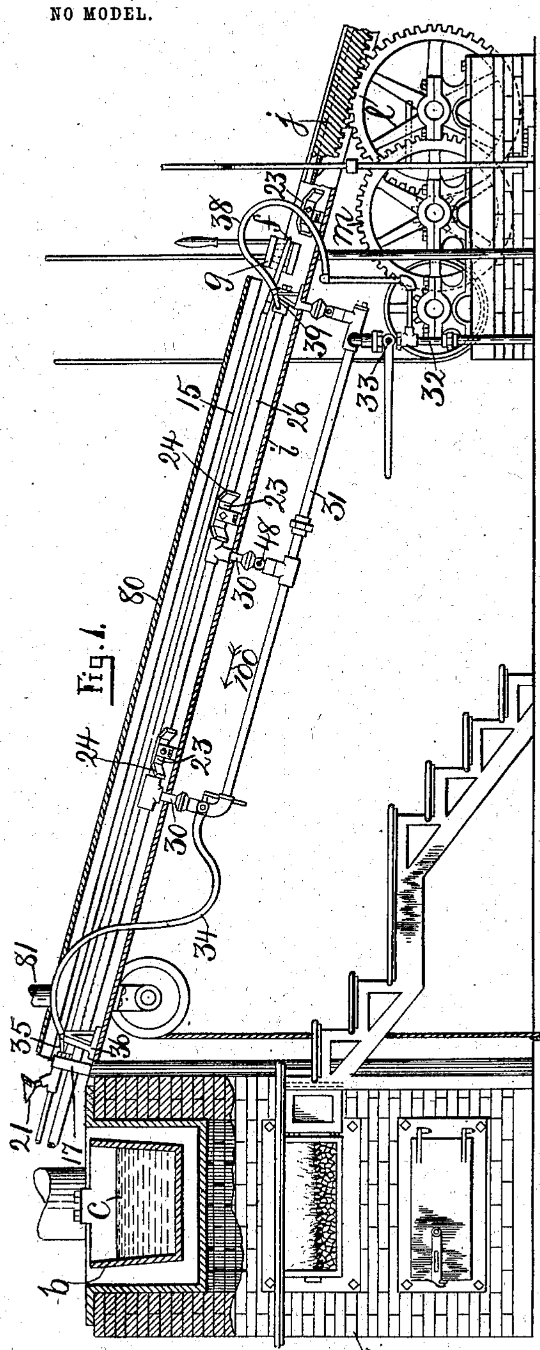
No. 729,796. PATENTED JUNE 2, 1903.

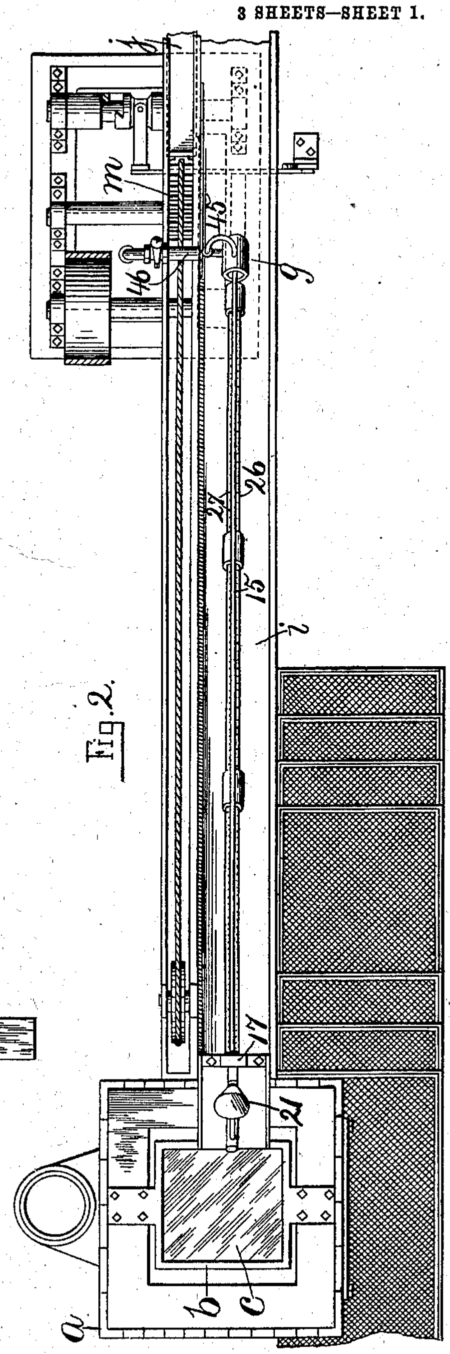
D. A. RITCHIE.

METHOD OF MANUFACTURING COMPOSITE PIPE.

APPLICATION FILED NOV. 25, 1902.

NO MODEL. 3 SHEETS—SHEET 1.





Witnesses.

Lauritz N. Möller

J Murphy

Inventor.

David A. Ritchie

by Jas. H. Churchill Atty.

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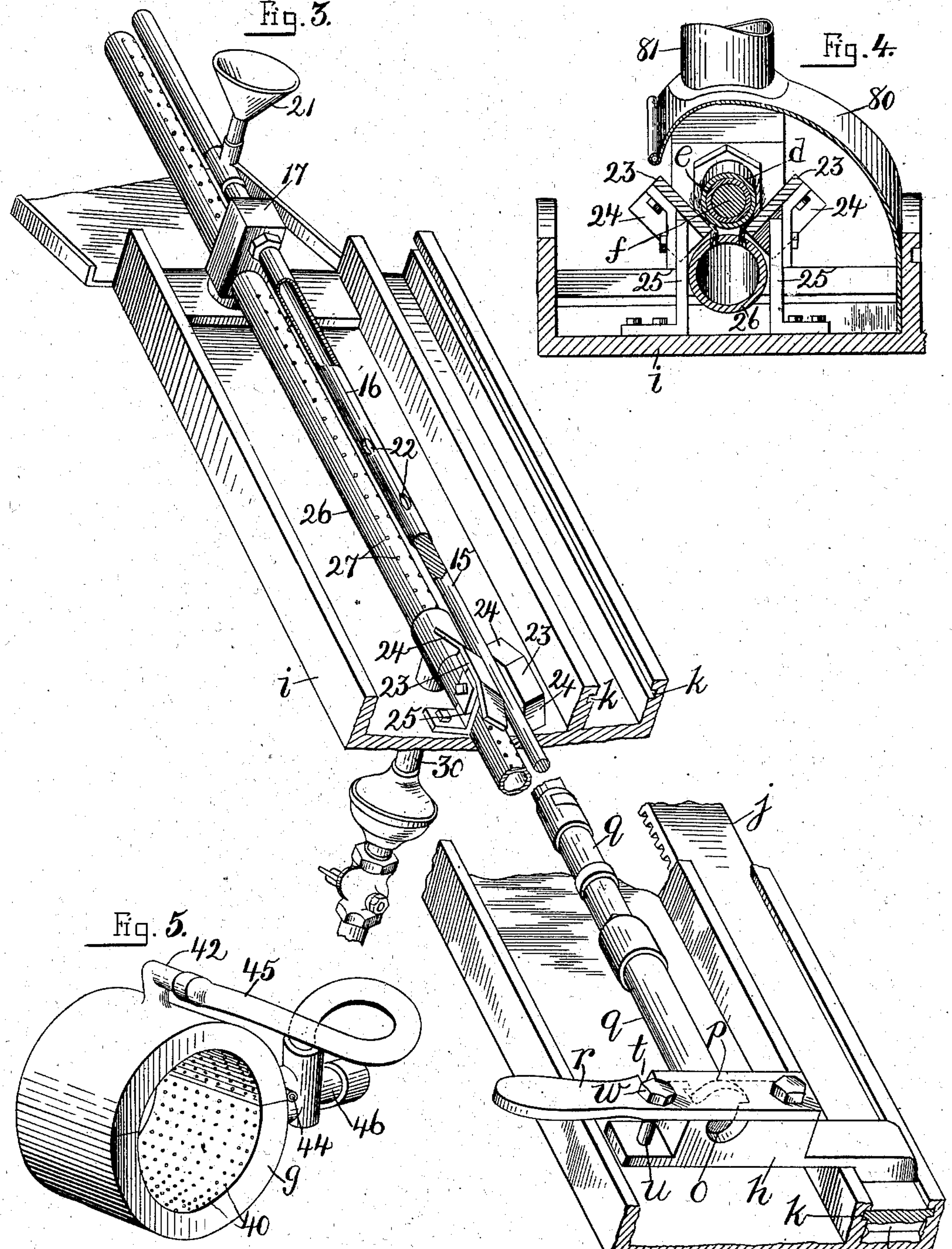
3 SHEETS—SHEET 2.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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3 SHEETS—SHEET 3.

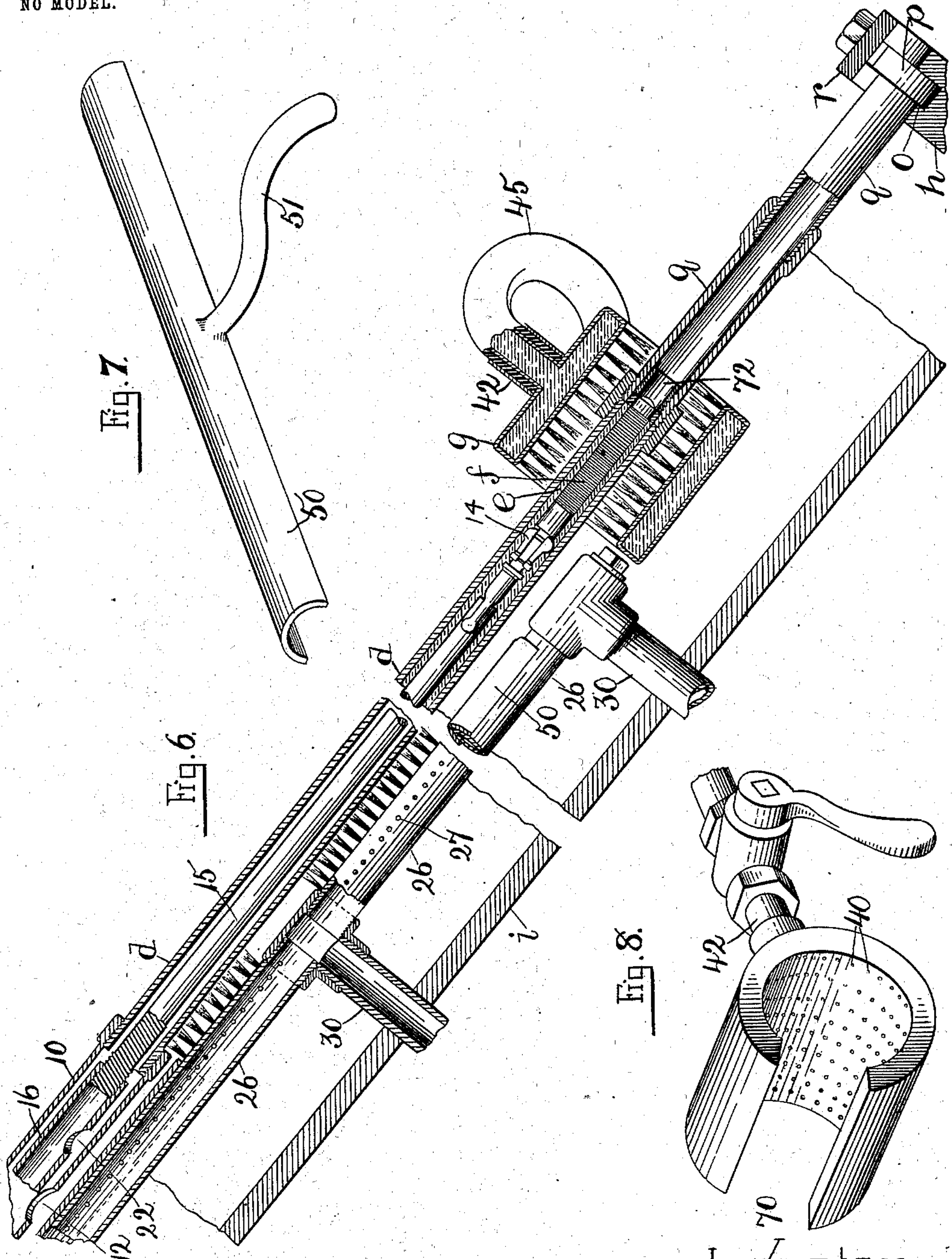

Fig. 7.

Fig. 6.

Fig. 8.

Witnesses.

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UNITED STATES PATENT OFFICE.

DAVID A. RITCHIE, OF CAMBRIDGE, MASSACHUSETTS, ASSIGNOR TO LAMB & RITCHIE, OF CAMBRIDGE, MASSACHUSETTS, A FIRM.

METHOD OF MANUFACTURING COMPOSITE PIPE.

SPECIFICATION forming part of Letters Patent No. 729,796, dated June 2, 1903.

Application filed November 25, 1902. Serial No. 132,776. (No model.)

To all whom it may concern:

Be it known that I, DAVID A. RITCHIE, a citizen of the United States, residing in Cambridge, in the county of Middlesex and State of Massachusetts, have invented an Improvement in Methods of Manufacturing Composite Pipe, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to a novel method of manufacturing composite non-corrodible pipe composed of an outer tube of iron or steel and an inner tube of non-corrodible metal of relatively lower melting-point, such as tin, lead, zinc, and the like or their alloys and substantially such as shown and described in United States Patent No. 610,224, dated September 6, 1898.

For convenience I shall hereinafter refer to the iron or steel tube or pipe as the "primary" tube and the non-corrodible tube as the "inner" tube.

In accordance with this invention a mandrel for determining the thickness of the inner tube is centered within the primary tube, and molten non-corrodible metal is poured into the primary tube to fill the space between the mandrel and the inner wall of the primary tube. The mandrel or the primary tube is moved longitudinally one with relation to the other, and the portion of the primary tube in line with or opposite to the mandrel is cooled to congeal the portion of the molten non-corrodible metal between the mandrel and the primary tube, while the remaining portion of the primary tube has applied to its outer surface heat from a source extraneous to the molten non-corrodible metal for maintaining the remaining portion of the non-corrodible metal within the primary tube in a molten condition until it in turn is congealed. These and other features of this invention will be pointed out in the claims at the end of this specification.

Figure 1 represents in side elevation and section an apparatus with which to practice this invention; Fig. 2, a plan view of the apparatus shown in Fig. 1; Fig. 3, a detail in perspective, on an enlarged scale, to be referred to; Fig. 4, a transverse sectional detail, on an enlarged scale, to be referred to; Fig. 5, a detail of the chilling device preferred for large sizes of pipes; Fig. 6, a detail in longitudinal section and elevation, on an enlarged scale, to be referred to; Fig. 7, a detail of the heater-protecting device, and Fig. 8 a modified form of chilling device.

Referring to Figs. 1 and 2, *a* represents a suitable furnace for heating a kettle or vat *b*, containing the non-corrodible metal *c*, which, as above stated, may be tin, lead, zinc, and like metal or their alloys. In the present instance the primary tube *d*, (see Figs. 4 and 6,) which is to be provided within it with an inner tube *e*, of non-corrodible metal, molecularly united thereto, is made movable with relation to a mandrel *f* and a chilling device *g*, and for this purpose I employ a movable support or carriage *h*, (see Fig. 3,) suitably supported to reciprocate in an inclined plane, the said carriage being shown as a bar extended transversely of a trough-shaped frame *i* and attached at one end to a rack-bar *j*, movable longitudinally of said trough or frame in suitable guideways *k*. The rack-bar *j* is adapted to be moved in opposite directions in any suitable manner, and, as herein shown, the said rack-bar is engaged by a gear *l*, (see Fig. 1,) which may be rotated by suitable gearing *m* under control of the operator. The carriage *h* is provided with suitable means for sustaining or anchoring one end of the primary tube, or, as is preferred, for anchoring an extension of or attachment to said primary tube. In the present instance the carriage *h* is shown as provided with a recess *o* (see Figs. 3 and 6) for the reception of a collar or flange *p* on the extension or attachment *q* of the primary tube, which attachment or extension is secured to the carriage by a locking device, shown as a lever *r*, pivoted to the carriage *h* and adapted to be moved over the recess *o*, the said lever having a slot *t*, which is adapted to engage a bolt or stud *u* below its head *w*, as clearly shown in Fig. 3.

The primary tube or pipe *d* is provided in the present instance at its opposite end, which may be designated its "upper" end, with a hollow extension or attachment 10, (see Fig. 6,) which is provided with one or more ports or openings 12, for a purpose as will be described. The primary tube *d* is adapted to be moved by the carriage *h* over the mandrel *f*, which may and preferably will be made as herein shown and which consists of a cylindrical body or section composed of disks of mica or like material and constituting the mandrel proper, an expansible section 14, composed of a plurality of pieces separated from one another to form channels through which the molten metal may flow, a rod 15, and the hollow portion or section 16, which latter is secured to a suitable support, shown as an upright 17, (see Fig. 3,) attached to the bottom of the inclined trough or frame *i*, which may be supported in any suitable manner. The trough or inclined run or frame *i* is made of sufficient length to permit the carriage *h* to be moved downward far enough to clear the mandrel and permit the completed pipe to be removed from the carriage. The hollow section 16 of the mandrel constitutes a supply-pipe for the primary tube and in the present instance is provided with a metal-inlet port having connected with it a funnel 21, through which the molten non-corrodible metal is admitted into said supply-pipe and from which it flows out into the primary tube through the outlet ports or openings 22 in said supply pipe. (See Figs. 3 and 6.) The primary tube *d* is supported in its travel longitudinally over the mandrel by suitable guides or supports, shown as pieces 23 of metal, (see Figs. 3 and 4,) provided with oppositely-inclined ends 24 and arranged obliquely to each other to form a substantially V-shaped space or passage, through which the primary tube passes while resting against the straight portion of the pieces 23. The guides 23 may be secured to uprights 25, fastened to the bottom of the trough or frame *i*, as clearly shown in Fig. 4. Below the mandrel is located a heater for maintaining the non-corrodible metal within the primary tube in a molten condition. The heater referred to may be made as herein shown and consists of one or more gas-pipes 26, provided with ports or openings 27 for the passage of the gas out of the said pipe. In the present instance I have shown a single burner-pipe 26, provided with two longitudinal rows of gas-outlet ports 27, which are suitably spaced, so as to cause the flame resulting from the ignition of the gas to pass up under and around both sides of the primary tube after the manner represented in Fig. 4. The burner tube or pipe 26 extends substantially the length of the mandrel and may be supported in any suitable manner and may be connected by suitable branch pipes 30 with a pipe 31, extended longitudinally of the trough *i* below the same and connected with a main supply-pipe 32, having a controlling cock or valve 33. The pipe 31 may be connected by a flexible pipe 34 (see Fig. 1) with a Bunsen or other burner 35, which is suitably supported above the trough, as by an upright 36, and which is employed to heat the hollow extension or supply-pipe 16 to prevent cooling of the molten metal poured into the same. The main gas-supply 32 may also be connected by a flexible pipe 38 with a Bunsen or other burner 39, which is employed to heat the mandrel proper, *f*, and prevent chilling of the molten metal in the primary tube prior to the desired exterior chilling, which latter is accomplished by flowing or directing cold water or other fluid through the chilling device *g*, which, as herein shown, consists, essentially, of a hollow body, preferably cylindrical or substantially cylindrical in shape, and provided on its inner surface with a plurality of outlet ports or openings 40 and having one or more inlet ports or openings 42. For small sizes of primary tubes, such as one-half inch in diameter, the chilling device may be made as represented in Fig. 8 and may be provided with a single inlet-port, whereas for large sizes of primary tubes—such, for instance, as from one-half inch upward in diameter—the said chilling device may be made in two parts or halves, as shown in Fig. 5, the said parts being pivotally connected, as at 44, and each provided with a fluid-inlet port. The inlet port or ports of the chilling device may be connected with the water-service of the building or with any other suitable source of supply. As shown in Fig. 5, the inlet-port for the upper half of the chilling device is connected by a flexible pipe 45 with the supply-pipe 46 for the lower half of said device. Each branch pipe 30 may be provided with a cock or valve 48 to regulate the supply of gas to the burners. The port or opening 12 in the hollow extension 10 of the primary tube serves as an oulet for the surplus molten metal, and in order to prevent the gas-outlet ports of the burner in the vicinity of the mandrel being closed by the surplus metal discharged through the said port I have provided a cover or shield (shown in Fig. 7) comprising a substantially semicircular piece 50, adapted to fit over the upper side or portion of the burner-pipe 26 and provided with a handle 51.

The mandrel *f* and its attached expansible section 14 are detachably secured to the rod 15, and when in operative position the mandrel extends wholly or partially through the chilling device, and in order to facilitate the attachment of the mandrel to the rod 15 and its detachment therefrom the chilling device is left with the opening 70 (shown in Fig. 8) or the upper section is movable, as shown in Fig. 5. The mandrel may be readily attached to and detached from the rod 15 by providing the end of the said rod with a slot, into which the upper end of the expansible section is fitted, as represented in Fig. 6.

The method of manufacturing composite pipe by the aid of the apparatus herein shown will now be briefly described. Assume the parts to be in what may be termed their "starting" position—namely, with the carriage *h* in its withdrawn or lowered position, the mandrel f uncovered, and the chilling fluid shut off—which condition is substantially represented in Figs. 1 and 2, also assume that the burners 26, 35, and 39 are lighted. The primary tube d having been previously tinned or galvanized has screwed upon its threaded ends the attachments or extensions 10 and q. The primary tube is then heated in a suitable manner, preferably by means of an apparatus not herein shown, until the said tube has been heated to substantially the melting-point of the tin coating. It is then placed in the trough-like frame i, with its lower end secured to the carriage h and its upper end resting on one set of the guides 23. The power is then applied to move the carriage upward or in the direction indicated by the arrow 100, Fig. 1, the primary tube being guided through the chilling device and over the mandrel f. The carriage continues its upward travel until the lower end of the primary tube is within the chilling device, substantially as represented in Fig. 6. At such time the upper extension or attachment 10 of the primary tube has been passed over the supply-pipe 16 and the lower end of the mandrel f is extended into a threaded ring 72 within the hollow extension q and of substantially the same diameter as the mandrel, as represented in Fig. 6. The ring 72 constitutes one form of stop to arrest the downward flow of the molten metal within the primary tube. The machine is then stopped, and an operator at the furnace dips a quantity of the molten metal from the kettle b and pours the same into the funnel 21. The molten metal flows through the port 22 into the extension 10 and thence down within the primary tube until it meets the ring or stop 72, where its flow is stopped. A second operator now turns on the supply of chilling fluid, which, as represented in Fig. 6, is projected against the outside portion of the primary tube within the chilling device and serves to congeal the portion of the molten metal between the mandrel and the extension q and also between the mandrel and the primary tube, and thus form a portion of the inner tube. The carriage h is then started on its downward movement and the primary tube is drawn over the mandrel, thus bringing another portion of the primary tube and molten metal within the chilling device, wherein the molten metal is chilled as it passes over the mandrel. This action is continued until the primary tube and the hollow extension or attachment 10 have been drawn off from the mandrel out of the chilling device, whereupon the carriage is stopped, and the composite pipe thus formed, together with the attachments 10 q, is removed from the carriage, after which the extensions or attachments are unscrewed from the ends of the primary tube, and any non-corrodible metal in said attachments is melted out, which may be accomplished by dipping the extensions in the kettle b. During the movement of the primary tube over the mandrel the said tube may and preferably will be turned by hand somewhat slowly, so as to avoid uneven heating of the primary tube. With the primary tubes of small size I prefer to pour into the same at one time a quantity of non-corrodible metal more than sufficient to form the inner tube, but with large sizes of primary tubes I prefer to make a number of pourings; but I do not desire to limit myself in this respect. Some of the surplus metal is discharged through the port 12 in the hollow extension of the primary tube, and to avoid this metal filling the ports or openings 27 in the gas-burner the cover or shield 50 is applied to the lower portion of the burner as the upper end of the primary tube approaches the chilling device, as represented in Fig. 6, when large sizes of tubes are used, the heat from the auxiliary burner 39 being sufficient to maintain the metal in the end of the primary tube and in its extension in a molten condition until solidified by the chilling fluid; but when small sizes of primary tubes are used the shield may be applied in the beginning of the operation, as the heat from the remaining portion of the burner is sufficient to maintain the non-corrodible metal molten in these small sizes of tubes. After the composite tube is formed as above described another tube previously prepared is placed in the apparatus, and the operation just described is repeated.

While I may prefer to employ the mandrel herein shown, I do not desire to limit myself to any particular form or construction of mandrel, provided, however, that it is constructed at its end so as to enter the ring 72 or equivalent device within the attachment, and thereby insure the free end of the mandrel being centered with relation to the primary tube. After a portion of the inner tube has been formed as above described this portion of the inner tube acts to center the free end of the mandrel as the primary tube is drawn off from the mandrel.

The upper portion of the trough or frame i may and preferably will have secured to it a hood 80, (see Figs. 1 and 4,) which acts to collect any fumes created by the heating of the coating on the outside of the primary tube and from which said fumes are drawn off through a suitable outlet-pipe 81, which may be connected with the chimney or with any suitable exhaust apparatus.

I may prefer to employ the apparatus herein shown for practicing the method herein described; but I do not desire to limit my invention in this respect.

I may prefer to pour the molten non-corrodible metal into the primary tube at its upper end; but I do not desire to limit my invention in this respect.

I claim—

1. The method of manufacturing composite non-corrodible pipe, which consists in placing a primary tube of corrodible metal over a mandrel, pouring molten non-corrodible

metal into said primary tube, applying heat from a source extraneous to the molten non-corrodible metal to the outer surface of the primary tube for maintaining the non-corrodible metal within the primary tube in a molten condition, moving the primary tube over the mandrel, and cooling the portion of the non-corrodible metal which is between the mandrel and the primary tube as the latter is moved over the mandrel, substantially as described.

2. The method of manufacturing composite non-corrodible pipe, which consists in placing a primary tube of corrodible metal over a mandrel, pouring molten non-corrodible metal into said primary tube, applying heat from a source extraneous to the molten non-corrodible metal to the outer surface of the primary tube for maintaining the non-corrodible metal within the primary tube in a molten condition, moving the primary tube or mandrel longitudinally one with relation to the other, and cooling the portion of the non-corrodible metal which is between the mandrel and the primary tube, as the latter or the mandrel is moved longitudinally one with relation to the other.

3. The method of manufacturing composite non-corrodible pipe, which consists in centering a mandrel within a primary tube of corrodible metal, directing molten non-corrodible metal into said primary tube, applying heat from a source extraneous to the molten non-corrodible metal to the outer surface of the primary tube for maintaining the non-corrodible metal within the primary tube in a molten condition, moving the primary tube or mandrel longitudinally, one with relation to the other, and cooling the portion of the non-corrodible metal, which is between the mandrel and the primary tube as the said mandrel or primary tube is moved longitudinally one with relation to the other, for the purpose specified.

4. The method of manufacturing composite non-corrodible pipe, which consists in centering a mandrel within a primary tube of corrodible metal, directing molten non-corrodible metal into said primary tube, arresting the flow of molten metal within the primary tube to fill the space between the mandrel and the said primary tube, applying heat from a source extraneous to the molten non-corrodible metal, to the outer surface of the primary tube for maintaining the non-corrodible metal in a molten condition, moving the primary tube or mandrel longitudinally one with relation to the other, and cooling the portion of the non-corrodible metal which is between the mandrel and the primary tube as the said mandrel or primary tube is moved longitudinally one with relation to the other, for the purpose specified.

5. The method of manufacturing composite non-corrodible pipe, which consists in providing a primary tube of iron or steel on its inner surface with a coating of a metal which will effect a union between the corrodible primary tube and a non-corrodible metal of relatively lower melting-point, centering a mandrel within the primary tube thus prepared, directing molten non-corrodible metal into said primary tube, applying heat from a source extraneous to the molten non-corrodible metal to the outer surface of the primary tube for maintaining the non-corrodible metal within the primary tube in a molten condition, moving the primary tube or mandrel longitudinally, one with relation to the other, and cooling the portion of the non-corrodible metal which is between the mandrel and the primary tube as the said mandrel or primary tube is moved longitudinally one with relation to the other, for the purpose specified.

6. The method of manufacturing composite non-corrodible pipe, which consists in centering a mandrel within a primary tube of corrodible metal, directing a quantity of molten non-corrodible metal into said primary tube to but partially fill the same, applying heat from a source extraneous to the molten non-corrodible metal directly to the outer surface of the primary tube for maintaining the non-corrodible metal within the primary tube in a molten condition, moving the primary tube or mandrel longitudinally, one with relation to the other, and cooling the portion of the non-corrodible metal, which is between the mandrel and the primary tube as the said mandrel or primary tube is moved longitudinally one with relation to the other, substantially as described.

7. The method of manufacturing composite non-corrodible pipe, which consists in centering a mandrel within a primary tube of corrodible metal, directing molten non-corrodible metal into said primary tube, applying heat from a source extraneous to the molten metal directly to the outer surface of the primary tube for maintaining the non-corrodible metal within the primary tube in a molten condition, moving the primary tube or mandrel longitudinally, one with relation to the other, and cooling the portion of the non-corrodible metal, which is between the mandrel and the primary tube as the said mandrel or primary tube is moved longitudinally one with relation to the other, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

DAVID A. RITCHIE.

Witnesses:

JAS. H. CHURCHILL,

J. MURPHY.