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E. A. AVERILL

METHOD AND DEVICE FOR TREATING LIQUIDS

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Fig. 1.

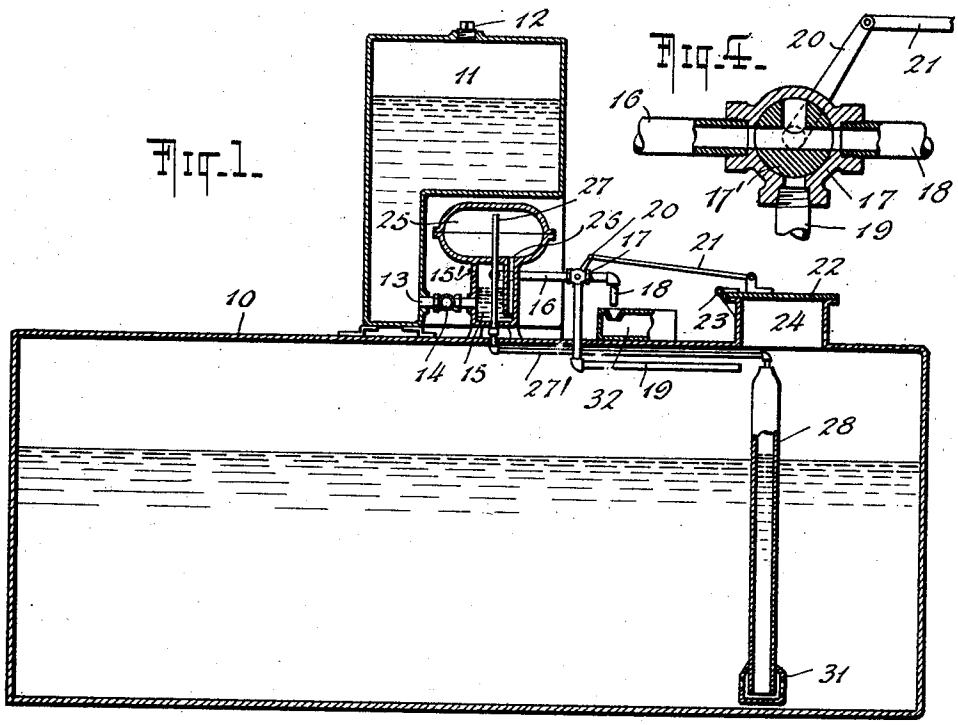


Fig. 4.

Fig. 2.

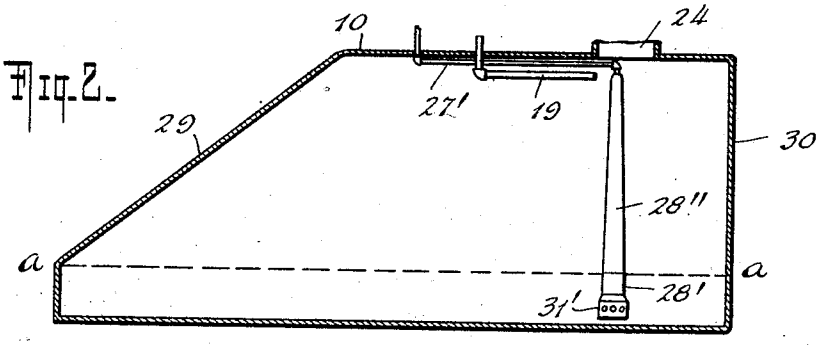
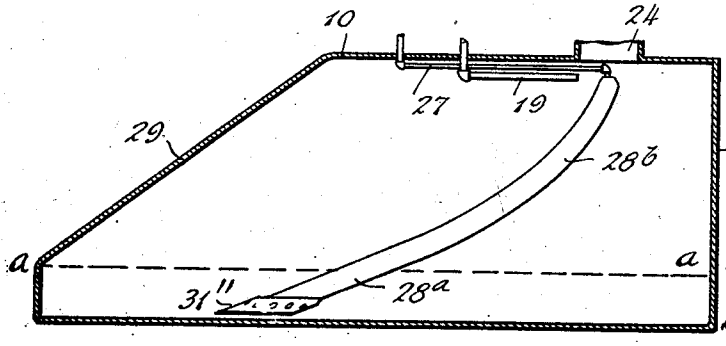


Fig. 3.



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UNITED STATES PATENT OFFICE.

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METHOD AND DEVICE FOR TREATING LIQUIDS.

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To all whom it may concern:

Be it known that I, EARL A. AVERILL, a citizen of the United States, and resident of Mount Vernon, county of Westchester, and State of New York, have invented certain new and useful Improvements in Methods and Devices for Treating Liquids, of which the following is a specification.

My present invention relates to methods and devices for supplying liquids with a treating agent in definite proportions, and has been devised primarily for the purpose of feeding a solution of a so-called boiler compound (anti-scale compound) to the water tank of a locomotive tender in measured proportion automatically as a raw supply of water is being admitted to such tank. For securing this result in an effective manner with the use of comparatively simple mechanism, I have devised a novel construction and arrangement of parts, three examples of which are illustrated by the accompanying drawings, in which Figs. 1, 2, and 3 are longitudinal vertical sections showing the different embodiments of my invention in connection with locomotive tender tanks; and Fig. 4 is an enlarged cross section of a valve forming part of my improved apparatus. I desire it to be understood, however, that the improvement may be used in other relations than the specific ones represented, and is by no means restricted to employment in conjunction with locomotive tenders.

The three forms of my invention shown herein differ chiefly in the shape of the tender tank and of the pipe which controls the feeding of the anti-scale liquid to the water. The other parts, which are substantially alike in these constructions, are as follows:

On the top 10 of the tank (or on any other suitable support) is located a container 11 provided at its upper portion with a filling opening which under normal conditions is closed in an air tight manner, as by a plug 12. From the lower portion of said container, a pipe 13, provided with a shut-off cock or valve 14 (normally open) leads to a reservoir 15 likewise carried by a suitable support, such as the top 10. This pipe 13 is preferably horizontal, or it may be sloping upward toward container 11. From a point above the outlet of pipe 13, another pipe 16 leads from the reservoir 15 to a three-way cock or valve 17, having a discharge opening or spout 18 open to the air, and a discharge connection 19 leading into the tank. The plug or other movable member 17′ of the valve 17 has a crank-arm 20 pivotally connected with one end of a link 21, the other end of which has a like connection with a movable cover 22 (indicated as hinged at 23) adapted normally to close the filling opening 24 in the top 10 of the said tender tank. Above the reservoir 15 is located a measuring vessel 25 supported in any suitable manner, the interior of reservoir 15 being under atmospheric pressure, for instance by making such reservoir with an opening or vent 15′, as shown. The measuring vessel 25, however, is closed to the surrounding air, and has no openings except the connections or pipes 26 and 27 leading from its bottom and its top respectively. The pipe 26 extends downwardly into the reservoir 15 to a point below the level of the bottom of pipe 13; it will be understood that the open lower end of pipe 26 is thus adapted to dip into the body of liquid normally contained in reservoir 15, while the upper end of said pipe opens into the measuring vessel 25. The pipe 27 passes through the top 10 of the tank, and the lower portion 27′ of this pipe connects with the upper end of what I term the metering pipe.

The shape and position of this metering pipe will depend on the shape of the tank 10. The condition to be fulfilled by this pipe is that for equal differences in the level of the liquid in said tank, the amount of liquid contained in the pipe between the two levels under consideration shall bear a constant relation to the volume of liquid contained in said tank between the same two levels. To illustrate by an example, let us assume that it may be desired to have the amount or volume of liquid within the metering pipe, between any two levels, to be 1/1000th of the volume of liquid within the tank 10 between the same two levels.

In the specific construction shown in Fig. 1, the tank is of equal cross-sectional area at all levels, and the metering pipe 28 is straight and of uniform inside cross sectional area. The pipe 28 has been shown vertical, but this is not essential.

In Figs. 2 and 3, (which represent a form of tank used frequently for locomotive tenders), the tank has a lower portion the

horizontal cross section of which is of uniform or at least constant area up to a certain level, indicated at *a—a*. Therefore as long as the level of the liquid is below the line *a—a*, equal changes of level (say, the distance of one inch) will cause equal additions to, or substractions from, the volume of liquid in the tank. Above the line *a—a*, however, the horizontal cross section of the tank is not constant, but diminishes upward gradually, owing to the fact that at its upper portion 29, one end wall of the tank is inclined inwardly and upwardly toward the opposite end wall 30. Therefore, in this upper portion of the tank, equal changes in the level of the liquid will not produce equal additions to or subtractions from, the volume of liquid in the tank. In view of these conditions the tank construction shown in Figs. 2 and 3 requires the metering pipe to be given different characteristics above and below the level *a—a* respectively.

In the construction illustrated by Fig. 2, the lower portion 28′ of the metering pipe is straight and of uniform or constant inside cross sectional area, while the upper portion 28″ is contracted upwardly gradually.

In the specific embodiment illustrated in Fig. 3, the metering pipe has a straight lower portion 28^a (shown as inclined in the same direction as the end wall portion 29, that is, upwardly toward the end wall 30), and an upper portion 28^b shown as curved in such a manner as to be tangential to the direction of the straight lower portion 28^a, the concavity of said curve facing upwardly, and the pipe 28^a, 28^b being assumed as of constant interior cross sectional area. The curve of the upper pipe portion 28^b will be such as to exhibit the desired property, in other words, if the amount of liquid in the tank 10 of Fig. 3 increases or decreases by any quantity n, the amount of liquid in the metering pipe 28^a, 28^b will be increased or decreased by a constant percentage $\frac{l}{c}$ (say .1%) of said quantity, or in other words, for every variation of the liquid in the tank by the amount n, the liquid in the pipe 28^a, 28^b will vary by the amount $\frac{n}{c}$.

The same result is obtained with the constructions shown in Figs. 1 and 2.

I prefer to provide a water seal at the lower end of the metering pipe as indicated at 31, 31′ and 31″ in Figs. 1, 2, and 3 respectively. It will be understood that Figs. 2 and 3 are fragmentary, the parts not illustrated therein being assumed as of the same construction as those shown in Fig. 1.

The container 11 is filled with the liquid (generally a solution of a suitable anti-boiler-scale compound) which it is desired to use for treating the water in the tank. For this purpose, the valve 14 is closed and the plug 12 removed. The liquid is then poured into the container 11 to the top and the plug 12 applied to close the container. The latter and the pipe 13 are of air-tight construction. Thereupon the valve 14 is opened to allow a small amount of the liquid to pass from the container 11 through the pipe 13 into the reservoir 15. On account of the air-tight character of the container 11, only a small amount of liquid will pass out, filling the reservoir 15 to a level slightly above the top of the outlet end of pipe 13, a partial vacuum being created in the upper portion of the container 11. In the main tank, the level of the water in the metering pipe will be the same as around said pipe, or slightly higher. The pipe 27, 27′ forms an air-tight connection between the metering pipe and the measuring vessel 25, the latter itself being air-tight and having an air-tight joint with the pipe 26. When the cover 22 is closed, the cock 17 will connect the pipe 16 with the outlet 18. Thus, should an excessive rise in temperature cause the liquid in the container 11 to expand and overflow into reservoir 15 and pipe 16, such excess will not reach the tank, but may be discharged to the open air or into a collector 32 placed under the end of pipe 18. When charging the apparatus for the first time, I would add to the water in the tank, in any suitable manner, the desired amount of liquid to treat the entire water contents of the tank. After this initial charge of treating liquid, however, the further supply of treating liquid to the water in the tank will take place automatically, in the following manner:

With the tank full of water containing the proper proportion of treating compound, and the cover 22 closed so that cock 17 closes the connection between reservoir 15 and the tank (through pipe 19), the following action will take place as treated water is being withdrawn from the tank for use in the boiler: The level of the liquid will fall about equally within and around the metering pipe (28 in Fig. 1, 28′, 28″ in Fig. 2, and 28^a, 28^b in Fig. 3). This will cause suction to be exerted within the upper portion of the metering pipe (28 in Fig. 1, 28′, 28″ in Fig. 2, and 28^a, 28^b in Fig. 3), the connecting pipe 27′, 27, the measuring vessel 25 and the pipe 26. As the latter dips into the liquid contained in the reservoir 15, a certain amount of such liquid will be drawn upwardly into the measuring vessel 25. Thus as the tank is being emptied, more and more liquid will be drawn into the measuring vessel 25 from the reservoir 15, and owing to the particular construction and arrangement of the metering pipe, the amount thus transferred to said vessel will be a definite and constant proportion of the amount of

water withdrawn from the tank. So, when finally the tank is empty, the measuring vessel 25 will contain an amount of liquid sufficient to treat the entire capacity of the tank. This vessel 25 has a volume somewhat greater than the total volume of the metering pipe 28, or 28′, 28″ or 28ª, 28ᵇ. Whenever the transfer of liquid from the reservoir 15 to the measuring vessel 25 causes the level of the liquid in the reservoir 15 to fall below the outlet of the supply pipe 13, air will pass through said pipe from the reservoir 15 into the container 11, and a corresponding amount of liquid will flow out of said container into the reservoir, thus keeping the level almost constant in said reservoir and always providing a sufficient amount of liquid therein for transfer to the measuring vessel in proportion to the amount of water withdrawn from the tank. The water seal arrangement at the bottom of the metering pipe prevents the slight vacuum now existing therein from being broken.

When the tank is subsequently to be refilled with water, the cover 22 is opened, so that the cock 17 takes the position in which the pipes 16 and 19 communicate with each other. As water enters the tank the level will also rise in the metering pipe, slightly reducing the vacuum or in other words increasing the pressure of the air trapped between the liquid in vessel 25 and the water in the metering pipe. This will cause an amount of the liquid in the vessel 25, proportional to the increase of pressure, to be forced through the pipe 26 into the reservoir 15, thereby raising the level of the liquid in the reservoir and establishing a flow through the pipe 16. As the valve plug 17′ has at this time been rotated by the opening of the cover 22, the pipe 16 is in communication with the pipe 19 and the liquid passing out of the reservoir 15 flows into the tank. Thus an amount of liquid substantially proportional to the amount of water entering the tank, will be fed or transferred automatically from the measuring vessel 25 (via the reservoir 15 and pipes 16, 19) to the tank, to mingle with the water admitted thereto through the opening 24. Therefore, whether the amount of water supplied to the tank is sufficient to fill it entirely, or only partly, the amount of treating compound (auxiliary liquid) transferred to such tank from the measuring vessel 25 will be in substantially the constant proportion desired.

The amount of liquid required to fill reservoir 15 from the level that may exist in it at the time the discharge from 26 begins, up to the level to discharge through pipe 16, will not be discharged into the tank. This however is a practically constant quantity and is allowed for in the original proportioning of the size of the metering pipe.

Various modifications may be made without departing from the nature of my invention as set forth in the appended claims.

I claim:

1. An apparatus of the class described, comprising a tank, a metering pipe communicating with the interior of said tank, a measuring vessel the top of which is connected with said metering pipe, a reservoir open to the outside air located at a lower level than said vessel and having a connection discharging into the tank, a pipe connecting the lower portion of said vessel with said reservoir at a point below its discharge connection, said pipe, measuring vessel and metering pipe forming a unit closed to the outside air, a supply pipe leading to said reservoir at a point below its discharge connection, and a container to deliver liquid to the reservoir through said supply pipe.

2. An apparatus of the class described, comprising a tank, a metering pipe communicating with the interior of said tank, a measuring vessel the top of which is connected with said metering pipe, a reservoir open to the outside air located at a lower level than said vessel and having a connection discharging into the tank, a pipe connecting the lower portion of said vessel with said reservoir at a point below its discharge connection, said pipe, measuring vessel and metering pipe forming a unit closed to the outside air, and means for supplying liquid to said reservoir automatically whenever the surface of the liquid therein falls below a predetermined level.

3. An apparatus of the class described, comprising a tank having a filling opening, a metering pipe communicating with the interior of said tank, a measuring vessel the top of which is connected with said metering pipe, a reservoir open to the outside air located at a lower level than said vessel and having a connection discharging into the tank, a pipe connecting the lower portion of said vessel with said reservoir at a point below its discharge connection, said pipe, measuring vessel and metering pipe forming a unit closed to the outside air, a cover controlling the said filling opening to said tank, a valve controlling said discharge connection, an operative connection between said cover and said valve to open the connection from the reservoir to the tank when said cover is open, and means for supplying liquid to said reservoir automatically whenever the surface of the liquid therein falls below a predetermined level.

4. An apparatus of the class described, comprising a tank, a metering pipe communicating with the interior of said tank, a measuring vessel the top of which is connected with said metering pipe, a reservoir open to the outside air located at a lower level than said vessel and having a connection discharging into the tank, a pipe con-

necting the lower portion of said vessel with said reservoir at a point below its discharge connection, said pipe, measuring vessel and metering pipe forming a unit closed to the outside air, a cover controlling a filling opening to said tank, a valve controlling said discharge connection, an operative connection between said cover and said valve to open the connection from the reservoir to the tank when said cover is open, and to provide a different path for the discharge of liquid from said connection when said cover is closed, and means for supplying liquid to said reservoir automatically whenever the surface of the liquid therein falls below a predetermined level.

5. An apparatus of the class described, comprising a tank provided with a filling opening, a movable cover for said opening, a pipe for supplying to said tank, a compound to be mixed with the liquid in the tank, a valve controlling said pipe, and an operative connection between said cover and said valve to open the liquid-supply path from said pipe to the tank when the cover is open, and to close said path to the tank when the cover is closed.

6. An apparatus of the class described, comprising a tank provided with a filling opening, a movable cover for said opening, a pipe for supplying to said tank, a compound to be mixed with the liquid in the tank, means, operated by the rise of the liquid level in the tank, for supplying said compound to said pipe, a valve in said pipe, and an operative connection between said cover and said valve to open the liquid-supply path from said pipe to the tank when the cover is open, and to provide, when the cover is closed, a different path for discharging from said pipe, any excess volume of compound due to expansion by heat.

7. An apparatus of the class described, comprising a tank, a measuring vessel located above the level of the tank, a metering pipe connecting said measuring vessel with the liquid-space of the tank, a source of supply from which said vessel draws an amount of auxiliary liquid by the suction produced by the fall of the main liquid in the metering pipe, as liquid is being withdrawn from the tank, and a connection through which said measuring vessel delivers auxiliary liquid to the tank automatically as the level of the main liquid rises in the metering pipe during the operation of filling the tank.

8. An apparatus of the class described, comprising a tank, a measuring vessel located above the level of the tank, a metering pipe connecting said measuring vessel with the liquid-space of the tank, a source of supply from which said vessel draws an amount of auxiliary liquid by the suction produced by the fall of a main liquid in the metering pipe, as liquid is being withdrawn from the tank, and a connection through which said measuring vessel delivers auxiliary liquid to the tank automatically as the level of the main liquid rises in the metering pipe during the operation of filling the tank, the internal volume of the said metering pipe, between any two levels, bearing a constant relation to the tank volume contained between the same two levels, whereby the amount of auxiliary liquid passing into and out of the measuring vessel will at all times be proportional to the amount of main liquid passing out of and into the tank respectively.

9. An apparatus of the class described, comprising a tank, a measuring vessel located above the level of the tank, a metering pipe connecting said measuring vessel with the liquid-space of the tank, a source of supply from which said vessel draws an amount of auxiliary liquid by the suction produced by the fall of main liquid in the metering pipe as liquid is being withdrawn from the tank, and a connection through which said measuring vessel delivers auxiliary liquid to the tank automatically as the level of the main liquid rises in the metering pipe during the operation of filling the tank, the said tank tapering upwardlly, and that portion of the metering pipe which lies within the range of the levels of the tapering tank portion, being curved, with the concavity of the curve facing upward, the length of metering pipe portions, between successive equidistant levels, decreasing upwardly in the same ratio as the members of a series of successive odd numbers.

10. An apparatus of the class described, comprising a tank, a measuring vessel located above the level of the tank, a metering pipe connecting said measuring vessel with the liquid-space of the tank, a source of supply from which said vessel draws an amount of auxiliary liquid by the suction produced by the fall of main liquid in the metering pipe, as liquid is being withdrawn from the tank, and a connection through which said measuring vessel delivers auxiliary liquid to the tank automatically as the level of the main liquid rises in the metering pipe during the operation of filling the tank, the said tank having a lower portion of constant horizontal area at different levels, and an upper portion tapering upwardly, that portion of the metering pipe which lies within the range of the levels of the tapering tank portion, being curved with the concavity of the curve facing upwardly, and that portion of the metering pipe which lies within the range of the levels of the said lower tank portion, being straight and tangential to the lower end of such curved portion of the metering pipe.

11. An apparatus of the class described, comprising a tank, a measuring vessel lo-

cated above the level of the tank, a metering pipe connecting said measuring vessel with the liquid-space of the tank, a source of supply from which said vessel draws an amount of auxiliary liquid by the suction produced by the fall of main liquid in the metering pipe, as liquid is being withdrawn from the tank, and a connection through which said measuring vessel delivers auxiliary liquid to the tank automatically as the level of the main liquid rises in the metering pipe during the operation of filling the tank, the said tank tapering upwardly, and that portion of the metering pipe which lies within the range of the levels of the tapering tank portion, being curved, with the concavity of the curve facing upwardly.

12. An apparatus of the class described, comprising a tank, a measuring vessel located above the level of the tank, a metering pipe connecting said measuring vessel with the liquid-space of the tank, a source of supply from which said vessel draws an amount of auxiliary liquid by the suction produced by the fall of main liquid in the metering pipe, as liquid is being withdrawn from the tank, and a connection through which said measuring vessel delivers auxiliary liquid to the tank automatically as the level of the main liquid rises in the metering pipe during the operation of filling the tank, the said tank tapering upwardly, and that portion of the metering pipe which lies within the range of the levels of the tapering tank portion, being contracted upwardly gradually in interior area.

13. An apparatus of the class described, comprising a tank, a measuring vessel located above the level of the tank, a metering pipe connecting said measuring vessel with the liquid-space of the tank, a source of supply from which said vessel draws an amount of auxiliary liquid by the suction produced by the fall of main liquid in the metering pipe, as liquid is being withdrawn from the tank, and a connection through which said measuring vessel delivers auxiliary liquid to the tank automatically as the level of the main liquid rises in the metering pipe during the operation of filling the tank, the interior cross sectional areas of said tank, and metering pipe bearing the same proportional relation to each other at all levels.

14. The method of supplying to a liquid within a tank, proportional amounts of an auxiliary liquid from a measuring vessel, which consists in utilizing the suction produced by the fall of the liquid in the tank as the latter is delivering liquid, to draw a proportional amount of said auxiliary liquid into said measuring vessel, and utilizing the action produced by the rise of the liquid in the tank during the filling operation, to cause the transfer of a proportional amount of auxiliary liquid from the measuring vessel to said tank.

15. The method of supplying to a liquid within a tank proportional amounts of an auxiliary liquid from a vessel in communication with said tank, which consists in providing a confined column of fluid between said liquid and auxiliary liquid, utilizing the variations in the liquid level of the liquid in said tank, caused by the addition and discharge of liquid, to produce pressure changes in said confined column of fluid, and employing said pressure changes to transfer automatically to said tank an amount of said auxiliary liquid proportional to the amount of liquid added for use.

16. An apparatus of the class described, comprising a tank to which a liquid is added, and from which it is withdrawn, a container holding an auxiliary liquid to be added to said tank, a measuring vessel to which said auxiliary liquid is supplied from said container, a connection from said measuring vessel opening into said tank, and a fluid column confined between the liquids in said tank and said measuring vessel, said column being operated by variations in the liquid level in said tank to transfer said auxiliary liquid from said container to said tank in predetermined amounts.

17. An apparatus of the class described comprising a tank to which liquid is added, and from which it is withdrawn, a container holding an auxiliary liquid to be added to said tank, a measuring vessel to which said liquid is supplied from said container, and means to utilize the variations in the liquid level of the liquid in said tank, caused by the addition and discharge of liquid to transfer automatically to said tank an amount of said auxiliary liquid proportional to the amount of liquid added for use, said means including a connection from said measuring vessel to said tank through which said auxiliary liquid flows and a fluid column confined between the liquids in said tank and measuring vessel, said column being operated by the lowering of the liquid level in said tank to admit auxiliary liquid to said measuring vessel and by a raising of the liquid level in said tank to expel said auxiliary liquid from said measuring vessel to said tank.

In testimony whereof I have hereunto set my hand.

EARL A. AVERILL.