U. A. GARRED.

COPPER REFINING.

APPLICATION FILED APR. 26, 1916.

1,198,434.

Patented Sept. 19, 1916.

3 SHEETS—SHEET 1.

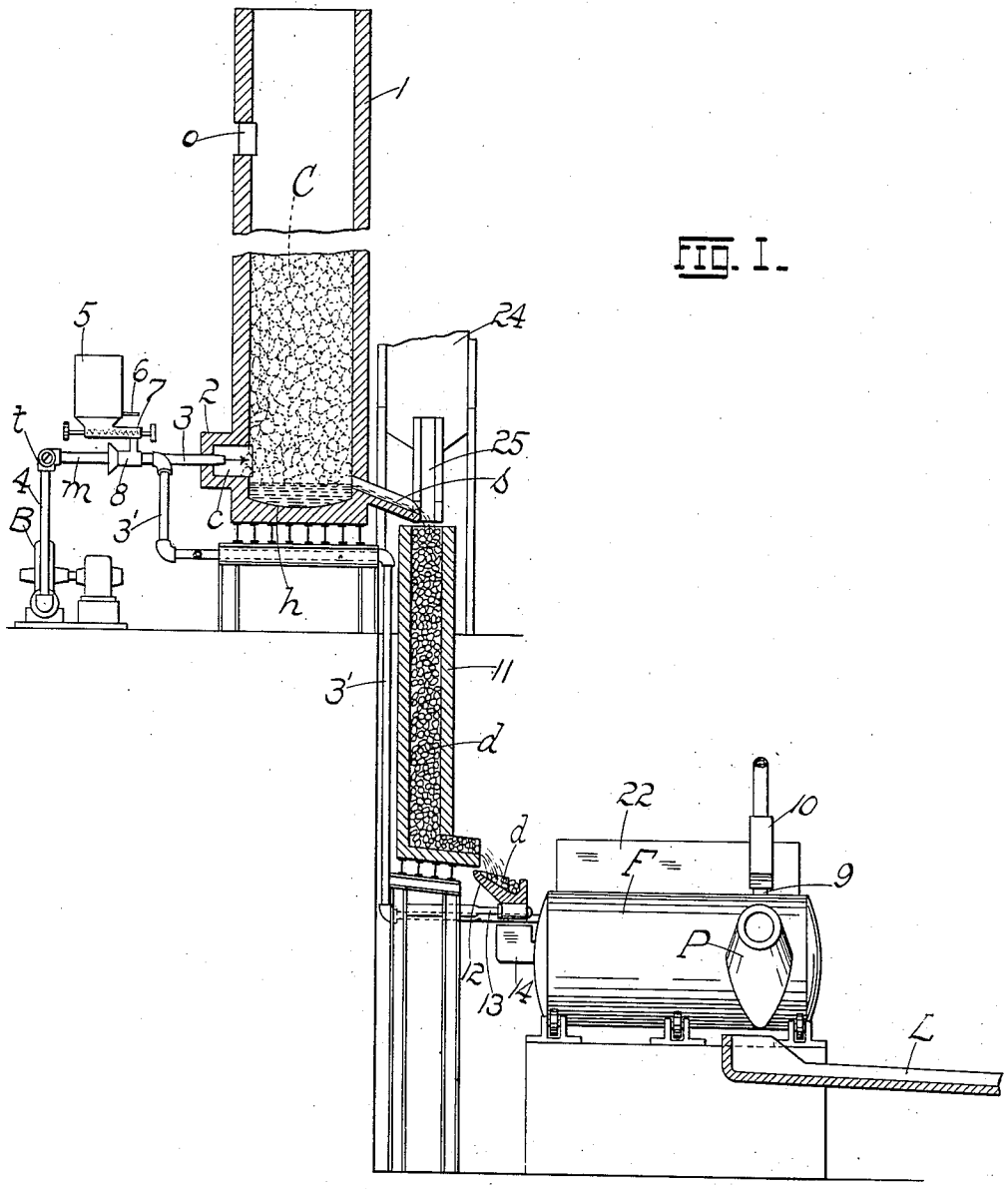


FIG. 1.

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3 SHEETS—SHEET 2.

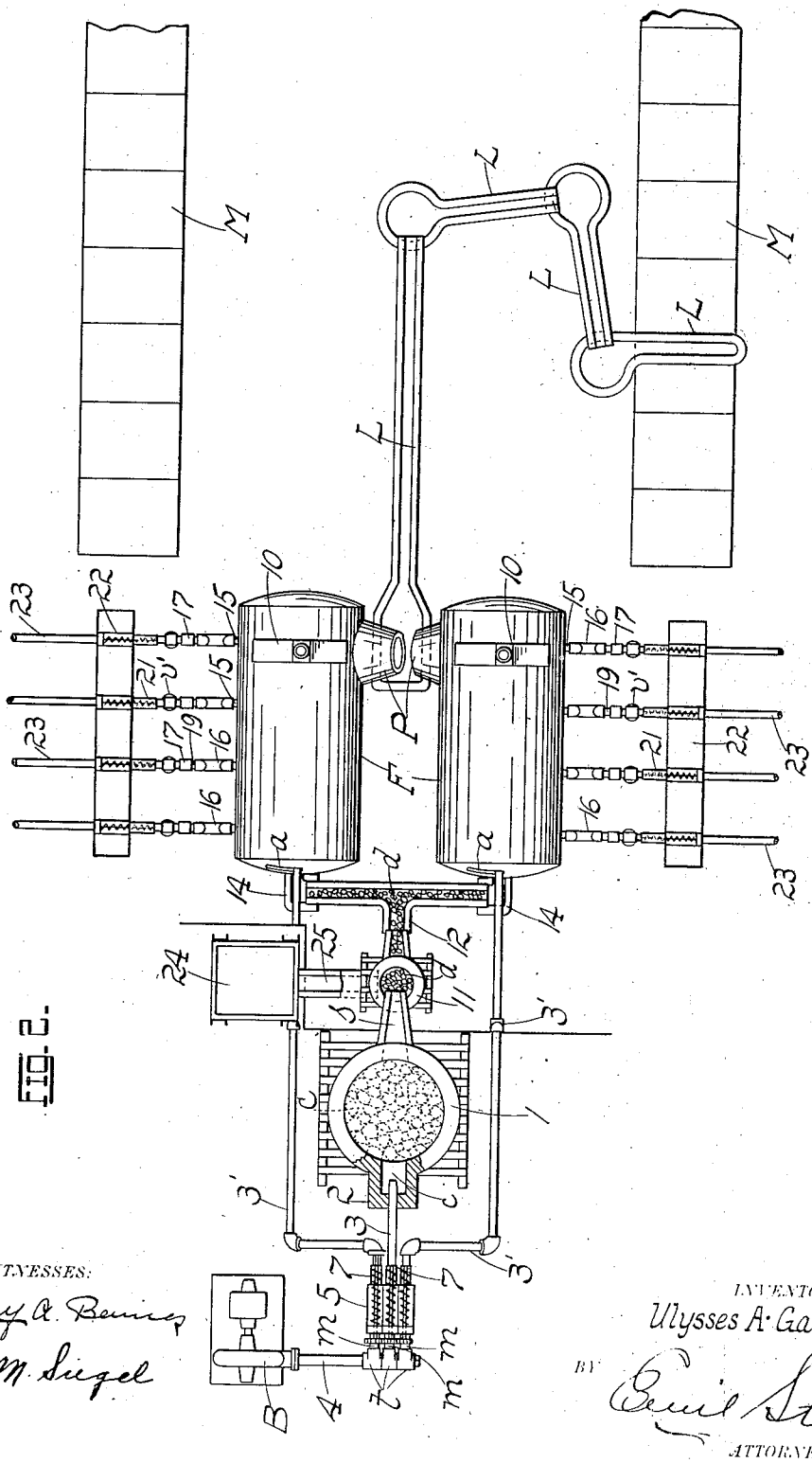


FIG. 2.

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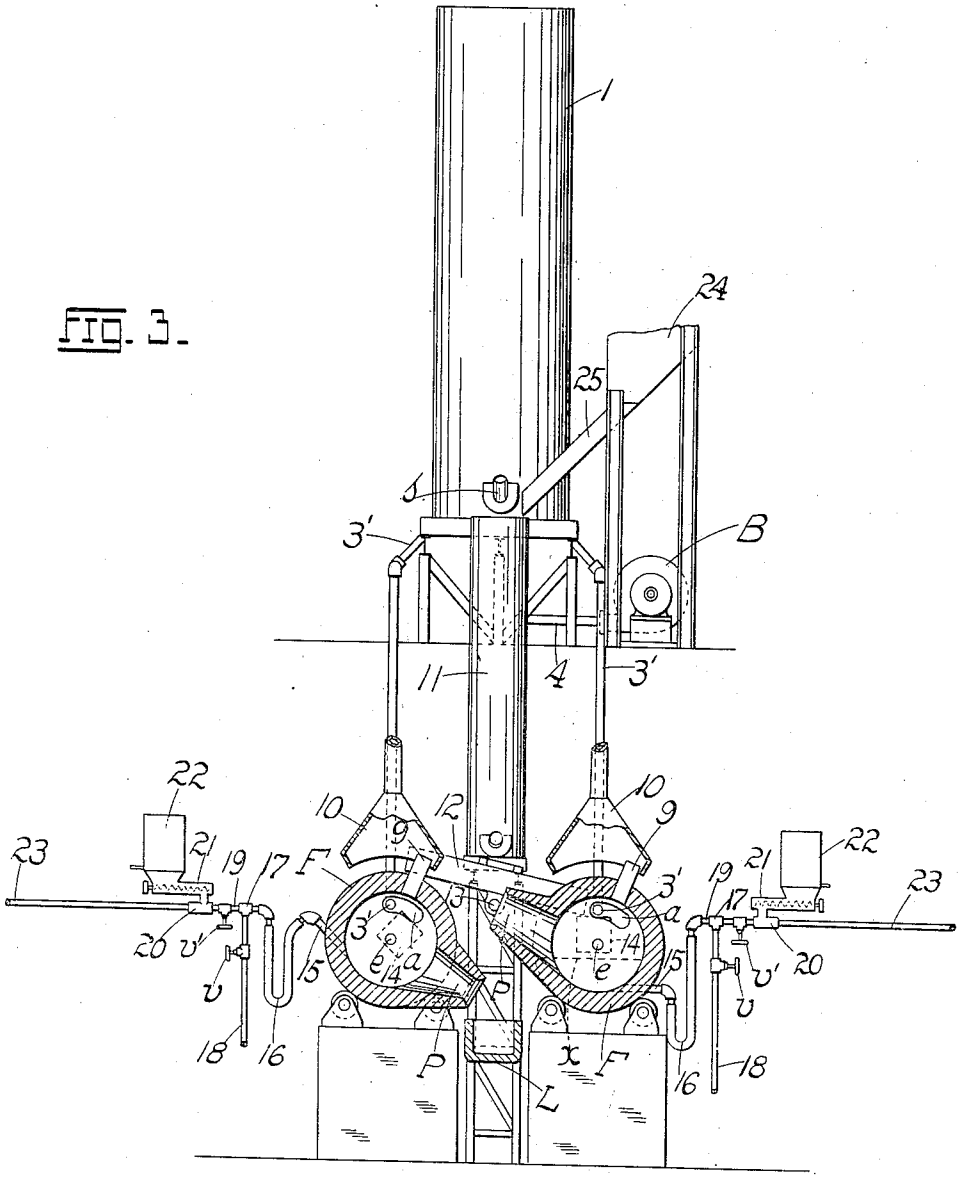
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3 SHEETS—SHEET 3.

FIG. 3.



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COPPER-REFINING.

1,198,434. Specification of Letters Patent. Patented Sept. 19, 1916.

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To all whom it may concern:

Be it known that I, ULYSSES A. GARRED, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Copper-Refining, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part hereof.

My invention has relation to improvements in copper refining; and it consists in the novel features more fully set forth in the specification and pointed out in the claims.

The present invention is particularly directed to the refining of impure copper such as blister copper, black copper, cement copper, scrap, or copper in whatever form or shape as it comes to the refinery, the object sought being to subject the impure metal to successive refining operations which shall involve a minimum amount of handling and labor, and with a view of obtaining a final product of copper practically stripped of all impurities and associated metals with the single exception of gold and silver where these happen to be present.

My improved process or method of treatment eliminates the prevailing unwieldy melting furnace of the present day, substituting in lieu thereof a cupola furnace operating on regulated quantities of a given charge whereby the operation of oxidizing or flapping to produce set copper is made easy and is under perfect control of the operator.

A further object is to dispense with the prevailing operation of wood poling and substitute in lieu thereof blast poling whereby the reducing agents may readily permeate all portions of the bath undergoing deoxidation, thereby reducing the time of poling to a minimum. The present improvement likewise makes provision for a preliminary poling by solid carbon between the flapping and final poling operations, thereby reducing the time of blast poling at the final stages of the process.

The invention contemplates not only the process of treatment but also the general arrangement of apparatus in which the successive stages of the process are carried on. Its advantages will fully appear from the following detailed description of the invention in connection with the accompanying drawings in which—

Figure 1 represents a combined side elevation and middle vertical longitudinal section of the flapping and poling apparatus, the casting machine being omitted; Fig. 2 is a top plan of the entire apparatus, parts being broken away; and Fig. 3 is a front elevation of the flapping and poling apparatus, the poling furnaces being shown in vertical cross-section, the plane of section being taken through the pouring spouts.

Referring to the drawings, 1, represents a cupola furnace provided with a charging opening *o* at a point from twelve to fifteen feet above the hearth *h*, a suitable discharge spout *s* leading from the hearth as well understood in the art. In the present embodiment of my invention the cupola is provided with a chambered offset 2 opposite the spout *s*, the chamber *c* of said offset receiving the spray of fuel discharged therefrom a nozzle 3 opposite the middle T or fitting *t* at the discharge terminal of the pipe 4 through which air under pressure is forced by means of a pump or blower B. The air current traversing the pipe or nozzle 3 is charged with pulverized coal or coal dust from the central compartment of a hopper 5, the rate of discharge from any compartment being controlled by a gate 6 past which the fuel drops into a screw conveyer casing 7, thence into a hollow fitting or mixing chamber 8 from which the nozzle or spray pipe 3 leads. The foregoing is the conventional and well known form of pulverized coal burner and further description thereof is unnecessary.

In the present embodiment of my invention the air pipe 4 terminates in three T's *t*, from which the air is conducted to the fittings or mixing chambers 8 by branch pipes *m*, suitable air-conducting pipes 3′, 3′, leading outward and downward from the terminal chambers and discharging sprays of fuel into the poling furnaces F through arcuate slots *a*, *a*, formed in the heads thereof, said furnaces being of the rotary or tilting type on the order of the conventional converter, the fumes from which are allowed to escape through pipes 9 under suitable hoods 10 whence the gases are conducted to any desired point as well understood in the art. Like the ordinary converter the poling furnace F is provided with the usual pouring

spout P. In the present embodiment of my invention the furnaces F are operated in pairs, one furnace discharging while the opposite one is poling or blowing, the poled copper being poured into a launder L whence it is conducted to any type of casting machine M. These are shown conventionally in the drawings, forming no part of the present invention.

In practising my invention I preferably pass the molten oxidized or flapped copper discharged by the spout *s* of the cupola furnace, through a tower 11 filled with charcoal *d* with a view of subjecting the molten metal to a preliminary poling while in contact with the charcoal, the partially poled metal discharging from the charcoal tower into a tilting launder 12 (containing charcoal *d*) mounted in any suitable manner to oscillate about a stud 13 (Fig. 3), the depressed end of the launder discharging into a receptacle 14 carried by the head of the poling furnace into which the metal finds its way from the receptacle through the opening *e*. Thus, while one of the poling furnaces is tilted to pour its contents into the launder L, the other is tilted to poling position and for receiving its charge from the launder 12 (Fig. 3).

In the present embodiment of my invention the final poling of the copper in the furnace F, is accomplished by blowing pulverized charcoal or its equivalent into the furnace at points beneath the charge, the driving fluid employed for forcing the fuel into the molten mass being any form of hydrocarbon or equivalent reducing gas under pressure, examples of which are illuminating gas, hydrogen and the like, the mixture of gas and pulverized charcoal (or its equivalent as for example saw dust) rising up through the copper and thoroughly stirring and mixing the bath and bringing every particle of copper in contact with the reducing agents (carbon, hydrogen) so admitted. To effect thorough stirring and agitation of the bath in the poling furnace, I prefer to have the blower nozzles or pipes 15 discharge tangentially to the inner cylindrical surface of the furnace lining (Fig. 3), a series of such pipes being disposed along the side of the furnace. The outer end of each nozzle or blower pipe is coupled to one end of a flexible hose 16 whose opposite end connects to a T 17, to one leg of which is coupled the air pipe 18 adapted to deliver air under pressure thereto, a suitable valve *v* being provided to cut off the air when not needed. Communicating with another leg of the T 17 is one end of a pipe 19 whose opposite end leads from the discharge end of the gas chamber 20 into which powdered charcoal or equivalent fuel drops from the feed-screw casing 21 to which said charcoal or fuel is supplied from a hopper 22 in much the same manner as the fuel is fed to the mixing chamber 8 from the hopper 5 previously described in connection with the cupola 1 and poling furnaces F. In the present instance however the chamber 20 in lieu of receiving air under pressure as is the case with the mixing chamber 8, receives a suitable reducing gas such as a hydro-carbon gas or hydrogen under pressure, said gas being conducted thereto through a pipe 23 leading from any suitable source of gas supply (not shown). The gas may be cut off from the T 17 when desired, by manipulating the valve *v'* on the pipe 19. With the arrangement just described I may discharge into the poling furnace beneath the surface of the bath therein either air for flapping (should this become necessary for any reason) by closing the valve *v'* and opening valve *v*, or a mixture of gas and fuel for purposes of poling by closing valve *v* and opening valve *v'*, or I may simply introduce gas under pressure by cutting off the fuel supply from the chamber 20 by stopping the screw-feed operating in the casing 21, the valve *v'* being left open and the valve *v* closed. The charcoal tower 11 is supplied with charcoal from time to time from a storage bin or hopper 24 from which it discharges into the tower through a chute 25.

The operation may be described as follows: The impure copper C is charged into the cupola furnace as described, the metal gravitating or settling toward the hearth *h*. As the metal melts away at the hearth fresh additions are made to the charge through the opening *o* so as to maintain the contents of the furnace at a constant height of from twelve to fifteen feet. In this way the greater portion of the waste furnace heat will be utilized to advantage, the heated gases rising up through the spaces or openings between the copper pieces, imparting their heat to the copper so that on escaping from the top of the furnace the gases will be comparatively cool. As the charge settles down past the chamber *c*, the pulverized fuel projected from the nozzle 3 and previously ignited impinges against the bottom portions of the descending column of copper, the flaming particles and highly heated products of combustion melting the charge which settles on the hearth *h*, the air supplied to the nozzle 3 being so regulated as to bring about the necessary flapping or oxidation of the melted portions of the charge, the flapped molten metal as fast as it accumulates on the hearth flowing through the spout *s* into the top of the charcoal tower 11, the charcoal in said tower and in the launder 12 into which it is subsequently discharged from the tower having the effect of partially poling or reducing the flapped or oxidized copper. From the launder 12 the copper runs into the receptacle 14 of either one or the other of the poling fur-

naces F into which it flows through the opening *e*. The temperature in the poling furnace is maintained sufficiently high to keep the copper in a molten or fluid condition, said temperature being brought about by the burning of the powdered fuel delivered thereto by the pipes 3′ identified with the pulverized coal burner which supplies the nozzle 3. Should the charge in the poling furnace require flapping or further oxidation before the same is subjected to the blast poling, such flapping can be accomplished by blowing air through the nozzles 15 beneath the charge by the opening of the valves *v* and the closing of the valves *v*′. The metal being in condition for final poling (with or without previous flapping in the furnace F, depending on the nature of the charge, a matter of which the skilled operator is a competent judge), the operator directs hydro-carbon or equivalent reducing gas under pressure from the pipes 23 to the chambers 20 and nozzles 15 (the valve *v* being closed), at the same time feeding a proper complement of powdered charcoal to the chambers 20 from the hopper 22 as previously described. The charcoal laden gas is thus forced beneath and through the molten charge the level of which is indicated by the dotted line *x* in the right hand furnace F, Fig. 3, and every particle of oxidized copper is thus reached and reduced to the metallic state. Any slag which forms may be skimmed off in any way known to the art before the copper is poured. When the metal is ready to be poured, the furnace is rotated through a sufficient arc to bring the spout P thereof into discharging position (the flexible hose 16 and the slots *a* allowing for the necessary rotation) when the metal runs into the launder L and thence into the casting machine M as well understood in the art. Should the gas alone prove sufficient to pole the metal in the furnace F, the fuel feed to the chambers 20 may be cut off as obvious from the drawings. When one furnace F is blowing or poling the other is discharging, the launder 12 being inclined or tilted toward the receptacle 14 of the furnace in which the charge is to be poled (see Fig. 3).

As the bottom portions of the charge of copper in the cupola furnace 1 melt away, and are flapped and discharged through the spout *s*, fresh portions of the descending or gravitating copper column confined in and constantly charged into the furnace take their place and come opposite the inflammable particles and highly heated products of combustion projected against them from the nozzle 3, and these in turn are melted and flapped and discharged, thus making the process continuous. By carefully regulating the fuel and air supply the copper may be brought to the desired oxidized or flapped condition before discharging into the charcoal tower 11. In some cases the charcoal tower may be omitted, in which event the flapped stream of copper may be discharged from the cupola directly into the launder 12. The purpose of the charcoal in the launder 12 is to keep the molten copper covered and protect it from the action of the air. I do not wish to be limited to the specific fuels or the reducing or deoxidizing or poling reagents here specifically mentioned as any equivalents thereof are contemplated by my invention. For example I am not limited to any particular composition of fuel or to solid fuel, or to the use of charcoal or specific gas for poling purposes. I may employ liquid or gaseous fuel for coal dust or powdered coal and sawdust in lieu of charcoal or in lieu of coal, and in fact I may use any reagent which will act properly, to bring about the results here contemplated.

The several instrumentalities by which the copper is handled and treated as described, are shown more or less conventionally, the furnaces, launders, towers, and so on being old *per se*, the novelty so far as it enters into the physical part of the invention residing in the coöperative relation between the several parts by which the copper may be refined with a minimum amount of handling. The process by which the refining is accomplished I consider to be new. Features shown but not alluded to are well understood in the art and require no description in the present connection. It is apparent too that so far as the apparatus is concerned I may depart in many particulars from the details here shown without affecting the nature or spirit of my invention.

In lieu of gas forcing the pulverized charcoal into the poling furnace I may if so desired, force the charcoal by mechanical means such as a screw without departing from the spirit of my invention.

Having described my invention what I claim is:

1. In the refining of copper, the process of feeding a charge of the copper through a cupola furnace, subjecting the same to the action of flaming particles and a proper complement of air to melt and flap the charge on the hearth of the furnace, passing the flapped molten metal over solid carbonaceous material to partially pole the metal, conducting the partially poled metal to a suitable poling furnace, blowing the molten metal in said furnace with air to effect any desired oxidation, and finally blowing the charge with non-oxidizing gas charged with finely divided carbon particles to complete the poling.

2. A copper refining system comprising a cupola chargeable with copper and provided

with a hearth and discharge spout leading therefrom, means for projecting inflammable particles and highly heated products of combustion and air above the hearth for melting and flapping the lower terminal of the descending column of copper, a pair of poling furnaces spaced apart, a tilting launder receiving the molten flapped copper from the cupola furnace and alternately delivering the same to the respective furnaces, and means for poling the fluid charges in said furnaces.

In testimony whereof I affix my signature, in presence of two witnesses.

ULYSSES A. GARRED.

Witnesses:
M. E. RUTLEDGE,
A. B. PHISTER.