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A. F. ALLAN
METHOD OF LINING METALLIC PIPES, RECEPTACLES,
OR OTHER CONTAINERS
Filed Aug. 24, 1945

2,491,467

FIG. 1.

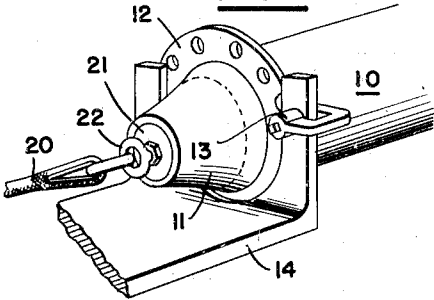


FIG. 4.

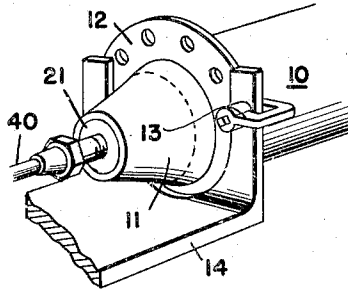


FIG. 2.

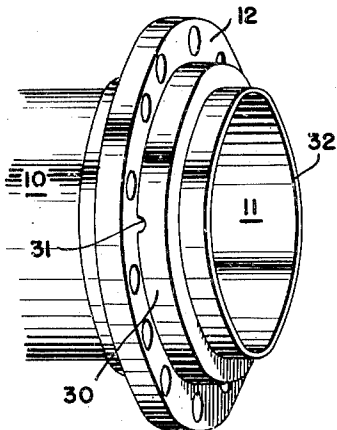


FIG. 3.

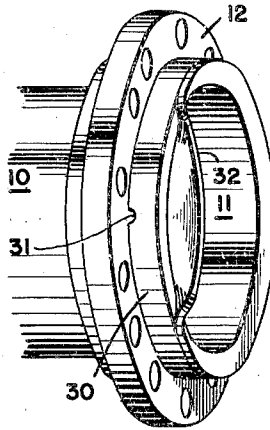


FIG. 5.

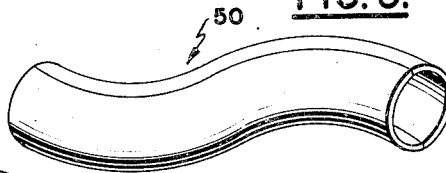
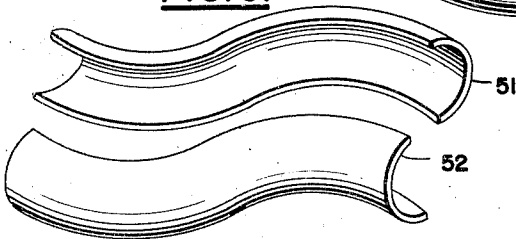


FIG. 6.



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METHOD OF LINING METALLIC PIPES, RE-
CEPTACLES, OR OTHER CONTAINERS

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1 Claim. (Cl. 29—162)

(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

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This invention relates to a method of lining metallic pipes, receptacles or other containers. It further relates to a method of lining metallic pipes, receptacles or other containers with a metallic lining which is resistant to the corrosive action of acids and alkaline solutions.

It has for its primary object the production of a composite structure of the above items which is leak-proof.

A further object of the invention is to produce a composite metallic structure which will prevent galvanic action being set up between the contained solution and the exterior elements of the composite structure.

An additional object of the invention is to produce a strong and durable construction which will carry solution at a relatively high pressure satisfactorily.

Heretofore, it has been customary to line, for example, pipe with a lead lining in which the lead lining is bonded to the exterior shell of the composite structure. Various methods for installing a lead lining, for example, in a copper pipe, have been used; but due to the fact that in the making of bends in the pipe, stresses and strains are set up in the lining and also in the exterior shell. Cracks develop in the lining permitting the solution to come into contact with the outside shell or at a flanged joint, where the lining is lapped, breaks frequently occur, not immediately visible at the time of manufacture, but in service, so that in general the results of such construction have been unsatisfactory.

With the above objects and defects in view, the present invention has been made with the idea of producing a structure which is free from the said defects.

In the accompanying drawings and in the following description is disclosed the preferred construction of a composite pipe. It is not desired to be limited thereto as it is obvious that the same construction is applicable to items other than pipe, for example, a header of a condenser. Also, the same construction could be used for the construction of an acid container, or other receptacle the purpose of which is to hold a corrosive liquid.

In order to have a clearer understanding of the process of this invention, reference is now made to the drawings showing perspective views in which:

Figure 1 is an elevation showing the method of drawing the lining into the pipe.

Figure 2 is an elevation showing the first step in the method of closing one end of the lining.

Figure 3 is an elevation showing the method of

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bending the flange of the lining over the leak ring.

Figure 4 is an elevation showing the method of attaching the air line to the other end of the lining.

Figures 5 and 6 are elevations respectively showing a lining and its two longitudinal sections preliminary to placing them in a surrounding tube.

In Figure 1, 10 represents the external pipe or tube of the composite structure into which tube 11 has been drawn. 12 represents a flange on the end of the external pipe. There is also another flange on the other end shown in Fig. 4. A wire rope 20 is attached to the reduced end of tube 11 at 21.

In Figure 2 the other end of pipe 10 is shown flanged as at 12. The projecting end of lining tube 11 is shown at 32. Leak ring 30 is shown placed against the face of flange 12 over the end of tube 11. At 31 is shown a leak notch whose function will appear later.

In Figure 3 is shown the first step of flanging the extending end 32 of lining 11 over the leak ring. This bending operation results in the production of a flange which will serve later on in forming a sealed joint.

In Figure 4 is shown a method of connecting an air line 40 onto the other end of the lining as at 41. In Figure 5 is an elevation showing a lining tube 50 which has been cut longitudinally into two halves 51 and 52 shown in Fig. 6 which are bent to fit approximately a compound curve.

The basic process of this invention is designed to secure a satisfactory lining in straight sections or in sections with a long radius bend. Certain modifications of the basic process are employed for sections with short radius bends, or with branches.

The lead lining may be made up in the shop or purchased commercially. When made up in the shop, it is formed into a tube from sheet lead and the seam is secured by lead burning. The seam is then hammered lightly to close the pores in the cast metal. The outside of the lead pipe so formed is then tinned heavily with half and half solder. The thick, heavy coat of solder is secured by not wiping the pipe closely during the tinning operation. This usually leaves some bubbles or solder on the pipe; but these are desirable if not too large or too sharp. Lead piping with a light and even coating of half and half solder is available commercially in sizes of nine inches and under.

The pipe to be lined is tinned on the inside, and particular care is exercised to see that all sharp edges are eliminated.

The outside diameter of the lead lining is about $\frac{1}{8}$ " less than the inside diameter of the section of the pipe to be lined. The lining is about 15" longer than the pipe. A reducing screw fitting is installed in one end of the lead pipe. This fitting is used as an attachment for pulling tubes through pipes. In Figure 1 this screwed fitting is clearly shown at 22 and 21. The lead lining is then drawn by cable 20 through the pipe to be lined, as shown in this figure.

An escape ring 30 is slipped over the lead on the end opposite to the drawing end and brought up against the flange of the pipe. This ring is $\frac{1}{2}$ " thick; its inside diameter is the same as the inside diameter of the pipe being lined. The outside diameter of the ring is such that the outer edge of the ring is just inside the bolt holes of the flange on the pipe being lined. A V-shaped gutter or leak-off groove 31 is cut across the face of the ring bearing against the flange of the pipe. There is no gasket between the two. The projecting lead of the liner is then cut off, leaving a sufficient projection 32 to turn back into the face of the ring, as shown in Figure 3. An ordinary steel blank is then bolted to the flange. A proper gasket is fitted between the blank and the turned over lead lining. A $\frac{3}{4}$ " hole is tapped in the blank.

The fitting on the opposite end of the lead lining is then plugged. An air hose is connected to this end of the lining and air admitted to the interior of the lead lining under pressure, as shown in Figure 4. The pressure is regulated to about 15 lbs. per square inch, which experience has shown to be the right amount to just force the lead lining snugly against the wall of the pipe. The air hose is then detached; pressure is released and the projecting end of the lead lining is cut off. Sufficient lead lining is left to turn over on the escape ring which is secured in the same manner as described above. Care must be exercised to see that the V gutters are in the same o'clock position at each end of the pipe.

After steel blanks or suitable closure means are secured for closing each end of the pipe, a hydrostatic pressure of about 150 lbs. per square inch is applied to the interior of the lining through the $\frac{3}{4}$ " hole in either one of the blanks. If there is any opening or porosity in the lead it will show as leakage between the ring and the face of the flange, particularly through the V-shaped groove. The blanks are then removed and any puckers or bulges noted are dressed down with a suitable hand tool. The blanks are then replaced and the hydrostatic test repeated.

The water is then emptied from the pipe, blanks replaced, and the pipe is placed in the heat treating furnace with the V groove in the rings at the top. An air connection is screwed into the blanks at both ends of the piping. Tubing from these connections serves as air supply with vent lines, and are led out through small holes in the furnace. Control valves are placed in both lines. Several pieces of pipe may be, and often are, placed in the furnace at once, fitted with a common air supply and vent line. Gauges are fitted on both supply and vent lines.

The furnace, equipped with thermo-couples for temperature control, is lighted and brought up to 500° Fahrenheit in 45 minutes. This temperature is maintained for about 15 to 20 minutes. While the furnace is heating, air is admitted slowly to the pipe and pressure brought up and maintained at 20 lbs. per square inch. When the furnace temperature reaches the maximum of

500° Fahrenheit, the air pressure is built up to 90 lbs. per square inch. Both supply and vent valves are then closed and left closed, leaving the air pressure on during the high temperature period and during the cooling period.

When the furnace has cooled down, the pipe is taken out of the furnace. Blanks are removed, ends of the lining cut, and rings removed. The excess lining projecting from the pipe is cut back to within $\frac{1}{8}$ of an inch of the flange face. The area between the lead and flange bevel is filled with half and half solder. The flange face is then filed smooth and the job is completed.

In the case of pipes or bends which are too short to be lined as described above, the procedure is modified somewhat. In such cases, piping lengths must be designed so that one flange will be close to the termination of the bend. The straight section of piping at the other end of the bend must be short enough so that a mechanic can reach into the area of the bend to perform burning operation. In each case the proximity of the flange to the area of the bend is determined by the diameter of the pipe. With larger pipes, the flange can be somewhat farther from the bend. The lead lining for the bend is made up in two half sections. Figure 5 shows half sections for a compound bend. Each section is bent and fitted to the shape of the bend. The two sections are secured together by lead burning. With a simple bend, the two sections can be formed by lead burning prior to installation and the resultant tube tinned with half and half solder. In the case of compound bends, the two half sections are tinned separately and burned together with lining in place in the pipe. In this case, the joint is lapped as described below for joints between the bends and straight sections of the lining. This is required in order to preserve a uniform coating of solder over the whole lining. It is desirable, therefore, to avoid compound bends wherever possible. Procedure from then on is the same as for straight pipe. Where there is a straight section of appreciable length on one end of the bend, a lead lining is made up in the usual manner for this section of the pipe. It is inserted in the pipe so as to overlap the lining of the bend by about 1". The tinning solder of the parts which overlap is wiped smooth beforehand. The lap is hammered lightly until the lead is hard against the pipe. The lap is then lead burned and lightly hammered again.

Piping with branches should be so flanged that the branch will be close enough to the end of the pipe to permit a lead burner to reach the branch from the end of the pipe. The lead lining is installed in the main section of the pipe just as if no branch existed. A metal plate saddle is inserted in the branch to provide adequate backing for the lead lining in this vicinity. It is slightly less in diameter than the diameter of the branch. A bolt is welded to it so that it will extend beyond the face of the branch flange. The saddle rests against the lining of the main section of the pipe. The saddle bolt projects through a strong back, bolted to the branch flange. The saddle bolt is provided with a nut at the top and bottom of the strong back for holding saddle in a fixed position relative to the branch flange. This provides the necessary support to the main lead lining at the branch for the application of air pressure. After the lining is installed with air pressure in the main section of the pipe, the saddle and blanks are removed. The lead at the bottom of the branch is cut out, leaving enough lead at the edge

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to turn up about 1½" into the branch with a suitable tool. A lead sleeve is then inserted into the branch with lap, as was the case above. The joint between branch and main lining is made by lead burning. The pipe is then tested hydrostatically and bonded as before.

The process herein described has defined a method of making a composite pipe structure. As stated, supra, the process is applicable to the production of items other than pipe, i. e. acid containers, condenser heads etc. These are obviously within the scope and spirit of the invention to the extent as defined by the appended claim.

The invention described herein may be made or used by or for the Government of the United States for governmental purposes without the payment to me of any royalties thereon or therefor.

What is claimed is:

A method for affixing a tubular liner to the interior surface of a tubular member, wherein said member is provided with a flanged end supporting a ring vented to the interior of said member, said method including the following steps: coating the interior of said member with solder; applying a thick coating of solder to the exterior surface of said liner; arranging said liner within said member so that said liner longitudinally ex-

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tends in an outward projection beyond said end of said member, and so that there is a substantial clearance between the interior surface of said member and the exterior surface of said liner; turning back said projection onto the face of said ring; securing closure means thereon for closing both ends of said member; supplying sufficient fluid pressure internally of said liner to fully seat said liner against the interior surface of said member; and simultaneously applying sufficient heat thereto to cause said thick coating to flow into and to fill all cavities, indentations and the like in the interior surface of said member.

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