Aug. 16, 1932. G. D. CLARK 1,872,245

EXPANSION SYSTEM FOR A GASEOUS MEDIUM

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Fig. 1.

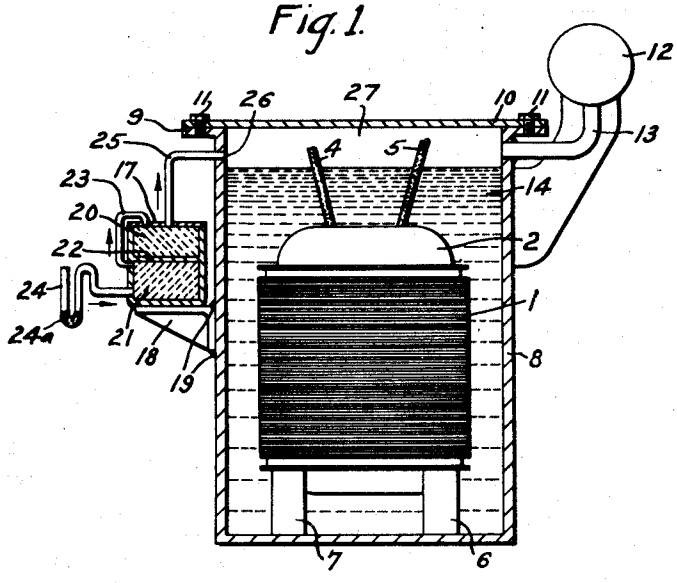


Fig. 2.

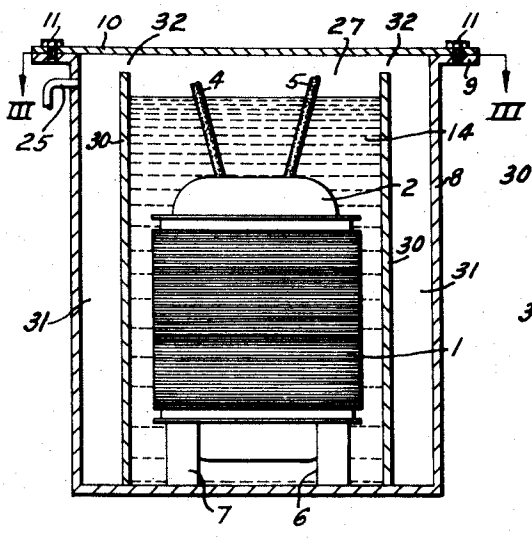
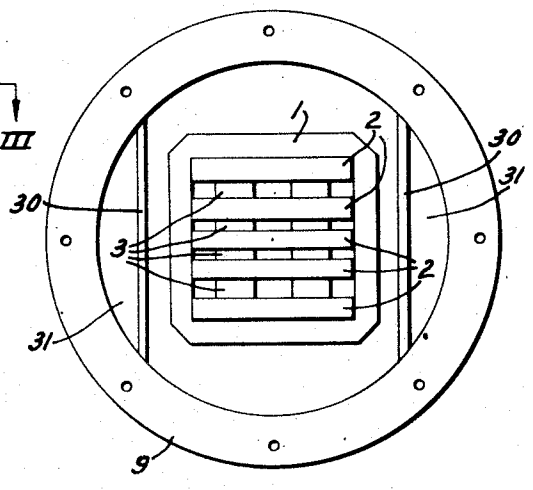


Fig. 3.



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Fig. 4.

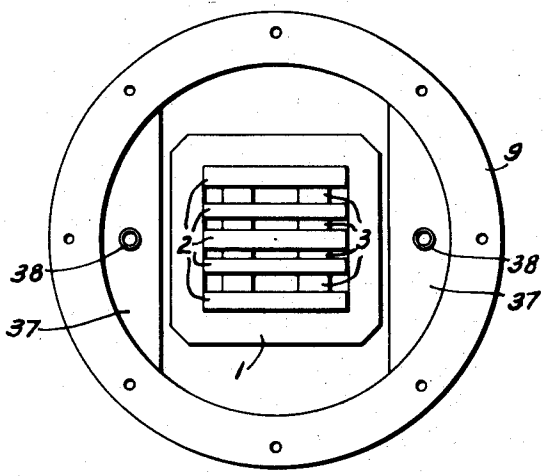
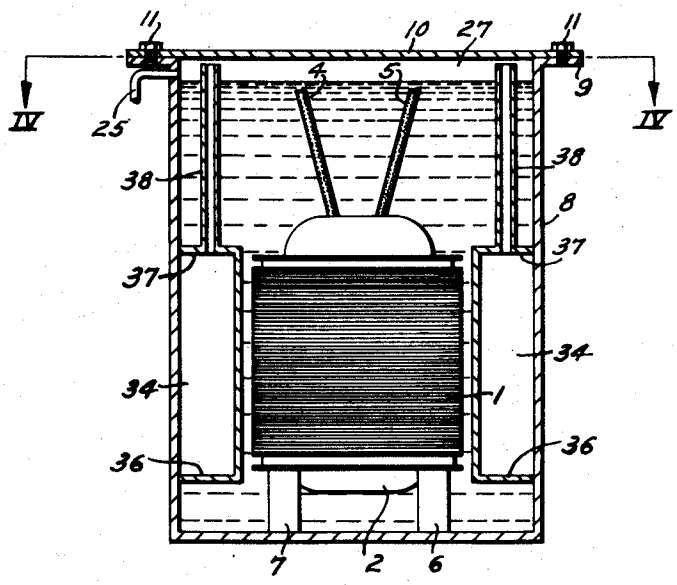


Fig. 5.



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Fig. 6.

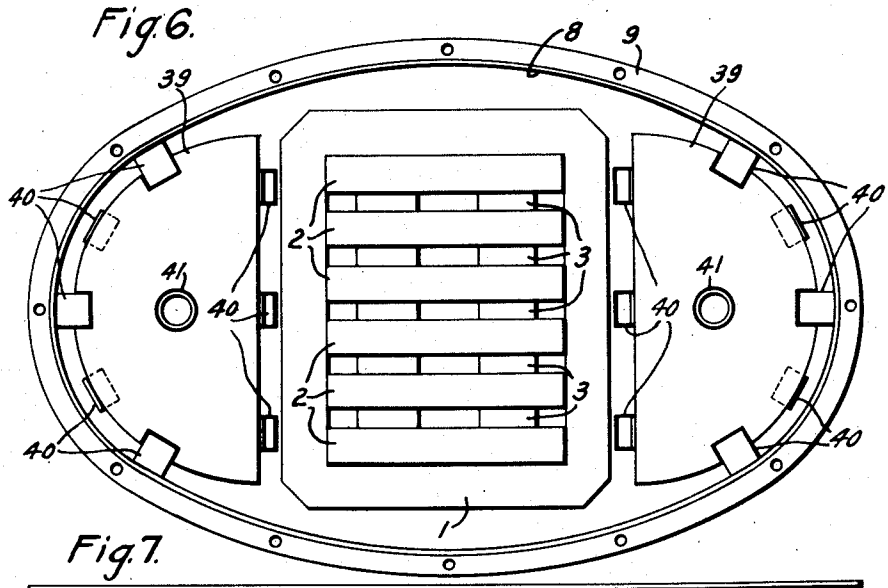
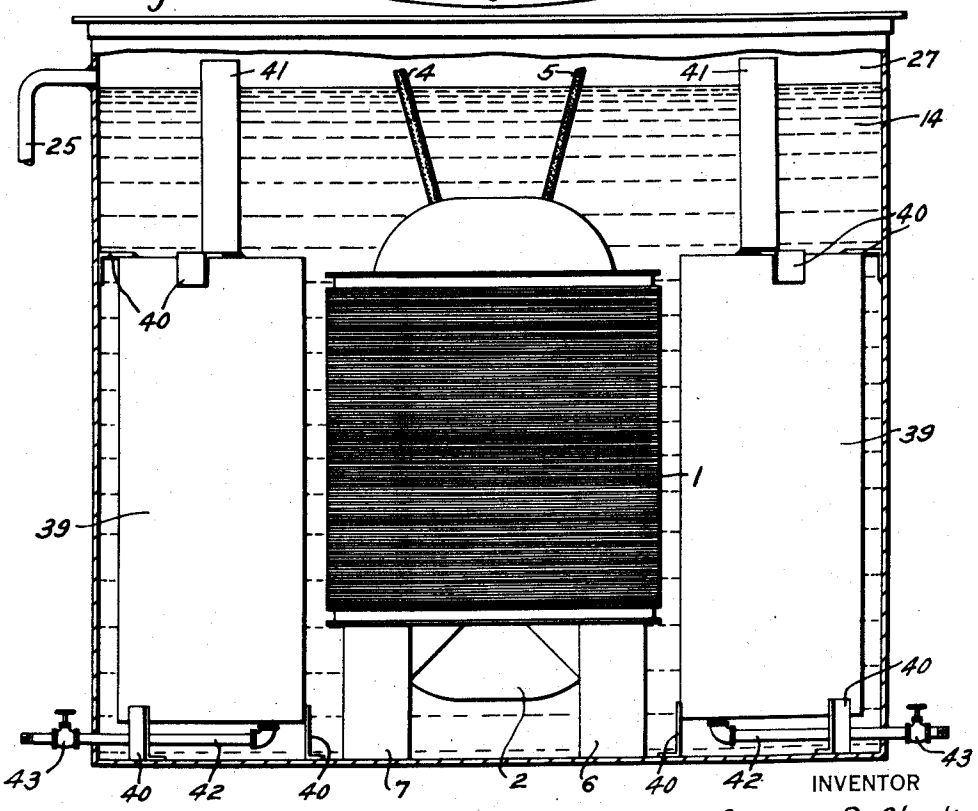


Fig. 7.



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Fig. 8.

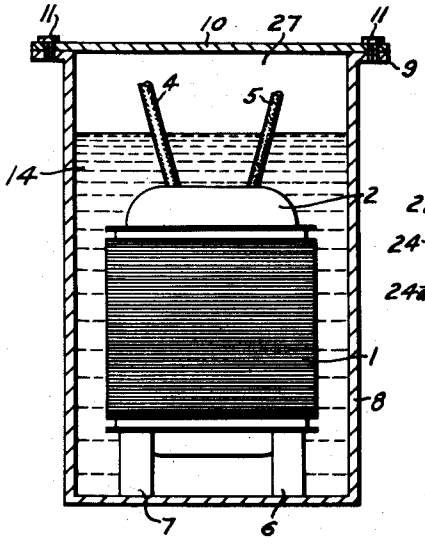
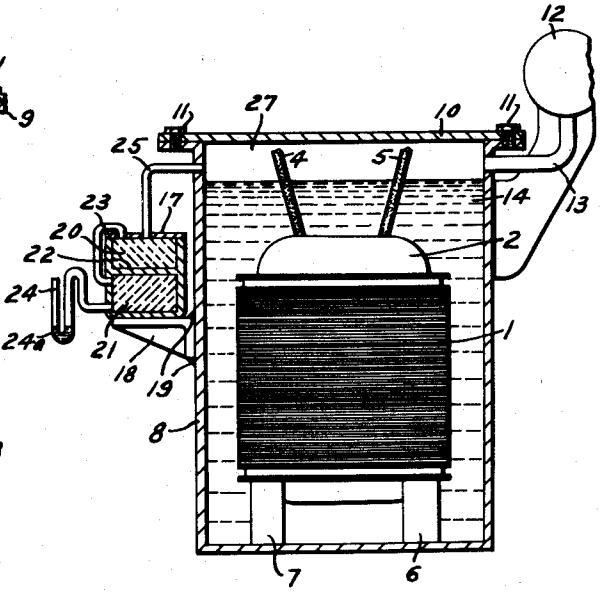


Fig. 9.



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UNITED STATES PATENT OFFICE

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EXPANSION SYSTEM FOR A GASEOUS MEDIUM

Application filed March 3, 1928. Serial No. 258,900.

My invention relates to expansion systems for a gaseous medium such, for example, as overlies the liquid medium contained in a casing or tank and enveloping an electrical heat-generating device, as a transformer, circuit-breaker, switch, or the like, hereinafter in this specification generally termed a "transformer".

In accordance with my invention, a chamber, usually of constant dimensions, is placed in communication with the space above a liquid medium contained in a casing and developing a transformer.

Further, in accordance with my invention, the aforesaid chamber may be disposed either interiorly or exteriorly of the aforesaid casing.

Further, in accordance with my invention, a gaseous medium, preferably an inert gaseous medium, preferably an inert gaseous medium, i. e. one from which oxygen has been largely or substantially excluded, is disposed within the aforesaid space to pass to and from the aforesaid chamber upon expansion and contraction of said liquid medium.

Further, in accordance with my invention, the pressure of the aforesaid gaseous medium is maintained within predetermined limits.

Further, in accordance with my invention, the space above a liquid medium contained in a casing and enveloping a transformer is supplied with an inert gaseous medium by a means functioning independently of a chamber into which said gaseous medium is expansible.

Further, in accordance with my invention, the casing of a transformer has substantially less height than have the casings of prior-art transformers of substantially the same load rating; more particularly, less space is provided in the transformer casing for the reception of the cushioning gaseous medium.

My invention resides in the system, method, apparatus, and features of construction of the character hereinafter described and claimed.

For an understanding of my method and for an illustration of some of the forms my system or apparatus may take, reference is to be had to the accompanying drawings, in which:

Figure 1 is a view, partially in elevation and partially in section, of a transformer having a gas-expansion chamber associated therewith in accordance with my invention.

Fig. 2 is a view, similar to Fig. 1, wherein gas-expansion chambers are provided by baffle walls separating the insulating liquid medium from a porton of the main casing.

Fig. 3 is a plan view of a portion of the device shown in Fig. 2, taken on the line III—III thereof.

Fig. 4 is a plan view of a portion of the device shown in Fig. 5, taken on the line IV—IV thereof.

Fig. 5 is a view, partly in elevation and partly in section, of a modified form of transformer.

Fig. 6 is a plan view of the transformer casing shown in Fig. 7, its cover being removed.

Fig. 7 is a view, partially in section and partially in elevation, of a modified structure embodying my invention.

Fig. 8 is a view, similar to Fig. 1, showing a prior-art transformer casing.

Fig. 9 is a view, similar to Fig. 1, showing, by comparison with Fig. 8, the reduction in height of a transformer casing which may be effected by practicing my invention.

In Figs. 1 and 3, is illustrated a transformer which may comprise a laminated magnetizable core 1, coils 2 suitably insulated from each other by washers 3 and connected to form a primary and a secondary winding for the transformation of alternating current from one voltage to another, all as is well understood in the art.

Leads or conductors 4 and 5 comprise the terminals of either the primary or the secondary winding and they, together with the terminals for the other winding, may be provided with insulator bushings, or the like, (not shown) that are mounted on the top of the transformer casing.

The laminated core 1 and the windings 2 are mounted, preferably, on supports 6 and 7 that rest on the bottom of the transformer tank or casing 8. The tank 8 is provided

with a flange 9 to which a cover 10 is secured by bolts 11, or the like. The cover 10 is mounted on the casing 8 in such manner that the latter is substantially air-tight.

In accordance with my invention, a suitably positioned chamber 12 has connected thereto a conduit or tube 13 communicating with the casing 8 near its cover and welded, or otherwise suitably secured to the wall structure to form said casing. The casing 8 is filled with a suitable insulating liquid medium 14, as oil, the normal level thereof being below the open end of the pipe 13.

As is usual in apparatus of the character described above, the space above the liquid medium 14 is occupied by a gaseous medium. Preferably, and in accordance with my invention, the gaseous medium is of the character designated in the art as "inert" with respect to gases evolved from the liquid medium 14. In other words, said gaseous medium is one from which oxygen has been largely or substantially excluded. This inert gaseous medium may be produced and maintained, as outlined in the copending application of Rodman et al., Serial No. 2,779, filed January 16, 1925 and assigned to Westinghouse Electric and Manufacturing Company, or otherwise, if desired.

When the inert gaseous medium is produced and maintained, as aforesaid, a container 17 may be mounted on a shelf 18 secured, preferably, to the side of the transformer casing 8 by welded joints 19. The container 17 is divided into two compartments 20 and 21 by a wall 22. The compartments 20 and 21 are placed in communication by a tube 23 opening into the upper portion of each of said compartments. A tube 24, opening into the compartment 21, comprises a U-tube portion containing a pool of mercury 24*a* and functioning as a pressure regulator. The compartment 20 is connected, by a tube 25, to an opening 26 in the casing 8 above the surface of the liquid medium 14. The aforesaid pressure regulator, herein conventionally shown, may be of any suitable type such, for example, as is illustrated in Hill application, Serial No. 608,791 filed December 23, 1922 and assigned to Westinghouse Electric & Manufacturing Company.

The container 17 contains substances or materials for dehydrating and deoxidizing ordinary atmospheric air before it is admitted to the space 27 in the transformer casing above the surface of the liquid medium 14. Accordingly, the upper compartment 20 of the container 17 is preferably filled with a dehydrating agent, such as calcium chloride, and the lower compartment 21 is preferably filled with a deoxidizing agent, such as finely ground copper mixed with a porous material.

When a load is imposed on the transformer, its core 1 and coils 2 are elevated in temperature, with a consequent rise in temperature of the liquid medium 14. As a result, the latter expands. Later, when the load on the transformer has decreased, the aforesaid liquid medium 14 cools and, consequently, contracts. With devices of the prior art, upon expansion of the liquid medium 14, as aforesaid, a portion of the gaseous medium in the space thereabove is passed to the atmosphere while, upon contraction of the liquid medium 14, some ordinary atmospheric air is drawn into said space.

When a large power transformer is changed from no-load to full-load condition, the gaseous interchange between the space above the insulating liquid medium and the atmosphere becomes substantial. It follows, therefore, that, if the aforesaid transformer is one wherein the gaseous medium overlying the liquid medium is to be maintained "inert", as aforesaid, large or relatively heavy demands are made on the equipment for removing oxygen from such ordinary atmospheric air as enters the transformer casing.

In accordance with my invention, gaseous interchange or "breathing", as aforesaid, between the space above the insulating liquid medium and the atmosphere is largely or substantially prevented by producing sufficient space to care for the expansion of the gaseous medium without development of abnormally high pressures. Such space may be provided either interiorly or exteriorly of the transformer casing, ordinarily, however, in some region other than the one directly above the insulating liquid medium and within the tank since such a construction may unduly increase the height of the transformer casing. In some cases and in accordance with my invention, the height of the transformer casing may even be decreased with consequent decrease in the height of the gas space therein without decrease, however, in the load rating of the transformer.

The arrangement illustrated in Fig. 1 and described above constitutes one form of my invention wherein the casing 12 is disposed exteriorly of the casing 8 and is utilizable as an expansion chamber for the gaseous medium in the space above the insulating liquid medium 14. When the transformer is placed in operation, the gaseous medium in the aforesaid space may be rendered inert in any suitable manner, or a quantity of inert gas may be suitably introduced into said space.

The breathing regulator 24*a* may be so adjusted that gas does not pass from the transformer casing to the atmosphere until some suitable pressure, as 5 lbs., greater than atmospheric pressure, more or less, has been built up in the space above the liquid medium 14. Under such circumstances, there is no interchange between the space above the in-

sulating liquid and the atmosphere until a pressure in excess of said 5 lbs. has been developed in said space.

Because of the control effected by the breathing regulator 24*a*, the quantity of gas stored in the chamber 12 is much greater than if the arrangement operates at atmospheric pressure. When a pressure has been developed in the casing 8 which exceeds the selected pressure, which, in the example assumed, is 5 lbs. greater than atmospheric pressure, interchange occurs between the space above the insulating liquid and the atmosphere and when ordinary atmospheric air passes toward said space, it traverses the substances 20 and 21 and is largely denuded of its oxygen and moisture content. Thus, in the apparatus shown in Fig. 1, because of the provision of the chamber 12, the demands imposed on the water- and oxygen-removing substances 20 and 21 are much reduced and without increase in the height of the transformer casing 8. This is an important advantage in modern transformer practice.

As stated above, it is characteristic of my invention that the transformer casing may be reduced in height without decreasing the load rating. This feature is illustrated in Figs. 8 and 9 where Fig. 8 illustrates a prior-art transformer having a typically-dimensioned gas space above the insulating liquid medium while Fig. 9 duplicates the illustration of Fig. 1. Comparison of Figs. 8 and 9 makes readily apparent the reduction of height which may be effected in a transformer casing, while preserving the same load ratings.

In Figs. 2 and 3 is illustrated another form of my invention wherein one or more expansion chambers is or are provided interiorly of the transformer casing. To this end, plates 30 are preferably welded to the bottom and side wall of the casing 8 to thereby form chambers 31. The plates extend above any level to which insulating liquid medium 14 rises but below the top 10 of the transformer casing 8 to form space or passages 32 therebetween. The plates 30 effectually separate the liquid medium 14 from the gas-expansion chambers 31, the latter performing the same useful function as described in connection with Fig. 1.

In Figs. 4 and 5 is illustrated another form of my invention wherein one or more gas-expansion chambers 34 is or are provided, the said chambers being formed by welding or otherwise suitably securing receptacles 35 to the wall structure of the transformer casing 8, the aforesaid receptacles 35 comprising bottom plates 36 and top plates 37. Tubes or conduits 38 extend from the respective chambers 34 upwardly through the liquid medium 14 and communicate with the space 27 thereabove.

Referring to Figs. 6 and 7, gas-expansion chambers 39 are disposed in the transformer casing 8 below the surface of the liquid medium 14 and are held in position by brackets 40 welded, or otherwise suitably secured, to the interior of the casing 8 and to the chambers. Pipes or conduits 41 extend from the tops of the chambers 39 above the upper surface of the liquid medium 14 and permit free passage of the gaseous medium to and from the chambers.

If desired, means may be provided for draining the expansion chambers 39 such, for example, as illustrated, where a pipe 42 provided with a valve 43 communicates with the bottom of each chamber 39 and extends through an opening in the side wall of the casing 8.

It will be observed that the chambers 39 shown in Figs. 6 and 7 are spaced from the side-wall structures of the casing 8. This arrangement is especially desirable in self-cooled transformers wherein the casing side-wall structure radiates the heat of the insulating liquid medium to the atmosphere. Under such circumstances, obviously, the aforementioned liquid medium should contact directly with the casing side-wall structure. Structures such as are illustrated in Figs. 2, 3, 4 and 5 are especially suitable in connection with water-cooled transformers.

When the gas-expansion chambers are mounted within the transformer casing, a considerable saving in the amount of the insulating liquid medium is effected because the space formerly occupied by said medium is now occupied by the gas-expansion chambers.

To sum up the advantages obtained by my invention, a decrease in the height of the transformer casing is effected; a decrease in the amount of insulating liquid is effected if the chambers are placed inside the tank; a reduction is effected in the amount of the oxygen- and moisture-removing substances that are used; and the capacity of large power transformers for the same heights of casings is considerably increased.

While I have shown several specific embodiments of my invention in connection with various applications, it will be understood that I do not wish to be limited to such specific embodiments, but only by the scope of the appended claims.

I claim as my invention:

1. A transformer casing including a chamber for containing a transformer and insulating liquid therefor and a gas space above the liquid, a totally enclosed expansion compartment providing a space of constant gaseous volume connecting with the space above the oil and located remotely therefrom, thereby permitting the tank to be constructed with a minimum height of the tank above the level of the liquid.

2. A transformer casing including a cham-

ber for containing a transformer and insulating liquid therefor and a gas space above the liquid, said tank being constructed to provide a totally enclosed expansion compartment providing a space of constant gaseous volume connecting with the space above the liquid and located remotely therefrom.

3. A transformer casing including a chamber for containing a transformer and insulating liquid therefor and a gas space above the liquid, said tank being constructed to provide a relatively small expansion space directly above the liquid level and a relatively large totally enclosed expansion space of constant gaseous volume remote from the space above the liquid level.

4. A transformer casing including a transformer chamber, an insulating liquid within said transformer chamber and a gas space above the level of the liquid, and an expansion chamber of constant gaseous volume within said casing and entirely submerged in said liquid communicating with said gas space.

5. A transformer casing including a transformer chamber, an insulating liquid within said transformer chamber and a gas space above the level of the liquid therein, and an expansion chamber of constant gaseous volume within said casing extending below the level of and surrounded by said liquid and communicating with said gas space.

In testimony whereof, I have hereunto subscribed my name this 23 day of February 1928.

GEORGE D. CLARK.