

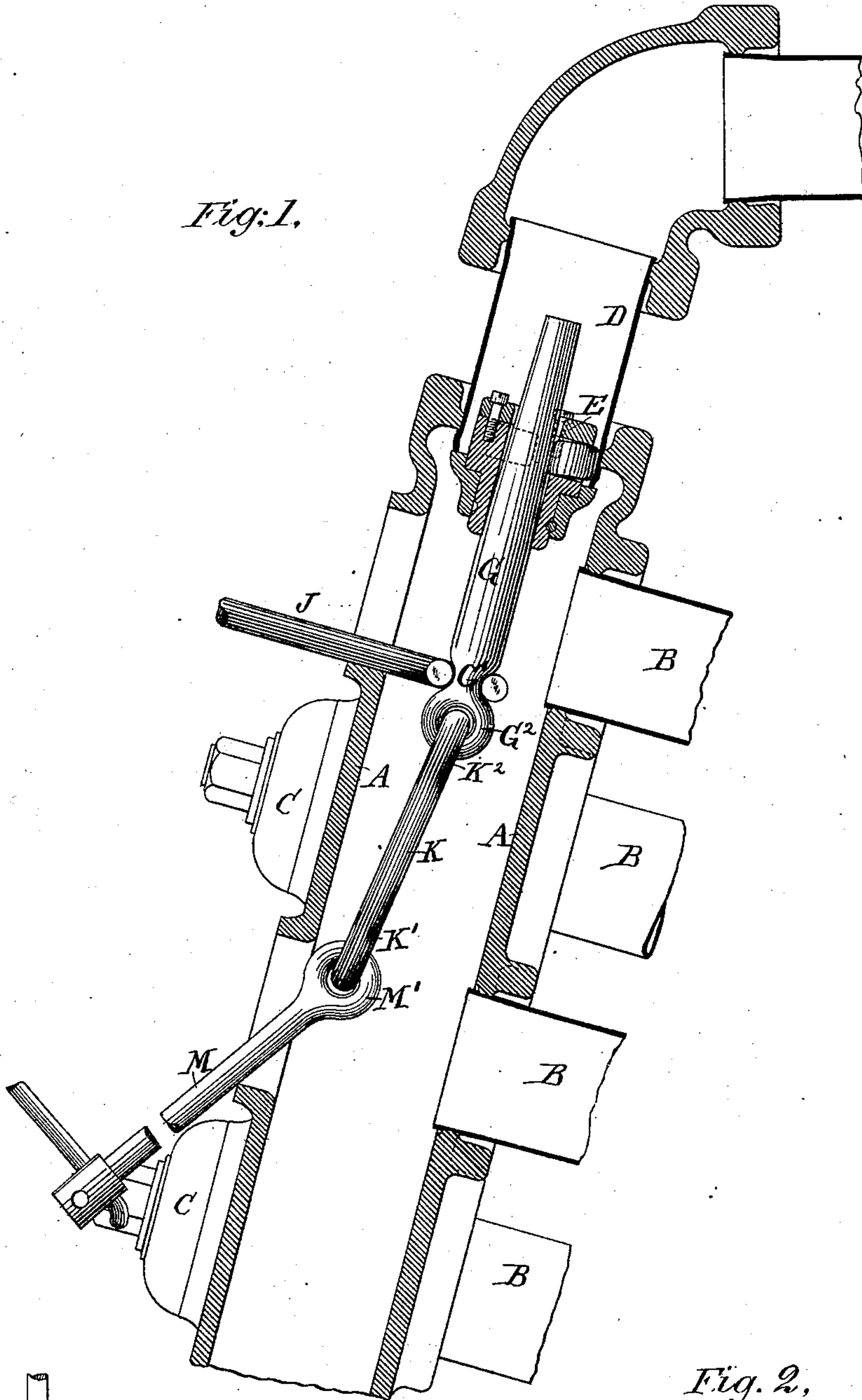
(No Model.)

C. P. HIGGINS.  
TUBE EXPANDER.

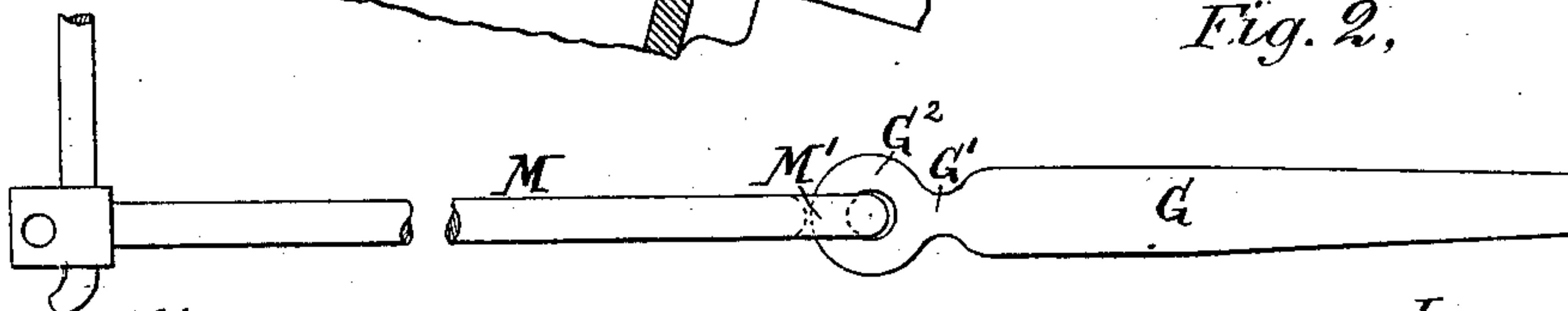
No. 275,766.

Patented Apr. 10, 1883.

*Fig. 1.*



*Fig. 2.*



Witnesses:  
*A. H. [Signature]*  
*A. C. Van [Signature]*

Inventor:  
*C. P. Higgins,*  
By his Atty: *Thomas D. Stetson.*



# UNITED STATES PATENT OFFICE.

CAMPBELL P. HIGGINS, OF PHILADELPHIA, PENNSYLVANIA.

## TUBE-EXPANDER.

SPECIFICATION forming part of Letters Patent No. 275,766, dated April 10, 1883.

Application filed January 4, 1883. (No model.)

*To all whom it may concern:*

Be it known that I, CAMPBELL P. HIGGINS, of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Tube-Expanders, of which the following is a specification.

There are or may be various constructions of steam-boilers tending to promote the convenience, efficiency, facility for repairs, &c., which are at present impracticable on account of the impossibility of expanding the tubes in such by the ordinary expander. My invention allows the tubes to be expanded with the ordinary efficiency in positions which would be otherwise inaccessible for the purpose. I equip the expander with one or more universal joints, and operate through lateral passages, which may be at various angles with the tube.

The following is a description of what I consider the best means of carrying out the invention.

The accompanying drawings form a part of this specification.

Figure 1 is a vertical section through a portion of a boiler of the style known as "Babcock & Wilcox." The expander is represented as in the act of expanding a short tube or thimble, which connects the header with the barrel of the boiler or with an intermediate casting which connects therewith. In this figure there are two universal joints. Fig. 2 is an outline, showing the same with one universal joint.

Similar letters of reference indicate corresponding parts in both the figures.

A A are the two walls of the header, by which term I designate the construction of cast-iron, semi-steel, or other material into which the several independent tubes which form the main heating-surface of the boiler are tightly set.

B B are the main tubes.

C C are the hand-hole covers, one opposite to each of the main tubes. By removing these hand-hole covers access is obtained to expand the tubes B by the ordinary expander with a straight shank.

D is a short tube or thimble set in the upper end of the header, and uniting the header with another part of the boiler. The construc-

tion of the other part may not allow an expander to be operated from the other end of the tube or thimble D.

E is the ordinary roller device, adapted to be inserted easily in the end of a tube at the point where it is to be expanded.

G is a short tapering mandrel, which, being strongly revolved and gently pressed endwise, traverses the rollers of the device E around in the interior of the tube, and expands it into forcible and tight contact with the casting A, making the desired joint. The mandrel G has a contracted neck, G', beyond which is a smoothly-finished eye, G<sup>2</sup>. The shoulder formed by the junction of the neck G' with the large portion G of the mandrel receives end-pressure and guidance from a lateral rod, J, having a forked or otherwise suitably-formed head to fit on the neck G'. This rod J is introduced through the hand-hole, which is adjacent, the hand-hole cover being previously removed. The eye G<sup>2</sup> is engaged by a corresponding eye, K<sup>2</sup>, formed in the end of a link, K. The other end of the link K has an eye, K', which engages with an eye, M', in the end of a mandrel, M, the other end of which is adapted to receive any suitable device for imparting rotary motion by hand or by machinery. The tapering mandrel G, with the link K and mandrel M, are all inserted through the hand-hole most favorably situated, the hand-hole cover being removed to allow this operation. The roller device E and the taper mandrel G may be set in the proper position by operating with the hand through the hand-hole nearest thereto. When all is ready the mandrel M is turned continuously with any required degree of rapidity, and the taper mandrel G is pressed endwise into the device E by means of the lateral rod J. This latter also serves an important function in steadying the mandrel G, particularly at the commencement of the operation. The junctions of the eyes G<sup>2</sup> K<sup>2</sup> and of the eyes K' M' serve as universal joints.

Modifications may be made in the forms and proportions of the parts. I can employ sets of the connected mandrels G K M, having different lengths to the several parts, selecting for each of the difficult situations where this device is to be used the set best proportioned



for that particular work. For many situations a device with a single universal joint may suffice. Fig. 2 shows such a construction, the eye  $G^2$  on the extended mandrel  $G$  being connected directly to the eye  $M'$  on the mandrel  $M$ , to which the revolving force is applied directly.

I can employ more elaborately-formed universal joints, if desired, in any case; but my experiments indicate that the simple locked eyes, being smoothly and accurately formed and lubricated, serve well. They occupy less room laterally than the most of the elaborate forms of universal joints. I can employ a universal joint formed simply by socketing one rod into another, the end of the tenon being squared or star-shaped and fitting in a correspondingly square or star-shaped socket, the socket being sufficiently larger to allow the required inclination of the parts.

I can employ a flexible shaft of wire or other material; but the force required to revolve the mandrel in expanding a large and thick tube of hard iron or steel makes it, in

my judgment, more expedient to use rigid bars or links with universal joints, as shown.

Parts of the invention may be used without the whole. I can operate with some success without the lateral rod  $J$ .

I claim as my invention—

1. The combination of the lateral rod or holder  $J$ , tapering mandrel  $G$ , having a contracted neck,  $G'$ , and flexible connection  $M$ , adapted for joint operation, as herein specified.

2. The universal joints described, composed of simple eyes  $G^2$   $K^2$   $K'$   $M'$ , in combination with the tapering mandrel  $G$ , rollers  $E$ , intermediate link  $K$ , and operating mandrel  $M$ , adapted to serve as and for the purposes herein specified.

In testimony whereof I have hereunto set my hand, at Philadelphia, Pennsylvania, this 18th day of December, 1882, in the presence of two subscribing witnesses.

CAMPBELL P. HIGGINS.

Witnesses:

ALEXANDER RICKEY,  
H. T. BREWSTER.