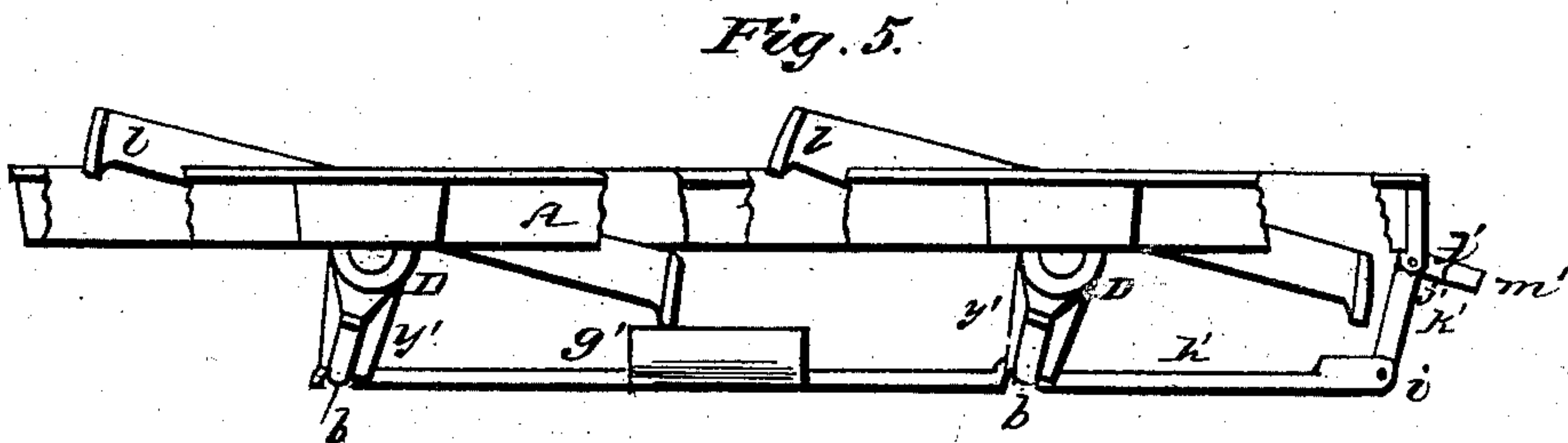
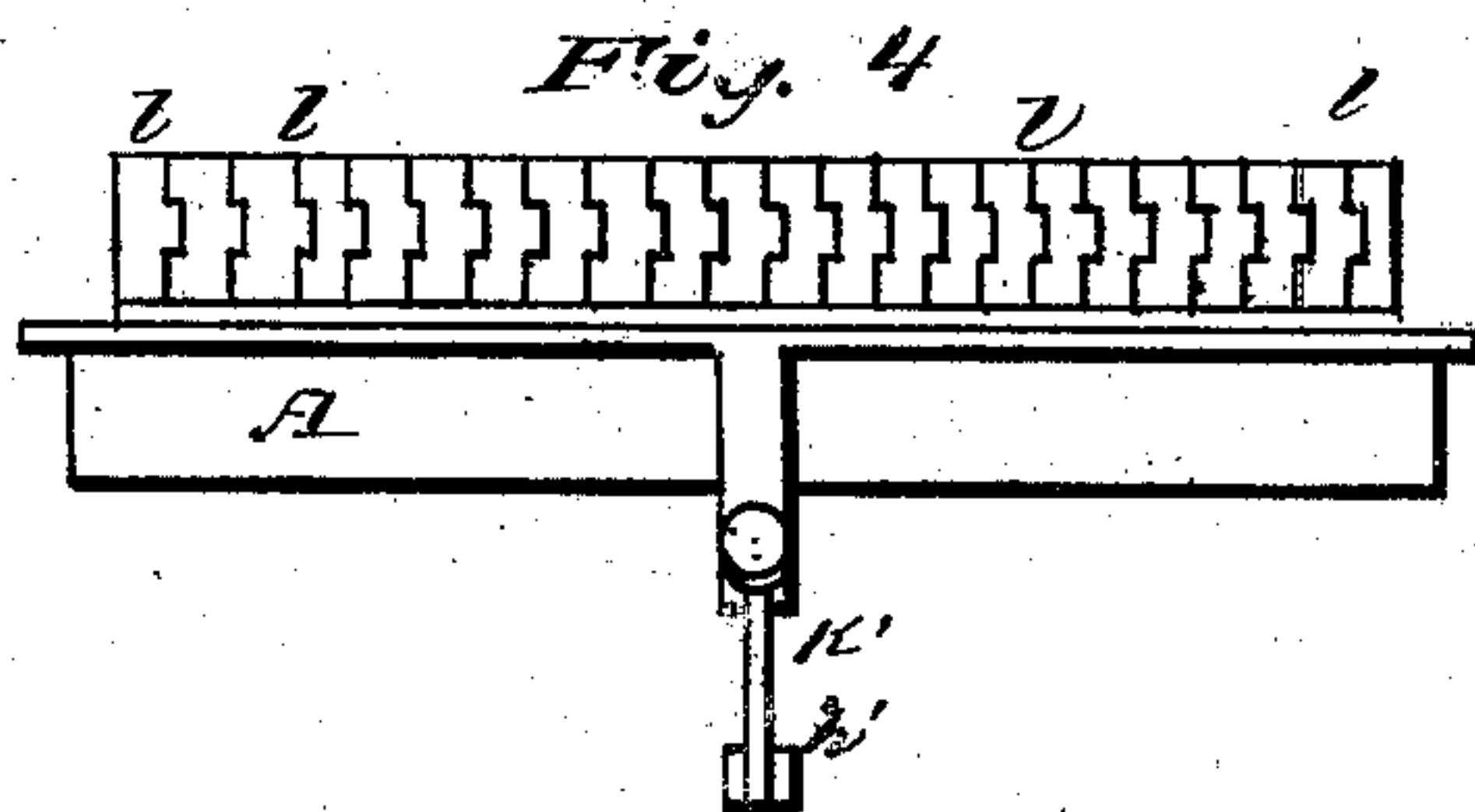
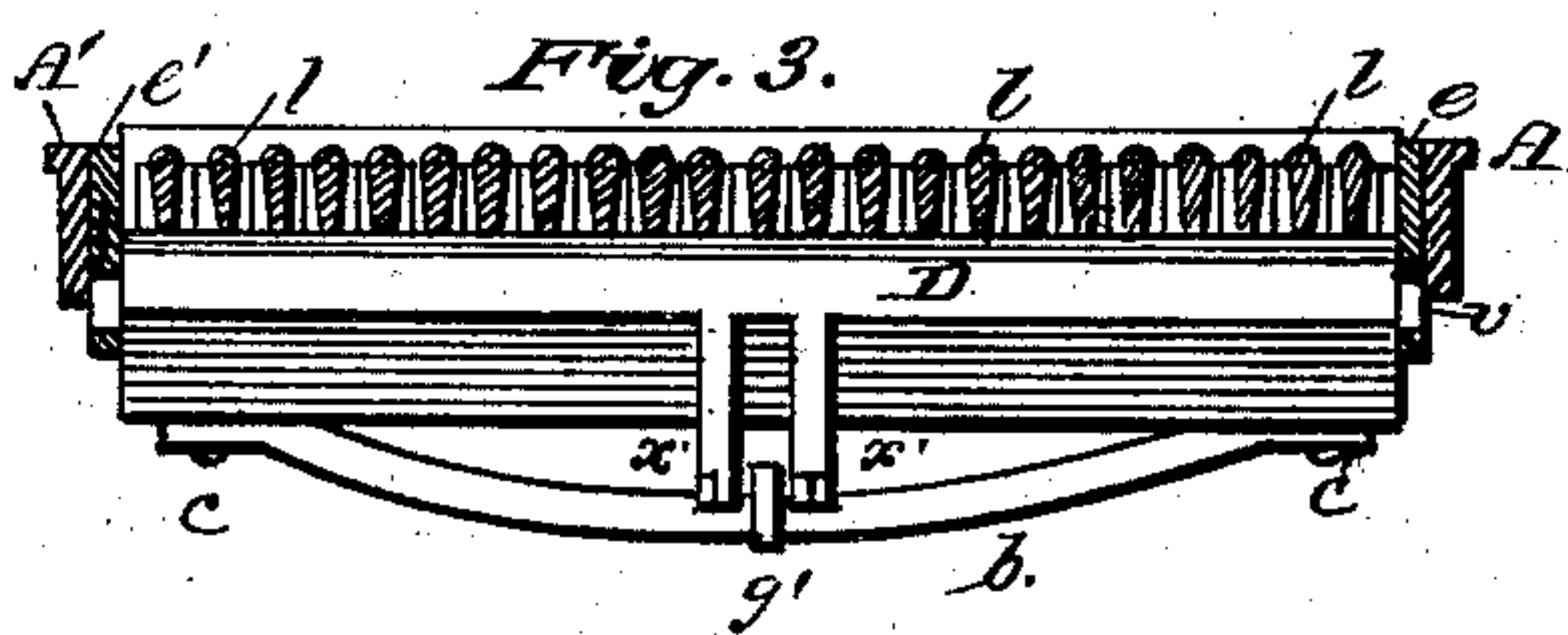
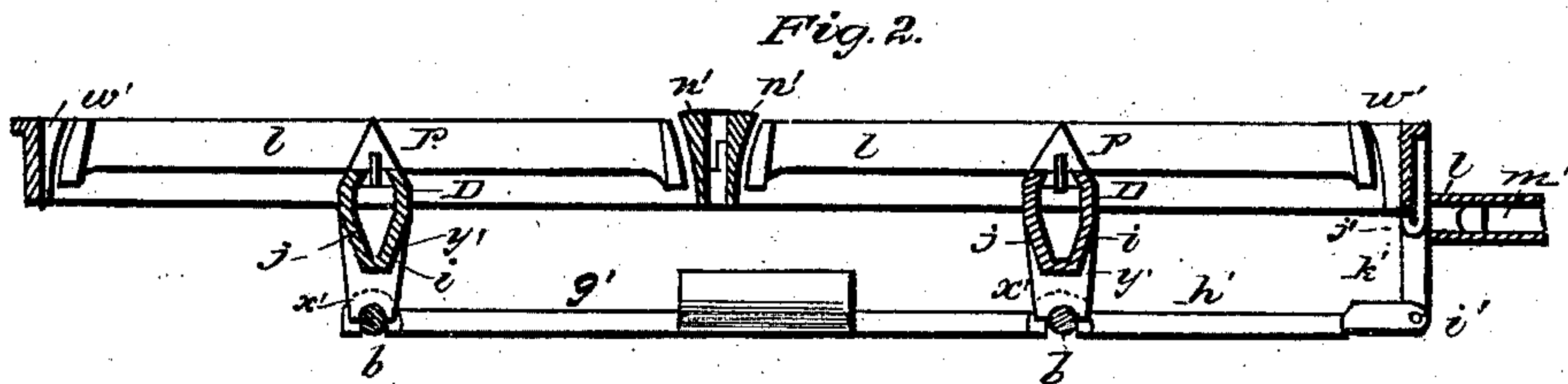
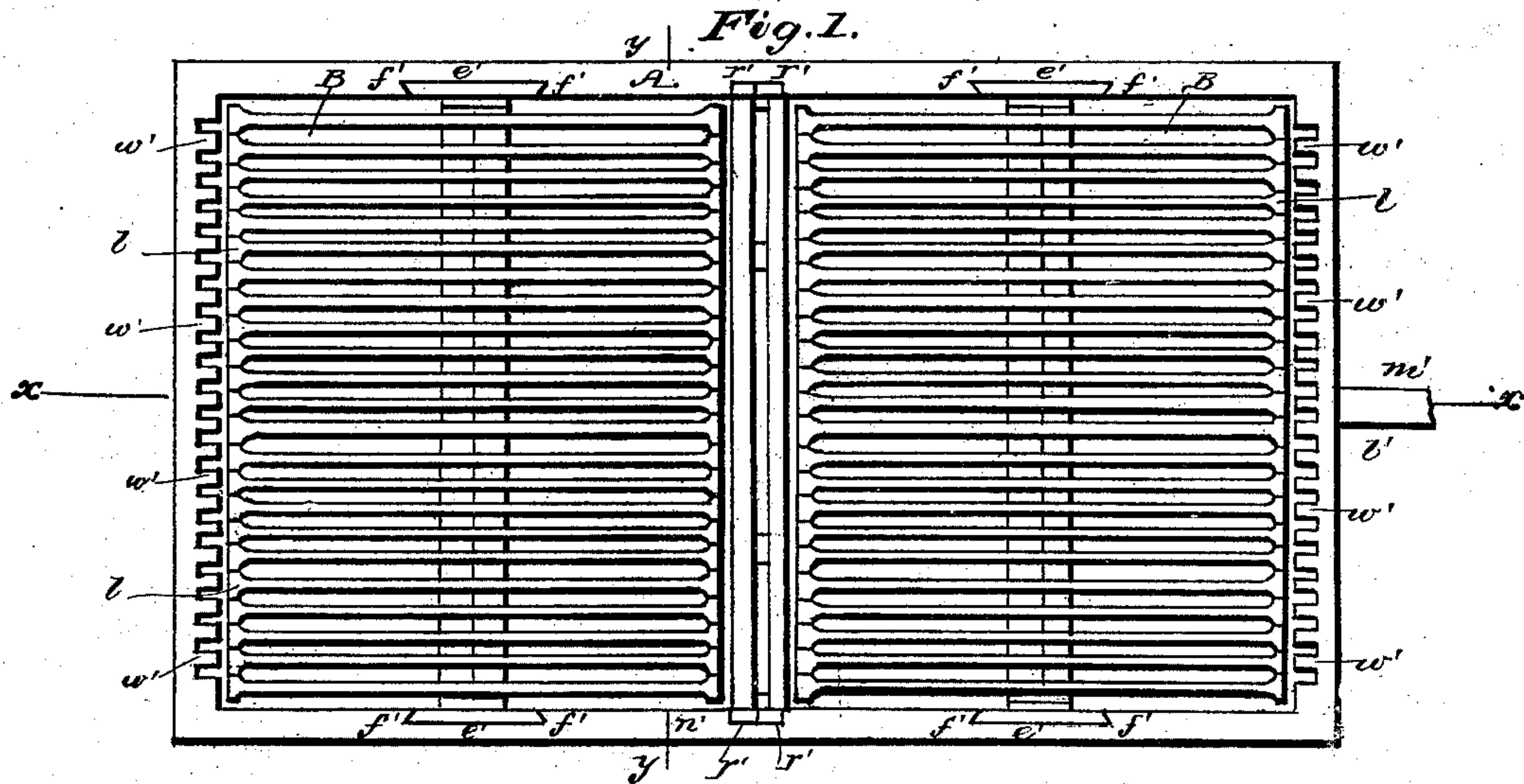


(No Model.)

2 Sheets—Sheet 1.

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Grate for Furnaces of Steam Boilers.  
No. 229,319. Patented June 29, 1880.



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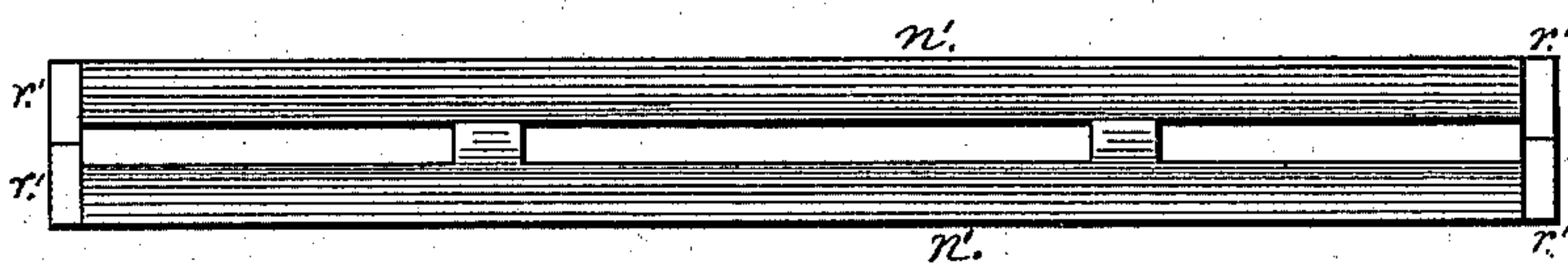


Fig. 6.

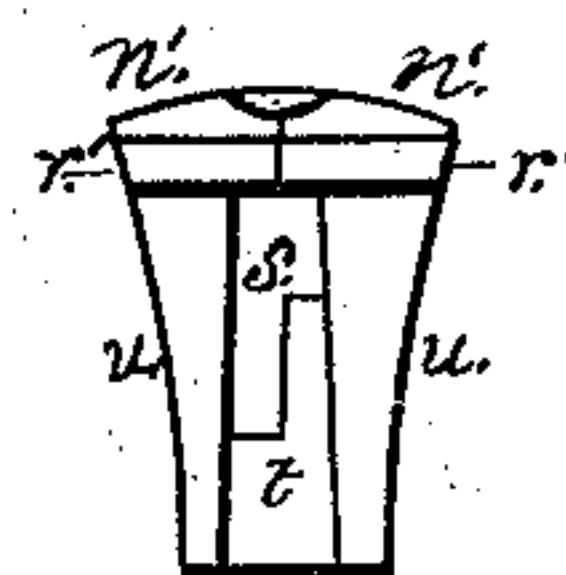


Fig. 7.

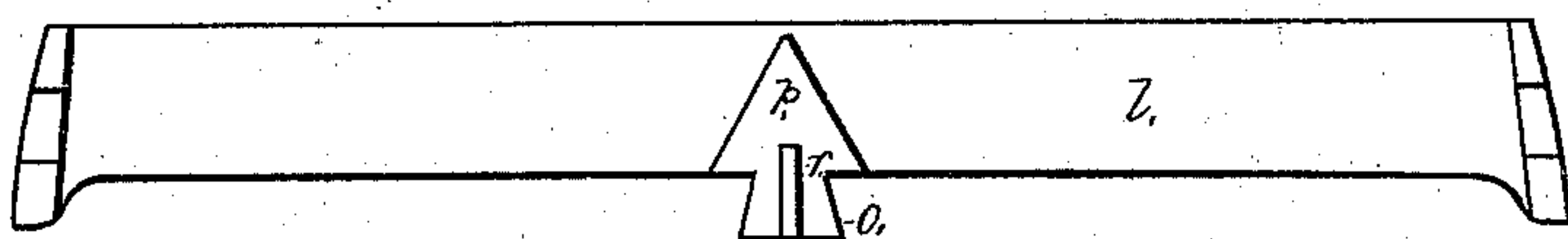


Fig. 8.



Fig. 9.

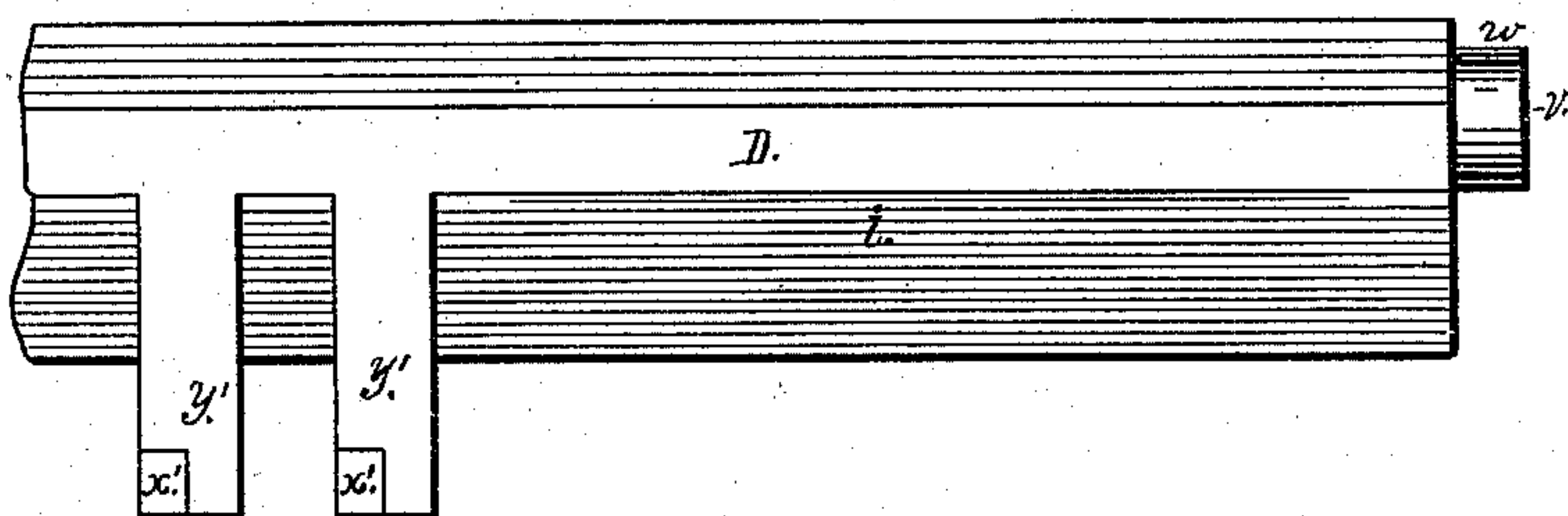


Fig. 10.

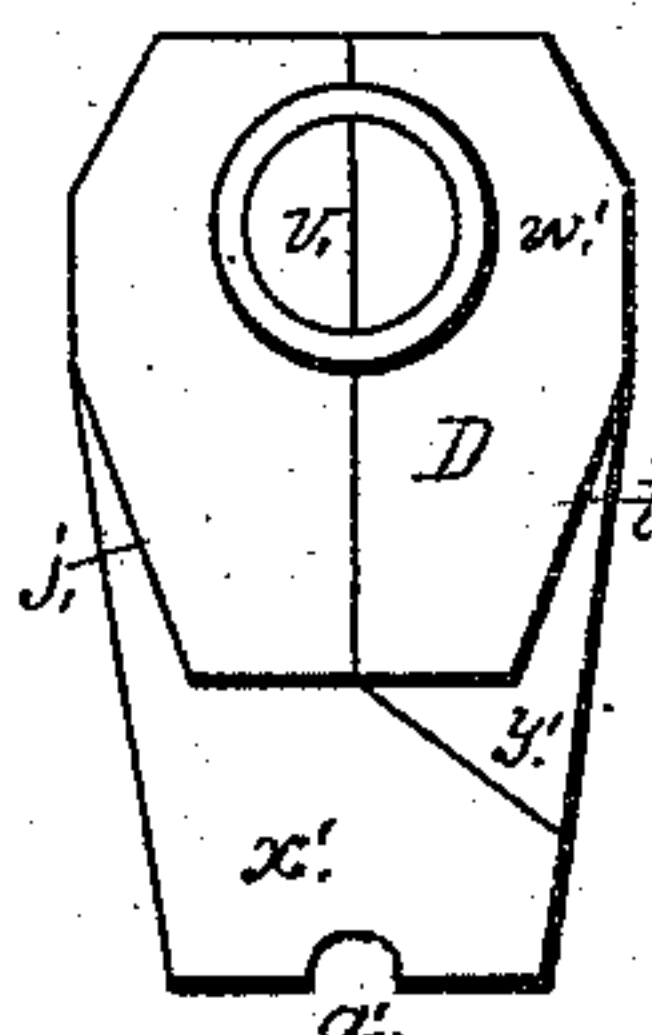


Fig. 11.

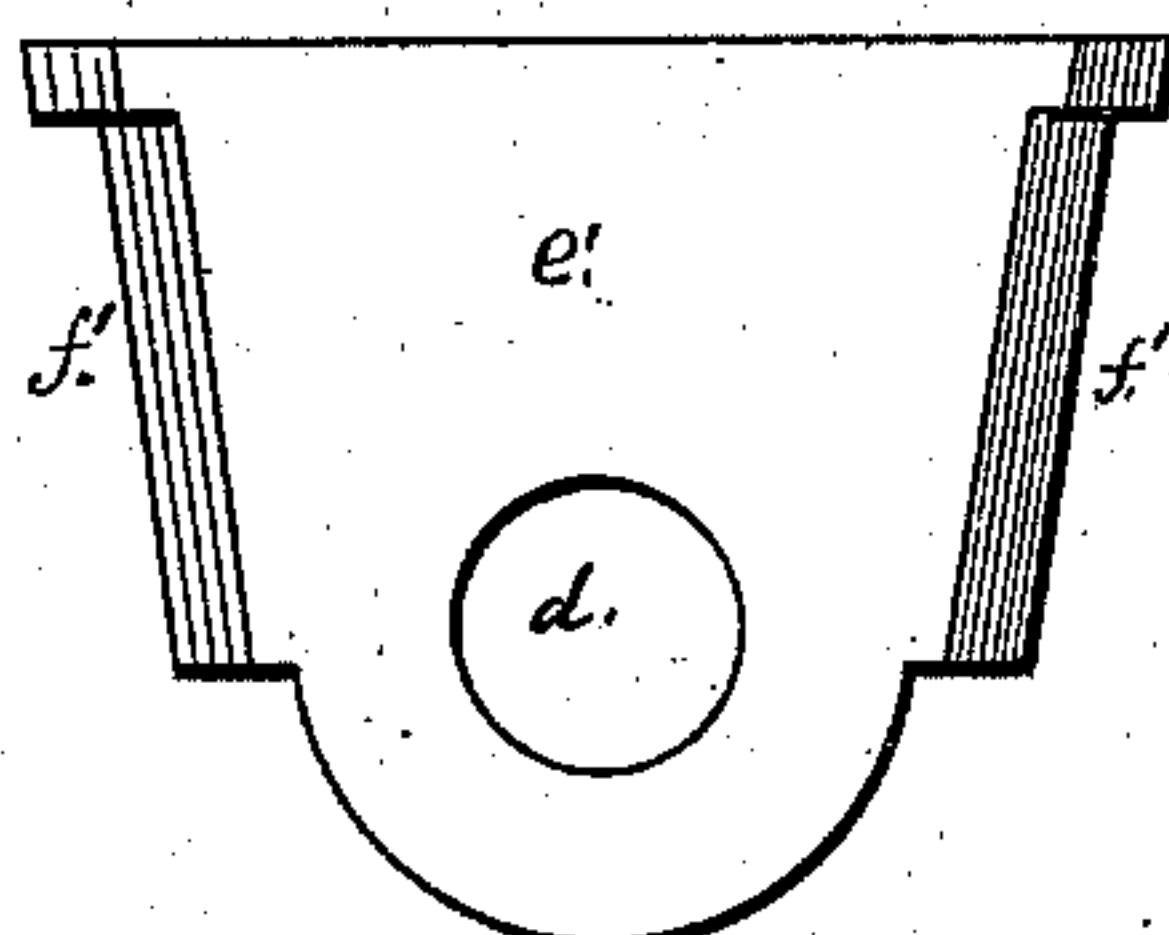


Fig. 12.

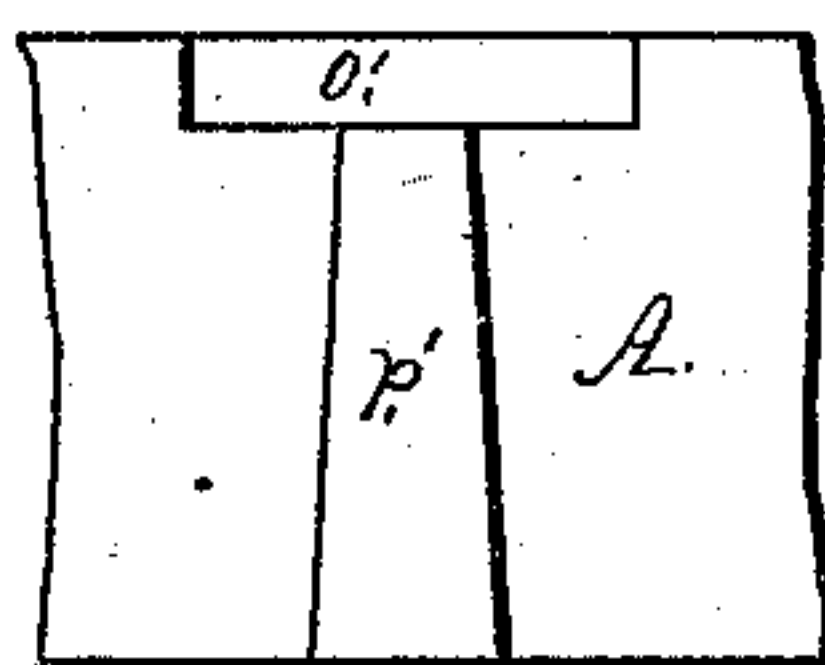


Fig. 13.

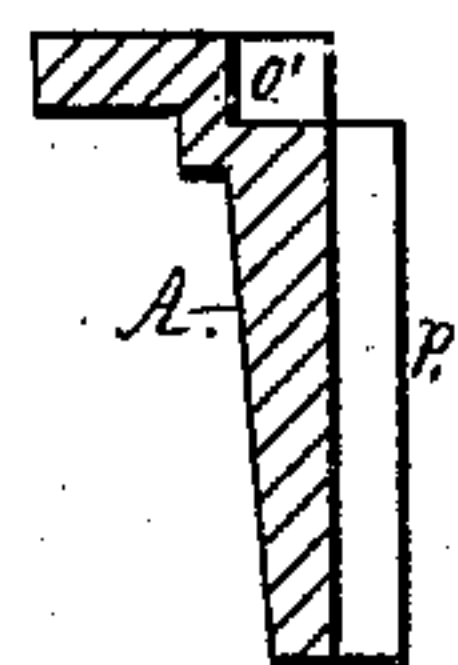


Fig. 14.

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# UNITED STATES PATENT OFFICE.

JOHN L. L. KNOX, OF ALLEGHENY, PENNSYLVANIA.

## GRATE FOR FURNACES OF STEAM-BOILERS.

SPECIFICATION forming part of Letters Patent No. 229,319, dated June 29, 1880.

Application filed April 29, 1880. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN L. L. KNOX, of Allegheny, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Grates for Furnaces for Steam-Boilers; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

My invention relates to an improvement in grates for furnaces for steam-boilers; and it consists in constructing the grates in detachable sections and pivoting them in a frame furnished with detachable bars arranged transversely in said frame, said grate-sections consisting of a series of bars attached to the upper side of a transverse detachable supporting-bar, constructed in two parts, with a sleeve-trunnion at each end fitted to detachable bearings and braced through the medium of a curved rod, (commonly called a "hog-chain,") and connected by detachable rods, for imparting an oscillatory motion to them and the bars supported thereon, the ends of which lock into each other, and thereby form a firm grate-section, the whole being so constructed, combined, arranged, and operating that the area of air-surface under the fire on the grate-sections is more than the area of the grate-bars upon which the fire rests, and the accumulation of ashes upon the bars avoided, thereby admitting an ingress of air sufficient to protect said bars from burning, and also insure complete combustion of the fuel, which may be agitated by the oscillation of the grate-sections, at the will of the operator, for rupturing the incrustated or conglutinated fuel.

To enable others skilled in the art with which my invention is most nearly connected to make and use it, I will proceed to describe its construction and operation.

In the accompanying drawings, which form part of my specification, Figure 1 is a top view or plan of my improvement in grates for furnaces for steam-boilers. Fig. 2 is a vertical and longitudinal section of the same at line *x* of Fig. 1. Fig. 3 is a vertical and transverse section of the same at line *y* of Fig. 1. Fig. 4 is an end view of the same, representing the grate-sections tilted. Fig. 5 is a side elevation

of the same, representing the grate-section tilted, with portions of one side of the grate-frame broken away. Fig. 6 is a top view of the detachable cross-bar of the frame for the grate. Fig. 7 is an end view of the same. Fig. 8 is a side view of one of the bars which form the grate-section. Fig. 9 is an end view of the same. Fig. 10 is a side view of the transverse detachable supporting-bar for the grate-sections. Fig. 11 is an end view of the same. Fig. 12 is a face view of the detachable bearings for the trunnions of the transverse detachable supporting-bar for the grate-sections. Fig. 13 is a detail view of that part of the grate-frame to which the detachable cross-bar is attached, and Fig. 14 is a vertical section of the same.

In the accompanying drawings, A represents the frame for the grate, which is constructed in two or more sections, B, by the union of a series of grate-bars, *l*, the ends of which are locked together by means of the side projections, *m*, of one bar being placed in a corresponding recess, *n*, in the next bar, as shown in Fig. 4, said grate-bars *l* being supported on a detachable supporting-bar, D, to which they are attached by means of the dovetail pendant *o*, which is placed between the two halves *i* and *j* of the supporting-bars D.

On each side of the grate-bars *l*, at their center, are projecting separating-pieces *p*, which terminate in a coniform point. On one of these separation-pieces is a projection, *r*, which is fitted to a recess made in the other separating-piece. This projection and corresponding recess in the separating-pieces *p* is of advantage in preventing longitudinal movement of the bars *l*, in arranging them for forming a grate-section, by holding the dovetail pendants *o* parallel with each other, thereby enabling the constructor to attach the supporting-bar to the grate-section with more facility than he could do in case of the absence of said projection *r* and its corresponding recess. This projection and recess in the grate-bar *l* is not an essential feature of the bar, which may or may not be used, as deemed best by the manufacturer.

The detachable supporting-bar D is constructed in two parts, *i* and *j*, and locked together by tongue-projections, such as shown



at *s t* in Fig. 7. On each of the detachable supporting-bars D is a trunnion, *v*, divided vertically, one-half the trunnion being on each part *i* and *j* of the supporting-bar D. The trunnions *v* are provided with a sleeve, *w*, which holds the two parts of the trunnion firmly together, as clearly shown in Fig. 11. From the lower edge of the parts *i* and *j* of the detachable supporting-bar D project pendants *x' y'*, recessed at *a'*, which pendants are united, as shown in Figs. 2, 3, 10, and 11, when the two parts *i* and *j* are placed in juxtaposition, as shown in Fig. 1. When the parts *i* and *j* of the detachable supporting-bar D are clamped together by tongued projections, such as *s t*, (see Fig. 7,) with the pendants *o* and bars *l* between them and sleeves *w* placed on the trunnions *v*, the supporting-bar D is then braced by the curved bar *b*, which is fitted in the recess *a'* of the pendants *x' y'*, and the ends of it secured to the ends of the supporting-bar D by screw-bolts *c*, as indicated in Fig. 3.

The section B of the grate is then ready to be pivoted in the frame A, which is accomplished by placing the trunnions *v* in the opening *d* of the detachable bearing-plates *e'*, having beveled edges *f'*, which bearing-plates are then placed in recesses in the frame A corresponding to the form of said plates, as shown in Fig. 1. The sections B of the grate having been pivoted in their frame A, as indicated in Figs. 1, 2, 3, 4, and 5, the different sections of the grate are coupled by means of connecting-rods *g' h'*, which are furnished with hook ends, which hook on the curved braces *b*, the forward end of the connecting-rod *h'* being pivoted to an angle or L lever, *k'*, at *i'*, which lever is pivoted to the frame A at *j'*, as shown in Figs. 2 and 3.

The arm *l'* of the lever *k'* is provided with a socket, *m'*, for the reception of the end of a lever for operating the lever *k'* and the parts attached thereto.

The detachable transverse bars *n' n'* are locked together by means of the tongued projections *s t*, and the projections *r'* on the ends of said bars are fitted to recesses *o'*, made in the frame A. (Shown in Figs. 1, 13, and 14.)

The projections *p'* (just below said recesses *o'*) on the inner walls of the frame A enter the space between the transverse bars *n' n'* and aid in supporting them in the frame.

The sides *u* of the transverse bars *n' n'* are curved, as shown in Figs. 2 and 7, and the projections *w'* on the inner walls of the ends of the frame A are also curved, as indicated in Fig. 2. These curvatures are made for the purpose of keeping the ends of the bars *l* of the grate-sections B the same distance from said projections *w'* and bars *n' n'* when vibrating the grate-sections B, for it will be observed that by the agitation of said grate-sections they have a compound movement—to wit, a vibrating and longitudinal movement, the latter a slight one, but sufficient to give a drawing or creeping action to the grate-surface, which, combined with the vibration, effectually cleans the whole

surface of the grate-section from all refuse of combustion, and at the same time breaks up the mass of fuel resting upon the grate. This compound action of the grate while agitating it is due to the fact that the bars *l* of the grate-sections rest upon the detachable supporting-bars D, the axes of the trunnions of which are considerably below the top edge of said bar and very much below the surface of the grate-sections B.

It will be observed that the upper edge of the bars *l* of the grate-sections B are circular when viewed in cross-section, (shown in Fig. 3,) which form prevents the accumulation of ashes in the bars, and at the same time gives a free inlet of air, which prevents the burning of the bars and insures complete combustion and consumption of the fuel.

It has been a matter of observation that grate-bars in furnaces, after their top edges have become rounded by use, last longer, and that the fire of the furnace is more efficient, and that the consumption and combustion of the fuel are more perfect and complete, than when said bars were first placed in the furnace; yet this suggestive fact has never been utilized prior to the date of my invention.

The operator, when he desires to agitate the fire on the grate-sections B, places a bar or lever in the socket *m'* of the lever *k'*, and by a vertical reciprocating movement of said bar or lever will, through the medium of the lever *k'* and coupling-rods *h' g'*, impart to the supporting-bar D and the grate-sections B a vibratory motion, which will effectually agitate the burning fuel resting thereon, and at the same time clean the bars *l* from ashes and other refuse of combustion.

The grate hereinbefore described may be adapted to any of the known forms of furnaces, fire-places, and stoves without departing from the essential features of my invention.

The sleeves *w* on the trunnions *v* of the supporting-bars D and the detachable bearing-plates may be readily replaced in case of wear, whereby about the same plane of grate may be always had, which is a very desirable thing in a furnace, the plane of the grate being always arranged with relation to the other elements of construction of the furnace.

Having thus described my improvement, what I claim as of my invention is—

1. The combination of the frame A, provided with detachable transverse bars *n' n'*, the grate-sections B, attached to detachable supporting-bars D, pivoted in detachable bearings *e'*, and operated through the medium of a lever, *k'*, and coupling-rods *g' h'*, substantially as herein described, and for the purpose set forth.

2. The frame A, the ends of which are provided with inward-curved projections *w'* and detachable transverse bars *n' n'*, the sides of which are curved, in combination with the grate-sections B, constructed and pivoted substantially as herein described, and for the purpose set forth.

3. The detachable supporting bearing-bar D,



constructed in two parts with pendants, and  
braced by a curved bar, *b*, and furnished with  
trunnions *v*, incased in sleeves *w*, substantially  
as herein described, and for the purpose set  
5 forth.

4. The grate-bars *l*, the ends of which are  
provided with a recess, *n*, and projection *m*,  
furnished with pendants *o* and separating-  
pieces *p*, substantially as herein described, and  
10 for the purpose set forth.

5. The detachable transverse bars *n'*, pro-  
vided with the projections *r'* and tongued pro-  
jections *s t*, in combination with the frame *A*,  
provided with the recesses *o'* and projections  
*p'*, substantially as and for the purpose herein 15  
shown and described.

JNO. L. L. KNOX.

Witnesses:

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JAMES J. JOHNSTON.