April 7, 1925. 1,532,555

J. T. RICE

STEEL FORM FOR AND METHOD OF APPLYING CEMENT LININGS TO PIPE LINES, TUNNELS, ETC

Filed Sept. 23, 1924 2 Sheets-Sheet 1

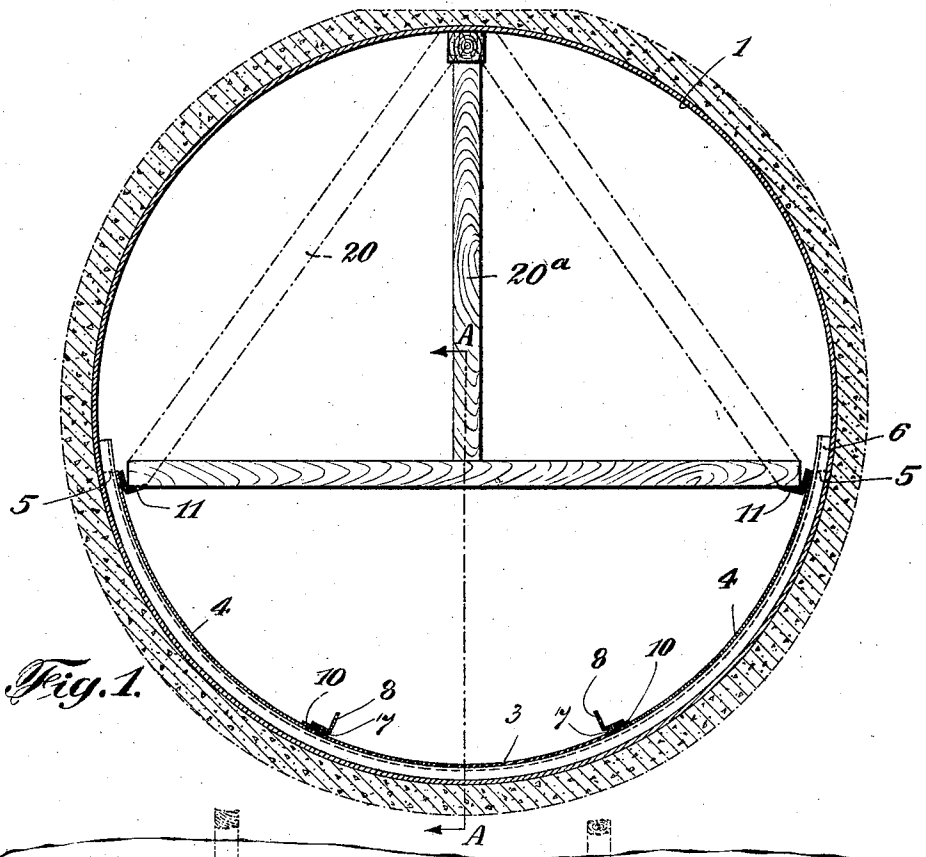


Fig. 1.

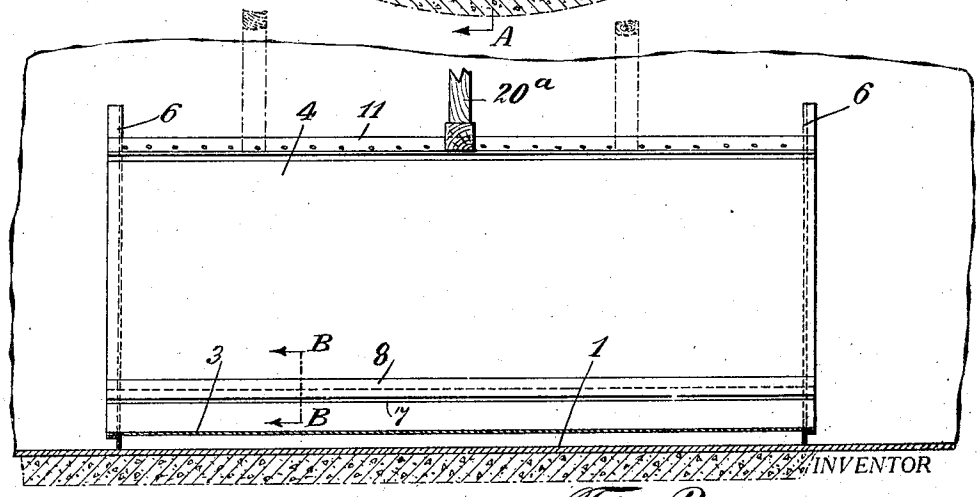


Fig. 2.

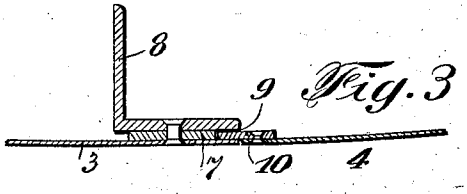


Fig. 3.

INVENTOR

Joseph T. Rice

BY

Dean, Fairbank, Albright & Hinman

his ATTORNEYS

April 7, 1925. 1,532,555

J. T. RICE

STEEL FORM FOR AND METHOD OF APPLYING CEMENT LININGS TO PIPE LINES, TUNNELS, ETC

Filed Sept. 23, 1924 2 Sheets-Sheet 2

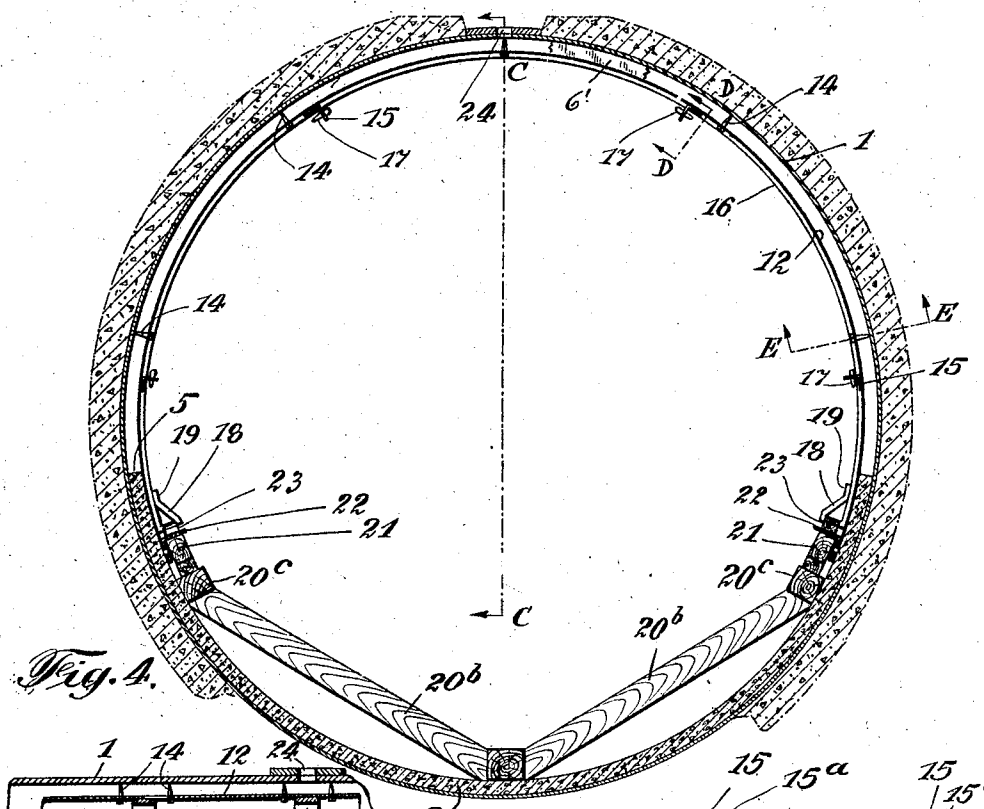


Fig. 4.

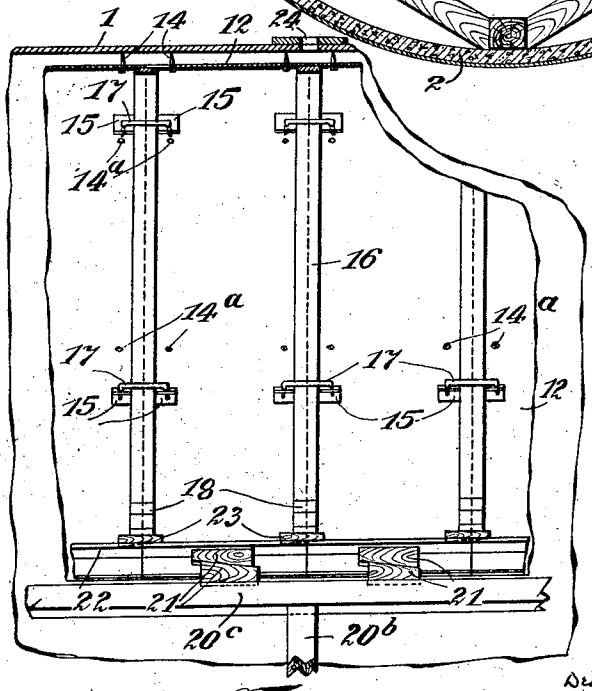


Fig. 5.

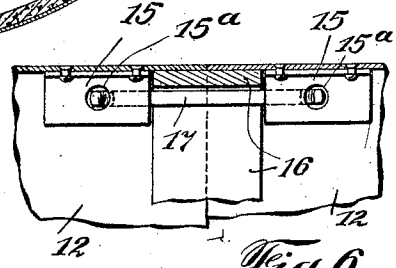


Fig. 6.

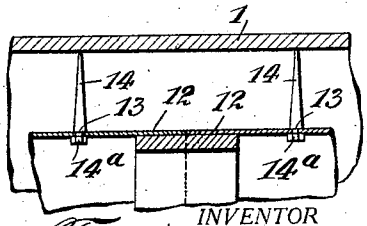


Fig. 7.

INVENTOR

Joseph T. Rice

BY

Dean, Townsend, Albright & Hirsch

his ATTORNEYS

Patented Apr. 7, 1925. 1,532,555

UNITED STATES PATENT OFFICE.

JOSEPH T. RICE, OF KINGSTON, NEW YORK.

STEEL FORM FOR AND METHOD OF APPLYING CEMENT LININGS TO PIPE LINES, TUNNELS, ETC.

Application filed September 23, 1924. Serial No. 739,405.

To all whom it may concern:

Be it known that I, JOSEPH T. RICE, a citizen of the United States, and resident of Kingston, in the county of Ulster and State of New York, have invented certain new and useful Improvements in Steel Forms for and Methods of Applying Cement Linings to Pipe Lines, Tunnels, Etc., of which the following is a specification.

My invention relates to steel forms and the method of applying them, to line with cement steel pipes and other curved surfaces.

In preparing forms for linings for riveted steel pipe lines and other curved surfaces, the present practice is to use forms, which require complicated bracing to support the arch forms while the cement lining is hardening. As it is important to have the forms adapt themselves to the inner contour of the pipe line or similar surfaces, the present practice is to prepare, fit and brace the forms as the work progresses and the form and bracing are broken down after the cement has set. This has been very expensive, both in labor and material. Further, it has been difficult to put in such forms and bracing, due to the fact that such linings must be put in after the pipe lines are laid, which gives a very restricted place in which to work.

By my invention, I provide steel forms that are readily installed and removable, are flexible, and capable of continuous and progressive re-use and being sectional in character, can be made of any length that the particular job shows is desirable.

Another object of my invention is to obviate the destruction and refabrication of these forms to fit the interior contour of the pipe line.

Another object of my invention is to obviate the use of arch bracings to support the forms while the concrete is being set.

Another object of my invention is to provide means to automatically secure a predetermined space between the interior surface of the pipe line and the outermost surface of the forms, in which space grout may be poured to form the cement lining of the pipe.

Another object of my invention is to so construct and arrange said forms that they may be readily assembled and disassembled by manual labor in the restricted interiors of pipe lines with a minimum expenditure of labor and materials.

In the drawings, Fig. 1 is a cross-section of the pipe line and forms of the lower segment of the cement lining.

Fig. 2 is a cross-section along the line A—A Fig. 1.

Fig. 3 is a cross-section along the line B—B Fig. 2.

Fig. 4 is a cross-section of the pipe line and arch forms.

Fig. 5 is a cross-section along the line C—C, Fig. 4.

Fig. 6 is a cross-section detail along the line D—D Fig. 4 of the means for locking the arch plates and arch rib.

Fig. 7 shows a detail of the spacing pins and is a cross-section along the line D—D Fig. 4.

In the drawings, the riveted steel pipe line 1, is to be lined with cement lining 2. While the drawings show a steel pipe line 1, it is obvious that my invention may be employed in lining with cement, the inside of a curved tunnel or other continuous, curved surfaces.

As shown in Fig. 1, the lower segment of the cement lining 2 is formed with the use of a bottom invert plate 3 and two side invert plates 4, which are laid longitudinally of the pipe line 1, having been bent to fit the transverse invert bulkheads 6, which bulkheads are bent to fit the lower segment of the inside surface of the steel pipe line 1, said lower cement segment terminating at 5.

The bottom invert plates 3, as shown in Fig. 3, has attached thereto straps 7, and angle bars or L's 8, the straps 7 being narrower than the lowermost legs of the L's, thereby forming grooves 9. The side invert plates 4, have attached thereto at one edge the tongue 10 and at the other end the L 11.

The grooves 9, and the tongues 10, are so constructed that the tongues 10, will readily fit into the grooves 9, to hold together the bottom invert plates and two side invert plates.

In practice I have found that the weight of the bottom and side invert plates 3 and 4 is sufficiently great so that but slight bracing is needed while the grout or mortar is poured. A simple form of such bracing is employed such as shown in dotted lines at 20 Fig. 1, or another form is that of an inverted T as indicated by 20ª. This latter form is preferable in practice, in permitting the passage of workmen in the tunnel.

The upper segment of cement lining 2 is laid with the use of steel arch plates 12, one of which is shown in Fig. 4 said arch plates being set up transversely of the pipe line 1. These steel plates 12, have open holes 13, punched in the same, in which are inserted spacing pins 14, which fasten to the plate 12, by the nuts 14ª. These spacing pins project from the outside circumference of the arch plate 12 the intended thickness of the grout to be poured between the inner circumference of the pipe line 1 and the outside circumference of the arch plates 12. This is shown in detail in Fig. 7.

Said arch plates 12 are bent so that the spacing pins 14 will contact with the inner circumference of the pipe line 1, regardless of whether or not the inner circumference assumes a true circle. This is hereinafter more fully described.

To the inner side of said arch plates 12 are riveted the angle irons 15. Over the side edges of the plates 12 is placed an arch rib 16, which serves as an auxiliary stiffening means, the edges of said arch plates 12 being brought in intimate contact by driving the wedging clips 17, into holes 15ª, provided therefor in the angle irons.

The ends of said arch plates 12 have riveted at the ends thereof the angle irons 22.

The arch ribs 16 have abutments 18 formed by reversely bending the ends thereof to form an eye, the extreme ends of the blank engaging the inner surface of the rib as at 19. The wedges 23 are driven between the abutments 18 on the arch ribs 16 and the angle iron 22 on the arch plates 12 to cause said arch ribs to contact with and reinforce the arch plates.

The bracing 20ᵇ serves as a base for the blocks 20ᶜ. Wedges 21 are driven, exerting endwise pressure on the arch plates and ribs, thereby causing the spacing pins 14 to come in intimate contact with the inner surface of the pipe line and automatically adjust the outside periphery of the arch plates to the inside periphery of the pipe line 1.

By the use of this construction an interior space is provided for the grout, which forms are sufficiently strong so that none of the usual complicated arch bracing is necessary to support the arch plates.

In Fig. 6, there is shown in detail the L's, 15, into the holes of which 15ª are driven the wedging clips 17, to draw the arch plates 12, together at the edges thereof and to hold the supporting arch rib interposed between the said L's 15, and wedging clips 17.

Having described certain of the means employed in my invention, the method by which said means are employed and the cement lining laid will now be described.

For purposes of illustration, let it be assumed that the pipe line 1, in this particular form, has an inside diameter of 8′ 10″, and is to have a cement inner lining 2″ thick.

The pipe line 1, being of light flexible steel without ribs, the various sections of which are merely riveted together at the seams so that the pipe line as a whole is more or less flexible.

Such pipe line 1 is laid under varying conditions, according to the contour of the land where laid. In practice, the pipe line is first completely laid, then the water is forced into the same under the pressure occurring in actual condition of use. In view of the differences in topography where the pipes are laid, and consequent variations in water pressure, the inner circumference of the pipe line in different parts thereof will assume varying curved shapes differing from a true circle. Thus, at the top of a hill where there is less pressure the top of the pipe line will have a tendency to flatten, the pipe line assuming a more or less elliptical shape, with the minimum diameter in the vertical. When the line assumes its permanent shape, the outside of the line is concreted, so that it will maintain such shape.

In view of the differences in the inner shape of the pipe line it has heretofore been absolutely impossible to use forms that are not specially fabricated, in place, to conform to the inner contour of the pipe line at each particular place.

Furthermore, in practice, it is likewise specified that the mortar lining of the cement pipe line 1, should be of a predetermined uniform thickness. This requirement is to save the waste of mortar and likewise to assure the largest possible interior diameter for the flow of water.

By use of my forms it has been found possible to have standard steel forms that not only automatically adjust themselves to these features of change in the interior periphery of the pipe lining, but a cement or mortar lining is obtained that is of uniform thickness regardless of the interior contour of the pipe line. Furthermore, in the use of steel forms a much smoother surface is given to the interior mortar lining, thereby avoiding friction to the flow of water.

The lowermost segment of cement lining between the points 5—5, Fig. 1, is laid in the following manner: on the lowermost portion of the pipe line 1, is placed transversely of the length thereof, two inverted bulkheads 6. These bulkheads are of any suitable form, preferably using 2″ x 2″ x ¼″ angle irons that are 13′ long and are laid less than 8′ 6″ apart, and have been formed to substantially fit the inner circumference of the pipe line 1, and these bulkheads, being of light weight, are readily adjustable to the differences in contour of the inner circumference of the lower segment of the pipe line 1.

Longitudinally of the pipe line and at right angles with said bulkheads 6, I place the bottom invert plate 3, which is 8′ 6″ long by 4′ wide, of No. 10 plate. The two side invert plates, each of similar dimensions, are fastened to the bottom invert plate by the tongue and groove 7, 8, 9 and 10 heretofore described. Grout is then poured in at the points 5, until filled.

This process is repeated at intervals of less than 8′ 6″ leaving between each set of lower forms and bulkheads an intervening portion of the pipe line that has not had the cement lining applied.

The bulkheads 6 and the plates 4, 3, 4, are then removed after the cement has set. The plates 4, 3, 4, are then put on the cement lining that has already been laid and the grout is poured in at both ends to fill the space not previously poured, thereby saving the necessity of laying the bulkheads 6 for these intervening sections.

Further, by this method the invert bulkheads 6 are prevented from becoming embedded in the cement.

If it is desirable to have the lower segment of the cement lining laid in a continuous strip, this may be done by placing the spacing pins heretofore described in connection with the arch plates 12, on the outer periphery of the invert lower and side plates 3, 4 instead of using the bulkheads 6 heretofore described.

When the cement lining is laid and set in the lowermost segment between the points 5, 5, the concrete lining for the remaining uppermost segment is then put in, in the following fashion:

The arch plates in the construction here described are preferably 22½″ wide by 17′ long of No. 10 plate. As the cement lining is to be 2″ thick, the spacing pins project 2″ from the outermost surface of the arch plates 12.

Arch plates 12, and rib 16 are put on by driving the wedges 23, between the abutments 18, on the arch ribs and the angle irons 22 on the arch plate. The arch rib 16 is preferably 4″ x ½″ x 17′. Arch plates 12 and arch rib 16 are fastened together by the wedging link 17, to cause the edges of the arch plates to meet. Then the wedges 21 are driven in to force the spacing pins in intimate contact with the interior circumference of the pipe line 1, regardless of the shape thereof and the assembled forms are illustrated in Figs. 6.

In practice, I have found that these arch plates 12, are so well sustained at the bottom by the wedging action of the wedges and the strengthening of the arch ribs 16 that all the links 17 are not necessary and some of them may be dispensed with in actual practice.

When sufficient of these arch plates have been assembled the grout is poured down into the grout holes 24, which have been provided at intervals in the steel pipe lines. This grout flows by gravity in the space between the inner surface of the pipe line 1 and the outer surface of the arch plate 12, until it contacts on both sides with the lowermost segment of the concrete lining which has already been laid, and completes cement lining up to the grout holes 24. while the cement lining is being set in these forms similar arch forms are being installed, as just described.

In practice I find that the typical pouring length for the arch forms is 120 feet containing 9 grout holes. In beginning to enclose a clearance space for the overhead cement lining or at the terminal of a 120 foot length of the forms, I employ a bulkhead 6′ like lower bulkheads 6 of 2″ x 2″ x ¼″ angle iron (but inverted) braced against the inner periphery of the pipe line and projecting a distance equal to the thickness of the mortar lining, which in this instance is 2″. The purpose of this bulkhead is to stop the cement, when poured, from exuding at the open end of a length of overhead arch forms.

When the upper concrete lining is set, the links, and wedges and blocks are removed, the arch plates and arch ribs are then taken down and all reassembled in another part of the work.

The pins 14 are tapered and therefore easily removed from the concrete by tapping the arch plates, the holes left by such pins being later pointed.

By this method steel forms are made standard, are easily applied, are automatically adjustable to interior circumference and may be used again and again, without refabrication and without the usual complicated bracing. The forms are of such sizes as are capable of easy handling, in the close quarters of the interior of a pipe line. The method of applying the cement lining is continuous. This method results in very material savings in labor, material and the time necessary to complete the lining of pipe lines, tunnels, etc.

Another embodiment of my invention, wherein the grout may be poured but once and the complete circumference of the lining made at one pouring, is as follows: After the bottom and side invert plates are laid as heretofore described, instead of pouring the grout, the arch forms are put up and wedged to the lower forms and where found necessary bracing may be used, blocks and wedges being used, as heretofore described.

By following this procedure, there is a complete inner chamber of a predetermined width, the space in the lowermost periphery being predetermined by the bulkheads and in the uppermost periphery by the spacing pins.

The grout is then poured through the grout holes 24, filling the entire inner chamber and the cement lining is made in one pouring. In following this procedure it is preferable to have the arch plates 25½″ wide, so that the width of four of said transverse arch plates will equal the length of the longitudinal bottom and side invert plates.

These forms are so flexible when disassembled, that they are not only adjustable to the contour of the interior circumference of the 8′ 10″ pipe line but they are also adjustable for use in pipe lines of somewhat smaller or larger diameters.

For convenience of description the foregoing specification has gone into details as to the dimensions of the forms having an inside diameter of 8′ 10″. Such dimensions may vary under different conditions, and I do not limit myself to the dimensions herein set forth.

It will be thus seen that there is herein described apparatus in which the several features of this invention are embodied, and which apparatus in its action attains the various objects of the invention and is well suited to meet the requiremens of practical use.

As many changes could be made in the above constructions, and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. In forms for lining with cement pipe lines and the like, longitudinal bottom and side invert plates demountably fastened; arch plates and arch ribs, demountably fastened, supporting and wedging means at the abutments thereof; and means to space the outside periphery of the plates a predetermined distance from the inner periphery of the pipe line.

2. In forms for lining with cement pipe lines and the like, longitudinal bottom and side invert plates, tongue and groove connections between the side edges of said plates, arch plates and arch ribs, demountably fastened supporting and wedging means at the abutments thereof; and means to space the outside periphery of the plates a predetermined distance from the inner periphery of the pipe line.

3. In forms for lining with cement pipe lines and the like, longitudinal bottom and side invert plates, demountably fastened and supported on invert bulkheads; arch plates and arch ribs, cross-pieces, blocks and L's to support said arch plates and arch ribs, spacing pins on the outer periphery of said arch plates, and linking means on the inner periphery of said arch plates, said linking means linking the arch plates and arch ribs and wedging means at the abutments of the arch plates and arch ribs, to force the spacing pins in intimate contact with the inner periphery of the pipe line and to support the said arch plates and ribs.

4. In forms for lining with cement pipe lines and the like, standard longitudinal bottom and side invert plates, demountably fastened; standard arch plates and arch ribs, demountably fastened, standard supporting and wedging means at the abutments thereof; and means to space the outside periphery of the plates a predetermined distance from the inner periphery of the pipe line, all of said parts being interchangeable and capable of re-use for their respective purposes.

5. In forms for lining with cement pipe lines and the like, standard longitudinal bottom and side invert plates, tongue and groove connections between the side edges of said plates, standard arch plates and arch ribs, demountably fastened supporting and wedging means at the abutments thereof; and means to space the outside periphery of the plates a predetermined distance from the inner periphery of the pipe line, all of said parts being interchangeable and capable of re-use for their respective purposes.

6. In forms for lining with cement pipe lines and the like, standard longitudinal bottom and side invert plates, demountably fastened and supported on invert bulkheads; standard arch plates and arch ribs, cross pieces, blocks and L's to support said arch plates and arch ribs, spacing pins on the outer periphery of said arch plates, and linking means on the inner periphery of said arch plates, said linking means linking the arch plates and arch ribs and wedging means at the abutments of the arch plates and arch ribs, to force the spacing pins in intimate contact with the inner periphery of the pipe line and to support said

arch plates and ribs, all of said parts being interchangeable and capable of re-use for their respective purposes.

7. As an article of manufacture, a unit for a form for lining pipes with cement, said unit comprising a rectangular sheet metal plate having cylindrical curvature, a longitudinal bar rigidly secured along one lateral edge of said plate, and a pair of bars in superposed relation rigidly secured along the opposite edge thereof, the inner of said pair of bars being narrower than the outer to afford a groove for accommodating the bar of an adjoining plate in the assembled form.

8. As an article of manufacture, a unit for a form for lining pipes with cement, said unit comprising a sheet metal arch plate having spacer means projecting therefrom and having rigid abutments at its ends for the application of thrust thereto to rigidly sustain the arch plate with said spacer means pressed into firm contact engagement with the interior of the pipe.

9. A form for lining pipe lines with cement or the like, comprising longitudinal bottom and side invert plates demountably fastened, arch plates extending through arcs complementary to said bottom and side invert plates, means clamping the arched edges of contiguous arch plates into firm demountable engagement, to form an arch length substantially equal to the length of the invert plates, and means to space the outside wall of all of said plates at a predetermined distance from the inner wall of the pipe.

10. A joint serving to connect successive arch plates in a form for lining pipes with cement, said joint comprising a reinforcing band superposed over abutting edges of contiguous plates, anchoring fittings on said plates and laterally of said band, and clamping pieces coacting with said anchor fittings and straddling said reinforcing band and serving to draw the edges of said plate into firm butting relation.

11. In forms for lining with cement pipe lines and the like, invert plate means, an arch plate extending through an arc complementary to said invert plate means, all of said plates yielding circumferentially of the pipe, spacer means for said plates, and means expanding said plates to press the spacer means into firm contact engagement with the interior of the pipe.

12. In forms for lining with cement, pipe lines and the like, longitudinal bottom and side invert plates demountably fastened, an arch plate extending through an arc complementary to said invert plates, all of said plates yielding circumferentially of the pipe, spacer means for interposition between the said plates and the pipe to be lined, and means for expanding said plates to press the spacer means into firm engagement with the interior of the pipe.

13. In forms for lining with cement pipe lines and the like, invert plate means, arch plates and arch ribs demountably fastened, said arch plates and ribs extending each through an arc complementary to said invert plate means, all of said plates and ribs yielding circumferentially of the pipe, spacer means for interposition between said plates and the pipe to be lined, and means for expanding said plates to press the spacer means into firm contact engagement with the interior of the pipe.

14. A form for lining pipe lines with cement or the like comprising invert plate means extending lengthwise of the pipe for a length substantially that of the pipe diameter, arch plates extending through arcs complementary to said invert plate means, means clamping the arch edges of contiguous arch plates into firm demountable engagement to form an arch length substantially equal to the length of the invert plate means, and means to space the outside wall of all of said plates at a predetermined distance from the inner wall of the pipe.

15. A form for lining pipe lines with cement or the like, comprising invert plate means, arch plates extending through an arc complementary to said invert plate means, supporting bulkheads for the ends of said invert plate means to space the latter from the inner wall of the pipe to be lined, spacer pins upon the arch plates to correspondingly space the latter from said pipe wall, said plates being yielding and means exerting pressure at the ends of said plates to accurately position the form to adapt itself to the inner wall of the pipe.

16. In a form for lining pipe lines with cement or the like, in combination arch plates, arch ribs overlapping contiguous edges of successive arch plates, wedging means coacting with the ends of said ribs and reacting against the ends of said plates to tighten said ribs with respect to said plates, and means coacting with the lower ends of said assembly to expand said plates in correct position within the pipe to be lined.

17. The method of providing a pipe installation with a uniform lining of cement which consists in laying an unlined light flexible steel pipe, subjecting it to substantially the conditions of normal use so that it will assume a cross-sectional form at each part of the length thereof corresponding to the stresses thereon in use, embedding the pipe to maintain said form, expanding demountable flexible standard metal forms to contact the interior of the pipe with a plurality of spacers thereon, filling cementitious material in the space between the pipe and the forms, and removing the forms for

repeated use after the material has hardened.

18. The method of lining a pipe length of light flexible steel, the cross section of which is deformed from a true circle, which includes the steps of expanding a demountable flexible standard metal form to press rigid uniform spacers thereon against the inner wall of the pipe, filling cementitious material in the space between the pipe and the forms, and removing the forms for repeated use, after the material has hardened.

19. The process of lining the interior of metallic pipes with mortar, which comprises first forming a series of non-contiguous lower sections of mortar-lining which extend less than half-way around the interior of the pipe, next forming the intervening lower sections of mortar-lining, and then forming the complementary overhead mortar-lining.

20. A set of flexible lower mold-forms of sheet-metal and a complementary set of flexible overhead mold-forms of sheet-metal, for use in applying to the interior of pipes a lining such as of mortar, means for maintaining the desired clearance-space between the convex face of said lower forms and the concave face of the pipe-wall, separate means for maintaining similar clearance-space for the overhead forms, and wedging means for forcing said forms into the desired curvature and maintaining them in their adjusted position.

21. A set of complementary lower and overhead flexible mold-forms of sheet metal, for use in applying to pipes a lining such as of mortar, in combination with means for maintaining the desired clearance-space between the convex face of said forms and the concave interior face of the pipe-wall, and wedging-means for forcing the respective forms into the desired curvature and maintaining them in their desired position.

22. A flexible mold-form of sheet-metal, for use in applying to pipes a lining such as of mortar, means for maintaining the desired clearance-space between the convex face of the form and the concave interior face of the pipe-wall, and wedging-means for forcing said form into the desired curvature and maintaining it in its adjusted position.

23. A flexible mold-form of sheet-metal, having a set of spacing-studs projecting from one face thereof, for use in applying to pipes a lining such as of mortar, in combination with wedging-means for forcing said form into the desired curvature and maintaining it in its adjusted position.

24. A flexible mold-form of sheet-metal, for use in applying to pipes a lining such as of mortar, in combination with wedging-means for forcing said form into the desired curvature and maintaining it in its adjusted position, and means comprising spacing-bulkheads for closing the ends of the clearance space enclosed by said form.

25. The herein-described process of applying to metal conduits an interior lining of mortar, which consists of first enclosing the ends of a plurality of lower clearance-spaces, then covering alternate clearance-spaces with sheet-metal forms which extend less than half-way up the sides of the pipe, then by wedging-action forcing said forms into the desired curvature and securely maintaining them in their adjusted position, then filling said enclosed alternate spaces with mortar and allowing it to set, next similarly covering and wedging and then filling said intervening spaces, then enclosing the complementary overhead space by means of contiguous overhead forms of sheet metal, next by wedging-action forcing said overhead forms into the desired curvature and securely maintaining them in their adjusted position, and finally filling said overhead space with mortar and allowing it to set.

26. The herein-described apparatus for applying to the interior of metallic pipes a lining such as one of mortar, which comprises a set of lower mold-forms of sheet-metal curved to extend less than half-way around the interior of the pipe, arcuate bulkheads separating them from the interior face of the pipe and with said forms enclosing a lower clearance-space, readily-appliable and readily-removable wedging-means for forcing said forms into the proper curvature and maintaining them securely in their adjusted position, a set of overhead mold-forms also of sheet-metal, arcuate overhead bulkheads separating said overhead forms from the interior face of the pipe and with said overhead forms enclosing an overhead clearance-space, and readily-appliable and readily-removable wedging-means for forcing said overhead forms into the proper curvature and maintaining them securely in their adjusted position.

27. The herein-described apparatus for applying to the interior of metallic pipes a lining such as one of mortar, which comprises a set of lower mold-forms of sheet-metal curved to extend less than half-way around the interior of the pipe, means for maintaining the desired clearance-space between the convex face of said forms and the concave wall of the pipe comprising means for closing the ends of said clearance-space, readily-applied and readily-removed wedging-means for forcing said forms in to the proper curvature and maintaining them securely in position, a set of overhead mold-forms also of sheet-metal, suitable means for maintaining the desired clearance-space between the convex face of said overhead forms and the concave wall

of the pipe comprising means for closing the ends of said space, and readily-applied and readily-removed wedging-means for separately forcing said overhead forms into the desired curvature and maintaining them in their adjusted position.

28. A flexible mold-form of sheet-metal having a set of spacing-studs projecting from one face, for use in applying to pipes a lining such as of mortar, in combination with wedging-means for forcing said form into the desired curvature and maintaining the same in its adjusted position, and spacing-bulkheads for closing the ends of the clearance-space enclosed by said form.

Signed at Kingston, in the county of Ulster and State of New York, this 17th day of September, A. D. 1924.

JOSEPH T. RICE.