No. 883,756.

PATENTED APR. 7, 1908.

K. J. STEINER.

HEAT RADIATOR FOR HYDROCARBON AND OTHER HEAT MOTORS.

APPLICATION FILED DEC. 28, 1906.

Fig. 1.

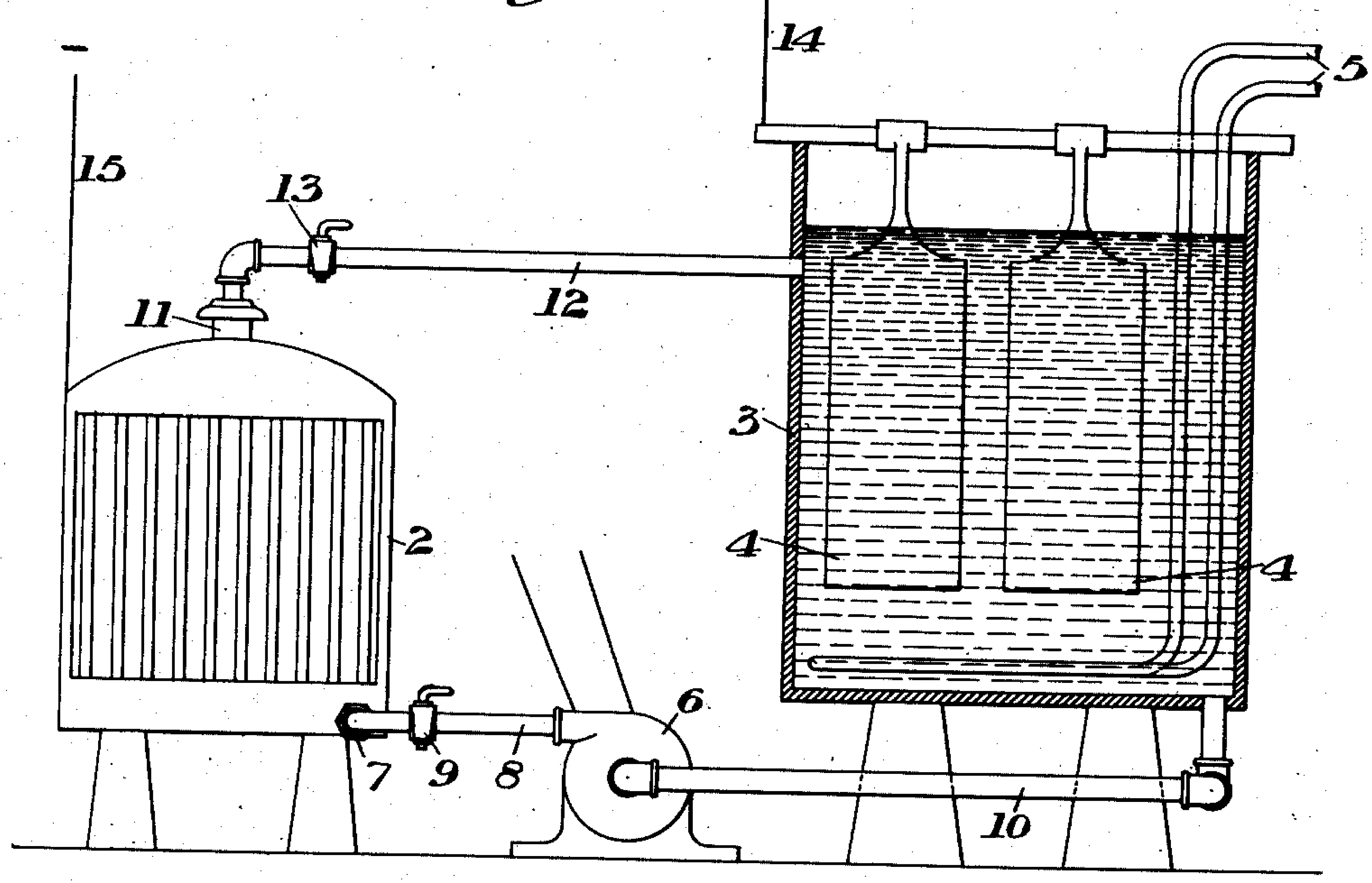


Fig. 2.

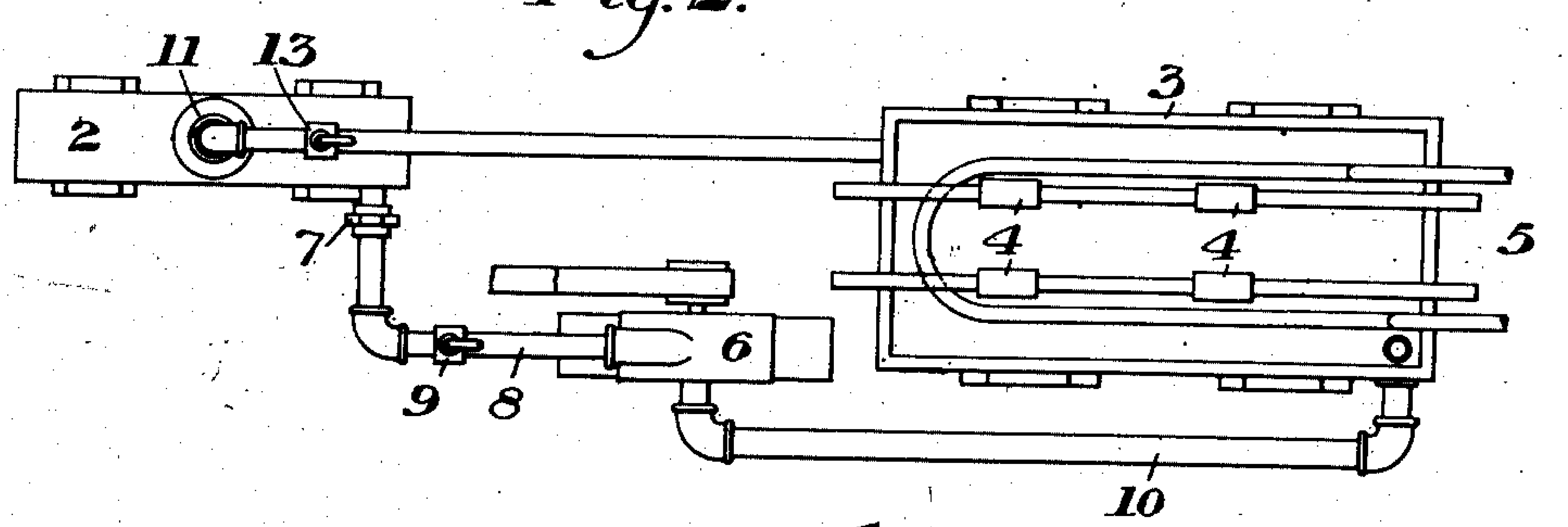
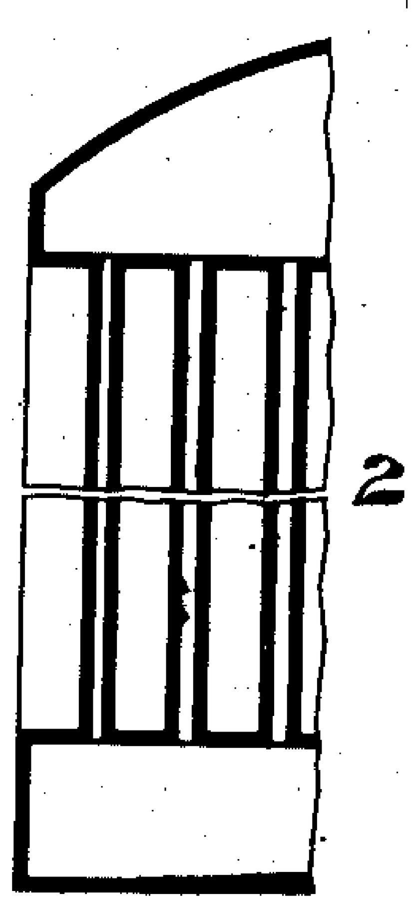


Fig. 3.



WITNESSES

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HEAT-RADIATOR FOR HYDROCARBON AND OTHER HEAT-MOTORS.

No. 883,756. Specification of Letters Patent. Patented April 7, 1908.

Application filed December 28, 1906. Serial No. 349,752.

To all whom it may concern:

Be it known that I, Klaus J. Steiner, of Pittsburg, Allegheny county, Pennsylvania, have invented new and useful Improvements in Heat-Radiators for Hydrocarbon and other Heat-Motors, and also in the Method of Making the Same, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a side elevation showing apparatus suitable for the practice of my invention; Fig. 2 is a plan view of the same; and Fig. 3 is a sectional view of a portion of a radiator embodying the invention.

My invention relates to improvements in construction of cooling devices utilized for radiating excess heat absorbed by the cylinder walls of hydro-carbon motors of the water-cooled type; likewise for similar structured cooling devices used in connection with steam motors, wherein the cooler acts as a condenser of the exhaust steam.

My invention relates particularly to improvements in the construction of cooling devices utilized in connection with automobile heat motors of the water-cooled hydrocarbon type, as well as for those cooling devices of similar construction used in connection with steam automobile engines for the purpose of condensing the exhaust steam. These devices are commonly known as radiators.

In the operation of hydrocarbon motors of the water-cooled type, as used on the great majority of automobiles, the cooling of the water, heated during its passage through the cylinder jackets, is accomplished by forcing the water through such radiator, usually mounted in front of the engine. This radiator consists of a large number of small metal tubes, usually of brass, leading into and connecting with and together, a closed top and bottom hollow, sheet metal chamber, through which system the hot water flows in a downward direction gradually radiating its heat to the walls of the tubes and the two chambers, which are kept cool by a draft of air drawn through the nest of tubes by a power-driven fan in the rear of the radiator. In the manufacture of such radiators, the tubes are commonly soldered or "sweated" into the heads of the top and bottom overflow chambers, with tinsmiths ordinary soft lead solder. Brazing with a more stable solder such as brass solder is not often done because the heat required is so high that the heads of the chambers and other adjacent parts are liable to buckle or warp. The result of the use of such a weak method of uniting two or more surfaces with soft solder is that the radiators so made are constantly giving trouble by leakage of cooling water around the points of junction of tubes and heads. The union is so weak that vibration, to which automobile radiators are particularly subject, is alone sufficient to cause disruption. Expansion and contraction by changes in temperature, to which radiators are being constantly subjected on account of the nature of their use, also produces fracture between tubes and heads. But the worst effect is due to the solvent action on the soft soldered junctions of water, practically at the boiling point and in a constant state of agitation. This is forcibly illustrated by the troubles experienced in conducting hot water through lead pipes, where the strong solvent action of water in motion will very soon eat its way through the walls of the lead pipe. In the case of steam radiators or condensers, the labove mentioned results are even more marked, the temperature changes and the solvent action being greater because the steam enters at a temperature far above the boiling point of water and leaves at a much lower temperature comparatively.

There is no better metallic medium to withstand the solvent action of hot water than pure copper. Likewise, there is hardly a more efficient conductor of heat than copper. A solid copper union will also stand a great deal of vibration before rupturing because of the softness, tenacity and ductility of copper. In all of these respects a copper union is far superior to a lead soldered union of same or dissimilar metals.

I purpose to make a practically leakage-proof, long-lived and more efficient radiator by the following process: In accordance with my invention a radiator is constructed in the usual manner out of very thin brass tubes soldered into correspondingly thin sheet brass heads of the top and bottom overflow chambers, using the ordinary soft solder and a non-resinous flux, as for example, neutral zinc chlorid. The only difference thus far in the construction over the usual method is that much weight of metal in tubes and chambers is dispensed with. The use of a non-resinous flux is important in order that no part of the interior surface may be covered with a medium that may prevent the interior coating being applied. When completed, this thin, light-weight radiator is thoroughly cleaned inside by the application of hot caustic solution, preferably forced through repeatedly by a circulating pump and reservoir tank arrangement similar to that used in the carrying out of the interior coating process hereafter described. This is necessary to thoroughly remove grease and dirt. This operation is followed by washing with water so that all traces of caustic solution are removed, after which a weak acid pickling solution is forced through the radiator in order to remove all scale and to produce a continuous bright metallic surface on the inside of the tubes and chambers. I then copper-plate the inside of these tubes and chambers with a continuous surface or deposit of pure metallic copper of requisite thickness by a special process of electric deposition, of which the following is a concise and clear description: The process of electro-deposition of copper on the inside of such a multiple tube radiator entails certain difficulties. The radiator cannot be plunged into a plating vat of the usual construction in which it acts as the cathode, as the deposition will then take place on the surface instead of only in the interior, unless this be prevented by some non-metallic coating applied all over the outside of the radiator, which is both difficult on account of its construction, is not desirable and would cause trouble to remove thoroughly. In addition, the deposition of copper in the interior of the radiator by simple immersion in the electrolyte would not be practicable. On account of the many small passages to be reached and the great amount of surface to be plated or coated with copper, the great difficulty would be to prevent the electrolyte from falling below its normal strength by the deposition of the copper it carries, over this large surface, from a comparatively small amount of solution. This would eventually interfere with the regular and uniform deposit of the copper coating, and will ultimately lead to a cessation of the deposition. Also, the gases formed by the decomposition of the electrolyte by the electric current, unless removed constantly, will interfere with the deposition, and by displacing an equal volume of electrolyte in the small and contracted passages of the radiator, practically stop the progress of the deposition. In order to present at all times over such extensive interior surface an electrolyte of constant and uniform strength and to remove all gases as rapidly as formed, it is necessary to draw the electrolyte from a large source of supply or reservoir, and to keep it passing in a constant and uninterrupted stream through the radiator while the process of deposition is taking place. To accomplish this desired end I arrange the electro-plating apparatus as shown in the drawings herewith.

Referring to Figs. 1 and 2, 2 is the radiator to be internally coated.

3 is the vat or reservoir containing the electrolyte in large quantity as compared to the capacity of the radiator. This reservoir 3 also contains the copper anode plates 4 from which the copper is dissolved to replace that removed from the electrolyte by the action of the current. To heat the electrolyte, a hollow metal coil 5 for circulating steam or hot water, is included in the vat 3, care being taken that it does not come in contact with the anodes 4 or any of the electrical connections.

6 is a small rotary pump, preferably of some material not acted on by the electrolyte, such as vulcanite. The outlet of the pump 6 is connected to the bottom ferrule 7 of the radiator 2 by an easily detachable rubber tube 8, having included in its length a stop-cock 9. The inlet of the pump 6 is connected to the bottom of the vat 3 by another rubber tube 10 which enters preferably at a point as far removed from that at which the used electrolyte reënters the vat, as the limits of the vat will permit. This is in order to procure a complete circulation throughout the vat. The top ferrule 11 of the radiator is connected to the top of the vat 3 by a rubber tube 12, also containing in its length a stop cock 13. The level of the solution in the vat 3 must at all times be above the level of the inlet into the vat of the tube 12 and the radiator should be placed on a level below that on which the vat rests.

The tubes connecting the radiator with the vat being non-metallic, are non-conductors of electricity and therefore have no action on the electrolyte, so that no deposition of copper can take place except on the inside of the radiator. The electric current is led into the system by way of the anodes through the entering conductor 14, thence passes into the electrolyte, and thence by way of the streams of electrolyte in the tubes 8, 10 and 12, which streams act as conductors, to the electrolyte in the radiator, where the current passes from the electrolyte into the metallic radiator and by means of a temporarily soldered contact 15 with the metal of the radiator, back to the source of generation. By this arrangement of the apparatus, the radiator or vessel to be coated internally with copper becomes an integral part of the "electrolyte containing" system, while at the same time serving as the cathode, on which the deposition of copper takes place.

The rotary pump forces a uniform stream of constant strength electrolyte through the radiator where part of its copper contents is deposited. Thence the weakened solution flows back into the vat where it is regenerated, partially by the gradual solution of the anodes, and partially by solution of salts of the metal constituents of the electrolyte contained in receptacles in the vat. The constant circulation of the electrolyte through the radiator removes all gases generated within the radiator by the electrolytic action and carries them into the vat where they escape into the air.

It is important that the cross sectional area of the tubes 8, 10 and 12 be as large as is consistently possible, as the streams of electrolyte in these tubes carry the electrical current, and should offer as little resistance to the passage of same as possible. In practice, the usual current density of from 10 to 16 amperes per square foot of cathode surface is utilized, at a pressure of from 6 to 10 volts.

The electrolyte can be either of the sulfuric acid and copper sulfate, or of the alkaline double cyanid of copper and ammonia types, whichever previous practice has dictated. It is believed that the acid solutions offer less resistance to the passage of the current, which is important in this process on account of the manner of conveying the electric current from anode to cathode through two streams of the electrolyte, relatively small in area as compared to the area of the cathode. Practice also dictates that a warm electrolyte gives best results, and means may be taken by the introduction of a steam or hot water coil in the solution in the vat to bring the electrolyte to the proper temperature. On account of the arrangement of the apparatus, by which the cathode becomes part of the "electrolyte containing" system, it is possible to warm the electrolyte to the desired temperature by the application of heat directly to the metal walls of the cathode with equally good results.

I am aware that it is not broadly new to cause the circulation of the electrolyte, as the necessity for constant agitation and circulation of such electrolyte during process of deposition has been recognized from the beginning of the art. The old methods, however, can not be utilized for the purpose herein described, viz: the internal coating of a complex, multi-tubular and multi-jointed vessel, of such construction that it is impossible to introduce the anodes within the confines of the cathode vessel, or where it is undesirable to introduce cathode and anode in the same vat, which latter method the old processes specifically contemplate. By the means herein described it is possible to internally copper-plate such multi-tubular, multi-jointed vessels of complex construction with a continuous and solid coat of copper of any desired thickness over the total interior area of such complex vessel and all its passages.

I do not wish to restrict myself to the exact arrangement of the apparatus as shown in the drawings, as this may be modified to suit the practice without diverging from the principles involved, neither do I wish to limit myself in the practice of this electro-deposition process to the deposition of the metal copper alone, as the same device can be utilized in the electro-deposition of all the other metals commonly used in such so-called "wet" electrolytic processes.

What I claim as my invention, and desire to secure by Letters Patent is:—

1. The herein described method for electroplating the interiors of metallic vessels of complex, multi-tubular, multi-jointed type, which consists in causing a current or stream of electrolyte to pass through said vessel in contact with the surfaces to be electroplated during the time of electro-deposition, the article being electroplated being placed exteriorly of the vessel containing the electrolyte and anode, and itself forming the cathode.

2. The herein described method of electroplating the interior surfaces of tubular objects, which consists in causing a continuous circulation of an electrolyte through the said object in contact with the surfaces to be electroplated during the time of electro-deposition the article being electroplated being placed exteriorly of the vessel containing the electrolyte and anode, and itself forming the cathode.

3. The herein described method of electroplating multi-tubular, multi-jointed articles, which consists in connecting the article to form a part of an electrolyte-containing and circulating system, the article forming the cathode therein, the article being placed exteriorly of the vessel containing the electrolyte and circulating the electrolyte through the article.

4. The herein described method of electroplating the interior surfaces of multi-tubular articles, which consists in circulating the electrolyte therethrough during the time of electro-deposition, and heating the electrolyte thus circulated; substantially as described the article being electroplated being placed exteriorly of the vessel containing the electrolyte and anode, and itself forming the cathode.

5. The method of electroplating the interior surfaces of multi-tubular articles, which consists in placing the article exteriorly to the vessel containing the electrolyte, and connecting the article with the vessel containing the electrolyte by hollow tubular connections, and causing a constant circulation of the electrolyte from the source through one of the connections to and through the article, and from the article back to the source, the article forming the cathode; substantially as described.

6. The method of electroplating the interior surfaces of multi-tubular articles,

which consists in connecting the article by tubular connections with a vessel containing an electrolyte and having anodes therein, and forcing a constant circulation of the electrolyte through the said article and back to the vessel, the article forming the cathode; substantially as described.

7. The method of electroplating the interior surfaces of multi-tubular articles, which consists in connecting the article by tubular non-conductive connections with a vessel containing an electrolyte and having anodes therein, and forcing a constant circulation of the electrolyte through the said article and back to the vessel, the article forming a cathode, and the electrolyte in the tubular connections completing the circuit between the anode and cathode; substantially as described.

8. The method of electroplating internal surfaces, which consists in placing the article outside the electrolyte-containing vessel and connecting it therewith by circulating connections, and carrying the electrolyte to flow through the connections into contact with the surfaces to be electroplated; substantially as described the article being electroplated being placed exteriorly of the vessel containing the electrolyte and anode, and itself forming the cathode.

9. The herein described method of electroplating the interior surfaces of tubular objects, which consists in causing an electrolyte to circulate through the object in contact with the surfaces to be electroplated during the time of electro-deposition the article being electroplated being placed exteriorly of the vessel containing the electrolyte and anode, and itself forming the cathode.

10. The herein described method of electroplating the interior surfaces of tubular articles, which consists in preventing contact of the electrolyte with any portion of the exterior surface of the article, and circulating the electrolyte through the article in contact with its inner surfaces, said article forming the cathode of the system.

In testimony whereof, I have hereunto set my hand.

KLAUS J. STEINER.

Witnesses:
H. M. Corwin,
Geo. H. Parmelee.