silica content concomitant with the lowest thermal coefficient of expansion. These properties are particularly possessed by vitreous silicas and more particularly those of the fused silica types. The latter materials have a silica content greater than 97% silica expressed as SiO$_2$ and a thermal coefficient of expansion not greater than about $6 \times 10^{-6}$ cm./cm.$/^{°}$ C.

A typical fused silica of the type described above which is extremely useful in the practice of the invention, having a thermal coefficient of expansion of about $5 \times 10^{-6}$ cm./cm.$/^{°}$ C., has the following typical analysis:

| TABLE 1 |
|-----------------|-----------------|
| **Ingredients:** | **Percent by weight** |
| SiO$_2$ | 97.3 |
| Al$_2$O$_3$ | 1.7 |
| Sub-oxides of silica | 1.0 |

The above type silica products are readily prepared by grinding very pure fused silica glasses. Likewise, the boro-silicate glasses and "Vycor" silica glasses may also be.
ground to produce extremely useful refractories. Vitreous silica substances marketed under the trademark, "Nalcast," have been employed with much success in preventing erosion of stools and adherence of same to the formed inogs.

As set out above, the preferred source of silicate material is a sodium silicate. Commercial sources of this material range from about 25% to about 40% by weight of solids of sodium silicate, generally supplied in aqueous form. More typically, they contain 30-40% by weight of solids. These commercially available silicates may be concentrated somewhat or diluted to any solids content as desired. Preferred alkali metal silicate binders for use in the invention are those materials containing 5-45% by weight of alkali metal silicate as a water solution.

While water alone may be used as the solubilizing agent for alkali metal silicate to form the liquid binders of the invention, it is understood that a binder may contain other solvents, polar in nature. It is only necessary that the organic solvents be compatible in water and do not deleteriously affect the alkali metal silicate, such by initiating polymerization of it to a solid, unsuitable, glassy mass.

Particularly preferred organic substances used in combination with water as solvents for the alkali metal silicate material are those which lower the freezing point of pure aqueous alkali metal silicates by their mixture with aqueous silicate solutions. Such products are especially useful during the colder months of the year when they must be stored and/or used at relatively low temperature. Amines such as morpholine, di-ethyl amine, etc., and polyhydric alcohols such as ethylene glycol, glycerine, etc., are preferred materials in making up solutions of alkali metal silicate binders.

A preferred binder, "winterized" against freezing contains 5-45% by weight of alkali metal silicate, 10-95% of water, and 5-50% by weight of a polyhydric alcohol water compatible polar organ compound.

Regardless of whether the binder is a relatively pure aqueous solution of alkali metal silicate or a combination solvent system involving both water and water compatible organic solvents of the type described above or others, the ratio of refractory to binder in making up the slurry products of the invention ranges from 2:1 to 1:50. The more preferred slurries contain refractory and more preferably crystalline silica or vitreous silica suspended in one or more of the above described binders above in a ratio of from 2:1 to 1:5.

The particle size of the refractory may vary over a wide range, as long as it is able to be dispersed in the alkali metal silicate binder. It is preferred, however, that the refractory particles be sufficiently small so that a uniform, relatively long lasting dispersion of refractory in binder may be made. The smaller the particle size, the longer a slurry made up of binder and refractory remains in a homogeneous state. It has been determined that refractory particles ranging in size from 150 mesh to as low as a fraction of a micron may be employed. The most preferred refractory materials have average particle diameter size below about 350 mesh, with particles corresponding to the lower range diameters of 20-500 microns being the most preferred.

The following examples show typical slurries which may be made in order to achieve a uniform coating surface upon the stool. The particular sodium silicate constituting a portion of the binder contained 37.5% solids, with the remainder being water. It is understood, of course, that these examples are merely illustrative and that the invention is not limited to use of these alone. The percentages expressed are percent by weight.

### Example I

<table>
<thead>
<tr>
<th>Sodium Silicate</th>
<th>Crystalline silica flour</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
<td>50%</td>
</tr>
</tbody>
</table>

### Example II

<table>
<thead>
<tr>
<th>Sodium Silicate</th>
<th>Water</th>
<th>Crystalline silica flour</th>
</tr>
</thead>
<tbody>
<tr>
<td>25%</td>
<td>25%</td>
<td>50%</td>
</tr>
</tbody>
</table>

### Example III

<table>
<thead>
<tr>
<th>Sodium Silicate</th>
<th>Water</th>
<th>Crystalline silica flour</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>40</td>
<td>50</td>
</tr>
</tbody>
</table>

### Example IV

<table>
<thead>
<tr>
<th>Sodium Silicate</th>
<th>Water</th>
<th>Crystalline silica flour</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>30</td>
<td>40</td>
</tr>
</tbody>
</table>

### Example V

<table>
<thead>
<tr>
<th>Sodium Silicate</th>
<th>Water</th>
<th>Crystalline silica flour</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>20</td>
<td>60</td>
</tr>
</tbody>
</table>

### Example VI

<table>
<thead>
<tr>
<th>Sodium Silicate</th>
<th>Water</th>
<th>Crystalline silica flour</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>75</td>
<td>5</td>
</tr>
</tbody>
</table>

### Example VII

A coating slurry was made up having the following proportions:

<table>
<thead>
<tr>
<th>Material</th>
<th>Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.5% aqueous solution of sodium silicate</td>
<td>117</td>
</tr>
<tr>
<td>Water</td>
<td>28</td>
</tr>
<tr>
<td>Ethylene glycol</td>
<td>31</td>
</tr>
<tr>
<td>Crystalline silica flour</td>
<td>140</td>
</tr>
<tr>
<td>Bentonite</td>
<td>3.5</td>
</tr>
</tbody>
</table>

The bentonite, used as a dispersing agent, was mixed with about 3 volumes of the crystalline silica powder and added slowly to the sodium silicate which had been further diluted with the water. Stirring was effected for 15 minutes, after which time the ethylene glycol was added. After the remainder of the crystalline silica powder was then rapidly stirred until a smooth suspension was obtained.

The above slurry was then sprayed onto a total of 17 cast iron stools which were approximately 7'' x 4'' x 18'' in dimension. The weight of each of these stools, which, after coating acted as mold bottoms, was approximately 20,000 pounds. Approximately 1/4 gallon of slurry was supplied per stool. Since the stools, when coated, were heated to a temperature of 200-400°F, the drying of the slurry by driving off the liquid phase, and deposition of silica film occurred in a matter of a few seconds. After the film had been applied, open bottom-open top metal mold sides were placed thereon, having approximate dimensions of 92'' in height and whose sides measured 38'' and 48'' respectively. The entire mold was then sprayed with water in order to cool sufficiently to allow personnel to spray the walls of the mold with a carbonaceous coating. At the same time the mold walls were cleaned of any adherent slag, metal, etc. After these operations were complete, a low carbon steel made by the Basic Oxygen Process was poured into the mold containers from a 3'' diameter hole in the bottom of the ladle.

In all cases the coating remained intact, even under the erosive process conditions of pouring of molten metal from a substantial height through an opening of relatively small diameter, thereby developing substantial head
pressures of the relatively small diameter stream of metal. This, along with the extremely high temperature of metal melt had succeeded in breaking up or penetrating the prior art protective coatings used in previous runs. These prior art coating materials had been almost completely ineffectual in combating the erosive effects of the falling metal melt. In all cases deep gouges had been made in the stools. Generally, a 12" depth of molten metal was formed over the conted stool before a metal skin formed. Thus, any gouges and pitting produced by the erosive falling effect of the molten metal would be greatly aggravated by the molten metal remaining in contact with the stool for a considerable length of time before solidification.

However, in the instant experiments, in no case did there appear any appreciable sign of erosion. Also, some of the stools could be reused in a number of runs before additional coating had to be applied. Moreover, after the metal had solidified and the ingot was removed from the mold sides and stool, no "stickers" appeared. That is, there was substantially no adherence of the stool or mold base to the newly solidified ingot, which could be easily removed with a minimum of process time. Also, since no erosion did occur, the amount of molten metal that passed away from the ingot was substantially reduced, and the amount of scrap lost upon subsequent slabbing was substantially reduced. In other runs in which the fall of molten metal on to the stool was from even greater heights than 7", either there was no erosion or only minimal amounts of erosion occurred.

Vitreous silica may be used in combination with solid silica to form a slurry having as good or better coating efficiency than the just described slurry. An excellent slurry combination comprises "Nalcast" material and sodium silicate.

The amount of binder making up a portion of the coating slurry must be such that it is present in an amount substantially preventing any refractory particles together to thereby form a tightly adherent, continuous and unbroken coating which is securely bonded to the surface of the stool. Without proper amount of binder in relation to refractory, the resultant coating, after application and drying of slurry, exhibits a "pan-cake" effect with numerous undesirable holes appearing in the coating, thereby exposing portions of the stool's surface. In those cases in which proper ratios of binder to refractory were not followed, the whole coating loosened itself from the stool surface even before molten metal pouring began.

It can be seen from the above experiment that the overall objectives of substantially preventing erosion of stools or base members of metal molds during pouring of molten metal thereon, and prevention of adherence of the subsequently formed solidified ingot to the base member have been achieved to a substantial degree. In addition, subsidiary good effects are to be noted. For example, since erosion has been reduced to a minimal effect, stool life is substantially increased. Likewise, since no adherence of the stools to the ingots occurs, no resort need be taken to physically contacting the two adherent articles against a third larger object such as a floor, to separate the united objects and recover the ingots. As mentioned above, not only is this separation procedure time consuming and costly, but it frequently results in cracking or complete disintegration of the stool, making it unsuitable for further employment. Also, since little or no erosion occurs due to cascading molten metal, the amount of butt required to be cropped from the ingot is substantially reduced. As an overall advantage, the stool inventory necessary for efficient operation may be substantially reduced through use of the slurries of the invention.

Other advantages are to be noted. For example, since semi-permanent coatings on stools may be maintained by formation of the coating film, more ducile stools may be utilized. Thus, lighter stools may be employed, cut-

ing down on track weight and truck maintenance, since stools are normally carried by means of flat cars on rails to the point of pouring of metal. Also, since the coating appears to withstand a wide range of temperature of molten metal, it is possible that severe temperature surface application may be performed which were heretofore impossible due to failure of prior art coatings. Many other advantages of the mold forming process of the invention are apparent.

The invention is hereby claimed as follows:

1. A method of inhibiting erosion of the surface of the base member of a metal mold used to cast ingots, which erosion normally occurs during contact of said surface with flowing molten metal, while subsequently preventing adherence of said ingots to said base member upon ingot formation; which comprises the steps of applying to said surface a slurry comprising a refractory selected from the group consisting of vitreous silica, crystalline silica, magnesium silicate, aluminum silicate, alumina, graphite, zirconium silicate and clay suspended in an aqueous alkali metal silicate binder, said slurry being employed in an amount adequate to form a coating of sufficient thickness to inhibit said erosion and prevent said adherence, thereby forming a protective solid coating is formed upon said base member, said binder being present in an amount sufficient to bind the refractory particles together to thereby form a tightly adherent coating bonded to said surface.

2. The method of claim 1 wherein said base member is cast iron, and said ingots cast are composed of steel.

3. The method of claim 1 wherein said aqueous binder comprises 5-45% by weight of alkali metal silicate, and the ratio of said refractory to said aqueous alkali metal silicate binder ranges from 2:1 to 1:50.

4. The method of claim 3 wherein said binder is comprised of 5-45% by weight of alkali metal silicate, 10-95% by weight of water and 5-50% by weight of a polyhydroxy water compatible organic compound.

5. The method of claim 1 wherein said refractory is crystalline silica.

6. The method of claim 1 wherein said refractory is vitreous silica.

7. In the method of casting metal ingots from a metal mold whereby adherence of the base member of said mold to said formed ingots and erosion of said base member during formation of said ingots are substantially prevented; which comprises the steps of applying to the surface of said base member leaving a thin film of refractory selected from the group consisting of vitreous silica, crystalline silica, magnesium silicate, aluminum silicate, alumina, graphite, zirconium silicate and clay suspended in an aqueous alkali metal silicate binder, said slurry being applied in an amount adequate to form a solid coating of sufficient thickness to inhibit said erosion and prevent said adherence, allowing such slurry to dry whereby the liquid phase of such slurry is driven from the surface of said base member leaving a thin film of refractory, pouring molten metal into said mold, allowing said metal to solidify into an ingot, and removing said ingot from said coated base member whereby said binder being present in an amount sufficient to bind the refractory particles together to thereby form a tightly adherent coating bonded to said surface.

8. The method of claim 7 wherein said coated base member is composed of cast iron and said ingots are steel.

9. The method of claim 7 wherein said aqueous binder comprises 5-45% by weight of alkali metal silicate, and the ratio of said refractory to said aqueous binder ranges from 2:1 to 1:50.

10. The method of claim 9 wherein said aqueous binder comprises 5-45% by weight of alkali metal silicate, 10-95% of water, and 5-50% by weight of a polyhydroxy water compatible organic compound.

11. The method of claim 7 wherein said refractory is vitreous silica.
12. The method of claim 7 wherein said refractory is crystalline silica.

13. An improved metal mold for casting metal ingots which comprises an open-top mold having at least its base member coated with a thin solid protective film of a refractory material derived from drying a slurry comprising a refractory selected from the group consisting of vitreous silica, crystalline silica, magnesium silicate, alumina silicate, alumina, graphite, zirconium silicate and clay suspended in an aqueous alkaline metal silicate binder, said binder being present in said slurry in an amount efficient to bind the refractory together to thereby form a tightly adherent coating bonded to said base member, and said coated base member being further characterized as being non-erosive to flowing molten metal and non-adherent to subsequently formed solid metal ingots.

14. The metal mold of claim 13 wherein said coating is derived from a slurry comprising an aqueous binder containing 5-45% by weight of alkali metal silicate and a crystalline silica refractory in a ratio to said binder of from 2:1 to 1:50.

15. The metal mold of claim 13 wherein said coating is silica.

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MARCUS U. LYONS, Primary Examiner.
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,184,815

Raymond Reuter

May 25, 1965

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 8, line 47, for "leaving a thin film of" read --, a slurry comprising a --.

Signed and sealed this 26th day of October 1965.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

Edward J. Brenner
Commissioner of Patents