

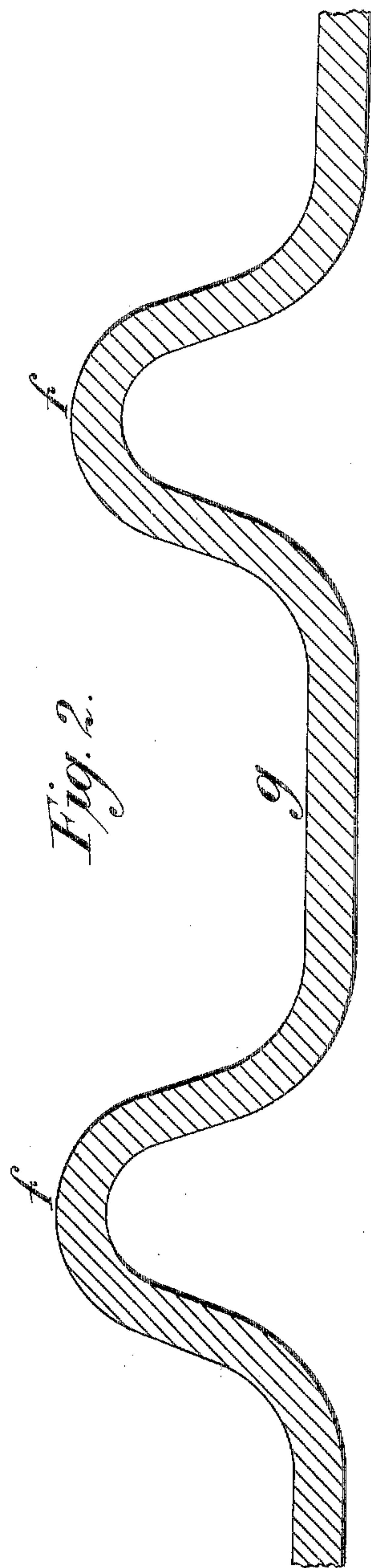
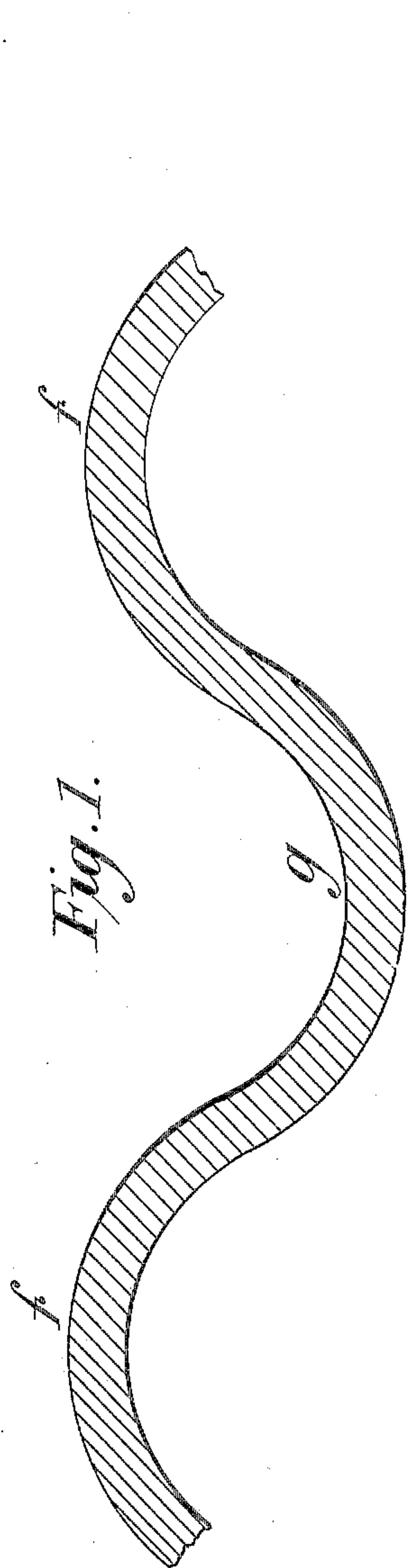
No. 794,091.

PATENTED JULY 4, 1905.

E. GEARING & W. RAINFORTH.  
MANUFACTURE OF STEAM BOILER FURNACES AND FLUES.

APPLICATION FILED FEB. 16, 1904.

2 SHEETS—SHEET 1.



Witnesses.  
*Arthur Woodman*  
*Wm. H. Spence*

Inventors  
*Ernest Gearing*  
*William Rainforth*  
Per *Wm. H. d. W. A. L.*  
Attorney.

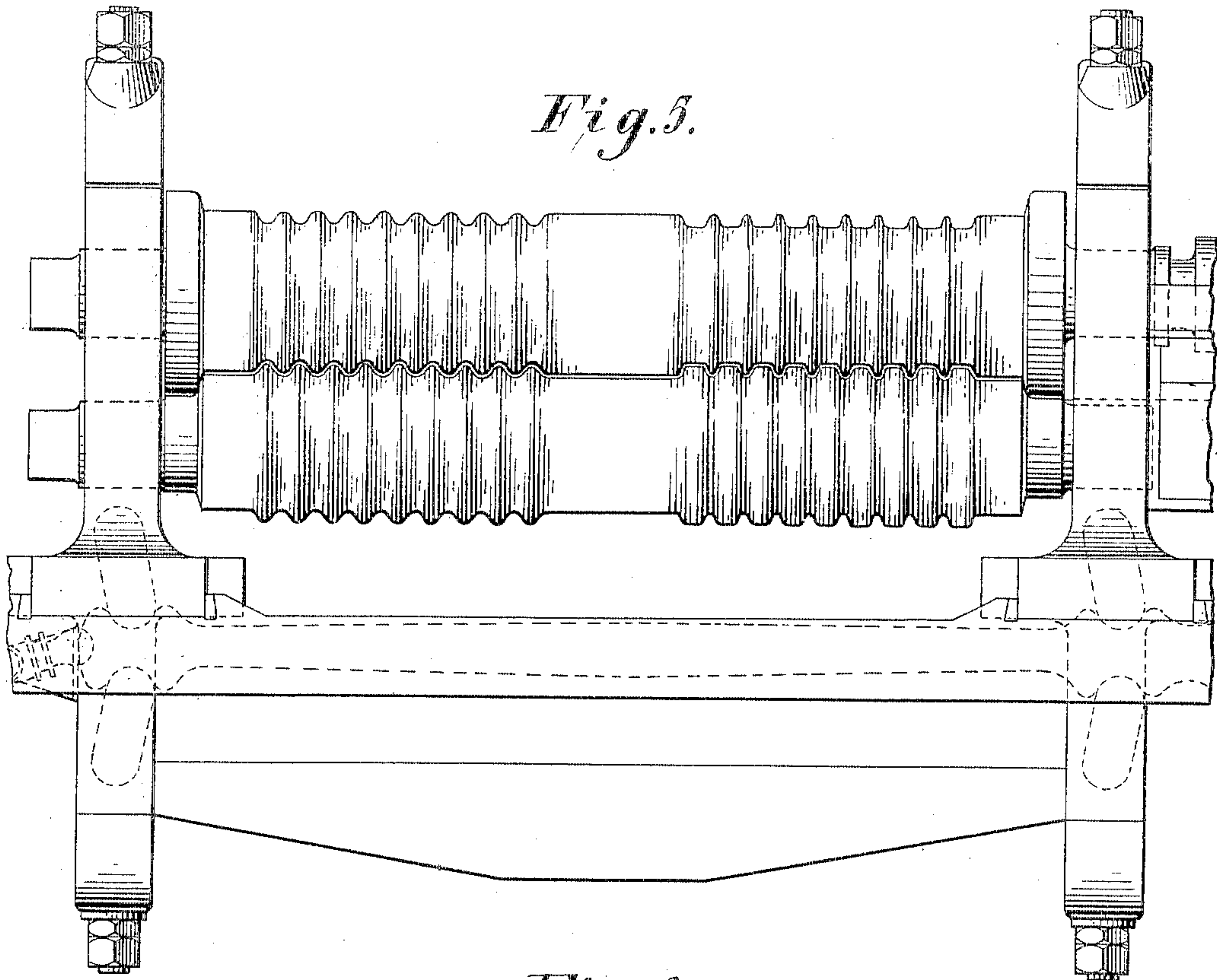
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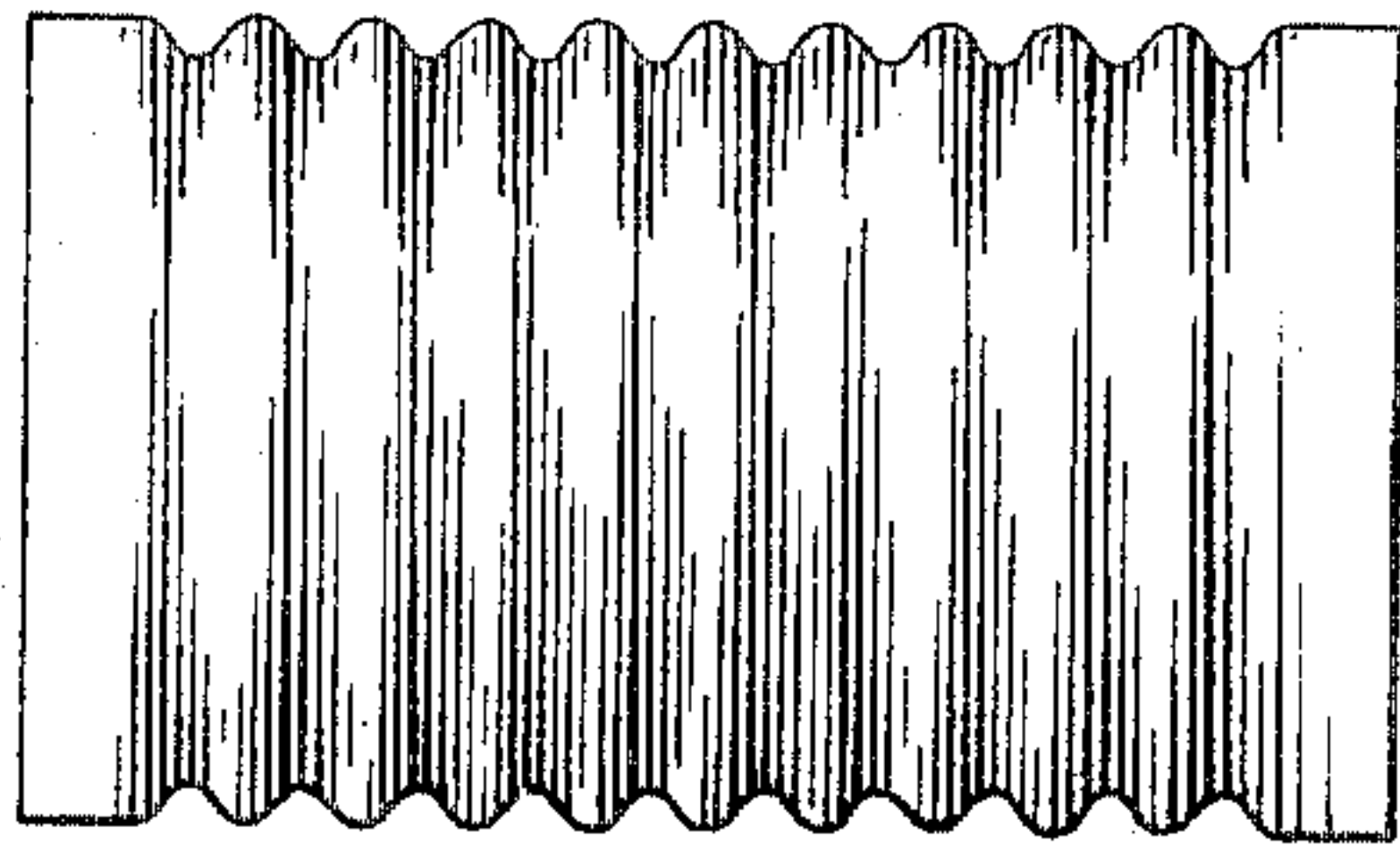
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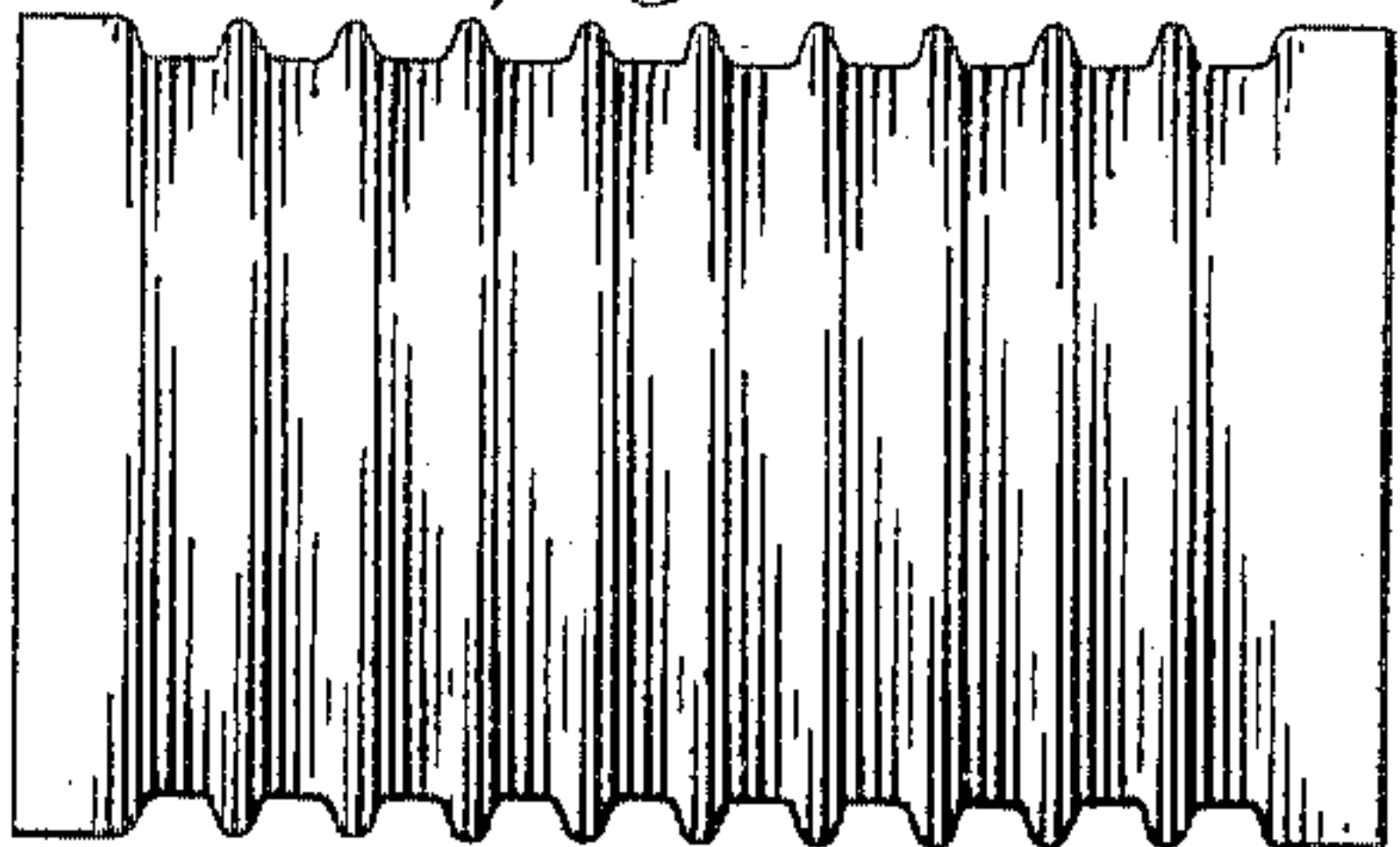
2 SHEETS—SHEET 2.



*Fig. 5.*



*Fig. 4.*



Witnesses.  
*E. P. Wright Jr.*  
*E. R. Peck*

Inventors  
*Ernest Gearing*  
*William Rainforth*  
By *A. S. Patterson*  
*Att'y.*



# UNITED STATES PATENT OFFICE.

ERNEST GEARING, OF HARROGATE, AND WILLIAM RAINFORTH, OF  
LEEDS, ENGLAND.

## MANUFACTURE OF STEAM-BOILER FURNACES AND FLUES.

SPECIFICATION forming part of Letters Patent No. 794,091, dated July 4, 1905.

Original application filed August 18, 1903, Serial No. 169,890. Divided and this application filed February 16, 1904. Serial No. 193,869.

*To all whom it may concern:*

Be it known that we, ERNEST GEARING, residing at Harrogate, and WILLIAM RAINFORTH, residing at Upper Armley, Leeds, in the county of York, England, subjects of the King of Great Britain and Ireland, have invented Improvements in the Manufacture of Steam-Boiler Furnaces and Flues, of which the following is a specification.

10 This invention has reference to the manufacture of steam-boiler furnaces or flues of the kinds that have corrugations or hollow strengthening ribs or ridges formed in their walls.

15 The invention, which more especially relates to the manufacture of furnaces or flues having deep steep-sided ribs or ridges, originally was included in our application Serial No. 169,890, of which this is a division.

20 According to the present invention such corrugations, ribs, or ridges (hereinafter referred to as "ridges") are produced by submitting a plate or tube to two or more corrugating operations, the effect of each successive operation being to maintain the pitch of the ridges and to cause the plate or the wall of the tube to assume a form as seen in longitudinal section more nearly approaching the intended final form, the pressure being so applied in successive operations as to gradually change the sectional form of the plate or tube without unduly distressing or thinning the metal. The first operation forms deep and wide, but not steep-sided ridges, and the succeeding operation or operations applies or apply pressure in a direction approximately normal to the general plane of the plate or to the axis of the tube to the sides of the ridges chiefly, so as to widen the valleys between the ridges by steepening the sides of the ridges, the pitch of which remains substantially the same as after the first operation—that is to say, the first operation having stretched the metal more or less equally throughout, the succeeding operations practically change the position of the material without further stretching it or altering the pitch of the ridges.

In rolling furnaces or flues according to

this invention there may be employed a mill 50 or mills similar in general construction to ordinary corrugating-mills. The mill-rolls may be made of extra length and be formed at different portions with corrugations or ribs of different contours, so that the plate or tube 55 may be submitted to two or more operations between the same rolls by shifting it from one part to another. When rolling ridges into a tube, this avoids reheating of the tube for each operation and changing of the rolls. 60

Referring to the accompanying drawings, Figures 1 and 2 illustrate sections through a plate or tube wall after the preliminary and final rolling operations, respectively. Figs. 3 and 4 illustrate, respectively, the tube after 65 the preliminary corrugating operation and the completed furnace or flue tube. Fig. 5 is an elevation of a machine suitable for carrying the invention into effect, the preliminary corrugating being effected at the left-hand portion of the rolls and the final corrugating at the right-hand portion of the rolls. 70

From Figs. 1 and 2 it will be seen that the effect of the first operation is to practically stretch the material equally throughout, while 75 the effect of the second operation is to alter the position of those portions intermediate between the top middle parts of the ridges and the bottom middle parts of the valleys, the pitch and depth remaining substantially 80 the same and the material not being further stretched to any appreciable extent.

Steam-boiler furnaces and flues may be formed with deep steep-sided ridges and valleys by more than two operations, if required. 85 In the manufacture of furnaces and flues according to this invention each rolling or pressing operation may be effected in a separate machine; but to avoid loss of time and heat it is preferable to effect two or more operations in 90 a single machine.

What we claim is—

1. The manufacture of steam-boiler furnaces and flues by submitting a plate to a plurality of corrugating rolling operations where- 95 in pressure is applied directly to the surfaces of the plate and, at the end of each operation to the whole of both surfaces thereof, the ef-



fect of each successive operation being to maintain the pitch of the ridges and depth of the valleys and to cause the plate to assume a form more nearly approaching the intended final form, as set forth.

2. The manufacture of steam-boiler furnaces and flues by submitting a plate to a plurality of corrugating rolling operations where-in pressure is applied directly to the surfaces of the plate and, at the end of each operation to the whole of both surfaces thereof, the first operation forming deep and wide but not steep-sided hollow ridges and intermediate valleys, and each successive operation maintaining the pitch of the ridges and depth of the valleys and applying pressure to the sides of the ridges chiefly and steepening them and widening the intermediate valleys, as set forth.

3. The manufacture of steam-boiler furnaces or flues by submitting a plate in the form of a tube to a plurality of corrugating operations, the effect of each successive operation being to maintain the pitch of the circumferential ridges and depth of the valleys and to cause the plate to assume a form more nearly approaching the intended final form, as set forth.

4. The manufacture of steam-boiler furnaces or flues by submitting a plate in the form of a tube to a plurality of corrugating operations, the first operation forming deep and wide but not steep-sided hollow ridges and intermediate valleys, and each successive operation maintaining the pitch of the ridges and applying pressure to the sides of the ridges chiefly and steepening them and widening the intermediate valleys, as set forth.

5. The manufacture of steam-boiler furnaces and flues by submitting a plate to a plurality of corrugating rolling operations, the

effect of each successive operation being to maintain the pitch of the ridges and to cause the plate to assume a form more nearly approaching the intended final form, as set forth.

6. The manufacture of steam-boiler furnaces and flues by submitting a plate to a plurality of corrugating rolling operations, the first operation forming deep and wide but not steep-sided hollow ridges and intermediate valleys, and each successive operation maintaining the pitch of the ridges and applying pressure to the sides of the ridges chiefly and steepening them and widening the intermediate valleys, as set forth.

7. The manufacture of steam-boiler furnaces and flues by submitting a plate to a plurality of corrugating rolling operations, the effect of each successive operation being to maintain the pitch of the ridges and depth of the valleys and to cause the plate to assume a form more nearly approaching the intended final form, as set forth.

8. The manufacture of steam-boiler furnaces and flues by submitting a plate to a plurality of corrugating rolling operations, the first operation forming deep and wide but not steep-sided hollow ridges and intermediate valleys, and each successive operation maintaining the pitch of the ridges and depth of the valleys and applying pressure to the sides of the ridges chiefly and steepening them and widening the intermediate valleys, as set forth.

Signed at Leeds, county of York, England, this 1st day of February, 1904.

ERNEST GEARING.

WILLIAM RAINFORTH.

Witnesses:

WILLIAM JOHNSTON,

HARRY SIDNEY HEPWORTH.