STRUCTURE AND OPERATION OF COLOR BOXES OF PRINTING APPARATUS

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INVENTOR.

JAMES REID JOHNSON

BY

ATTOYNEY
STRUCTURE AND OPERATION OF COLOR BOXES OF PRINTING APPARATUS

James Reid Johnson, Stonington, Conn., assignor, by
numerous assignments, to The Johnston Fast-Print Machine
Corporation, Brooklandville, Baltimore County, Md., a
company of Maryland

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This invention relates to apparatus by which a design is
printed on a moving length of material by a plurality,
usually several, print rolls, and especially to the color
box and color transfer brush, and the means for supply-
ing color to and emptying unused color from the color
box and cleaning the color box, the brush and the color
supply and discharge conduits. It is an improvement
upon apparatus disclosed in U.S. Patent 2,821,913, issued
February 4, 1958.

In the printing of a length of cloth or the like each
print roll has associated with it a trough called a "color-
box" which is open on top and from which the desired
color is supplied. The color is transferred from the
trough to the print roll by a brush mounted so that its
periphery dips into the color during part of each revo-
lution and contacts the surface of the print roll during
another part of each revolution.

With apparatus of the prior art, previous to Patent
2,821,913, cleaning of color boxes at the end of each day,
or when changing the printing color, was very time-
consuming and inefficient. The individual color boxes
had to be detached from the printing apparatus and carried
to a sink and washed out by hand. In printing textiles,
for example, it is often necessary to change the printing
color several times a day, as for running different designs.
A large part of each day was unproductive due to the
time required for washing color boxes, and the work
was manual thus taking up workmen's time as well as
keeping the printing apparatus inactive.

Patent 2,821,913 taught the concept of washing the
color boxes without removing them, and disclosed means
for upsetting the color boxes and washing them by non-
manual means and without removing them from the mak-
ing machine.

This invention provides means which are an improve-
ment and simplification of the means disclosed in Patent
2,821,913, and provides novel means coacting with the
color boxes, for emptying the color boxes and facilitating
the washing of the color boxes and the transfer brush,
the disposal of the wash water, and the cleaning out of
the color supply and discharge conduits.

An object of this invention is to provide a color box
of improved structure.

Another object of the invention is to provide simple
and efficient means for moving a color box and its brush
toward and away from its associated print roll and for
overturning it, and afterward, for righting the color box
and returning it and its brush to operative position.

Another object of the invention is to provide a com-
bination of color boxes and receptacle means which coat
to prevent splashing during the dumping of the color
boxes, the washing of the color boxes and their brushes,
and the disposal of the wash water or other wash me-
dium.

Another object of the invention is to provide means
of the above mentioned kind which is simple and de-
pendable.

A further object of the invention is to provide control
means, for activating and controlling the movements of
the color boxes and brushes, and for adjusting their po-
sitions relative to their print rolls respectively, in a first
plane toward and away from the print roll and in a second
plane normal to said first plane.

The invention will best be understood if the following
description is read in connection with the drawings in
which:

FIG. 1 is a plan view of printing apparatus embodying
the invention;

FIG. 2 is an end view of the apparatus shown in
FIG. 1;

FIG. 3 is a side elevation looking at the inside of the
nip and the slide thereon which is at the viewer's left
in FIG. 1, and taken on the line 3—3 of FIG. 4;

FIG. 4 is a vertical section taken on the line 4—4 of
FIG. 3;

FIG. 5 is a plan view of the structure shown in FIG. 3;

FIG. 6 is a vertical section taken on the line 6—6 of
FIG. 3;

FIG. 7 is a detail view showing the means for adjusting
the position of a color box and brush in a plane normal
to the brush shaft and the supporting nip;

FIG. 8 is a plan view of the structure shown in FIG. 9,
showing the shoes and cam track for holding a color box
from tipping, and of the means for overturning the color
box;

FIG. 9 is a side elevation of the structure shown in
FIG. 8;

FIG. 10 is a diagrammatic view showing conduits inter-
connecting a color box, a supply of color, a receptacle
and a source of air under pressure, and a combination
of manually controlled and solenoid controlled valves
for operating the system;

FIG. 11 is a diagrammatic view of the color box and
receptacle showing the color box in various positions
while being overturned; and FIG. 11a is an enlarged de-
tail view of link 66c shown in FIG. 11.

FIG. 12 is a view similar to FIG. 11 showing the color
box completely overturned and forming a closure with
the receptacle.

In the principal embodiment of the invention described
herein color boxes 10 are shown each suspended on the
shaft ends 12a and 12b of a rotary color transfer brush
12. The ends 12a and 12b are respectively supported in
the members 14a and 14b which are mounted on the screw
rods 16a and 16b, which are rotatable in support means
solidly related to support means on, and between which,
a related print roll 20 is supported. When the screws
are turned the members 14a and 14b are moved in unison
away from, or toward the print roll 30 or toward or away
from a receptacle R, depending upon the direction of ro-
tation of screw rods 16a and 16b.

As best seen in FIGS. 1 and 2, the print rolls 30 are
mounted on splined mandrels 32 the ends of which are
supported for rotation on bearings which, when the ap-
paratus is assembled, are contained within the bearing
housings 36a and 36b provided on the respective slides
comprising each pair of slides 38a and 38b, which are
mounted for sliding movement, as by cylinders 37a and
37b, on the pairs of nips 40a and 40b, which project from
the flats 42 defined on the peripheries of spaced support
members 44a and 44b, between which a backing cylinder
46 is rotatably mounted on trunnions 48a and 48b.

As is more fully disclosed in copending applications
S.N. 219,678, and S.N. 243,175, now abandoned, each
print roll 30 together with its supporting slides 38a and 38b,
color box 10 and brush 12, and a doctor blade 31, not
shown except as indicated by numeral 31 in FIGURE 1
beyond the left hand end of the print roll, color box and
brush, comprise a sub-assembly, movable together to-
ward and away from the backing cylinder 46 and the level
of the sub-assembly is adjustable in a plane at right angles
to the supporting nip. Each doctor blade is also adjust-
able toward and away from its print roll, on means carried by and projecting from the opposed sides of a pair of slides, in the plane of, or in a plane parallel to, the supporting nip, and also in a plane normal to the supporting nip, and each color box and brush combination is also adjustable toward and away from the associated print roll, on means carried by and projecting from the back-41" cylinder, to move the print roll sub-assemblies simultaneously or selectively and bring the print rolls into contact with a length of material to be printed, which is led around the backing cylinder, and between the print rolls and the backing cylinder.

The screw rods 16a and 16b for each color box and brush, on which the color box and brush are moved between their print roll 30 and receptacle R, are supported in frame or support means 104a and 104b (FIG. 5) which in turn are supported by, and slideable in the plane of the supporting nips, in support members 69a and 39b which embrace, and are slidable on, in a plane normal to said nips, the T-shaped members T-1 and T-2 projecting toward one another from the opposed sides of slides 35a and 35b.

The screw rods 16a and 16b have at their outer ends the bevel gears 22a and 22b respectively which are engaged by the bevel gears 22a and 22b respectively on the ends of shaft 20 which is supported in angle bracket 21 (FIGS. 1 and 5). When shaft 20 is rotated the color box and brush combination supported on said screw rods are moved back and forth in sliding relation to support members 39a and 39b, in accordance with the direction in which the screw rods 16a and 16b are rotated.

As best seen in FIGS. 1 and 3, the means provided here-42" for rotating shaft 20 comprises hydraulic means including the motor 16, on the shaft of which is a worm 19 which engages a worm wheel 21 on shaft 20.

The support members 39a and 39b and 104a and 104b together with screw rods 16a and 16b, the color box and brush, and the receptacle R and its pivot rod, are adjustable in planes normal to the brush shaft and receptacle pivot rod on the pairs of screw rods 104a, 104a and 104b, 104b which are mounted in brackets 110a, 110b and 110b, 106b projecting from slides 35a and 35b respectively, and extend through, and threadedly engage, the support members 39a and 39b. Consequently, as screws 104a, 104a and 104b, 104b are turned, the respective ends of the color box brush and receptacle move up or down in a plane normal to the brush shaft and receptacle pivot rod, in accordance with the direction in which these screws are rotated.

The screws comprising each pair of spaced opposed pairs of screws 104a or 104b are rotated in unison. As best seen in FIG. 7, bevel gears 108a, 108a and 108b, 108b are provided on the lower ends of the screw rods 104a, 104a and 104b, 104b and engaged by bevel gears 110a, 110a and 110b, 110b, provided on the control rods 112a and 112b, each of which at one end has the worm gear 114 meshing with the worm 116 on the shaft 118 on which is also mounted the hand wheel 120. It will be understood that there is a control rod 112a for the pair of screws 104a and 104b, and a separate control rod 112b for the pair of screw rods 104b, 104b so that either end of a color box and brush assembly may be adjusted in position relative to the other end, in a plane normal to the axes of the brush shaft and the receptacle pivot rod.

Each color box 10 is dish-shaped and from its ends project bearing supports 52 adapted to encircle and be fastened around the ends 12a and 12b respectively of the associated brush shaft (FIG. 6). Each color box is thus free to swing around its associated brush through 180°, from an operating printing position below, and partly enclosing the brush, to a position above, and partly enclosing, the brush. Pinions 54 are fixed on the respective ends of the color box bearing, each above, and aligned with a rack 56, carried by supports 100a and 100b. As a color box is moved away from its print roll and at first toward, and then over, its receptacle R, the pinions 54 engage the rack 56 carried by said slides, start it, swing by swinging around its brush shaft. Rack 56 is long enough to cause the color box to be completely overturned when it is fully superimposed upon its receptacle R.

While moving between its print roll 30 and its receptacle R, each color box is held against lifting by a slot 69a pivotally mounted on the brush shaft ends 12a and 12b (FIG. 9) which travels on a cam surface 75a the outer end of which terminates just beyond the point where the pinions 54 engage the rack 56 and start the overturning action. While it is overturning (FIG. 11) the leading end 10a of the color box passes over the curved lip portion 50 of the receptacle R which is tilted toward it, and swings down and into the open upper end of receptacle R, and then upwardly under, and into contact with, the curved inwardly projecting upper edge or lip portion 58 of the receptacle. Each receptacle R is pivotally supported on pivot shafts 60a and 60b on the opposed inner sides of the pair of slides 35a and 35b which by the related color box and brush are supported. The pivot shafts 60a and 60b are disposed off center of the receptacle so that, when not engaged by a color box, the receptacle will hang on the pivot shaft in an inclined position, with its top inclined inwardly toward the color box.

As the color box is overturning it is also moving outward over the receptacle, and this movement, together with the relative movement related to the dot movement provided by the perforations 62a and 62b 64a and 64b, enables the leading end of the color box to clear the lip 58 of the receptacle. After the end 10a of the color box strikes the receptacle R it becomes lodged under the lip 58 of the receptacle, and, as the overturning movement of the color box continues, it swings the receptacle R on its pivot mountings 60a and 60b, bringing the receptacle into a substantially vertical position. When the receptacle reaches substantially vertical position the color box will have been swung around the brush shaft 12a substantially 180° and will be superimposed over the receptacle in an upside down position, with its top edge resting on the upper edge of the receptacle and with its end 10a engaged under the lip 58 of the receptacle, and with its other end 10b abutting against portion 70 of the upper edge 71 of the receptacle. Preferably the upper edge 71 of the receptacle is made of material suitable for coating with the edge of the color box and providing a seal that color and wash water discharged into the receptacle will be confined and disposed of through the flexible outlet conduit 72 attached to the bottom of the receptacle, and not splashed onto the floor.

Extending longitudinally of each receptacle R is a header 78 through which water or other cleaning fluid is supplied to a series of nozzles 80 spaced at intervals along the header and inclined so that they will direct streams of water or other cleaning fluid against the periphery of brush 12. Since the brush is enclosed within the closure formed when the color box is superimposed, in upside down position, on the receptacle, the water or other cleaning fluid in the nozzles strikes the brush, and also the inside surface of the color box, and falls into the receptacle and is drained away through the discharge conduit 72 leading from the receptacle, without wetting the floor on which the apparatus is located. In this way the floor is kept dry and clean providing desirable working conditions.

It will be understood that although the nibs project radially at different angles from the supports 44a and 44b, the color boxes are all upright, with their tops level and parallel with one another while in operative position, and
the receptacles are all positioned in the same relation to their color boxes respectively, so that regardless of the angle of the nips 40a and 40b and the slides 38a and 38b supported thereon, all the color boxes move through the same length of path in moving from operative printing position and in superimposed position over their receptacles R respectively and back.

Each color box has a pipe 124 extending through its wall and adapted to receive the discharge end of a flexible conduit 140 by which color and cleaning fluid can be supplied into the color box. As shown in FIG. 10, color may be supplied from a color-changer container 130, through tube 131, conduit 132, coupling 134, conduit 136, coupling 138 and conduit 140 to the color box, when valves 142 and 144 are in open position, and valve 146, which is in conduit 148 leading from coupling 138 to the receptacle R, and valve 170 in main water line 168 are in closed position. The color within the container 130 may be maintained under pressure supplied, for example, from a shop air line through conduits 150 and 152, when the solenoid operated valves 154 and 156 are open.

A sonic vibration member 160 which may be the "single sensor" liquid level control made and sold by Delavan Company of West Des Moines, Iowa, and identified by the registered trademark Sunele, operates to draw in through each color box at a predetermined level, and is connected through switch 162 in an electrical circuit which also includes the solenoid valve 164 which controls the flow from the color receptacle 130 through the feed pipe 131, which extends to the valve 164 through the closed top of the receptacle from a point near the bottom of the receptacle.

Level control member 160 is of known kind and adapted to call for color by vibrating and maintaining valve 164 open until sufficient color has been supplied into the color box to submerge it when it ceases to vibrate and causes the closing of the valve 164 which cuts off the flow of color.

When it is desired to wash the color box and the connecting conduits, the coupling 166 between feed pipe 131 and conduit 132 is disconnected, allowing conduit 132 to assume the position shown in dotted lines in FIG. 10. Wash water or other liquid may be introduced through conduit 168 and valve 170 to the coupling 134 and through conduit 126 to the receptacle R, either together or separately, by properly setting valves 144 and 146 and, of course, at the same time closing valve 142 in conduits 132.

As explained herein wash water supplied into the color box will drain within the conduit 72. Water supplied through conduit 148 into the header 78, extending longitudinally of the receptacle, will be discharged through nozzles 80 directed at the periphery of the brush and will serve both to wash the brush and to give it a spinning motion. When the supply of washing liquid is cut off the brush will continue to spin long enough to become substantially dry.

It will be understood that by opening valve 142 while washing fluid is being supplied through conduit 168, the conduit 132 and the attached coupling 164 and feed pipe 131 may also be washed out.

After the color box, and the conduits which supply color to it, have been washed, it is desirable to dry them to prevent rusting and this may be accomplished by air under pressure supplied through air line 171 through valve 172 into the coupling 134 from whence it can be directed by the proper adjustment of valves through conduit 138 leading to the brush conduit 136, coupling 138 and conduits 140 and 148.

A sonic member 174, similar to 160, is provided in chamber 139 to call for additional color when the level of the color falls too low and uncovers it.

As best seen in FIGS. 8 and 9, means are provided for driving a brush in reverse direction, as is sometimes desired. The portion of the brush connected in contact with the surface of its associated print roll. On the end of the brush shaft 12a a worm wheel 176 is mounted, in position to be engaged by the worm 178 on the shaft of a motor 180 pivotally mounted on bracket 182 which in turn is supported on support means 184 on frame member 100a. When desired, the motor 180 can be swung on its pivot mounting to bring worm 178 into engagement with worm wheel 176.

There has thus been provided an apparatus in which the objects mentioned above are accomplished in a thoroughly practical manner.

What is claimed is:

1. In apparatus for use as part of apparatus for printing a running length of material, an open top washer-receptacle having a wash-fluid inlet means therein and connected with a drain and disposed adjacent the main body of the printing apparatus, an open top trough-shaped color box and transfer brush combination and means for supporting the combination in the main body of the printing apparatus, an open top trough-shaped color box and transfer brush combination and means for supporting the brush of the color box in the apparatus in operative relation to a print roll, the color box and washer-receptacle each having means cooperating, when the color box is inverted over the washer-receptacle, to interengage to form an enclosure around the brush, the fluid inlet means in the receptacle being adapted to direct washing fluid over the inner surface of the color box and against the brush within the enclosure.

2. In cloth printing apparatus comprising an open top receptacle and an open top color box, said color box and receptacle being shaped so as to coact to form a closure when the color box is inverted and superimposed over the receptacle, the receptacle having fluid inlet means connected to a drain and communicating with header means within the receptacle having at intervals outlets adapted to direct fluid from the header over the inner surface of the color box within the closure.

3. A printing machine comprising a print roll, an open top color box, a brush extending into the color box and movable with it, and receptacle means, the upper marginal portions of the color box and receptacle being complementary and adapted to meet around their peripheries when the color box is inverted and placed on the receptacle, thus forming a closure containing therein the brush and the inner surfaces of the color box and receptacle, the receptacle means having a wash fluid inlet connected with a drain, and header means within the receptacle comprising a series of outlet ports adapted to direct jets of washing fluid against the brush and streams of fluid over the interior surface of the color box.

4. A printing machine comprising a print roll, an open top color box and brush combination, and an open top receptacle having washing fluid inlet means therein and connected with a drain, means for moving the color box and brush between the print roll and the receptacle, means operative as the color box and brush move toward the receptacle to overturn the color box and superimpose it in upside down position upon the receptacle, the receptacle and the color box being characterized by means coacting to form a closure enclosing the brush.

5. A printing machine comprising a print roll and a backing roll, an open top color box and brush combination, and an open top receptacle having a washing fluid inlet means therein connected with a drain, support means for said receptacle and said color box and brush combination, means for moving the color box and brush between the print roll and the receptacle, means operative as the color box and brush move toward the receptacle to overturn the color box and superimpose it in upside down position upon the receptacle, the receptacle and the color box being characterized by means coacting to form a closure enclosing the brush, and means within the closure to wash the inner surface of the color box and the brush while they are within the closure.

6. A printing machine comprising a print roll, a backing roll, a pair of slides on which the print roll is supported for movement toward and away from the backing
7. Printing apparatus comprising backing cylinder means, means for rotatably supporting the backing cylin-
dier means, a plurality of pairs of nips disposed radially with respect to the backing cylinder means, means for supporting each pair of nips spaced apart and aligned in a common plane extending radially with respect to the backing cylinder, pairs of slide members supported on said pairs of nips respectively, means for moving said slides longitudinally of said nips, print rolls supported between said pairs of slide members respectively, color box and brush combinations and support means for said combinations projecting from the pairs of slide members respectively, receptacle means associated with the color boxes respectively and having upper rims which are com-
plementary to the upper rims of the color boxes respectively, and means for pivotally mounting the receptacle means between said pairs of slide members respectively, means for moving each color box and brush combination between its related print roll and receptacle means, means for rotating each color box into upside down position, each receptacle having an inwardly extending rim portion under and against which the color box abuts as it is over-
turned thereby swinging the receptacle to upright position as the color box is fully superimposed over it, respec-
tively, and means for raising and lowering each color box and brush combination relative to its related print roll and its related receptacle means.

8. A printing machine comprising a print roll and a backing roll, support means for the backing roll, a pair of nips projecting radially from the backing roll support means respectively, a pair of slides carried by the respective nips comprising the pair of nips, means for supporting a print roll between said slides, means for pivotally supporting an open top receptacle between the slides comprising said pair of slides, said receptacle having washing fluid inlet means therein and connected with a drain, an open top color box and brush combination, means for moving each color box and brush combination between the print roll and the receptacle, means operative as the color box and brush move toward the receptacle to overlap the color box and superimpose it in upside down position upon the receptacle, and coactive means carried by the color box and receptacle acting to engage as the color box is in-
verted and thereby form a closure enclosing the brush.

9. A printing machine comprising a print roll and a backing roll, support means between which the backing roll is mounted, a pair of nips projecting radially from the backing roll support means respectively, a pair of slides carried by the respective nips comprising the pair of nips, means for supporting a print roll between said slides, an open top color box and brush combination, an open top receptacle having washing fluid inlet means therein and connected with a drain, means for pivotally supporting a receptacle between the outer ends of the slides comprising said pair of slides so that the receptacle is normal-
ly inclined as the color box and brush move thereon along which the color box and brush are movable between the print roll and the receptacle, means operative as the color box and brush move toward the receptacle to overlap the color box, the color box and receptacle being so constructed and dis-
posed that as the color box is inverted it engages the receptacle and swings it upright position at which time the inverted color box is superimposed upon, and engaged with, the receptacle and coacts with the receptacle to form a closure enclosing the brush.

10. A printing machine comprising a print roll and a backing roll, support means between which the backing roll is mounted, a pair of nips projecting radially from the backing roll support means respectively, a pair of slides carried by the respective nips comprising the pair of nips, means for supporting a print roll between said slides, means for pivotally supporting a receptacle between said slides, said receptacle having an open top and having said inlet means therein connected with a drain, a color box and brush combination, the brush being mounted for ro-
tation within the color box and the color box having an open top, means carried by the slides respectively along which the color box and brush are movable between the print roll and the receptacle, means operative as the color box and brush move toward the receptacle to overlap the color box and superimpose it in upside down position upon the receptacle thus forming a closure around the brush, the receptacle having along one side an inward-
ly extending rim portion and the color box having along one side a rim portion adapted to move under said inwardly extending rim portion of the receptacle and to swing the receptacle into upright position, the meeting rims of the receptacle and color box comprising sealing means providing a liquid tight seal at the interface between the receptacle and the overturned color box.

11. A printing machine comprising a print roll, an open top color box and brush combination, means for mounting the color box for rotating around the brush, an open top receptacle having washing fluid inlet means therein and connected with a drain, means for moving the color box and brush combination between moved outwardly, to-
ward the receptacle, a sufficient distance to carry the shoes beyond the outer ends of said surface and cause the color box to be overturned above the receptacle, the color box and receptacle being provided with upper rims adapted to be engaged when the color box is fully overturned and provide a liquid tight seal between the receptacle and the over-
turned color box.

12. Printing apparatus comprising backing cylinder means, pairs of slide members, and support means there-
for radially disposed with respect to the backing cylin-
dier, means for moving said slides longitudinally of said support means, print rolls supported between said pairs of slide members respectively, color box and brush com-
bounds supported between the pairs of slide members respectively, and receptacle means supported between the pairs of slide members respectively, the color box and brush combination between them moved outwardly, to-
ward the receptacle, the color box and brush combination between its related print roll and its related receptacle means and means for overturning each color box and superimposing it in upside down position over its related receptacle, the means for moving the receptacle means including links pivotally mounted to the slide members respectively on pivots disposed above the trans-
verse midpoint of the links, pivot shafts extending from the respective ends of the receptacle means, and bearings pro-
vided in said links below the transverse midpoint and adapted to receive said pivot shafts respectively.

13. A printing machine comprising a print roll, an open top color box and brush combination and an open top receptacle, support means for said combination and
said receptacle, means for moving the color box and brush between the print roll and the receptacle, means for controlling the relative positions of the color box and receptacle to align them vertically, with the color box superimposed over the receptacle, said color box and receptacle each having means coextensive to form a closure having therein the brush and the inner surface of the color box, a source of supply of color, and a conduit system for supplying color into a color box, said system including conduit means disposed within the color box and moveable with the color box, flexible conduit means, and means for coupling it with the conduit means within the color box, a closed container of color, means for controlling the pressure in the container, valve means controlling the supply of color from the container, conduit means interconnecting said valve means and said flexible conduit means, means for controlling said valve means including means disposed within the color box and serving to maintain the level of color within the color box at a predetermined level.

14. A printing machine comprising, a print roll, color box and brush combination, and an open top receptacle, support means for said combination and receptacle, means for moving the color box and brush between the print roll and the receptacle, means for controlling the relative positions of the color box and receptacle to align them vertically, with the color box superimposed over the receptacle, said color box and receptacle each having means coextensive to form a closure having therein the brush and the inner surface of the color box, a source of supply of color, a source of washing fluid, means for supplying color from the color box supply source into the color box including, a first conduit system, and means for shutting off the supply of color when the color has reached a predetermined height within the color box, header means within the receptacle for receiving washing fluid and delivering it over the inner surface of the color box and against the brush, and a second conduit system for supplying washing fluid to the first conduit system and to the header for washing out said first conduit system, the color box and the brush, a source of supply of air under pressure, and a third conduit system including control means for supplying air under pressure into the conduits comprising said first and second systems to dry them.

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ROBERT E. PULFREY, Primary Examiner.
EUGENE R. CAPOZIO, Examiner.
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,227,078
January 4, 1966

James Reid Johnson

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 5, line 6, for "in" read -- to --.

Signed and sealed this 25th day of October 1966.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents