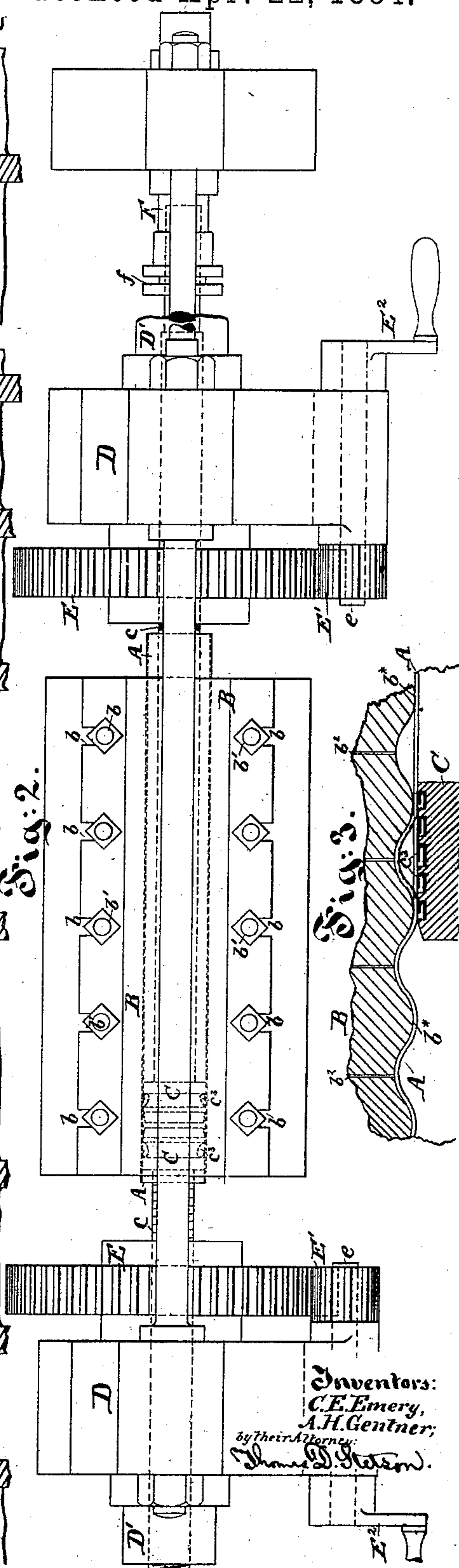


2 Sheets—Sheet 1.

No. 297,244.

Patented Apr. 22, 1884.



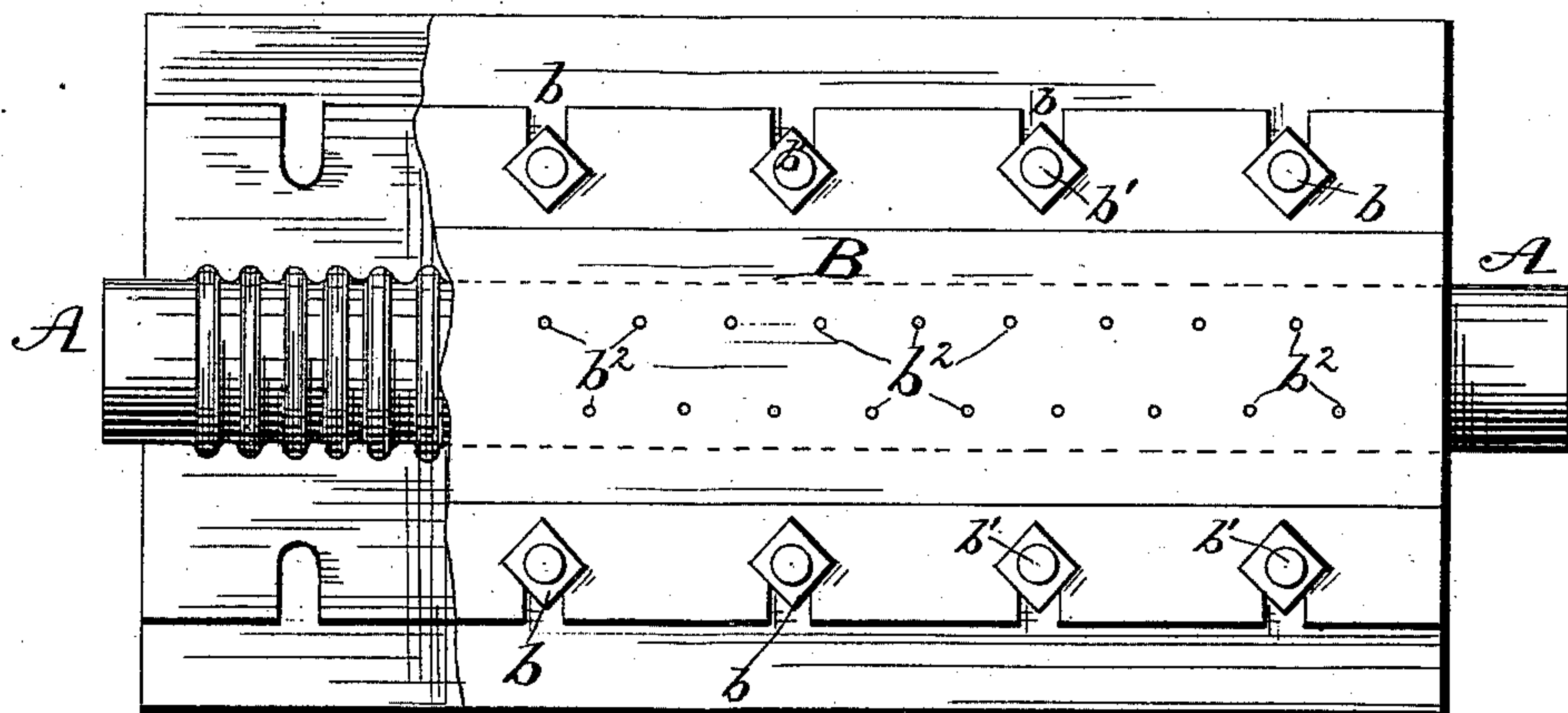
**Inventors:**  
**C.E. Emery,**  
**A.H. Gentner;**  
*by Their Attorney:*  
**Thomas D. Stetson.**

(No Model.)

2 Sheets—Sheet 2.

C. E. EMERY & A. H. GENTNER.  
METHOD OF AND APPARATUS FOR CORRUGATING TUBES.  
No. 297,244. Patented Apr. 22, 1884.

*Fig. 4.*



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# UNITED STATES PATENT OFFICE.

CHARLES E. EMERY, OF BROOKLYN, AND A. HENRY GENTNER, OF NEW YORK, N. Y., ASSIGNORS TO SAID EMERY.

## METHOD OF AND APPARATUS FOR CORRUGATING TUBES.

SPECIFICATION forming part of Letters Patent No. 297,244, dated April 22, 1884.

Application filed April 25, 1883. (No model.)

*To all whom it may concern:*

Be it known that we, CHARLES E. EMERY, of Brooklyn, Kings county, in the State of New York, having an office in New York city, in the State of New York aforesaid, and A. HENRY GENTNER, of New York city, in the county and State of New York, have invented certain new and useful Improvements in Methods of and Apparatus for Corrugating Tubes; and we do hereby declare that the following is a full and exact description thereof.

Our apparatus produces circular corrugations extending around the tubes. For various reasons it is preferable to effect the corrugating in such manner that the innermost points of the corrugations correspond to the original diameter of the tube. Our apparatus is intended for doing this in a simple and efficient manner without injury to the metal. We effect this by hydraulic pressure, and arrange the apparatus in such manner that a minimum amount of strain only is exerted on the metal. This enables us to use material of comparatively little thickness, and insures the correct performance of the work without injury to any part of the tube operated upon.

The accompanying drawings form a part of this specification, and represent what we consider the best means of carrying out the invention.

Figure 1 is a longitudinal vertical section, partly in elevation. Fig. 2 is a corresponding plan view. Fig. 3 is a longitudinal section through a portion of the tube and the immediately-adjacent parts, on a larger scale. Fig. 4 is a detail view of a portion of the form broken away to show a portion of the interior.

Similar letters of reference indicate like parts in all the figures.

The tube may be of copper, and the corrugations impressed to allow it to serve as an expansion-joint. The tube to be corrugated (marked A) is introduced into a form, B, of cast-iron or other suitable material, having its interior finished corresponding to the form of the corrugations which it is desired to impart to the tube. The form B is constructed in halves, with recesses B, which receive stout bolts and nuts  $b'$ , or equivalent removable fastenings adapted to secure the parts very strong-

ly, and to be easily removed and applied. It is preferable that the interior diameter of the form at the points  $b^*$  shall correspond as near as possible to the external diameter of the tube A. The latter should be of greater length than the length of the corrugated tube it is desired to produce.

C C are pistons, the rods  $c$  of which are screw-threaded, and are engaged in stout internally-threaded wheels E. Each piston-rod  $c$  is formed with a spline for receiving keys  $c'$ , which engage also with brackets  $D'$ , and prevent the piston-rods from turning.

E E are stout gear-wheels, the interiors of which are screw-threaded to match the threads on the piston-rods  $c$ . These wheels are operated by pinions  $E'$  on shafts  $e$ , which latter may be turned by cranks  $E^2$ , or by any other suitable means. The turning of the wheels E effects the forward and backward motion or the motion toward and from each other of the pistons C, as will be easily understood. Through one of the piston-rods  $c$  and its piston C is a continuous passage,  $c^2$ , through which water is forced under pressure. Each piston is equipped with one or more packings of leather or other suitable material. One piston-rod extends through a stuffing-box,  $f$ , into a sleeve, F, supported on a stout part of the framing, and which communicates, by means of a stationary pipe,  $g$ , with the pump or series of pumps G. The diameter of each piston C corresponds as nearly as possible with the inside diameter of the tube to be corrugated, and in order to insure its easy introduction into the latter its inner end is slightly conical. Each piston is in addition provided with suitable hydraulic packing, as represented at  $c^3$ .

The method of operation is as follows: The pistons C are first withdrawn to a point near the wheels E, then the upper half of the form B is removed, the tube A is introduced in the form, and the upper half secured by means of bolts and nuts  $b'$ . Then both pistons C are caused to enter into the tube by turning the shafts  $e$ , and consequently the gear-wheels E. In most cases we consider it advisable to bring the pistons close together in the interior of the tube. The pump G is then started, and the water under pressure, entering through the passage  $c^2$ , expands a short portion of the tube



A which is between the pistons C, until it assumes the shape of the interior of the form B. It will be noticed that the ends of the tube A being free to move endwise, these ends can  
 5 move inward as much as the expansion requires, the tightness of the pistons being maintained by the packing  $c^3$ . After the pressure has been brought to the required degree, which has insured the expansion of the tube into one  
 10 or two corrugations of the form B, the operator begins to slowly move one or both the pistons outward by turning the corresponding shafts  $e$ , the pressure of the water being maintained by continuing the operation of the  
 15 pump. This exposes fresh surfaces of the tube A to receive the pressure of the water, and these surfaces successively yield outward and assume the shape of the corresponding portion of the inclosing-form B. In this manner,  
 20 the entire tube will gradually be corrugated, beginning near the center, the metal required for the corrugations being furnished by the inward motion of the ends of the tube.

We have shown the work as being commenced at one end of the form B, and progressing gradually toward the other by the withdrawing of one piston only, while the other stands still. We have shown the corrugations as of full depth at the end where the  
 30 work is started, and gradually diminishing in depth toward the other end of the form B; but these matters may be varied. Where, as is here shown, the tube is corrugated in gradually-diminishing depths, we propose to  
 35 remove both pistons, open the form B, and shift the tube A forward, and, after closing the form B and again inserting the pistons, to subject the tube to the hydraulic pressure, thus increasing the depth of the corrugations  
 40 which were formed only to a part of their full depth in the first operation. The tubes may, if found necessary, be annealed between the two or more operations to which they are thus subjected. There may be two or more of the  
 45 packings  $c^3$  in each piston. The length of the piston in advance of the first packing may be considerably less than here shown. The entire depth of the pistons may be considerably greater than here shown.

50 Modifications may be made in the details without departing from the principle of the invention.

Holes  $b^2$  allow the air to escape from between the form B and the tube A when the  
 55 latter is being expanded.

In some cases one of the pistons may be made stationary; but we prefer to make them both movable.

In some cases the pistons may serve without the packing.  
 60

In some cases there may be several cup-leathers or analogous packings in each piston.

The piston is represented in Fig. 3 as having several packings.

65 We claim as our invention---

1. The method described of giving a desired form to metallic tubes, which consists in inclosing the tubes in a proper former, and then applying hydraulic pressure to the interior of successive sections of said tubes, as herein  
 70 specified.

2. The method described of producing corrugations in tubes, which consists in inclosing the same in a former, and then applying hydraulic pressure to the interior of the successive lengths of such tubes, and allowing the uncorrugated portion to be drawn longitudinally to supply the material for the corrugations successively, as set forth.  
 75

3. As an apparatus for annularly corrugating tubes, the divisible form B  $b^*$ , and the removable fastenings  $b'$ , pistons C, operated singly or together, to increase or diminish the capacity of the chamber, the pump G, for inducing a strong hydraulic pressure, and a passage,  $c^2$ , for conducting the water under pressure to the interior of the tube, all combined and arranged for joint operation, substantially as and for the purposes herein specified.  
 80 85

4. The divisible form B, having internal annular corrugations diminishing in depth toward one end, in combination with pistons C, operated singly or together to increase or diminish the capacity of the chamber, means for introducing water under pressure, and means  
 90 95 for inducing the gradual retreat of a piston C, all arranged to serve as herein specified.

5. The form B, having annular corrugations and vent-holes  $b^2$ , in combination with means for introducing hydraulic pressure in the interior of an inclosed tube, and pistons C, fitting tightly within the tube and operated singly or together to increase or diminish the capacity of the chamber, all substantially as and for the purposes herein specified.  
 100 105

6. The divisible form B  $b$ , with suitable fastenings therefor, the pump G, sleeve F, having stuffing-box  $f$ , the pistons C, operated singly or together to increase or diminish the capacity of the chamber, and gears E E', for moving the pistons, all combined and arranged to operate substantially as herein specified.  
 110

7. In a machine for shaping tubes, the duplicate pistons C, and means for introducing and operating them, in combination with a divided form, B, and suitable fastenings, means for introducing hydraulic pressure in the space between the pistons, and means for allowing the pistons to move apart while the pressure is on, all substantially as and for the  
 115 120 purposes herein specified.

In testimony whereof we have hereunto set out hands, at New York city, this 16th day of April, 1883, in the presence of two subscribing witnesses.

CHAS. E. EMERY.  
 A. H. GENTNER.

Witnesses:

CHARLES R. SEARLE,  
 B. E. D. STAFFORD.