United States Patent [19]

Henderson et al.

[11] **3,754,880**

[45] **Aug. 28, 1973**

[54] **CHANGING LIFT-OUT ROLLS SUPPORTING A CONTINUOUS RIBBON OF GLASS**

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[22] Filed: **Sept. 9, 1971**

[21] Appl. No.: **178,983**

[52] **U.S. Cl.** **65/27**, 65/172, 65/173

[51] **Int. Cl.** **C03b 15/02**

[58] **Field of Search** 65/27, 171, 172, 65/173

[56] **References Cited**

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1,868,274	7/1932	Cone	65/171
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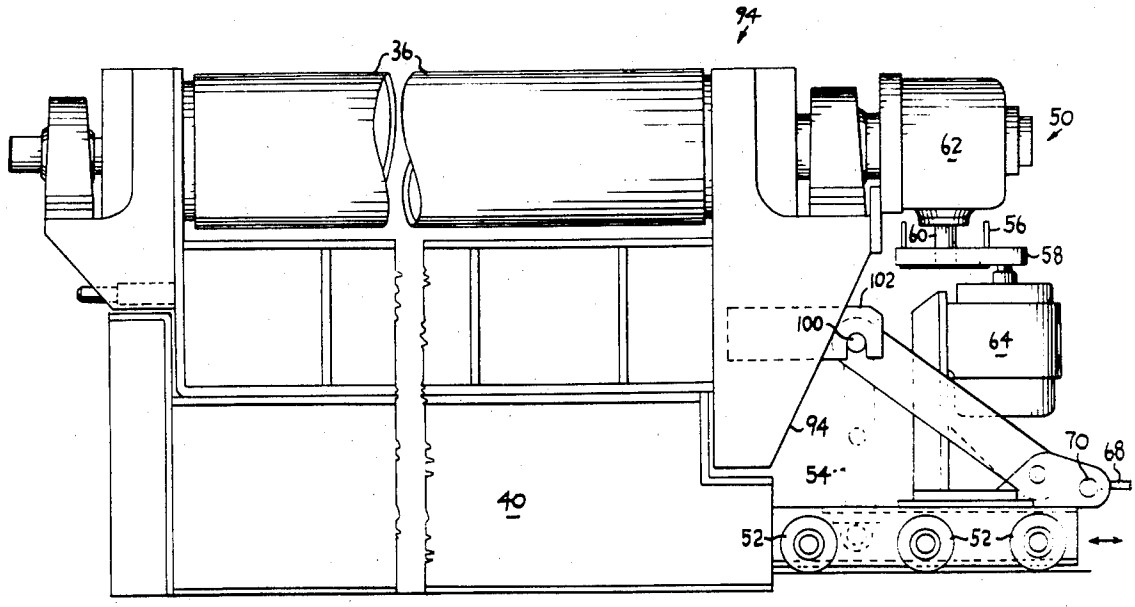
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[57] **ABSTRACT**

The instant invention improves the float-glass process, transforming the operation of changing of a lift-out roll from one that requires a shutdown of three to four days to one that may be conducted without interruption of the production of float-glass ribbon. Hardware related to the dross box is modified to permit a lift-out roll to be moved substantially axially, preferably along with its associated bottom seal. The equipment used preferably includes first (end) and second (center) support-carriage means; these operate to permit continual rotation of the lift-out roll during the removal operation to prevent warpage.

3 Claims, 6 Drawing Figures



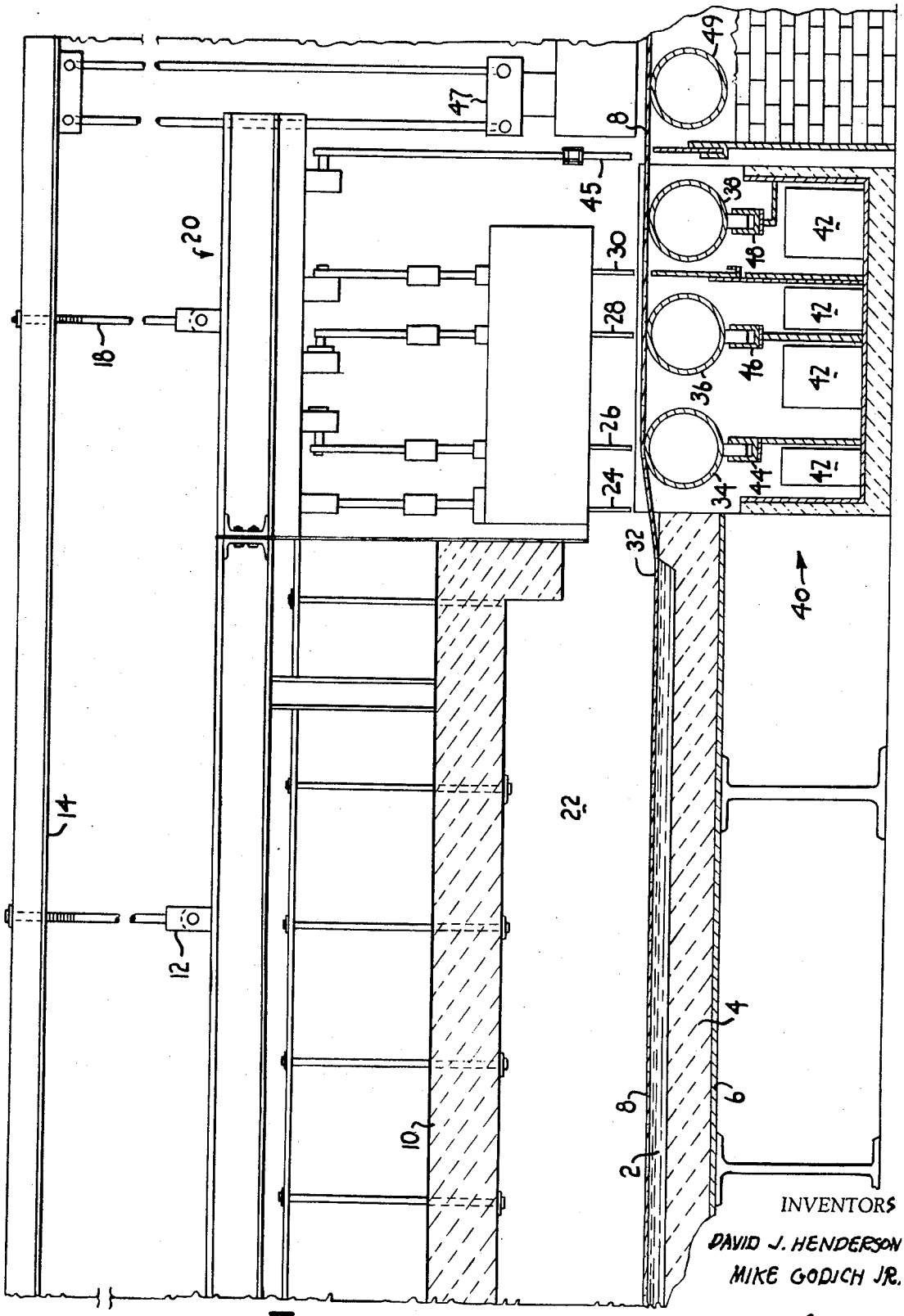


FIG. 1

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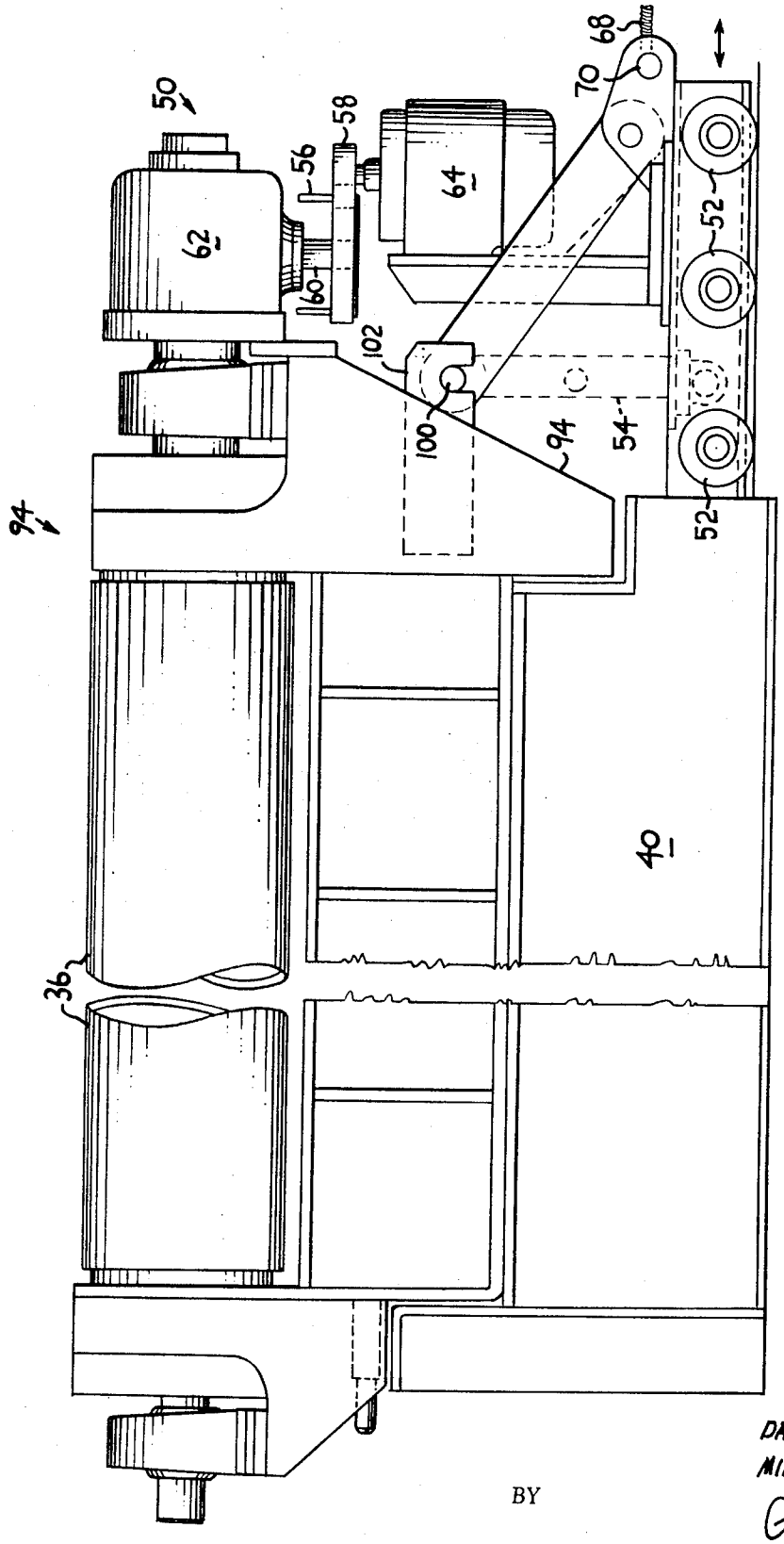


FIG. 2

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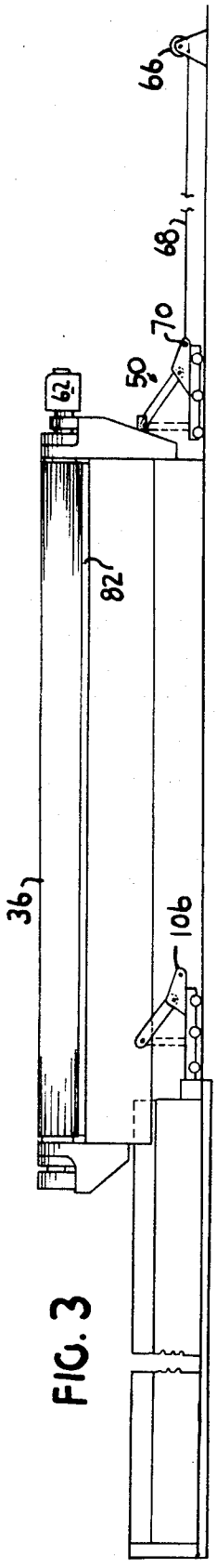


FIG. 3

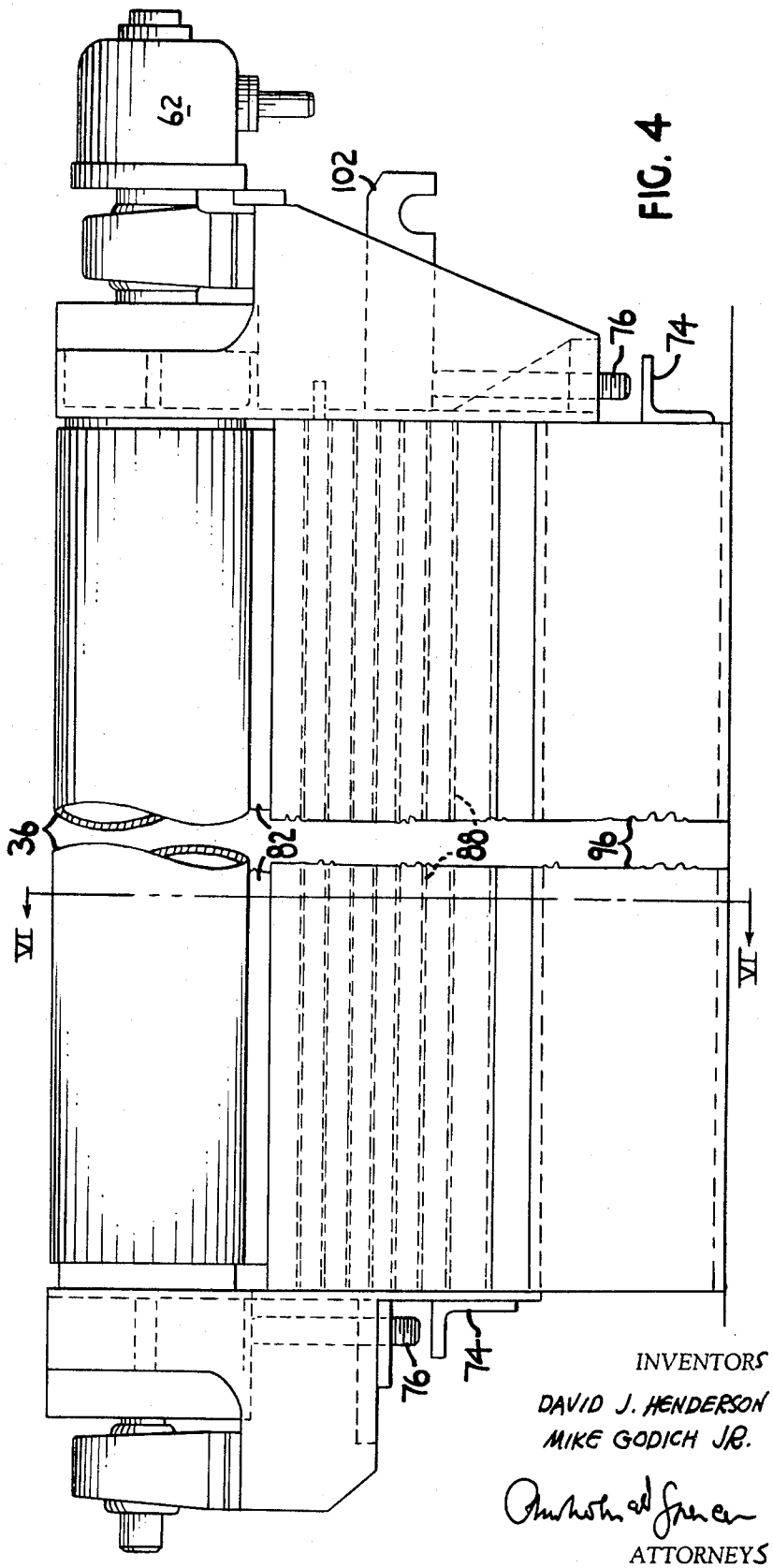


FIG. 4

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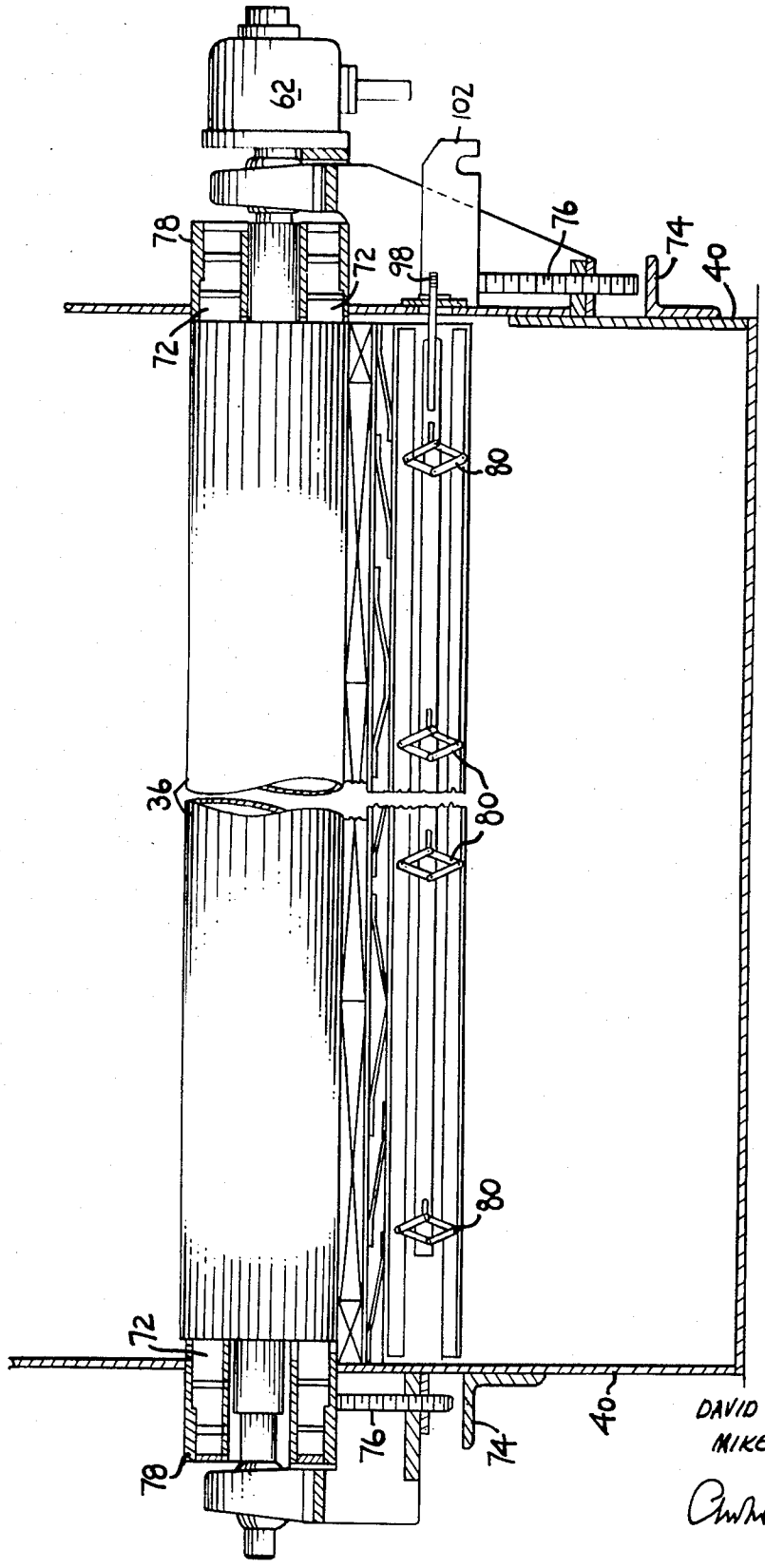


FIG. 5

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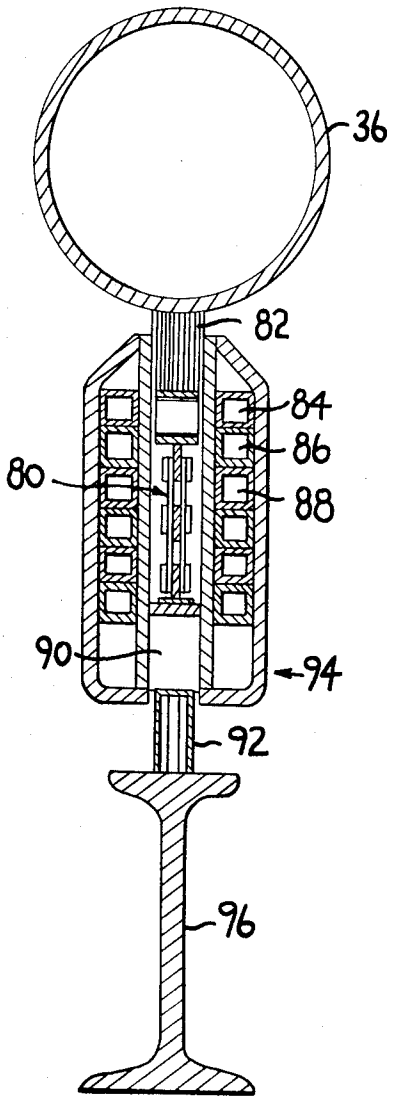


FIG. 6

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CHANGING LIFT-OUT ROLLS SUPPORTING A CONTINUOUS RIBBON OF GLASS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the changing of rolls in contact with a moving web of material, and in particular, to the changing of lift-out rolls used at the exit end of the float bath in a process for the production of flat glass.

2. Description of the Prior Art

Those skilled in the art are familiar with the "float" process for the production of flat glass, substantially as described in U. S. Pat. No. 3,083,551. In that process, molten glass is poured onto a bed of molten tin or the like, and immediately next to the exit end of the bath of molten tin or the like, there is an assembly that comprises a "dross box," into which excess molten tin is periodically spilled, and a plurality of lift-out rolls. It is customary, moreover, to provide suitable means to prevent the atmosphere above the bath of molten tin or the like from escaping at the exit end of the float bath; to this end, it is customary to provide exit-end curtain means that comprise drapes that touch the issuing ribbon of flat glass, or nearly so.

It is known, moreover, that the lift-out rolls, onto which the recently formed ribbon of glass is brought, require reconditioning or replacement from time to time. At the best, the lift-out rolls require such attention about once per year.

The replacement of such lift-out rolls has been, before the instant invention, an arduous undertaking. In accordance with practices known before the instant invention, it has been considered necessary to remove the above-mentioned curtain means. In accordance with practices known before the instant invention, the dross boxes have been constructed in such manner that it has been necessary to insert any of the lift-out rolls into them by passing a lift-out roll into and, to some extent, through an opening in the upper part of a side of the dross box, then lowering the other end of the lift-out rolls so that the end of its neck is centrally located with respect to a corresponding and opposite opening in the side of the dross box. The lift-out roll is then moved axially a short distance to an installation position, and water-cooled, self-aligning bearings are affixed to the roll necks, exteriorly of the dross box. The curtain means needs to be reinstalled. The operation indicated above requires for its completion something on the order of three to four days, and during that time, there is no production of glass ribbon. This means that the annealing lehr gets cold, which gives disadvantages indicated below.

There is a further drawback that, even if the lift-out roll involved has been carefully finished to a low surface microroughness, there will be an end portion thereof that is subjected to possible abrasion by the above-mentioned openings in the sides of the dross box.

There has been, moreover, the problem that the lift-out rolls tend, when removed, to develop warpage. Such warpage may, and usually does, render the lift-out roll unsuitable for further use, at least in the absence of time-consuming reconditioning.

The prior art with respect to the changing, replacement, or reconditioning of rolls in contact with a ribbon of glass or a strip of other web-like material is discussed

in a number of previous patents, among which there may be mentioned Neenan U. S. Pat. No. 1,529,258 and Blackshere U. S. Pat. No. 1,865,819. Both of these patents relate to the changing of a bending roll in a Colburn Process for the production of sheet glass, and they are both concerned with the matter of permitting a change of such bending roll without an interruption of production. They teach bringing an auxiliary roll into contact with the moving ribbon of glass, so that the glass is brought out of contact with the main bending roll that is to be changed. Apart from the similarities indicated above, the above-mentioned patents have little to do with the instant invention. They concern a different process for flat-glass manufacture, a process wherein the standards for desired quality are usually very substantially lower than with the float-glass process. Moreover, the rolls to be changed are not necessarily driven, nor is there necessarily any problem concerning the desirability of preventing the escape of the ambient atmosphere. The environment in which the rolls operate is substantially different, and substantially less demanding.

Those skilled in the art will appreciate that the atmosphere above the float glass in the bath is such that it operates at a pressure of less than about 3 inches of water above atmospheric pressure; this means that in the region between the float-bath atmosphere and the annealing lehr atmosphere (which is substantially at atmospheric pressure) there is a substantial pressure drop, and there is a distinct requirement that, in order to avoid upsetting the conditions within the float bath, it is highly desirable to avoid undue losses from the float-bath atmosphere.

Those skilled in the art have well appreciated the economic losses that tend the changing of lift-out rolls, in the way that such changing has hitherto (prior to the instant invention) been done. Such lift-out roll changing has made necessary an interruption of three to four days in the production of glass ribbon; moreover, since the annealing lehr depends for its operation upon receiving an appropriate and steady supply of heat from the ribbon of glass passing therethrough, it is sometimes eight to sixteen hours, after the passage of ribbon through the annealing lehr is re-established, before conditions return to those approximating normal and proper production. Having the annealing lehr go cold and then be reheated is a disadvantage in another way; it surely is no benefit to the lehr to have its refractories subjected to a cycle of being cooled and reheated. In the light of these facts, the advantages of an invention that permits the changing of lift-out rolls without any interruption in the production of glass ribbon, even if the ribbon produced during a relatively brief period of time is not of salable quality, will more readily be appreciated.

Under the conditions of the prior art, it has not been economically feasible to change the lift-out rolls any more frequently than about once every twelve months, unless the quality of the product being made strictly necessitates that a change be made sooner. As those skilled in the art are well aware, moreover, there are numerous times that it would be desirable, from the standpoint of maintaining a desirably high level of product quality, to bring about a change of lift-out rolls earlier, except for the severe economic penalty that has hitherto attended the making of such a change. Accordingly, the instant invention may be considered as

facilitating the maintenance of a generally higher level of product quality, without undue added cost.

As has been intimated above, the known practice for changing a lift-out roll has necessarily involved not only the at least partial disassembly and removal of the upper gas-curtain apparatus but also a practice of lowering the lift-out roll into place through appropriately sized side openings in the dross box, in rather a see-saw fashion. The handling, in a chain sling or the like, of a highly-polished lift-out roll may, by itself, cause problems, particularly if there is slippage of the chain sling or the like. The problems concerned with removing a lift-out roll are similar, but they are (of course) of less importance, since there is usually enough time to proceed to recondition the roll after it is removed. Considerable economic losses attend the damaging of a lift-out roll when an attempt is made to place it into operative position, and as has been pointed out above, the risk of such damage is considerably more substantial with the prior-art practice than with that of the instant invention.

DESCRIPTION OF THE DRAWINGS

A complete understanding of the invention may be obtained from the foregoing and following description thereof, taken together with the appended drawings, in which:

FIG. 1 comprises an elevation view, partly schematic, showing an exit end of a float bath, a dross box with the first three lift-out rolls and appropriate upper and lower curtain seals associated therewith, and the first roll of a downstream annealing lehr;

FIG. 2 comprises an elevation view illustrating a mechanism to be associated with a lift-out roll for a float-glass line, together with its associated dross box;

FIG. 3 is a schematic view, illustrating a lift-out roll in partially removed condition;

FIG. 4 is an elevation view of a lift-out roll and its associated equipment;

FIG. 5 comprises a view similar to that of FIG. 4, but in somewhat greater detail, and

FIG. 6 is a detailed sectional elevation view, taken on the line VI—VI of FIG. 4, of a lift-out roll apparatus in accordance with the present invention.

Referring now to FIG. 1, there is shown the downstream end of a line for the production of flat glass by the float process, substantially in accordance with U. S. Pat. No. 3,083,551. In particular, at such downstream end, there is provided a bath 2 of molten tin contained within a linear 4 of refractory material. As those skilled in the art will understand, the refractory material is provided with an exterior shell 6 of steel or the like, and there is a stratum or layer 8 of glass that floats in ribbon form on tin bath 2. The downstream portion of the bath has a roof, generally indicated at 10, which is supported with respect to its vertical position by means indicated at 12, the roof portion 10 being ultimately supported by an overhead member 14.

The overhead member 14 also contains an opening 16 that provides in cooperation with means 18 for the adjustment of the vertical position of means 20 that serve to prevent the atmosphere in space 22 for communicating freely with ordinary ambient atmosphere. The atmosphere 22 comprises hot gases that ordinarily must not, if flat glass of high quality is to be made by the float process, be permitted to vary in temperature to the extent that such variation would take place if the free escape of the atmosphere 22 were to be permitted. The atmosphere 22 is ordinarily at an absolute pressure slightly above the atmospheric.

For reasons explained above, the means 20 contain wipers or curtains such as 24, 26, 28 and 30 that are, for example, of asbestos cloth, or the like, and touch, or nearly so, the top surface 32 of the glass 8.

As those skilled in the production of the glass by the float process will understand, the ribbon of glass 8 is caused to leave the bed of tin 2 over a lip 32 and be received and further conveyed by means of a plurality of lift-out rolls 34, 36 and 38.

The above-mentioned lift-out rolls 34, 36 and 38 are contained within a dross box 40. Whenever the thickness of the ribbon of glass 8 is to be changed, it is necessary either to add additional molten tin to the bath (if the thickness of the glass being produced is being lessened), or to provide a means for receiving additional tin and dross that are displaced from the bath (if the thickness of the ribbon of glass being produced is being increased). The latter is one of the purposes of the dross box 40. Clean-out doors 42 are provided to permit the removal of tin and tin oxide from the bottom of the dross box 40.

To maintain the desired sealing of the atmosphere 22 within the bath, there are associated with the bottoms of the lift-out rolls 34, 36 and 38, seal means 44, 46 and 48, respectively; and as will be more fully explained hereinafter, these means and lift-out rolls 34, 36 and 38 are, in accordance with the present invention, adjustable with respect to their vertical position.

Also shown in FIG. 1, depending from the support means 14, directly or indirectly, there is a further seal means 45 and a roof portion 47 of the annealing lehr, a first roll of which is indicated at 49.

There has hitherto been a considerable problem in connection with the changing of lift-out rolls, such as the rolls 34, 36 and 38. In accordance with the manner in which dross boxes, such as the dross box 40, have hitherto been constructed, it has ordinarily been considered necessary, in order to change one of the lift-out rolls 34 or the like, to remove the assembly 20 and its associated wiper means 24 through 30. This has meant that it has been necessary to shut down the operation of producing flat glass by the float process for the period of one to four days. In accordance with prior practices, the assembly 20 is removed, then all the lift-out rolls are changed. The openings in the sides of the dross box 40 that receive the necks of the lift-out rolls are so small, ordinarily, that it is necessary to move a new lift-out roll into position in rather a see-saw fashion, positioning the narrow neck portion of one end of the lift-out roll through the small opening in one side of the dross box, then lowering the other end of the lift-out roll to the same level and into alignment with a similarly small opening in the side of the dross box that is directly opposite, and then moving the lift-out roll axially a short distance into its final position. Bearings and drive means are attached in the usual fashion. The practice described above is exceedingly disadvantageous, not only from the consideration that the production of flat glass by the float-glass process needs to be suspended one to four days, but also from the consideration that the lowering of the roll into place is done while the lift-out roll is held by means of a chain sling or the like, with the possibility existing that the lift-out roll will slip during the operation of insertion, with a

consequent marring of its surface. It is highly important that the surfaces of the lift-out rolls remain unmarred, because they come into contact with the flat glass while it is still very hot and quite likely to be deformed by any imperfection in such surfaces.

A further reason in favor of the adoption of the instant invention is that, apart from such marring during insertion, as has been mentioned above, a lift-out roll may develop, while in service, a surface imperfection that would tend to give roll marks on the finished flat glass. In accordance with the methods and apparatus known before the instant invenion, it was usually impractical to change just one of the lift-out rolls, unless it was creating marking problems sufficiently severe to warrant a general change of rolls and a shut-down of the float line. In contrast, it becomes possible, with the instant invention, to change a desired one of the lift-out rolls, even if the deterioration in quality that is caused by its surface imperfections is, though undesirable, relatively mild. In other words, the instant invention makes it considerably easier to maintain a higher standard of quality in the flat glass that is being produced, without the expense that would be incurred if it were necessary to maintain the same high standard of quality with the methods and apparatus of the prior art.

A full understanding of the instant invention will be promoted by the following description of the apparatus and methods herein proposed for making it possible to change a lift-out roll without any cessation of production of the ribbon **8**.

If, for example, the lift-roll **36** is to be changed (for example, because it is marring the glass), the roll **36** is lowered or the rolls **34** and/or **38** are raised, so that the ribbon **8** is brought out of contact with the roll **36** that is to be changed. The drive for the roll that is so brought out of contact with the glass is disconnected, and a carriage is brought up into contact with one of its roll necks, and an auxiliary drive is connected at this point (see later description). A winch or similar removal means is then used to move the roll axially, and as soon as the end of the roll remote from the carriage has cleared its corresponding opening in that side of the dross box **40**, asbestos-sheet shielding or the like, is applied to that opening, to assist in maintaining the desired seal. Removal of the roll axially is continued until the roll is withdrawn to a certain extent, perhaps one-fourth to three-fourths of its overall length, at which time a steady-rest or second carriage means or other support means is brought under the portion of the roll that is being removed that lies between the carriage and the dross box.

The problem of removing a lift-out roll during operation, if it is intended that the lift-out roll be reconditioned and reused, is more than a little complicated by the consideration that it is necessary to cause the lift-out roll to continue to revolve while it is being removed. If the lift-out roll is not at least continually revolved during its removal, it tends to develop a warpage that will make it impossible to reuse the roll. Accordingly, there is provided, in accordance with the instant invention, a carriage that comprises not only means for grasping the neck, but also means for causing the roll to be revolved. In a broad sense, the invention includes apparatus wherein such revolving of the lift-out roll is done manually, but, in accordance with the preferred embodiment of the invention, suitable means, such as a one horse power motor, are provided to bring about the continuous revolution during its removal.

Referring now to FIG. **2**, there is shown a carriage **50** that rides on wheels **52** and contains a scissors-jack means **54** for adjusting a portion of the carriage **50** so as to enable it to grasp the roll **36** or the like, that is to be removed. As is also to be seen in FIG. **2**, the carriage **50** comprises means **56** that cooperate through a belt **58** and a shaft **60**, together with suitable equipment indicated at **62** to permit the continued revolution of the roll **36** or the like. Moreover, the carriage **50** comprises in a preferred embodiment of the invention, a motor **64** that similarly cooperates with the belt **58.** As indicated in FIG. **3**, the apparatus of the invention includes a winch **66** that connects with a cable **68** that is joined as at **70** with the carriage **50.**

Referring now to FIG. **4**, there is shown an elevation view of a roll, such as roll **36**, together with the associated equipment for operating it. For the sake of lending suitable perspective to the nature of the operation of making flat glass in accordance with the instant invention, it is helpful to observe that the diameter of the roll **36** is on the order of **10** to **14** inches and its overall length is on the order of **8** to **20** feet.

Referring now to FIG. **5**, there is shown the lift-out roll assembly, including roll revolving linkage **62** previously mentioned in connection with the description of FIG. **2**, along with such other details as the packings or bearings **72** that cooperate with the sides of the dross box **40** to maintain the above-mentioned seal. Also indicated in FIG. **5** are the flanges or other means **74** that cooperate with the screws **76** or the like, to adjust, as desired, the vertical locations of the housings **78** for the packings **72** and thereby the vertical position of the roll **36**, or the like. FIG. **5** also shows a plurality of linkage means **80** that, as will be explained more fully in connection with FIG. **6**, cooperate to insure adequate contact between the leaves or other means **82** (see FIG. **6**) that maintain the seal against the bottom of the roll **36** or the like.

Reference is now made to FIG. **6**, which is a sectional vertical elevation view, taken on the line VI—vI of FIG. **4**, showing in considerable detail one particular embodiment of the instant invention. In FIG. **6**, there is shown a plurality of cooling water passages **84, 86, 88,** etc., as well as a passage or space **90** ordinarily filled with packing of asbestos or the like, and a guide means **92** upon which the entire assembly **94**, comprising the leaves **82**, cooling water passages **84, 86, 88,** etc. and linkage members **80** may ride during the removal of the means **94**, together with the roll **36.** Supporting all of this is an I-beam indicated at **96.**

OPERATION

The apparatus hereinafter described may be operated in the following manner:

To bring about, for example, a change of the lift-out roll **36** without any interruption of the production of flat glass, steps may be taken in the order indicated hereinbelow.

The packing in the space **90** (FIG. **6**) is removed. This may be done with the use of rods, or the like, provided that an opening sufficiently large has been provided in at least one of the sides of the dross box **40.**

The lift-out rolls **34** and **38** are raised slightly, perhaps 1/16 inch or thereabouts, by the use of the por-

tions thereof that correspond to the screws 76 and flanges 74 (see FIG. 5).

The usual means for driving lift-out roll 36 are declutched or disconnected, as those skilled in the art will understand.

The screws 76 cooperating with the flanges 74 of the roll 36 are operated to cause the roll 36 to descend by perhaps 1/16 inch or thereabouts. Within a short time after the disconnection of the shaft drive roll 36, it is necessary to being either with the manual rotation means 56 or the motor 64 to cause the roll 36 to continue to revolve. After such disconnection of the drive shaft and the beginning of manual or powered rotation of the roll 36, the carriage 50 is brought into position against one end of the roll 36 and the scissors-jack means 54 is operated to bring shaft 100 (see FIG. 2) into position within the flange 102 that comprises a part of the assembly 94. With the carriage 50 in position, drive motor 64 is activated and the cable 68 is attached to the point 70, after which the winch 66 is operated to begin to pull the roll 36 and its associated assembly 94 out.

At this point, it becomes necessary to maintain the desired seal, as mentioned above, by using an asbestos sheet (or similar means) to close the side of the assembly that is remote from the carriage 50.

The winch 66 may be operated sufficiently rapidly to bring about a removal of the roll within about 2 to 20 minutes. When the roll is preferably about two-thirds to three-quarters removed, it is desirable to bring a second steady-rest or cart or similar means 106 (see FIG. 3) under the end of the roll assembly 94 nearest to the centerline of the float line. The winch 66 is then operated further to complete the removal of the roll 36 (in assembly 94), following which the carriage-side opening is similarly closed with the use of an asbestos sheet or the like.

In most instances, it is possible to operate the float-glass line with only two of the three usual lift-out rolls in place, at least for a time long enough to permit adequate reconditioning of the roll that has been removed.

Of course, it is necessary to continue to revolve the roll that has been removed until its temperature has decreased to such an extent that it cannot be expected to warp substantially during any further cooling. In most instances this requires 15 minutes to two days. Cooling to about 200° and 300° Fahrenheit is usually sufficient to prevent warping. The rotation needed to prevent warping is possibly quite slow, being possibly as slow as ⅛ revolution per minute. Those skilled in the art will readily perceive how to effect further gearing down, beyond that illustrated in the embodiment shown in FIG. 2, if such gearing down is considered desirable or necessary. The turning of the roll may conceivably be done by hand, though it will surely be preferable in most instances to provide equipment for turning the roll at a suitable rate, such as ½ to 10 revolutions per minute.

Similarly, carriage and support equipment of the kind indicated above may be used, in a reverse operation, to re-install a lift-out roll that has been removed for reconditioning or replacement. Those skilled in the art will readily understand that this operation involves not only suitable preparation of the roll involved, but also the use of suitably designed equipment for removing it from a preheated furnace wherein its temperature has been raised so that it approximates that of the other lift-out rolls already in service, along with the other suitable reverse steps for inserting the new roll into the furance and connecting it with its appropriate drive system.

This invention has remained unobvious to those skilled in the art chiefly because it necessitates a complete redesign of the sides of the dross box, departing from the design that has hitherto been used, and because it is necessary at the same time to provide adequate means for continuing the revolution of the lift-out roll during and after its removal, to prevent warpage.

Although hereinabove there have been discussed in detail the steps and means used for the changing of lift-out roll 36, it is apparent to those skilled in the art how similar steps and means may be used for the changing, if desired, of the other lift-out rolls 34 or 38. In the changing of the lift-out roll 34, it is desirable to raise the lift-out rolls 38 and 36, and then lower the lift-out roll 34 before its removal. In the case of a changing of the lift-out roll 38, it may suffice to merely lower the roller 38, leaving the rolls 36 and 34 in place, or, if desired, those rolls may be raised slightly.

Those skilled in the art will perceive, in the light of the foregoing, various possible modifications and equivalents. It is not necessary, for example, that a lift-out roll be moved precisely by sliding it along its bottom seal, as described above. The use of chain slings or other overhead means for supporting the roll to be removed in the vicinities of its ends is not to be ruled out. The roll can be turned, letting it rub upon the slings or the like, or as another possibility the ends of the slings can be repositioned during the removal operation to cause the lift-out roll to revolve while cradled in the slings. The mention above of these possibilities is not to be taken as ruling others out.

While I have shown and described herein certain embodiments of the invention, I intend to cover, as well, any change or modification therein which may be made without departing from its spirit and scope.

We claim as out invention:

1. In an apparatus for making a continuous ribbon of glass comprising an enclosed chamber having therein a pool of molten metal on which the ribbon of glass may be formed and at the exit end of said chamber means for withdrawing the continuous ribbon of glass from said chamber comprising seal means, a dross box and a plurality of lift-out rolls for engaging the bottom surface of said continuous ribbon of glass to support it while it is conveyed from said pool of molten metal to an annealing lehr, said lift-out rolls being mounted at elevations such as to engage the bottom surface of the continuous ribbon of glass during its withdrawal, wherein said lift-out rolls are so mounted as to require the stoppage of said ribbon of glass to remove and replace them; the improvement comprising

means for adjusting the position of at least one lift-out roll with respect to a horizontal datum level and with respect to the elevation of the other lift-out rolls, such that a continuous ribbon of glass may be caused to disengage from a lift-out roll to be removed providing a space between the top of said lift-out roll to be removed and the bottom of said continuous ribbon of glass to permit said lift-out roll to be removed without contacting said ribbon of glass; and

means for moving said lift-out roll to be removed substantially axially from beneath said continuous ribbon of glass, said lift-out roll being provided with means for revolving said lift-out roll during and after its removal from beneath the continuous ribbon of glass.

2. An improvment as defined in claim 1, characterized in that said means for moving at least one of said lift-out rolls substantially axially to remove it from said dross box comprises a carriage comprising means for grasping an end of a lift-out roll and motor means operatively connected to said end of said lift-out roll to cause it to revolve during its removal from the dross box.

3. A method for changing a lift-out roll for supporting a continuous ribbon of glass that is located in a dross box in the vicinity of the exit end of a float bath, said method comprising the steps of

disengaging said lift-out roll to be removed from contact with said continuous ribbon of glass without interrupting the continuity of said continuous ribbon of glass by supporting said continuous ribbon of glass on another lift-out roll, causing relative movement of said lift-out roll to be removed and said supporting lift-out roll, said movement being such as to provide a space between said lift-out roll to be removed and the surface of said continuous ribbon of glass that had been in contact with said lift-out roll to be removed;

moving said lift-out roll substantially axially to remove it from said dross box; and

causing said lift-box roll to revolve continually during its removal from said dross box to prevent warpage of said lift-out roll.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,754,880 Dated August 28, 1973

Inventor(s) David J. Henderson and Mike Godich, Jr.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Claim 3, column 10, line 15, "lift-box roll" should read --lift-out roll--.

Signed and sealed this 26th day of February 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.

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