Nov. 22, 1966 K. W. BAEHR 3,287,721

INTRAVENOUS ALARM SUPPLY MONITOR

Filed July 3, 1964 2 Sheets-Sheet 1

Fig. 1.

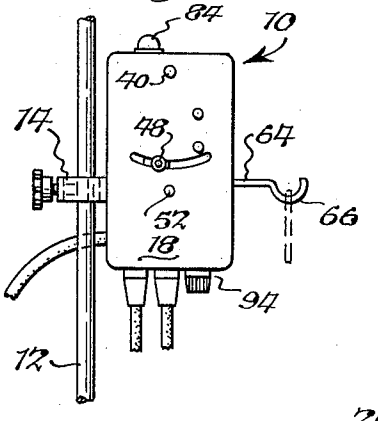


Fig. 2.

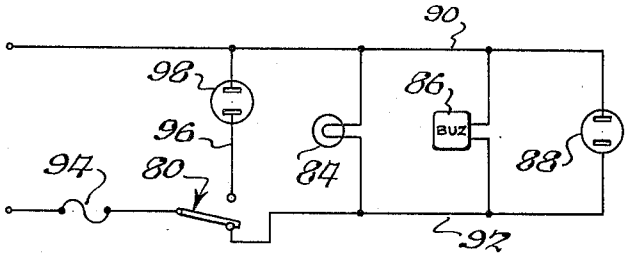
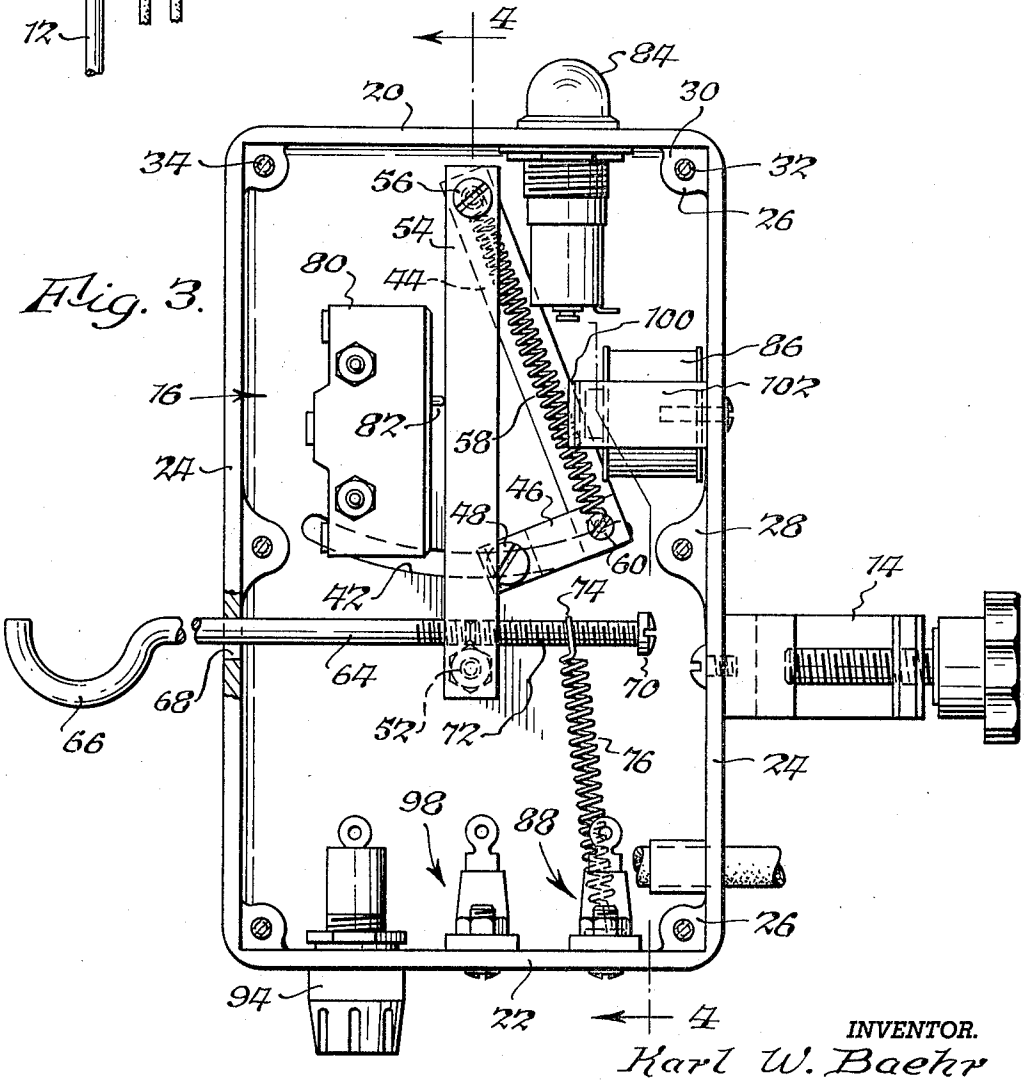


Fig. 3.



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Fig. 4.

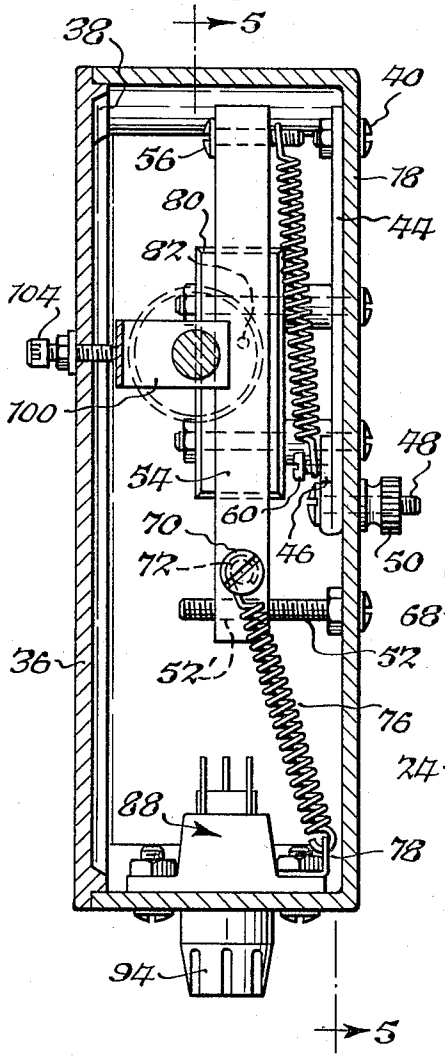
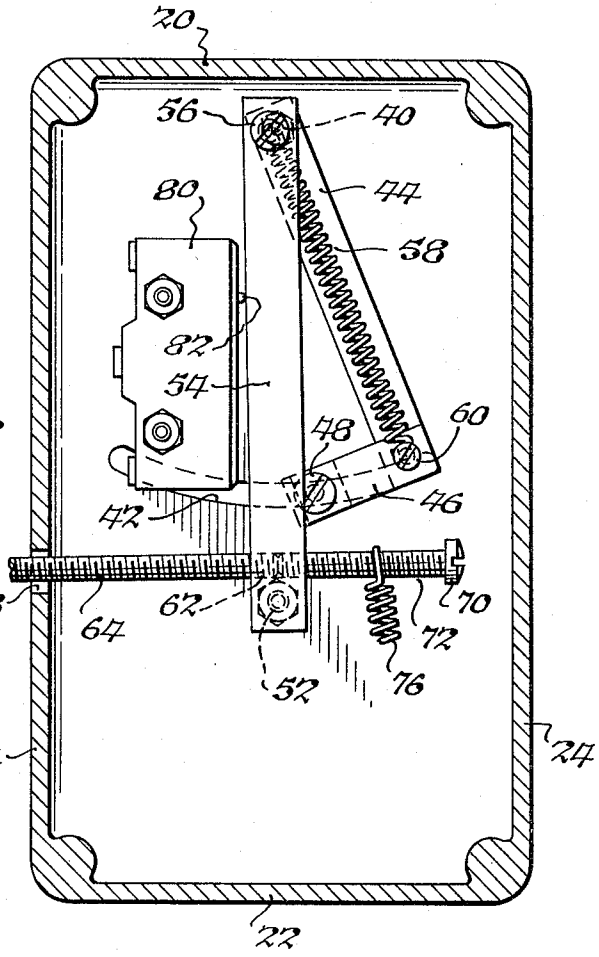


Fig. 5.



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INTRAVENOUS ALARM SUPPLY MONITOR

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11 Claims. (Cl. 340—272)

This invention relates to improvements in apparatus for controlling or monitoring the giving of intravenous feeding, blood transfusions and the like.

In the giving of intravenous feeding or blood transfusions it is important that the development of certain conditions be guarded against for the safety of the patient under treatment.

One of the conditions to guard against is the formation of air embolism if the container from which fluid is being fed becomes empty during forced infusion.

Another condition which it is important to prevent is the occurrence of delays in the administration of blood or other vital solutions during continuous gravity feeding.

Another condition which must be given prompt attention is to see that containers be changed while liquid still remains in the supply container to prevent clotting in needle or catheter.

A primary object of the present invention is to provide a compact, readily portable monitoring device for intravenous feeding, transfusions, and the like, which is easily attached to a laboratory type stand and incorporates means by which accurate adjustments can easily be made to insure the feeding of a prescribed amount of fluid from a receptable, or the stopping of the feed when the fluid level in a receptable has dropped to a predetermined level, in a manner such that the development of any of the above stated conditions can be avoided.

In one aspect thereof, a monitoring apparatus of my invention is characterized by the provision of an electric signal circuit having a controlling switch, a pivoted support for an infusion liquid container, the support having a raised position and a lowered position and a rock bar pivotable therewith, and control means including a pivoted spring operatively coupled with the rock bar, the spring being movable toward and away from dead center relative to the rock bar to a position permitting a predetermined weight on the support to move the latter to its lowered position, the spring being movable to another position moving the support and a predetermined weight thereon to the raised position of the support, the switch being actuated to one or the other of its positions when the support is moved to one or the other of its positions, together with means for securing the control spring in various positions including that in which it raises the support and the predetermined weight thereon.

In another aspect thereof, a monitoring apparatus constructed in accordance with my invention is characterized by the provision of an electric signal circuit including a control switch, a housing, a support member for a liquid receptable mounted on the housing and having raised and lowered positions, the switch being actuated to one or the other of its positions when the receptacle support member is in one or the other of its positions, a control spring pivotally coupled at one end to the support member, arm means pivotally mounted on the housing and connected to the spring adjacent its opposite end for swinging the same to a position yieldingly urging the member with a weight thereon to its raised position and to another position yieldingly urging the member and weight to its lowered position, together with means for securing the arm means in multiple positions.

Other objects and advantages of the invention will become apparent as the description of the same proceeds and the invention will be best understood from a consideration of the following detailed description taken in connection with the accompanying drawings wherein:

FIGURE 1 is a view in front elevation of a monitor of the present invention showing the same secured to a supporting standard or mast.

FIGURE 2 is a diagram of the electric circuit of the monitor.

FIGURE 3 is a view of the interior of the monitor housing as seen with the back of the housing removed showing the over-center switch control arm in a set position preparatory for the hanging of a dispensing container on the support hook.

FIGURE 4 is a vertical section taken substantially on the line **4**—**4** of FIGURE 3.

FIGURE 5 is a vertical section taken substantially on the line **5**—**5** of FIGURE 4, parts being omitted or broken away for greater clarity.

Referring now more particularly to the drawings, the numeral **10** generally designates a monitoring device of the present invention in mounted position upon a supporting mast or standard **12** to which it is secured for adjustment by a conventional type clamp **14**.

The monitoring device comprises a rectangular housing generally designated **16**. This housing may be formed of any suitable material such as a synthetic resin, which may be Bakelite or the like, which is adapted to be molded in the desired form.

The housing comprises a front wall **18**, the top and bottom walls **20** and **22** and side walls **24**. These, as shown, are formed in one piece or a unitary structure with corner reinforcing ribs **26** and a reinforcing rib **28** on the inner side of each side wall, which rib and the ribs **26** extend through substantially the width of the side and top walls, terminating at the back of the housing short of the back edges of the top and side walls to form the recesses **30** and the ribs are formed with threaded bores **32** for the reception of screws **34** by which the back wall **36** of the housing is secured in closing position. As it will be readily apparent from FIGURE 4, the back wall is bordered on its inner side by the encircling rib **38** which rests upon the ends of the reinforcing ribs **26** and **28** and through which the securing screws **34** pass.

At the top center of the front wall a pivot screw is secured which extends through the front wall. This screw is designated **40**.

Below the pivot screw **40** the front wall has therein the arcuate slot **42** which is struck from pivot screw **40** as a center.

Positioned against the inner side of the front wall and supported at one end upon the pivot screw **40** is a pendant arm **44** which forms an element of an over-center operator means for the hereinafter described micro-switch.

The lower end of the arm **44** has secured thereto a short right angularly extending leg **46** and the free end of this leg carries a threaded screw **48** which projects through the slot **42** and on its outer end and at the front of the wall **18** it carries a knurled binding nut **50** by means of which the arm **44** can be swung to and secured in a desired set position.

In vertical alignment with the pivot screw **40** and below the slot **42** there is secured to the front wall **18**, one end of a relatively long support screw **52** which projects rearwardly through a substantial part of the front-to-rear depth of the housing as shown in FIGURE 4.

The numeral **54** designates a rock bar. This rock bar **54** has the screw **52** extending therethrough at one end thereof and is thereby vertically supported in the housing for rocking movement in a plane parallel with the front wall and spaced a substantial distance from the front wall and from the arm **44**.

As is shown the rock bar **54** is of substantial length and at its top end it has extending therethrough and

supports a screw or suitable pin **56** to which is attached one end of a fine adjustment coil spring **58**.

At the lower end of the arm **44** there is secured the rearwardly projecting pin **60** which is in alignment longitudinally of the arm with the center of the pivot screw or pin **40**.

The fine adjustment spring **58** is under constant tension. When the arm **44** is swung on the pivot screw or pin **40** to a vertical position where it is parallel with the rock bar **54**, a direct down pull will be applied to the rock bar, the pin or screw **56** being axially aligned with the pivot screw or pin **40**. When, however, the lower end of the arm **44** is swung to the right or to the left, the spring **58** will apply a slight lateral pull to the top end of the rock bar causing it to swing slightly as hereinafter described.

The lower end portion of the rock bar **54** has formed therethrough a passage or bore **62** which is at right angles to the passage or bore **52'** through which the screw **52** passes. The bore **62** is above but closely adjacent to the screw **52** and has extending therethrough the relatively long shank **64** of the hook **66**.

The hook **66** is, of course, upon the outer side of the housing as illustrated and the shank passes through an aperture **68** in the adjacent side wall of the housing. The shank **64** also extends a substantial distance beyond the side of the rock bar **54** remote from the aperture **68** and carries on its free inner end the head **70** and between this head and the rock bar the shank is coarsely threaded as at **72**. These threads **72** provide notches in a selected one of which the eye **74** forming the terminus of a coarse adjustment spring **76**, may be engaged, the shank extending through this eye as will be readily seen. The opposite end of the spring **76** is attached to a suitable bracket **78** affixed to the underlying bottom wall of the housing whereby the spring maintains a constant down pull on the inner end of the shank **64**, tending to rock the bar **54** to the right, as it is viewed in FIGURES 3 and 5 and elevating the hook to the limit permitted by the aperture **68** through which the shank passes.

Mounted upon the front wall **18** of the housing on the inner side thereof, above the arcuate slot **42** and on the side of the rock bar **54** remote from the spring attached end of the shank **64**, is a micro-switch **80**. The numeral **82** designates the switch finger which projects toward and is adapted to be engaged by the rock bar **54** to effect the opening and closing of the circuits illustrated in FIGURE 2.

In the circuit diagram forming FIGURE 2, there are shown connected in parallel three electrical units representing respectively a signal light, preferably a neon glow lamp **84**, a buzzer **86** and a service outlet **88**. These are connected across the two sides **90** and **92** of the alarm circuit controlled by the micro-switch **80**. The numeral **94** designates a fuse element in the current feed side of the circuit and the switch as shown in the circuit diagram is in position to close the circuit through the lamp and buzzer and to any unit which may be connected with the outlet **88** when the device functions to give the signal designating the exhaustion or near exhaustion of fluid furnished from a supply receptacle, not shown, which would be suspended from the hook **66**.

When the switch is in the opposite position from that shown in FIGURE 2, a circuit **96** will be closed through a service outlet **98** with which may be connected a motor operating a pump for pumping fluid from the supply receptacle to a patient receiving forced infusion.

The buzzer **86** is mounted in the housing on a side wall thereof as best seen in FIGURE 3 and the numeral **100** designates the buzzer armature which is supported upon a spring **102**.

For controlling the intensity or loudness of the buzzer, the back wall **36** which parallels the armature spring **102**, carries an adjustment screw **104** which may be engaged at its inner end against the armature spring to limit the rate of movement of the armature.

In setting the monitor for operation, there is selected an empty or partially empty bottle of equal make and proportion and an administration set of the same type as will be used in the duty performance. The Ad Set is inserted in the bottle and the bottle is hung on the hook **66** after, of course, the monitor unit is mounted in the desired position of operation on the mast **12** as shown in FIGURE 1.

Two procedures may be followed for setting the monitor to give a signal when the contents of the receptacle have been lowered to a level where a predetermined or known amount of liquid remains therein, or in other words, when a predetermined amount of the liquid has been dispensed from the receptacle. One procedure involves the employment of weights while the other involves setting up the unit with a partially empty bottle containing the amount desired to be left in the bottle.

In using weights for determining the number of cubic centimeters of liquid desired to have remaining in the bottle, the appropriate number of weights, marked in approximate cubic centimeters of water, are placed upon the top of the bottle, the bottle being suspended in inverted position in the customary manner by a hanger bail engaged over the hook **66**. Alternately, the partially empty bottle is suspended in this fashion. In both cases, the adjusting and setting nut **50** is then loosened and the nut is moved toward the right of the device, as it is viewed in FIGURE 1 or away from the supporting mast **12** or, in other words, toward the side of the casing from which the hook projects. This will move the arm **44** over-center across the rock bar **54** from the position shown in FIGURES 3 and 5 to extend at an opposite angle to that shown in these figures. In so moving the nut and arm to the extreme right, a click will be heard or such a click may be heard when the bottle is suspended from the hook. This click results from the downward swinging of the hook which places the coarse adjustment spring **76** under additional stretch or tension and moves the rock bar against the switch finger **82**, the click being caused by the movement of the switch blade into the position where it closes the circuit **96** through the service outlet **98**.

The nut **50** is then moved back or in the reverse direction very slowly until a click of the switch is again heard and the nut **50** is then tightened to secure the arm in position. This second click is caused by the tensioned spring **58** imposing a slight lateral pull upon the top end of the rock bar **54** sufficient to move the bar to permit the switch to open the circuit **96** and close the circuit across which the units **84**, **86** and **88** are connected, the arm **44** then being approximately in the position shown in FIGURES 3 and 5.

The empty weighted bottle is now removed from the hook and the heavier filled bottle is hung on the hook with all of the administration set operatively attached thereto, after which the proper connection is made between the circuit of the monitor and a source of current supply.

It will be readily apparent from the foregoing that when the fluid level in the bottle which has now been placed upon the hook, is lowered to the point where the combined weight of the bottle and the remaining fluid equals the weight of the first suspended bottle with its weights or with the fluid therein, the tensioned springs **58** and **76** will rock the bar **54** and the hook shank in a direction to raise the bottle with the remaining liquid therein, permitting the switch to function to open the circuit **96** and close the alarm circuit.

As will be readily apparent, when the circuit **96** is opened power will be cut off from a pump motor connected with the service outlet **98** so as to stop the motor whereupon the necessary change of fluid feeding bottles can be made if desired.

From the foregoing it will be apparent that there is provided by the present invention a very compact readily portable unit which is easily attachable to any laboratory

stand of proper size and by means of which easy and accurate adjustments can be made to insure the feeding of a prescribed amount of fluid from a receptacle or the stopping of the feed when the fluid level in the receptacle has dropped to a predetermined point or a point at which it is known that a predetermined amount of fluid remains in the receptacle.

The delicate beam arrangement of this invention permits use of a strong spring. Also, pivot **40** is alined with pin **56**, whereby the length of spring **58** does not change with positional adjustment of arm **44**. A constant spring rate thereby is maintained, using a relatively long spring and without complications.

Where there is relatively litle variation in the weight of the various bottles and administration sets used with the monitor of my invention, the coarse adjustment spring **76** can be omitted. The monitor will function in the manner described above with only the fine adjustment spring **58**.

As this invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive, since the scope of the invention is defined by the appended claims rather than by the description preceding them, and all changes that fall within the metes and bounds of the claims or that form their functional as well as conjointly cooperative equivalent, are therefore intended to be embraced by those claims.

I claim:

1. An intravenous infusion monitor comprising, an electric signal circuit, an electric signal circuit controlling switch having a first position for closing said circuit and a second position for opening the circuit, a pivoted support means adapted for supporting an infusion liquid container and having a raised position and a lowered position, a rock bar pivotable with said support means, and control means including a pivoted spring operatively coupled with said rock bar, said spring being movable toward and away from dead center relative to said rock bar to a position permitting a predetermined weight placed on said support means to move the same to said lowered position and to another position moving said support means together with said weight to said raised position, said switch being actuated to one of its said positions when said support means is moved to said lowered position and being actuated to the other of its said positions when said support means is moved to said raised position, and means for securing said control means in various positions including said other position.

2. The invention according to claim **1**, wherein said pivoted support means comprises a hook having an elongated substantially horizontally positioned shank and rockable on its pivot in a substantially vertical plane, together with a spring secured to said shank and applying downward force thereto on the side of its pivot remote from said hook.

3. Apparatus for monitoring the dispensing of a liquid from a receptacle, comprising an electric signal circuit including a control switch having a first position for opening the signal circuit and a second position for closing the signal circuit, a housing, a member adapted to support a liquid receptacle, said member being mounted on said housing and having a raised position and a lowered position, said switch being actuated to one of said positions thereof when said member is in said raised position and being actuated to the other of said positions thereof when said member is in said lowered position, a control spring, means pivotally coupling one end of said spring to said support member, arm means pivotally mounted on said housing and connected to said spring adjacent the opposite end thereof for swinging the same to a first position yieldingly urging said member with a predetermined weight thereon to said raised position and to a second position yieldingly urging said member and weight to said lowered position, and means for securing said arm means in multiple positions including said first position thereof.

4. Apparatus for monitoring the dispensing of a liquid from a receptacle comprising an electric signal circuit including a control switch having a circuit closed position and a circuit open position, a casing, said switch being carried by said casing, a support member pivotally mounted in said casing, said support member having a part extending exteriorly of said casing and adapted to suspend a receptacle, said support member having a raised position and a lowered position, an upright rock bar mounted upon said support member adjacent to and engageable with an element of said switch for effecting actuation of said switch, an arm pivotally mounted in said casing for swinging movement relative to said bar, a spring connected under tension between the end of said bar remote from said support member and the end of said arm remote from its pivotal mounting, whereby swinging movement of said arm will vary the effective force of said spring on said bar, and means for securing said arm against swinging.

5. The invention according to claim **4** wherein said switch is a micro-switch.

6. The invention according to claim **4** wherein said signal circuit includes a visual and an audible signal means.

7. The invention according to claim **4** with a second electric circuit having a service outlet therein for connection to an electrically actuated machine, such as a pump, said switch being connected in said second circuit to close the latter when it is in said open position with respect to the first mentioned circuit.

8. The invention according to claim **4**, wherein the pivot axis of said arm is substantially alined with the point of connection of said spring to said bar.

9. The invention according to claim **4**, wherein said support member consists of a hook having a relatively long shank disposed substantially horizontally in said casing, said pivot mounting means being secured to said shank.

10. The invention according to claim **9**, wherein said arm securing means comprises a threaded pin carried by said remote arm end and extending through an arcuate slot in a wall of said casing, and a binding nut on said threaded pin on the outer side of said casing wall spanning said slot, said slot having as its radial center the pivot axis of said arm.

11. The invention according to claim **9**, together with a spring attached to said shank on the side of said pivot mounting means remote from said hook.

References Cited by the Examiner

UNITED STATES PATENTS

2,466,355	4/1949	Baker.	
2,667,629	1/1954	Frost	200—85 X
2,706,755	4/1955	Krasno	340—272 X
3,105,490	10/1963	Schoenfeld	340—244 X
3,115,152	12/1963	Goldberg	128—214 X

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