

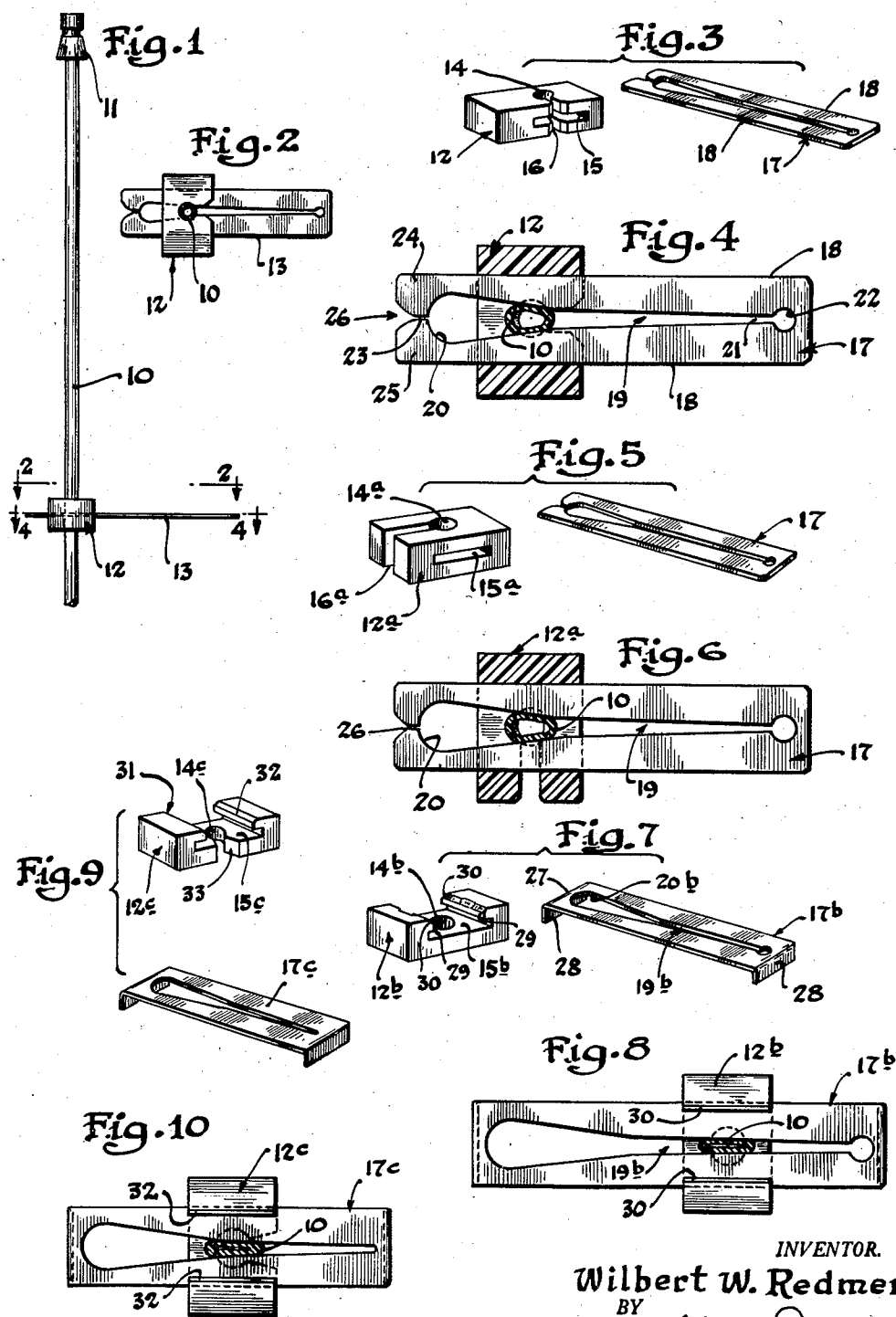
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2,889,848

FLOW CONTROL CLAMP

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2,889,848

FLOW CONTROL CLAMP

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This invention relates to a flow control clamp useful in connection with compressible tubes for incrementally compressing the walls thereof to restrict the flow passage therethrough and thereby regulate and control the flow of fluid through the tube.

There are numerous applications wherein it is desired to accurately control the flow of fluid through a tube incrementally from a full flow condition to a complete interruption or termination of the flow of fluid through the tube. As examples, reference may be made to chemical laboratories and research laboratories generally, and also to hospitals where the flow of intravenous solutions into the veins of patients must be accurately regulated. In the latter case, intravenous solutions are stored in bottles or containers and when used these containers are supported near a patient and at an elevation thereabove so that the solution can flow downwardly by gravitational attraction through a tube and through a needle connected thereto and into the blood stream of the patient.

Ordinarily, in such an arrangement valve means are provided with the tube, which is flexible and compressible, so that the flow of fluid therethrough can be metered. Accuracy of control is essential for quite often the intravenous solutions are administered at such a slow rate that the rate is measured in drops per minute. For example, the flow rate may vary from a few drops per minute to several hundred drops per minute. The flow control clamps presently in use are not entirely satisfactory for they have a number of severe disadvantages. Those that permit a fair degree of accuracy in the regulation of the flow rate are cumbersome and bulky and quite heavy, and all of these factors makes their use with relatively light and flexible plastic tubing difficult. Other known clamps now in use, while being relatively lightweight, have the very serious disadvantage that they cannot be placed in position about the tubes after the tube is connected with the container for the intravenous solution and after the needle has been connected to the other end of the tube. Further, in use of such clamps, it is found that regulation cannot be accomplished accurately because the tube is distorted during adjustment of the clamp. At the same time, the tube is moved and jiggled during such adjustment and frequently the needles are pulled out of the patient's vein. Except when in clamping position, these clamp members are generally movable freely along the tube and do not hold any preselected position thereon, but always fall downwardly to the lowermost point along the tube. Also, the more commonly available clamps have the additional disadvantage of being difficult to shift rapidly from a full-open to a full-closed position, and flushing the tube, which is nothing more than a rapid opening and closing of the flow passage, is a difficult and uncertain operation.

It is, accordingly, an object of this invention to provide a flow control clamp that overcomes the disadvantages inherent in prior art clamp structures. Another object of the invention is to provide a flow control clamp use-

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ful in metering and controlling the flow of fluids through compressible flow conduits which facilitates the rapid and accurate incremental adjustment between full-open and full-closed positions through one-hand manipulation without jiggling or otherwise moving the flow conduit. Still another object is in the provision of a flow control clamp that can be infinitely varied so as to completely open or completely close a compressible conduit, or to provide any intermediate flow control position therebetween, and that can be rapidly shifted from full-open and full-closed positions so that a flow conduit with which it is used can be flushed.

Yet another object of the present invention is to provide a flow control clamp as described, which is lightweight and which will hold any preselected position along a flow conduit even though the clamp is not in clamping condition. A further object of the invention is in providing an improved flow control clamp useful in connection with the flexible and collapsible tubing employed as a conduit in connecting an intravenous solution container with a needle inserted into a patient's arm, and which can be mounted upon the flow conduit after that conduit has been connected at one end to a needle and at its other end to the solution container. Still a further object is in providing a flow control clamp of the character described, in which a block of material is provided with a bore extending therethrough that slidably receives an intravenous flow conduit therein, and that is provided with a slot extending therethrough that opens into the bore, a wedge plate being slidably received within the slot and having a tapered surface adjacent the bore and that is adapted to engage a conduit extending therethrough. It is also another object of the present invention to provide an improved flow control clamp for a flexible conduit or tubing which comprises a body section or block with a flexible tubing receiving bore and a transversely extending slot which is adapted to be operatively positioned on the tubing after the ends of the tubing have been provided with conventional end fittings. It is still another object of the invention to provide an improved flexible conduit or tubing clamp which is adapted to have a wedge plate of the type disclosed in U.S. Patent No. 2,503,327, operatively assembled therewith after the plate has been mounted on the tubing and the ends of the tubing have been provided with conventional end fittings. Additional objects and advantages will appear as the specification proceeds.

Embodiments of the invention are illustrated in the accompanying drawing, in which:

Figure 1 is a side view in elevation of a tubular flow conduit equipped with a flow control clamp of this invention; Figure 2 is a transverse sectional view taken on the line 2—2 of Figure 1; Figure 3 is a perspective view showing the parts of the clamp in exploded or spaced-apart relation; Figure 4 is a transverse sectional view taken on the line 4—4 of Figure 1; Figure 5 is a perspective view showing the parts of modified form of clamp in spaced-apart relation; Figure 6 is a transverse sectional view taken along a line comparable to the line 4—4 of Figure 1 and showing the modified form of clamp illustrated in Figure 5; Figure 7 is a perspective view showing the parts of a further modified clamp in spaced-apart relation; Figure 8 is a top view showing the assembled modified clamp structure of Figure 7 in partially closed position; Figure 9 is a perspective view showing the parts of a further modified clamp in spaced-apart relation; and Figure 10 is a top view showing the assembled modified clamp structure of Figure 9 in partially closed position.

Figure 1 illustrates an elongated flexible tubular flow conduit 10 that is made from a compressible material and that is preferably resilient so that it restores itself to

initial condition after a compression thereof. The conduit 10 may be formed from any suitable material and certain plastics, such as polyvinyl plastic, have been found suitable. The conduit provides a flow passage therethrough, and at its opposite ends is adapted to be connected to a fluid supply and to a receiver for the fluid. For example, if the conduit 10 is a flexible and compressible plastic tube used in controlling the flow of intravenous solutions, the tube 10 at one end may be equipped with an adapter 11 that will be attached to a needle for insertion into the vein of a patient, and at its opposite end the conduit will be provided with any conventional means for connecting the tubing to a container for the intravenous solution.

Mounted upon the conduit 10, as shown in Figure 1, is a clamp body section or block 12 that co-acts with a wedge plate 13, which may be of the type disclosed in U.S. Patent No. 2,503,327, in a manner to be described hereinafter. As is shown best in Figure 3, the block 12 is provided with a bore 14 extending transversely therethrough and that has a diameter that is sufficiently large so that the tube 10 can be movably received within the bore. Preferably, the walls of the bore 14 frictionally grip the tube 10 so that the block 12 can be supported axially along the tube at any preselected position thereon. The block 12 is provided with a slot 15 that extends thereacross through substantially the mid-portion thereof, and at substantially right angles to the longitudinal axis of the bore 14. The slot 15 opens into the bore 14 and preferably the bore is substantially centered relative to the edges of the slot 15. Along one of the longitudinal edge portions of the block 12, a cut-out area is provided that defines a mouth 16 that opens into the bore 14 and communicates therewith from top to bottom thereof. The mouth 16 has a widened entrance area through which the tube or conduit 10 freely passes, and a restricted inner edge portion adjacent the bore 14 and communicating therewith that permits the conduit 10 to be slipped into the bore through the mouth.

The block 12 may be formed from any desired material, and preferably the material employed will be relatively lightweight. Therefore, I prefer to use plastic for forming the block 12, and while any of a number of plastics may be employed, polyethylene has been found entirely satisfactory. The block 12 may be of one-piece construction and formed in a molding operation or, if desired, the block 12 might be made in a plurality of separate pieces secured together by adhesives, pins or rivets, or if heat-sealable plastic is used in the forming of the block 12, the separable sections might be heat-sealed together.

Slidably receivable within the slot 15 is a wedge plate 17 that is elongated and that is equipped with substantially parallel longitudinal edges 18. Extending longitudinally through the center of the plate 17 is a slot or channel 19 that, at its forward end, is enlarged and is generally arcuate, as is shown at 20, while the other end portion thereof tapers inwardly and is reduced in cross section, as is shown at 21. The enlarged portion 20 has dimensions such that the flow conduit 10 can pass freely therethrough. The tapered slot 19 at its reduced portion 21 is sufficiently narrow so that the conduit 10 will have the walls thereof pressed together so as to close off the flow passage therethrough when the conduit is moved into that end portion of the slot, as is shown in Figure 8. If convenient, because of fabrication procedures, the reduced end portion 21 of the slot 19 may open into an arcuate aperture 22.

Adjacent the enlarged end portion 20 of the slot 19, the plate 17 is slit, as is shown at 23, to define the two legs 24 and 25 of the plate member. The slip portion 23 flares outwardly to provide an entrance area 26 through which the conduit 10 may be moved into the enlarged portion 20 of the slot 19.

In operation of the clamp structure shown in Figures

1 through 4, the tubular conduit 10 at one end is connected to a container for intravenous solution, and at its other end is equipped with a needle that is to be inserted into the vein of a patient. The block 12 is then moved toward the conduit 10 to position the conduit within the mouth 16 of the block. The conduit is then pressed through the mouth 16 and into the bore 14. The block can then be moved axially along the conduit 10 to any selected position, and will maintain itself at that position because of the frictional engagement between the walls of the bore 14 and the conduit. Next, the plate 17 is pressed into the slot 15 and preferably from the side thereof adjacent the mouth 16 of the block. As the wedge plate 17 advances farther into the slot 15, the entrance area 26 of the plate is brought into engagement with the conduit 10; and upon further movement of the plate into the slot, the conduit 10 compresses and passes through the slit 23 and moves into the enlarged arcuate portion 20 of the slot.

Since the enlarged portion 20 is larger than the diameter of the conduit 10, the wedge plate at this time does not restrict the flow passage through the conduit, and does not then restrict the free passage of fluid therethrough. The wedge plate will be maintained in this position for it cannot slip outwardly from the slot 15 because the legs 24 and 25 of the plate substantially abut each other at the slit 23. Thus, the wedge plate 17 in effect hangs loosely in position within the block 12.

In order to manipulate the plate 17 so as to compress the flow conduit 10 and restrict or limit the flow of fluid therethrough, two fingers of the hand may be slipped behind the block 12 and the thumb of the hand pressed against the rear edge of the wedge plate. The plate may then be pushed forwardly into the slot 15 by the thumb, and such movement will tend to compress the conduit 10 as is shown in Figure 4, and thus restrict the size of the flow passage therethrough. The wedge plate 17 can be pushed to a position wherein the conduit 10 lies within the reduced end portion 21 of the slot, and at such time the walls of the conduit 10 will be pressed against each other, and the flow of fluid through the conduit will be interrupted.

In describing the use of the structure illustrated in Figures 1 through 4, it has been stated that the wedge plate 17 is preferably inserted into the slot 15 through the side thereof adjacent the mouth 16. The clamp structure will function properly, and in substantially the same manner, if the wedge plate 17 is inserted into the slot 15 through the opposite end thereof. However, in the latter operation care must be exercised so that in pressing the conduit 10 through the slit 23 of the wedge plate, the conduit does not push outwardly from the bore 14 through the mouth 16.

The form of the flow control clamp illustrated in Figures 5 and 6 is substantially the same as that of the flow control clamp shown in Figures 1 through 4. The wedge plate may be identical, and since it is illustrated as such it is designated again with the numeral 17, and will not be further described. The block is substantially similar, but because there are some differences it is designated with the numeral 12a. The block 12a is provided with a bore 14a therethrough and a slot 15a, all as has been described hereinbefore. The mouth 16a, however, while communicating with the bore 14a along the length thereof, is at substantially right angles to the longitudinal axis of the slot 15a rather than lying along that axis of the slot as in the form of the block shown in Figures 1 through 4. The operation or use of the clamp structure shown in Figures 5 and 6 is identical with the use of the clamp structure as described hereinbefore.

The location of the mouth 16a, as shown in Figures 5 and 6, may be preferred over the positioning of the mouth 16 shown in Figures 3 and 4. The reason for this is that since the mouth 16a is at right angles to the slot 15a, it makes no difference through which side the

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wedge plate 17 is inserted into the slot 15a. From either side the conduit 10 cannot be inadvertently pushed outwardly from the block through the mouth 16a, for the mouth is at right angles to the path of movement of the plate 17 through the slot 15a.

In the form of the clamp shown in Figures 7 and 8, the wedge plate 17b is generally similar to the plate 17 described hereinbefore, except that the end portion of the plate adjacent the enlarged end of the wedge slot is completely closed, as is shown at 27, and the ends are turned downwardly, as shown at 28, to provide a bearing surface which facilitates manipulation of the slide. The block 12b is provided with a bore 14b extending transversely therethrough and a slot 15b. The form of block 12b shown in Figures 7 and 8 has its upper side cut away, as shown at 29, to provide a passage communicating with slot 15b and which has a width only slightly less than the width of the plate 17b. The sides of the passage are preferably provided with oppositely disposed beveled surfaces 30 which co-act with the plate 17b and facilitate the positioning of the plate 17b in the slot 15b by causing the sides of the said passage to move laterally sufficiently to permit the clamp to drop into slot 15b. It is also to be noted that the block 12b is not provided with a mouth portion communicating with the bore 14b, and then, to mount the block upon the conduit 10, the conduit must be threaded through the bore and before both of the conduit ends are connected to a needle at one end and a container for solutions at the other end.

The plate 17b is operatively positioned in the slot 15b by placing the said plate with its outer longitudinal edges in contact with the oppositely disposed beveled surfaces 30 and pressing inwardly to "snap-fit" the slide into the slot 15b. The use of the control clamp when thus assembled is the same as that described with reference to the forms of the clamp as shown, respectively, in Figures 1 through 4 and Figures 5 and 6.

In the form of the clamp structure shown in Figures 9 and 10, the block 12c is provided with a bore 14c extending transversely therethrough and with a slot 15c which extends thereacross through the mid-portion thereof and at substantially right angles to the longitudinal axis of the bore 14c which it intersects. As in the form shown in Figures 7 and 8, the upper surface of block 12c is cut away, as 31, to provide a passageway having a width slightly less than the width of plate 17c which is similar to plate 17b. The sides of the block 12c defining the passage in the upper surface are also beveled, as at 32, to facilitate positioning the clamp 17c in the slot 15c. Also, one of the longitudinal edge portions of the block 12c is cut out so as to define a tapered mouth portion 33 which opens into bore 14c and provides a passage through which the flexible conduit or tubing 10 can be forced into the bore 14c, similar to mouth 16 of Figure 3. The plate 17c is operatively positioned in the slot 15c by placing the said plate with its longitudinal edges in contact with the oppositely disposed beveled surfaces 32 and pressing inwardly to "snap-fit" the slide into the slot 15c.

In all forms of the clamp structure disclosed and described, the block and the wedge plate are relatively lightweight and do not cause appreciable pulling on the conduit 10 and sagging thereof. The wedge plate may be made from metal, such as aluminum, or from any other suitable material and, as has been brought out before, the block may be made from plastic which is relatively lightweight. The clamp structure may be moved to any selected position along the conduit 10, and will maintain itself in the selected position because of the frictional fit between the conduit and the walls of the transversely extending bore through the block. In the form of the invention shown in Figures 7-10 the block is made of material which is sufficiently resilient to permit inserting the wedge plate into the slot without permanently deforming the block which will then return to its original

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shape, and preferably of a plastic material such as polyethylene plastic or methylmethacrylate plastic.

Operation of the wedge plate within the block may be carried out with the fingers and thumb of one hand, and no jiggling or movement of the conduit 10 accompanies the positioning of the wedge plate within the block for the block itself is used as a support or backing member that is gripped by the fingers of the hand, while the plate is moved against the holding force on the block by the thumb of the hand. There is no danger, then, is disconnecting the conduit from the container for the intravenous solution and, similarly, there is no danger of inadvertently pulling the needle outwardly from the patient's vein. Metering of the flow rate is exceptionally accurate because the compressing of the tube is infinitely variable between full-closed and full-open positions. Further, because of the co-action between the block and the wedge plate, and because a firm grip on each is provided through the fingers and thumb of one hand, the wedge plate can be moved to any selected position readily and with a positive action that is not present when the tube or conduit itself is used as the backing member. In the latter case, it will be appreciated that the conduit would be bent or distorted during positioning of the control clamp, and when the fingers are removed from the conduit, there would be an automatic change in the size of the flow passage therethrough and in the flow of fluid therethrough.

If it is necessary to flush the conduit to remove air therefrom, no particular problems are presented for the wedge plate may be quickly shifted from one end to the other within the block so as to first open and then close the flow conduit.

A further advantage in inherent in the forms of the clamp structure illustrated in Figures 1 through 6, for with these forms of the invention the block may be positioned upon the conduit 10 after the conduit is assembled with a needle and with a container. The conduit is simply slipped into the transverse bore through the block by movement of the conduit through the mouth of the block. Similarly, the wedge plate can be positioned within the block and about the conduit after the block is mounted upon the conduit. While a closed end wedge plate 17b has been illustrated in Figures 7 and 8, it will be apparent that wedge plates 17 might be used with the block 12b, and in such case only the block would have to be positioned upon the conduit 10 prior to the assembly of the conduit with a container and with a needle. The wedge plate 17 could be moved through the slot 15b after the block 12 is threaded onto the conduit.

It will be evident that in the form of the invention shown in Figures 7-10, it is possible to provide the slide plate or wedge plate with downwardly extending ends to facilitate adjusting the clamp without having to bend the ends of the clamp after it has been positioned in the slot.

It will also be apparent that with the form of the invention shown in Figures 9 and 10, the clamp body or block can be assembled with a slide plate or wedge plate which has previously been mounted on a length of tubing which has both ends provided with end fittings. This feature is particularly useful where it is desirable to steam sterilize the tubing and associated apparatus and where the plastic block of the clamp cannot stand steam sterilization without being damaged. In the latter instance, the length of tubing is threaded through the slide plate and the assembly steam sterilized, after which the block is fitted about the tubing and the slide plate is "snap-fitted" into the slot in the block.

In the foregoing description and in the drawing, each embodiment illustrating the invention has referred to a slide plate or wedge plate as the means for compressing the tubing. It should be understood, however, that the invention is not limited to the combination which uses a flat or thin member as the tubing compressing means. If desired, the tubing compressing member having the tapered channel therein can be made of wire or the like

without departing from the broad scope of the present invention.

Others may readily adapt the invention for use under various conditions of service, by employing one or more of the novel features disclosed or equivalents thereof. As at present advised with respect to the apparent scope of my invention, I desire to claim the following subject matter.

I claim:

1. A flow control clamp structure adapted for use with a compressible and flexible conduit comprising clamp elements which include a block element and a wedge plate element, said block having a transverse bore extending therethrough, said block also being provided with a slot extending thereacross and opening into said bore and being generally normal to the longitudinal axis of the bore, and said wedge plate slidable within said slot, and said block also being provided with a passage extending along the entire length of said slot from the outer surface thereof into the said slot and said passage having the upper wall surface providing a restricted opening with a width slightly less than the width of the said wedge plate to restrain the said plate against accidental withdrawal therefrom, and at least one of said elements being

of resilient material to facilitate positioning the said wedge plate in the said passage whereby the said plate can be operatively positioned in the said slot without requiring the insertion of the end of said plate into the said slot.

2. A clamp substantially as in claim 1 in which the said passage is provided with an inwardly tapered lateral surface which facilitates positioning the said wedge plate in the said slot.

3. The structure of claim 1 in which said block is provided with a mouth extending from end to end of said bore and communicating therewith, said mouth being dimensioned and arranged for passing said conduit there-through and into said bore.

References Cited in the file of this patent

UNITED STATES PATENTS

1,055,440	Boden	Mar. 11, 1913
2,092,400	Miller	Sept. 7, 1937
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21,170	Great Britain	of 1899
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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,889,848

June 9, 1959

Wilbert W. Redmer

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.

In the grant, line 2, for "assignor to Redmer Sons Company, of Franklin Park, Illinois," read -- assignor, by mesne assignments, to Abbott Laboratories, --; line 11, for "Redmer Sons Company, its successors" read -- Abbott Laboratories, its successors --; in the heading to the printed specification, lines 3 and 4, for "assignor to Redmer Sons Company, Franklin Park, Ill." read -- assignor, by mesne assignments, to Abbott Laboratories.

Signed and sealed this 10th day of November 1959.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON
Commissioner of Patents