Dec. 3, 1935. E. A. HARTY 2,023,226

RECTIFIER UNIT FOR ELECTROLYSIS CONTROL

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Fig. 1.

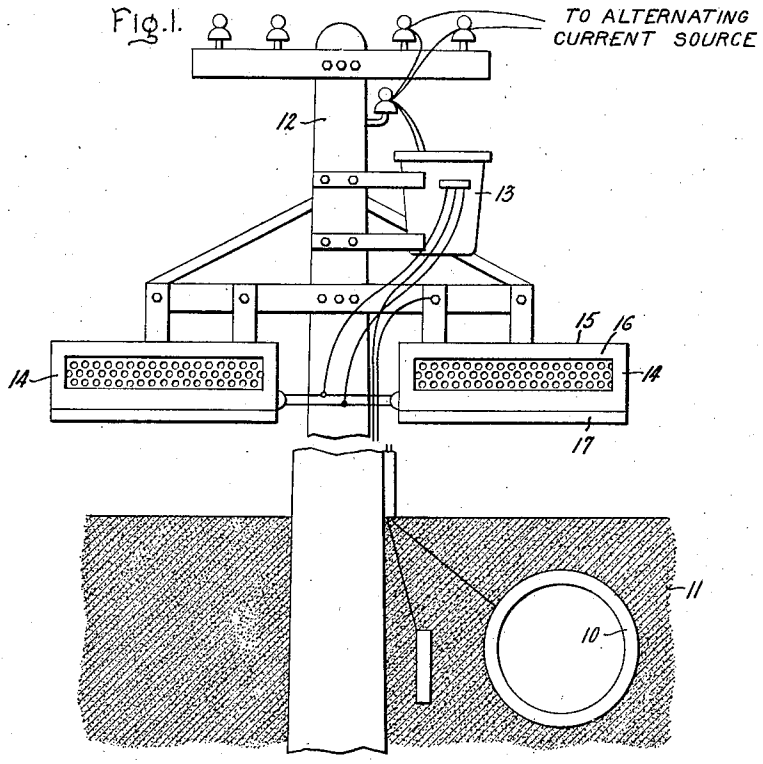
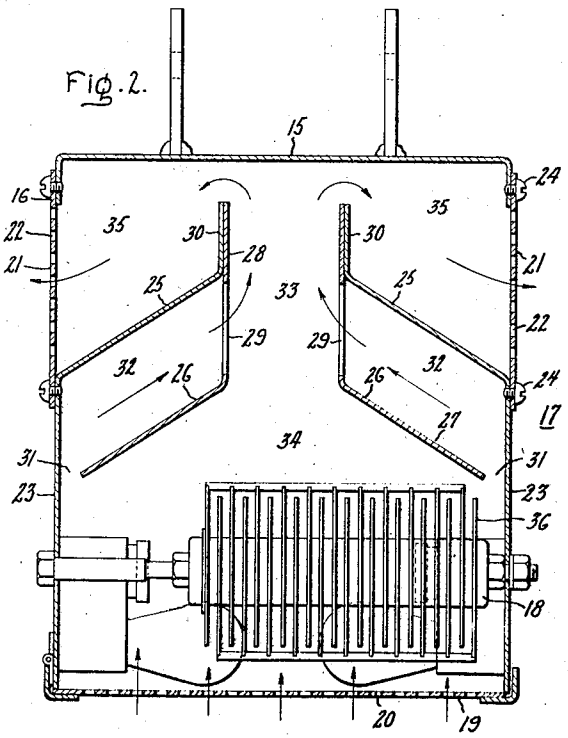


Fig. 2.



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RECTIFIER UNIT FOR ELECTROLYSIS CONTROL

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7 Claims. (Cl. 175—366)

My invention relates to rectifier apparatus of the contact type and particularly to rectifier apparatus which comprises copper-oxide rectifier elements and which is employed in systems for the control of electrolysis in pipe lines or similar structures. One of its objects is to provide an improved rectifier apparatus unit for such systems or similar systems whereby the temperature of the copper-oxide or other rectifier active elements is prevented from rising above a predetermined limit under all conditions of operation.

Ground electrolysis, as commonly known, generally involves the removal of metal from underground structures by the action of stray railway or other negative return currents. However, in the case of long transmission pipe lines for either gas or oil, destructive corrosion does not result usually from the action of stray currents but is due chiefly to the chemical action of the soil on the metal. This action is more or less severe in accordance with the soil condition, which varies in different localities.

Protective coatings for the pipe lines, such as paint, clay and cement, have been suggested but these are effective only if they are so applied as to cover the pipe very thoroughly. In fact, it is found usually that pin holes and occasional breaks in the coating which occur while installing the pipe line, cannot be eliminated. It is the parts of the metal at these pin holes and breaks that bear the whole brunt of the chemical action of the soil, and it is also at these pin holes and breaks that any stray or drainage currents, if present, enter and leave the pipe.

It has been found that if the painted or otherwise coated pipe is made electrically negative with respect to the ground, corrosion at the pin holes, breaks, or other bad spots can be stopped. For this purpose the voltage required is very low, the current required depending on the soil condition and being of the order of several amperes.

In installations for impressing the required negative potential on a pipe line, the current supply is in practice an alternating current transmission line operating at a suitable voltage, for example 2300 volts. For the supply of the required direct current, of the order for example of 10 amperes, to the pipe line from the power line, rectifier devices spaced at relatively short intervals are required. It has been found that for this purpose contact rectifiers of the copper-oxide type are eminently satisfactory by reason of their rugged construction, relatively low cost, long life, and freedom from the necessity of servicing. In the above-mentioned installations the copper-oxide rectifier stacks and their protective elements are mounted in housings to form complete rectifier apparatus units. These rectifier units are mounted, together with suitable transformers, on the poles which support the power line.

Difficulties have been encountered, however, in adapting the copper oxide rectifier to use in the above-described system for the control of electrolysis in a pipe line, or in similar systems. These difficulties have arisen because of the fact that the copper oxide rectifier is a device which is injured if the temperature therein is permitted to rise beyond a predetermined safe limit. Thus for a rectifier unit operating in an ambient temperature of 40° C., the permissible rise of temperature in the rectifier device is 10° to 12° C. Since in the hereinbefore described system for preventing electrolysis in pipe lines the rectifier units are mounted in the open, preferably on the poles supporting a power line, a tendency to serious overheating of the rectifier devices has resulted due to the exposure of the housings to the rays of the sun. Under such conditions extensive tests have shown that the top of the rectifier housing may register a temperature as high as 70° C. when the ambient air temperature is only 40° C. This high temperature on the top or upper portion of the housing has tended to build up a layer of hot air within the housing which has gradually seeped into and overheated the rectifier device. To avoid this difficulty in the rectifier units employed heretofore, abnormally large cooling fin areas have been required in the rectifier devices with consequent added cost of construction of these devices.

In accordance with my invention, the above-described overheating difficulties and other difficulties have been overcome by the provision of a rectifier housing construction having baffle or screen elements mounted within the housing, the housing walls and the baffles being so arranged that the heating of the rectifier devices due to heat radiation falling upon the housing walls is prevented, and operation of the rectifier devices within safe temperature limits is insured, without the necessity of providing excessive cooling fin area for these devices.

My invention will be better understood from the following description when considered in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

Referring to the drawing, Fig. 1 illustrates a system for the control of electrolysis in a pipe line, wherein my invention has been embodied,

and Fig. 2 is a cross-sectional view of a rectifier apparatus unit in accordance with my invention.

In Fig. 1, the numeral 10 designates a metal pipe line buried in the soil 11 and subject to corrosion on its outer surface by chemical action of the soil thereon. To prevent this corrosion a negative voltage is supplied to the pipe 10, the power required being derived from an alternating current power line supported on poles as 12, which also support transformers as 13 required to step down the high voltage to a low voltage suitable for the rectifiers. To rectify the current from the transformers 13, the rectifying apparatus units 14 are provided, preferably a pair of these units being associated with each transformer and connected between the transformers 13 and the pipe 10.

For economy and convenience in construction of the system, and for the better protection of the contact rectifier devices from mechanical injury, and further to insure a free circulation of air about the contact rectifier devices, the apparatus units 14 are mounted on the poles 12 which support the power lines and the transformers 13.

With this preferred disposition of the rectifier apparatus units 14, whereby, however, the units are exposed to direct radiation from the sun, under conditions of considerable sun heat as during the hot summer months the solar radiation falling upon the top walls or rain shields 15 and side walls 16 of the housings 17, which form the outer casings of the units 14, tends to cause the accumulation of a body of hot air in the upper portion of the housing. Such a nearly stagnant body of air, if permitted to accumulate, would contribute materially to a prohibitive temperature rise in the contact rectifier devices.

To prevent the above-described undesirable temperature effects, I provide a special housing arrangement best understood in connection with Fig. 2. In this housing arrangement, a plurality of contact rectifier devices 18, only one of which is shown, are mounted in the lower portion of the housing 17. The lower portion of the housing is provided with an opening or openings for the flow of air. For this purpose, the lower or base plate 19 is preferably formed as a screen or provided with a plurality of openings 20. The upper portion of the housing is likewise provided with an opening or openings for the flow of air, the upper portions of the side walls being preferably formed as screens, or, if desired, as separate members 21 provided with a plurality of openings 22 and fastened to the lower portions 23 and to the top wall 15 by any suitable means such as screws 24.

The lower openings 20 and the upper openings 22 thus provide, respectively, passages for the flow of cooling air into the interior of the housing and for the discharge of air from the housing after the air has been heated not only by absorbing heat from the contact rectifier units 18 but also by contact with the walls of the housing or by heat radiated inwardly from the walls.

The air openings 20 and 22 in the housing 17 provide in themselves for a certain amount of air flow through the housing. In order, however, to ensure sufficiently rapid flow of the cooling air through the housing to cause a relatively large mass of air to pass over the rectifiers 18 in a given time, and in order at the same time to shield the rectifiers 18 to a large extent from heat radiated from the housing walls and from the hot air in the upper portion of the housing, I have provided a double-decked baffle or screen assembly mounted within the housing.

Referring to Fig. 2, the baffle or screen assembly comprises a plurality of baffle elements, as the two sets of baffle elements 25, 25 and 26, 26, preferably disposed longitudinally of the housing 17 and between the contact rectifier units 18 and the discharge openings 22. The upper set of baffles 25 may be formed as inwardly bent extensions of the lower side plates 23 of the housing. The lower set of baffles 26 may each comprise two portions: a portion 27 spaced from the corresponding upper baffle and extending from a point near the median line of the housing to a point near a side wall 23 of the housing, and a portion 28 having an opening or openings 29 formed therein and preferably connected as by welding to an upwardly extending portion 30 of the corresponding upper baffle 25.

It will be seen that the baffles are so disposed that: lateral air passages 31 extending the length of the housing are provided between the walls 23 of the housing and the outer edges of the lower baffles 26; passages 32 extending the length of the housing are provided between the laterally extending portions of the upper and lower baffles; passages (constituted by the openings 29 of the lower baffle) are formed between the inner edges of the laterally extending portions of the baffles; and a central passage 33 is provided extending the length of the housing and connecting the space 34 below the baffles to the spaces 35 above the baffles.

In operation of the protective and cooling system incorporated in the housing arrangement illustrated in Fig. 2, let it be assumed that normal load current flows in the rectifiers and that heat radiation from the sun or other source falls upon walls of the housing 17, for example upon the top wall and one of the side walls. Under these conditions the temperature of the air in the interior of the housing tends to rise due to the heat losses from the rectifiers 18 and to the heat radiated inwardly from the walls. Convection air currents, therefore, start to flow in the housing, the cool air entering through the openings 20 of the bottom plate 19. After passing over the rectifier fins 36 and thereby absorbing heat losses from the rectifiers, the air stream divides. One portion of the air stream passes directly upwardly from the space 34 into the central passage 33. Other portions of the air stream pass through the lateral passages 31 into the passages 32 formed between the upper and lower baffles and thence through the openings 29 to join, in the central passage 33, the first-named portion of the air stream. From the passage 33 the heated air flows into the spaces 35 in the extreme upper portion of the housing and from these spaces escapes to the outer air through the upper openings 22.

It will be seen that by reason of the chimney effect of the centrally disposed passage 33, a strong current of cooling air is drawn over the fins 36 of the rectifier devices, part of the air in passage 33 rising directly from the fins and part flowing along the sides 23 of the housing and through the lateral passages 31 and 32. It will be seen further that any tendency of the rectifier devices 18 to absorb heat transmitted through the air within the housing or radiated by the sun-heated walls into the housing is effectually prevented by the interposition, between the rectifiers 18 and the outside walls, of the double-decked baffle assembly which provides,

between the rectifiers and the outside walls, the two metal plates, 25 and 27, and the thick layer of air which flows rapidly in the lateral passages 31, 32.

I have found that under no-load conditions in the rectifier devices 18, but with the housing 17 exposed to sun heat or other radiation sufficient to raise the temperature of the top plate 15 to 70° C., the ambient air temperature being 40° C., substantially no rise in temperature of the rectifier devices 18 occurred. In the case of certain other rectifier housing arrangements, however, wherein the hereinbefore described cooling means was not incorporated, under the same conditions as last above noted the temperature of the rectifier devices rose to 55° C., the rectifiers therefore in this latter case showing a 15° C. rise over the ambient temperature of 40° C. even though not operating under load. Since the permissible temperature rise of the rectifier devices under load was 12° C. it is evident that with the last-named housing arrangements sufficient cooling to permit operation under load when the housing was exposed to the sun could not possibly be obtained.

I have found, further, that under full load conditions for the rectifier devices 18 and with the housing exposed to the above described extreme degree of sun heat, in the rectifier devices when mounted in the housing assembly hereinbefore described as in accordance with my invention the temperature rise was of the order of 10° C. or well within the permissible limit of 12° C.

My invention has been described herein in a particular embodiment for purposes of illustration. It is to be understood, however, that the invention is susceptible of various changes and modifications and that by the appended claims I intend to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In an electric apparatus, an electric device and a housing therefor, said housing having perforations in its lower portion for the admission of cooling air and having perforations in its upper portion for the escape of air heated by contact with said device, and baffle means mounted in said housing to protect said device from heat due to heat radiation falling upon said housing, said baffle means including two baffles connected respectively to opposite walls of said housing below said second-named perforations and two baffles mounted parallel respectively to the first-named baffles and interposed between said first-named baffles and said device.

2. In an electric apparatus including an electric device, means to enclose said device and to prevent undue temperature rise therein comprising a housing member, means to mount said device in said housing member, means to conduct cooling air into the lower portion of said housing member, means to conduct heated air from the upper portion of said member, and a plurality of parallelly disposed baffle members mounted within said member and between said device and the outer walls of said housing member, to prevent undue temperature rise in said device due to heat radiation falling upon the outer walls of said housing.

3. In an electric apparatus, an electric device and a housing therefor, said housing having openings in its lower portion for the admission of air and having openings in its upper portion for the discharge of said air from said housing, and a plurality of parallelly disposed screens mounted in said housing between said first-named and said second-named openings and interposed between said device and the upper walls of said housing to shield said device from heat radiation falling upon said walls.

4. In a rectifier apparatus, a contact rectifier device and a housing therefor having openings in its lower portion for the admission of air to said housing and having openings in its upper portion for the discharge of said air from said housing, a pair of screens fastened at their outer edges to opposite walls of said housing, and a second pair of screens mounted in said housing below said first-named pair of screens, said second pair of screens being spaced from said opposite walls to form a pair of passages adjacent said walls for the flow of air within said housing, the individual members of each of said pairs of screens being spaced apart to define a centrally disposed passage for the flow of said air within said housing.

5. In a rectifier apparatus, a plurality of contact rectifiers and a housing therefor having a plurality of openings in its base portion for the admission of air to said housing and screened openings in the upper portions of its side walls for the discharge of heated air, a pair of screens spaced apart in said housing and fastened at their outer edges to said side walls to provide an air passage centrally disposed within said housing, and a second pair of screens having perforated portions connected to and extending downwardly from the inner edges of said first-named screens, said second pair of screens having portions spaced from said side walls to form passages extending from said side walls to said perforated portions for the flow of air from points adjacent said side walls into said centrally disposed passage.

6. In a system for the control of electrolysis comprising an electric apparatus unit exposed to solar radiation, a housing, a plurality of electric devices mounted in said housing, a plurality of openings in the lower portion of said housing to admit cooling air thereinto, a plurality of openings in the upper portion of said housing for the escape of heated air therefrom, and baffle means mounted within said housing and interposed between said devices and walls of said housing heated by radiation falling upon said walls to prevent undue temperature rise of said devices due to heating of the walls of said housing by said solar radiation, said baffle means including two sets of parallelly disposed baffles.

7. The combination with a system for the control of electrolysis comprising a contact rectifier apparatus unit including a plurality of copper oxide rectifier stacks mounted within a housing having openings in its lower and upper portions for the flow of air through said housing and in contact with said stacks, said apparatus unit being so mounted that the outer walls of said housing are exposed to solar radiation, of means to prevent temperature rise of said rectifier stacks above a predetermined limit due to said solar radiation on said walls, said means including a plurality of screens mounted within said housing to provide an air passage disposed centrally of said housing and to provide at least two other air passages extending from said centrally disposed passage to points adjacent the sidewalls of said housing.

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