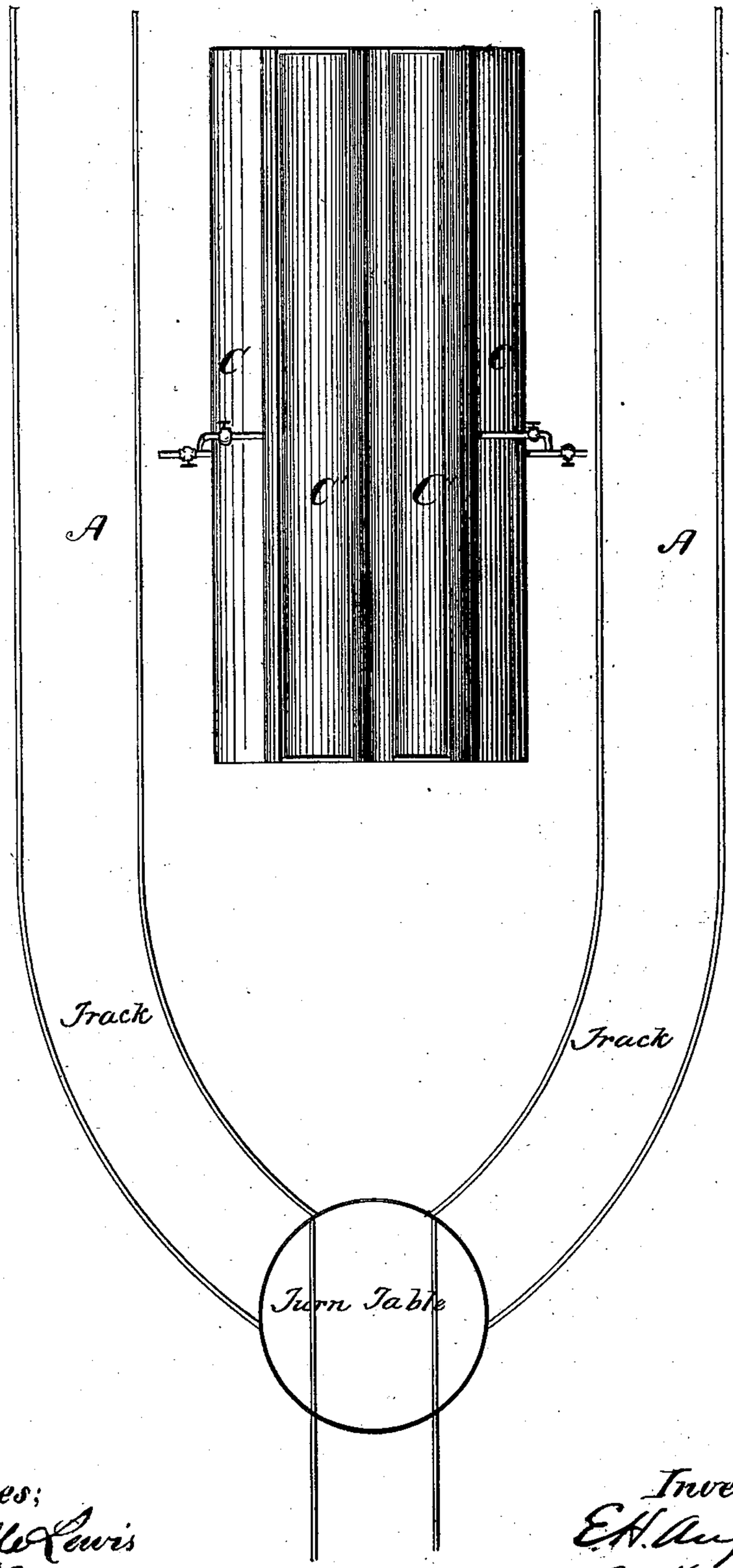
5 Sheets—Sheet 1.

E. H. ANGAMAR.

Steam-Motor for City Passenger Cars.

No. 197,584. *Fig.* **Patented Nov. 27, 1877.**



Witnesses;
Grenville Lewis
F. McKenzy.

Inventor.
E. H. Angamar.
By Hill & Ellsworth.
His attys.

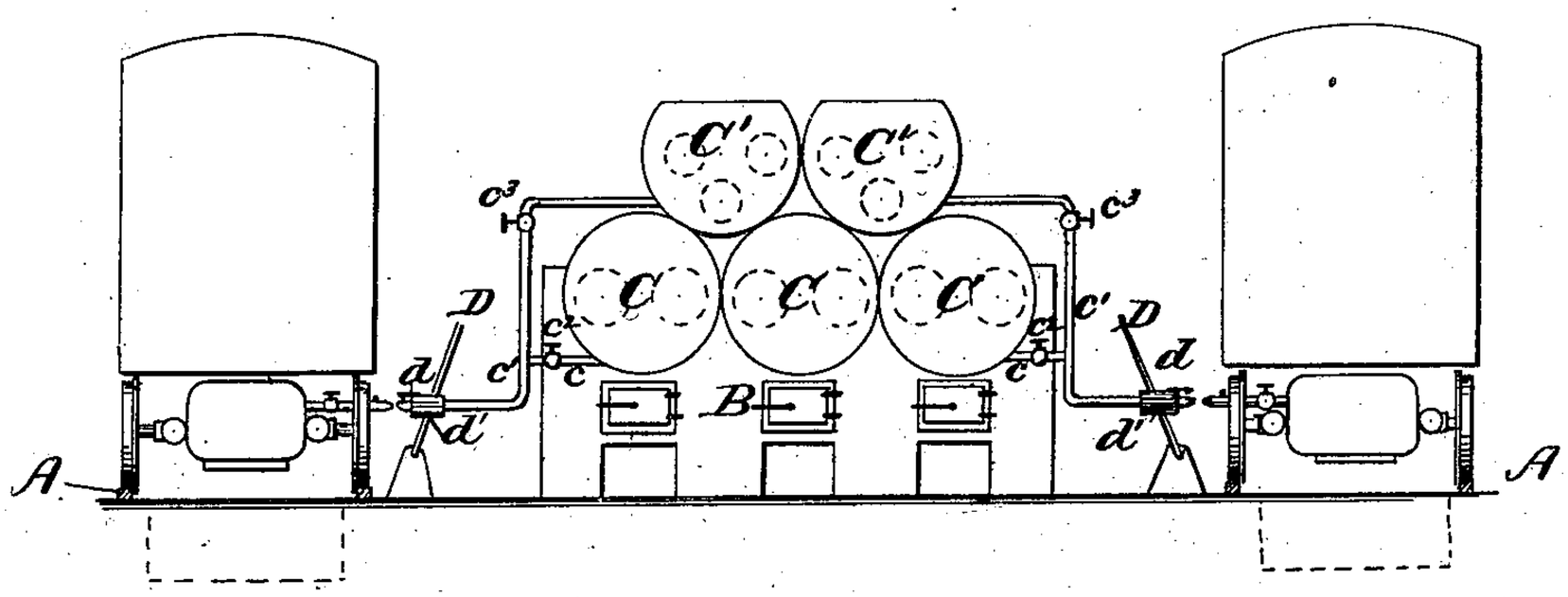
5 Sheets—Sheet 2.

E. H. ANGAMAR.

Steam-Motor for City Passenger Cars.

No. 197,584. **Patented Nov. 27, 1877.**

Fig. 2.



Witnesses
Granville Lewis
J. McKenny

Inventor
E. H. Angamar
By Hill & Ellsworth
His attys.

E. H. ANGAMAR.

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Fig. 3.

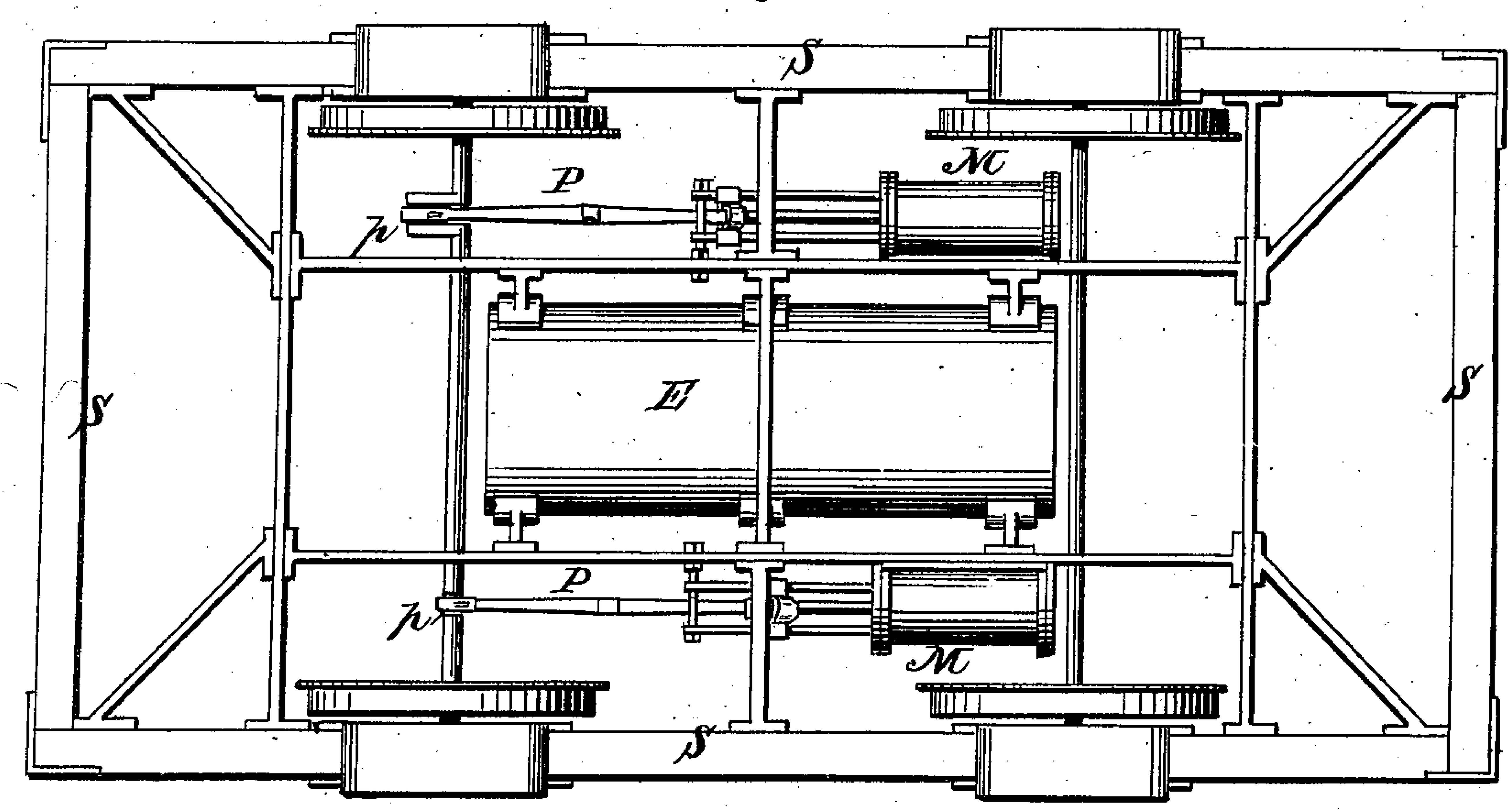


Fig. 4.

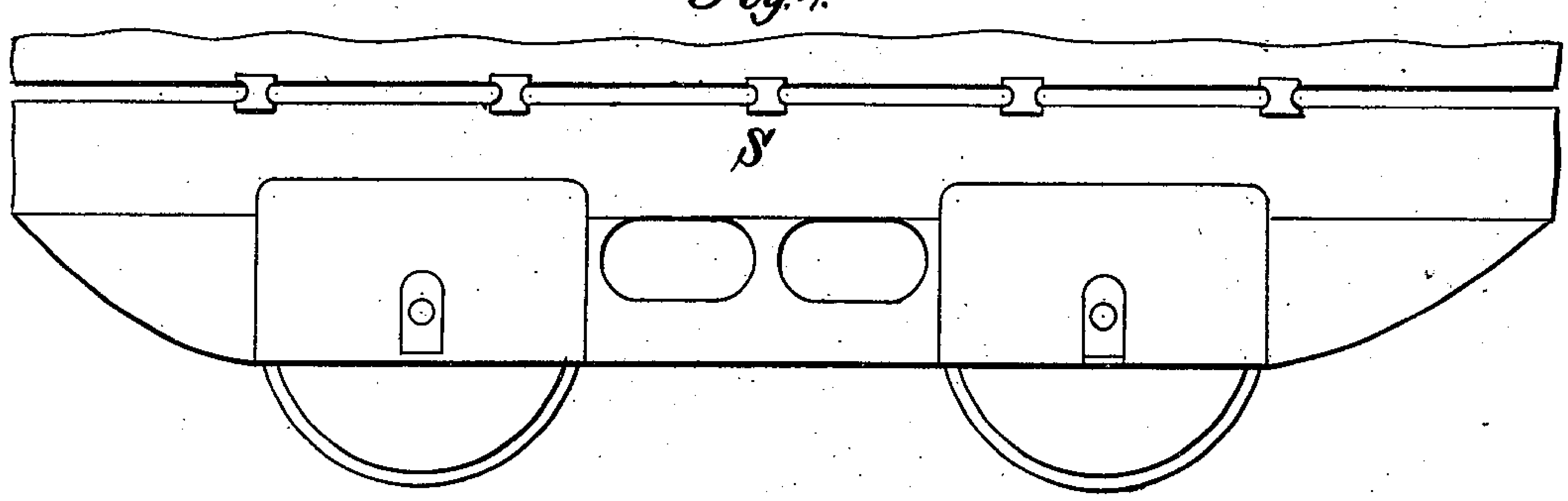


Fig. 5.

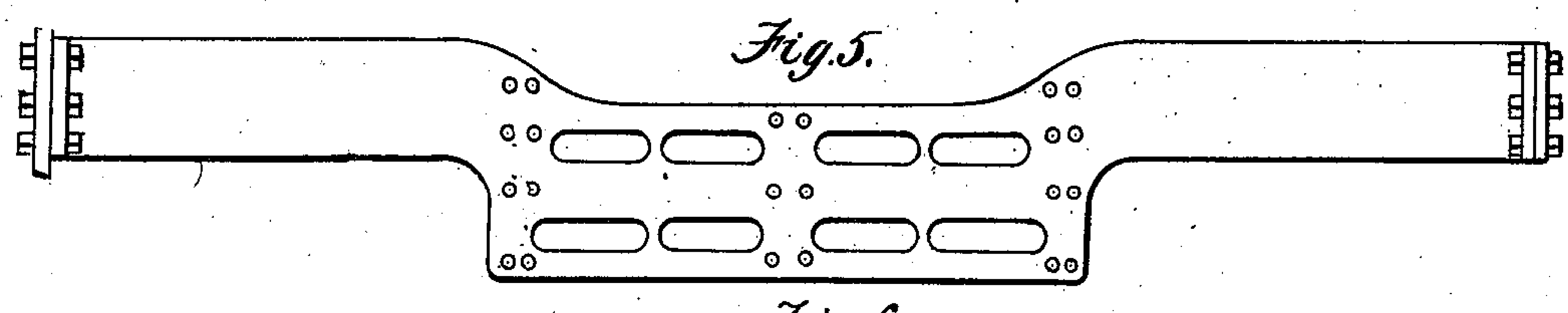
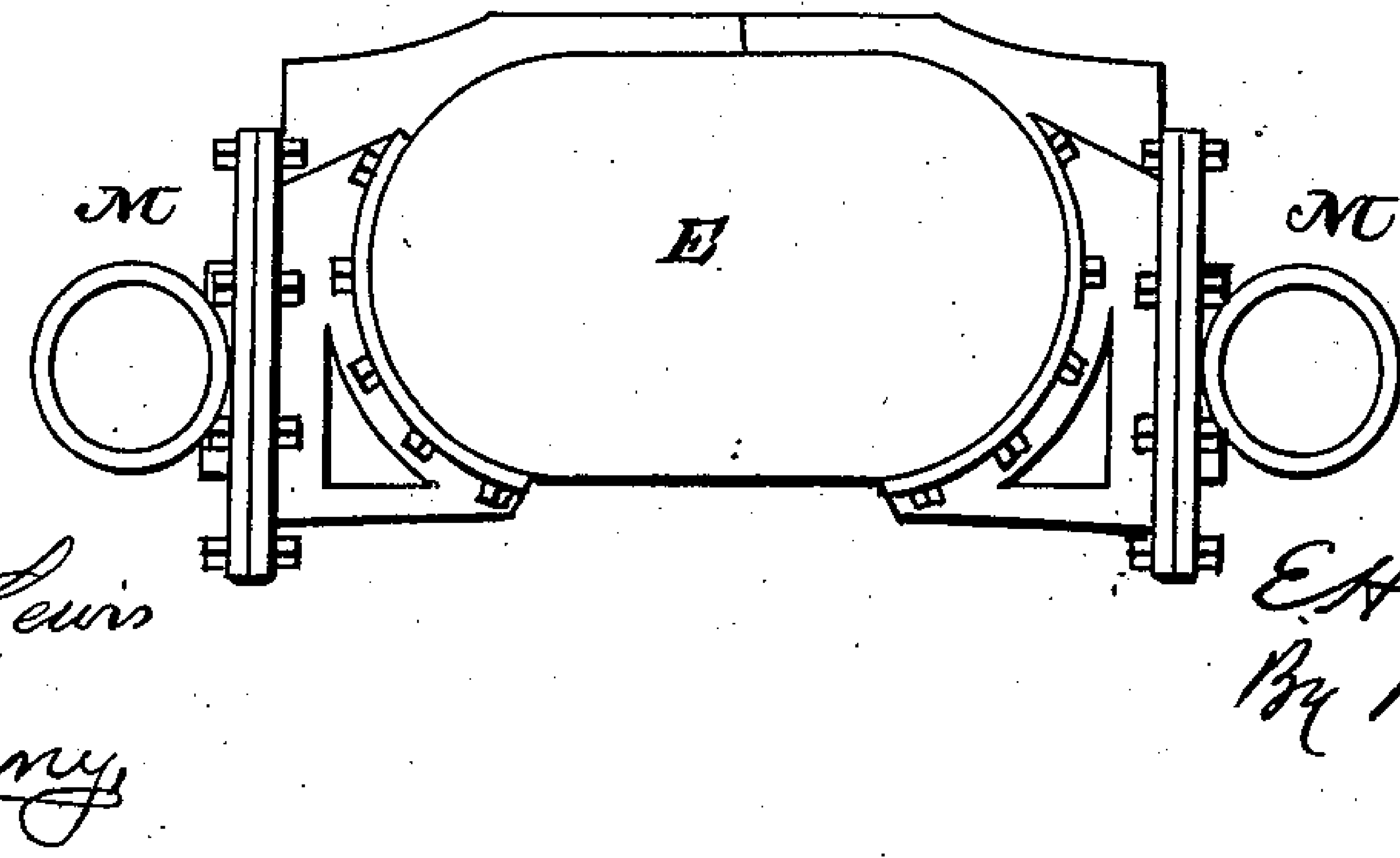


Fig. 6.



Witnesses
Grenville Lewis
J McKenny

Inventor
E. H. Angamar
By Hill & Ellsworth,
His attys.

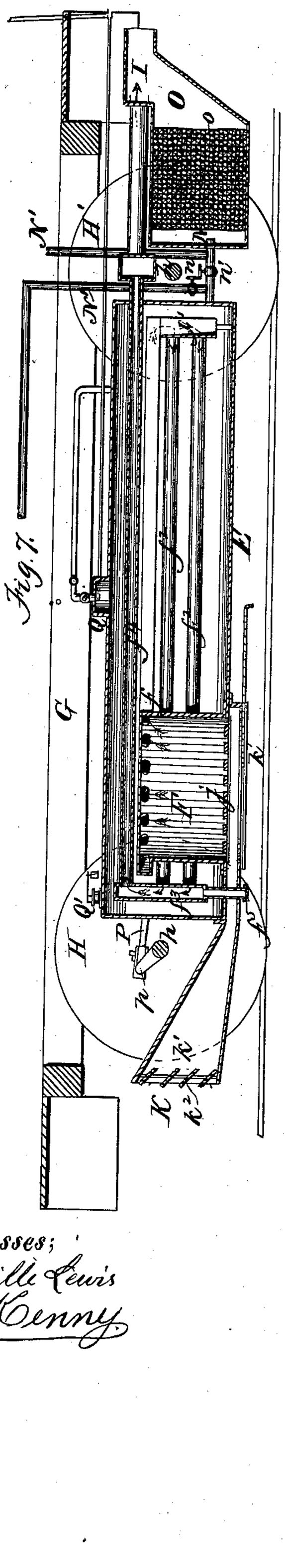
5 Sheets—Sheet 4.

E. H. ANGAMAR.

Steam-Motor for City Passenger Cars.

No. 197,584. **Patented Nov. 27, 1877.**

Fig. 7.



Witnesses;
Granville Lewis
Jno. McKenny.

Fig. 9.

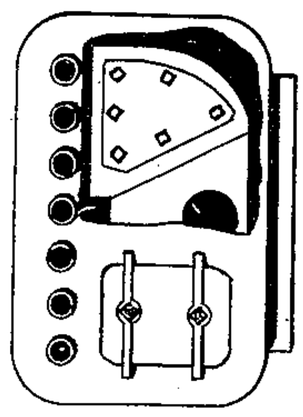


Fig. 10.

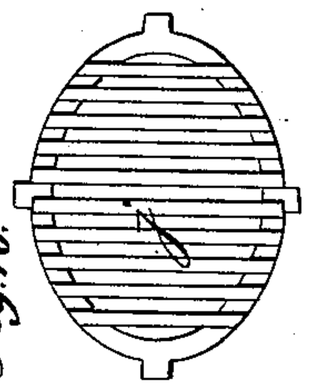


Fig. 8.

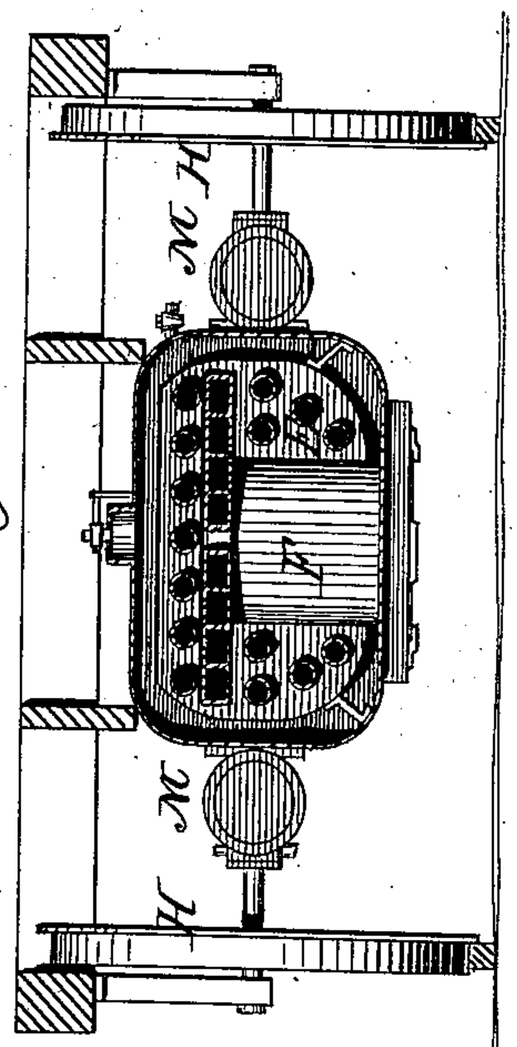
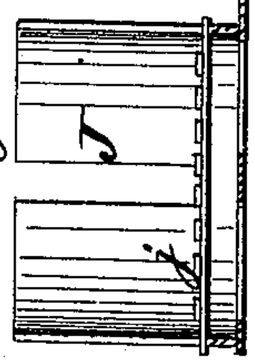


Fig. 11.



Inventor
E. H. Angamar.
By Hill Ellsworth
His Attys.

E. H. ANGAMAR.

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Fig 12.

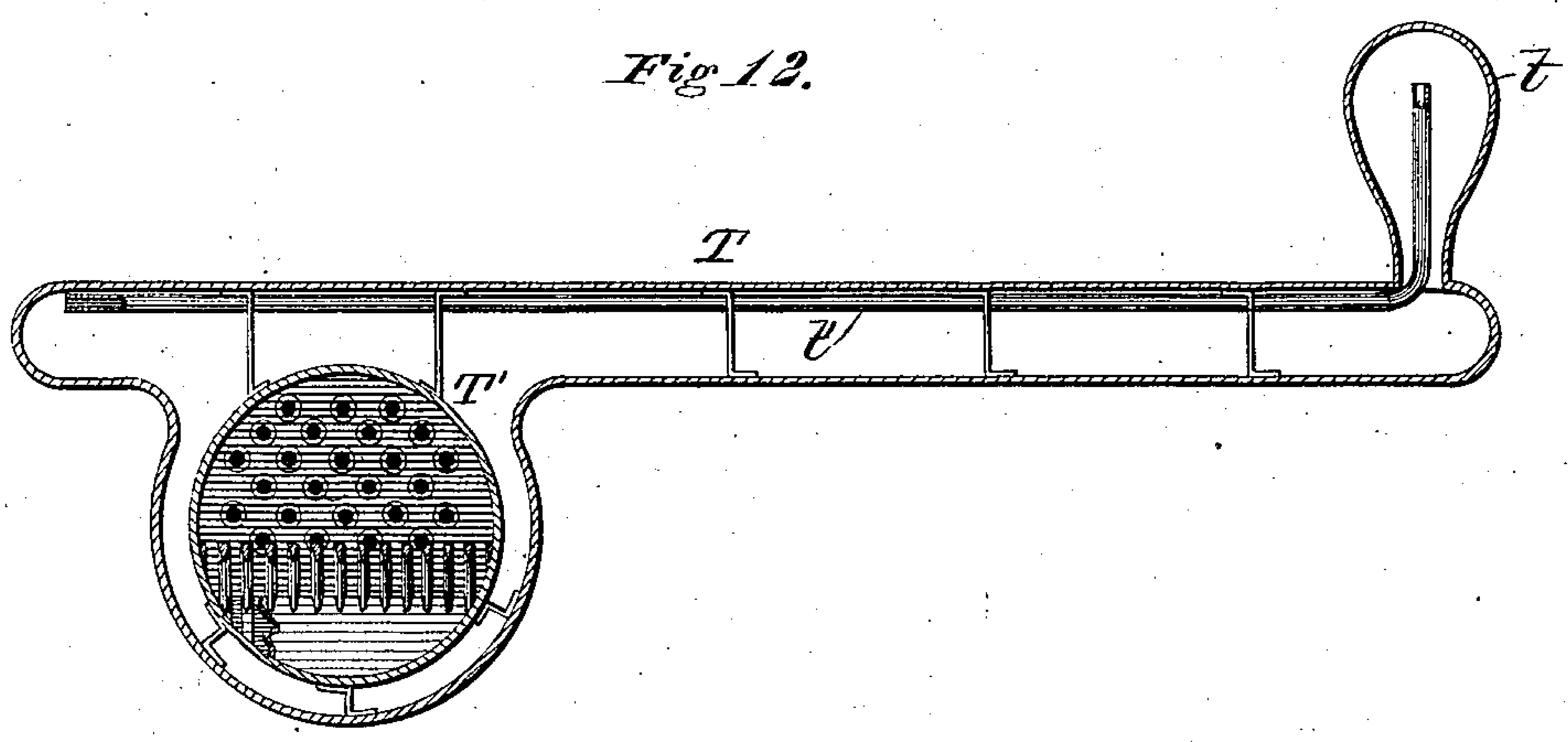
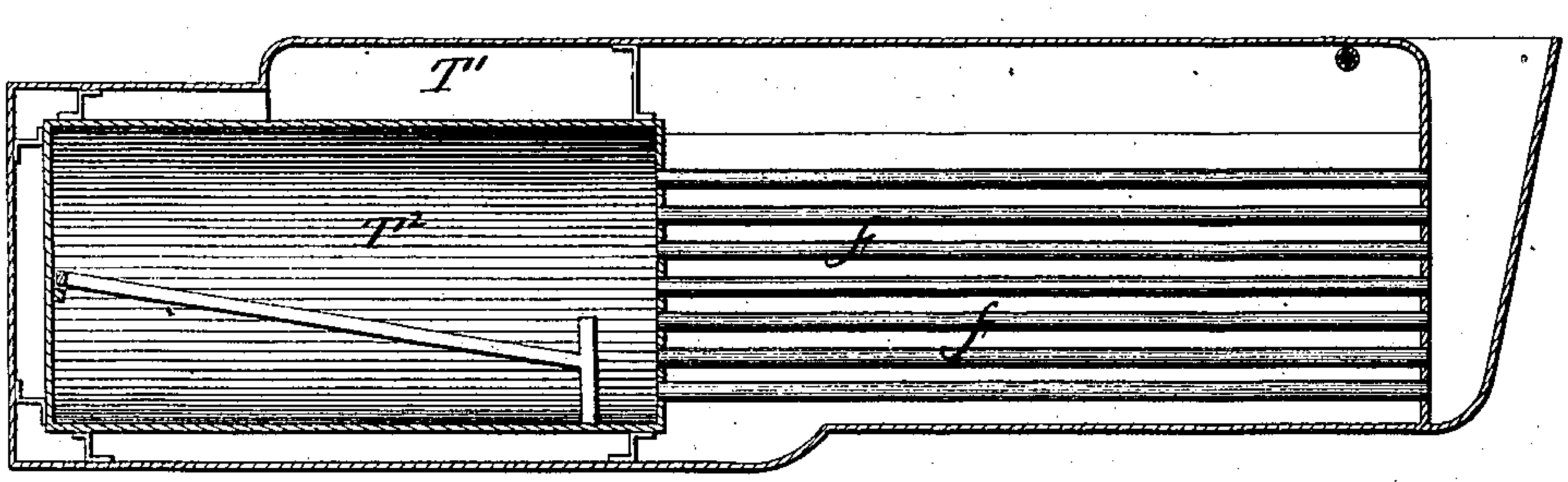


Fig 13.



Witnesses

M. L. Church

F. McKenney

Inventor:

E. H. Angamar

By Hill & Ellsworth

His Attys.

UNITED STATES PATENT OFFICE.

EUGENE H. ANGAMAR, OF NEW ORLEANS, LOUISIANA, ASSIGNOR TO ANGAMAR MOTOR COMPANY.

IMPROVEMENT IN STEAM-MOTORS FOR CITY PASSENGER-CARS.

Specification forming part of Letters Patent No. 197,584, dated November 27, 1877; application filed March 7, 1877.

To all whom it may concern:

Be it known that I, EUGENE H. ANGAMAR, of New Orleans, in the parish of Orleans and State of Louisiana, have invented a new and Improved Steam-Motor for City Passenger-Cars; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a plan view of the stationary boilers and a part of the road. Fig. 2 is an end view of the stationary furnace and boilers. Fig. 3 is a plan of one form of iron truck. Fig. 4 is a side elevation of the same. Fig. 5 is a side elevation of one of the longitudinal beams of the truck. Fig. 6 is an end elevation of the car-boiler and the beams shown in Fig. 5. Fig. 7 is a longitudinal vertical section of one form of the boiler and furnace in working position in the car. Fig. 8 is a cross-section of the same. Fig. 9 is an end view of a boiler, showing one mode of cleaning the flues. Figs. 10 and 11 represent the grate and vessel for inserting and removing it. Fig. 12 is a longitudinal vertical section, showing another form of boiler; and Fig. 13 is a transverse vertical section of the same.

Similar letters of reference in the accompanying drawings denote the same parts.

The object of this invention is to provide for the public a street-car motor which shall present the advantages of both steam and horse power without the disadvantages of either; or, in other words, a motor which shall render it practicable to retain the present light and commodious form and internal arrangement of horse railroad-cars, and to run them economically by steam-power without the necessity for a "dummy" or a separate locomotive, or for the services of a skilled engineer, and without noise, smoke, danger of explosion, or the liability to frighten horses on the street.

To this end my invention consists, first, in a new mode or process of supplying to a city passenger railroad-car the heat necessary for its motive-power, such mode or process constituting a new and valuable improvement in the art of steam-railroad engineering; secondly, in the construction and adaptation of the boilers and furnace to be used in carrying my first-mentioned improvement into practice; and, thirdly, in the details or subordinate arrangements of mechanism herein shown and described, substantially as I will now proceed to set forth.

The first part of my invention consists in providing the motive heat for a railroad-car on short routes by supplying its boiler at the railroad-stations with water previously heated by means independent of the car, and keeping up this initial heat of the boiler-water by a furnace transported with the car; or, in other words, in supplying the feed-water, at or near the requisite heat and pressure, from a stationary boiler or furnace, and sustaining that heat and pressure subsequently during the trip by the car boiler and furnace.

My improvement is, therefore, on the one hand, distinguished by the use of the car-furnace from the mere application of hot water supplied from a stationary boiler; while, on the other hand, the application of the hot water from a stationary furnace distinguishes it from the ordinary mode of supplying feed-water to locomotives and other portable engines, it comprising neither all of the one process nor all of the other, but only the combination of portions of both, which obviates their disadvantages and results in a new, practicable, and exceedingly valuable improvement in the art.

This part of my invention is applicable to ferry-boats and other short-line conveyances.

The means by which I carry this part of my invention into practice are as follows: Alongside of a track, A, of a city passenger-railway or other short-line railway, I construct a furnace, B, and arrange in connection with it a boiler or boilers, C, from which the feed-water is taken by any suitable means to the car-boiler. I prefer to employ two stationary boilers or tiers of boilers, C C′, both connected by branch pipes c c^1 to a tube or nozzle, d, extending toward the track, each branch having a cock, c^2 or c^3, which controls the flow of water through it. The flues of the furnace pass directly through the lower tier of boilers, then through the upper tier to the smoke-stack, so that the upper tier are heated by the waste heat not utilized in the lower tier, and the lower tier may be fed with water first heated

by the upper boiler. The water is to stand at about 212° Fahrenheit in the upper tier, but to stand in the lower tier at about the same temperature and pressure as are required for the water in the car-boilers. In filling an empty car-boiler, the cock of branch c^1 will first be opened and the car-boiler filled up to about the lower try-cock with water at 212° Fahrenheit, after which the cock c^3 will be closed and cock c^2 opened, and the rest of the supply introduced from boilers C at a pressure of from fifty to seventy pounds, more or less, as may be required. D is a lever, and d' a sliding coupling, by which the connection can be readily effected between the stationary boilers and the boiler of the car, and said coupling may be provided with a bayonet-fastening or other locking device to prevent the steam-pressure from forcing the connection apart.

The boiler of the car, constructed and arranged in any suitable manner, being thus supplied with water at the required temperature, fire is furnished to it during the trip to the next supply-station by means of fuel burning in a furnace attached to it. This furnace, also, may be of any suitable form and construction, and may be supplied from a reservoir of oil or hydrocarbon, or suitable fuel carried on the car; but, preferably, it is constructed for the burning of anthracite coal, and is supplied with incandescent coal from the stationary furnace B at the beginning of each trip, so as to avoid all necessity for transporting the fuel or firing up during the trip. The amount of incandescent coal required will only be the small quantity requisite to keep up the steam at or near its initial pressure, or so that it shall not fall below the working pressure required, and hence the car-furnace may be made of comparatively small dimensions, and will occupy but little room. Any form and arrangement of steam-engine that will answer the purpose may be employed in connection with the apparatus above referred to for driving the car. This completes the description of the first part of my invention.

It will be seen that, by the apparatus and system or process above described, in proportion as the quantity of water in the car-boiler boils away and decreases, and steam thereby makes faster, in almost the same proportion does the fuel in the furnace burn away and decrease in quantity and heating power, and thus counteract the tendency to increase of pressure, so that the car-boiler is rendered practically isothermal, the pressure automatically adjusting, and the apparatus non-explosive. It will also be seen that all danger of the boilers running dry while the fires are up, and of the feed-water being introduced upon red-hot surfaces, and of the steam-pressure being raised to a great and undue limit—the common causes of explosions—are by this system avoided, and that the care and skill required with ordinary locomotives in attending to the condition of the water and fire are rendered entirely unnecessary with my improved system.

Although the form and arrangement of the car boiler, furnace, and engines are not essential to the first part of my invention, which may be carried into successful practice by many different forms and arrangements thereof, yet I give preference to a boiler, furnace, and engines arranged under the body of the car, so that, substantially, the entire space inside of the car-body may be available for the seating of passengers or the storing of freight, and so that the presence and movements of the working machinery may be as completely concealed as possible, and, therefore, the second part of my invention consists in such arrangement, and in a boiler, furnace, and engine adapted, when so arranged, to the practical working of my system.

For successful use within the limited space available beneath the car, the boiler and furnace must have three peculiarities, viz., the boiler must be arranged horizontally to accommodate itself to the space, the furnace must be surrounded, as far as practicable, with the boiler-water, for the purpose of economizing heat, and the boiler-flues or passages into which the heated air, gases, and smoke first pass from the furnace must be arranged so near the low-water line that there will be no danger of their exposure at any time while the fires are burning fiercely. These three features are all found combined in the second part of my invention, and I have shown many of the different modes in which they may be practically embodied. In one of these embodiments (represented in Figs. 7, 8, 9, 10, and 11) E is the horizontal boiler, arranged under the car G, between the axles *h* of the traction-wheel H H′, and F is the furnace, arranged inside of the boiler, and having flues which traverse the boiler, beneath or near the low-water line thereof, and discharge the smoke, &c., into the smoke-stack at I. I prefer to have the flues traverse the boiler three times, as shown in Figs. 7 and 8, the smoke, &c., first passing into the flues *f* at or near the low-water line, thence into a vertical flue, f^1, arranged within the boiler, to prevent waste of radiated heat, thence passing by other flues, f^2, arranged as low as possible, to another vertical flue, f,^{3} at the opposite end of the boiler, and thence, by a series of upper flues, f^4, to the smoke-stack. By this arrangement the heat passing into the smoke-flues is, to the fullest extent, utilized in making steam, and none of the flues that are liable to become exposed above the water are near enough to the furnace to become red hot. The horizontal flues may be cleaned through the end of the boiler in the usual manner, or by a blast of air driven through them by any suitable machinery, and the vertical flues may be cleaned through a short pipe or pipes, f^5. The grate *j* is held in place during the trip by a key or other locking device, which, when unlocked or withdrawn, permits it to be removed with the coals upon it. A convenient device for inserting the grate and burning coals into the

furnace at the beginning of the trip, as well as for removing them when desired, is shown at J in the form of a slotted bucket or pan provided with a handle. The grate is to be set into the pan and the latter filled with coals, when, by means of the handle, the pan can be raised into the furnace till the grate registers with its bearings. The grate can then be locked in place and the pan removed. A draft-flue for the introduction of air under the grate is shown at K, and is provided with a door or sliding-plate at *k* to permit the introduction and removal of the grate and coals, and with a funnel-shaped mouth, k^1, and damper or register k^2 to enable the attendant to control and regulate the draft. With this furnace and boiler, the engine-cylinders are preferably arranged at the sides of the boiler, as shown at M, the pitmen P running to cranks *p* on the rear axle between the wheels. The exhaust N discharges into a chamber, O, of any suitable form, in which the exhaust-steam is condensed by means of blankets *o*, wet, preferably with salt-brine, through which or in contact with which the steam is obliged to pass on its way to the smoke-stack; or any other suitable condensing apparatus may be substituted in place of the cloths.

For the purpose of warming the cars in winter, a branch pipe, N′, is connected to the exhaust-pipe, and extends to radiators or coils under the seats, or in any other suitable place in the car, and thence back to the exhaust-pipe again, cocks *n n′* being provided for the purpose of directing the exhaust steam through the branch N′ in winter, or shutting it off therefrom in summer.

The steam-dome is shown at Q, and the safety-valve at Q′, the various gages, cocks, levers, valves, &c., being arranged as usual.

A boiler of this class twenty-four inches high, thirty inches wide, and sixty-six inches long will contain about one hundred and forty-eight gallons, of which about sixty gallons will be evaporated in a trip of an hour and a half, thus furnishing sufficient steam to supply two cylinders of six inches diameter and fourteen inches stroke, cut off at one-half, and having about eighty-eight gallons of water in the boiler at the end of the trip. For such a boiler the furnace should be about ten inches in height, which will bring the flues *f f* always under the low-water line.

Various modifications of this boiler and furnace may be used, if preferred, of which I have shown one in Figs. 12 and 13, where T is a flat boiler, suitably stayed, and having a steam-dome at *t*, and a transverse water-cylinder at T^1, communicating with the upper part of the boiler.

The furnace T^2 is arranged in one end of the water-chamber T^1, so as to leave a surrounding water-space, and the flues *f* pass directly through the other end of the chamber T^1, as shown in Fig. 13. A pipe, *t′*, may be arranged inside of the boiler, extending from the steam-dome to the opposite end of the part T, so that when, on inclines, the water runs into either end of the part T the steam can readily pass to the dome *t*. This form of boiler has many advantages, being simple and cheap in construction, readily cleaned, economizing heat, and keeping all the flues submerged. The steam-dome may be arranged at the end of the car, projecting up through the platform.

With this form of boiler the forward axle may be employed as the driving-axle, the boiler and furnace being arranged so far forward as to bring the most of the weight thereon to increase the traction of the wheels, and the steam-cylinder may be arranged in any suitable position for applying the power, which, as above stated, may be communicated by means of cranks applied at the outer ends of the axles, and screened from sight.

Whatever form and arrangement of boiler, furnace, and engine may be employed, I support all those parts upon a strong iron truck, S, suitably braced in every direction to resist the strains of the machinery and prevent the racking and dislocation of the parts. Both axles are mounted in this truck, and the car-frame is so attached to it as to be readily detachable for the purpose of substituting a close car in winter, or an open one in summer.

All the working machinery is to be boxed or otherwise screened from the sight of horses on the street. The wheels not used as driving-wheels may be made to run loosely on their axles to facilitate the turning of short curves.

I claim as my invention—

1. The process or improvement in the art of supplying motive heat to railroad-cars, substantially as herein described, the same consisting, essentially, in supplying the engine-boiler with water previously heated by means independent of the car, and sustaining such initial heat, during the trip or any part thereof, by a furnace or other equivalent source of heat transported with the car.

2. The combination of a railroad-car, a steam-boiler and engine for driving the same, a furnace independent of the car for heating the feed-water before its injection into the car-boiler, and a furnace or other source of heat transported with the car for generating or imparting heat to keep up the initial temperature of the boiler-water, substantially as described.

3. The combination of the furnace B, the boilers C′ for supplying to the car-boiler heated water not under pressure, the boilers C for supplying to the car-boiler heated water under pressure, the tubes leading from the two sets of boilers to the car-boiler, and the controlling-cocks, coupling and locking device, whereby the car-boiler can be first partially filled from boilers C′, and the filling completed from boilers C, substantially as described.

4. The combination of the horizontal boiler E with the furnace F, the flues *f* leading di-

rectly from the furnace to the rear end of the boiler, the flues f^2 arranged under the flues f and leading back to the front end of the boiler, the flues f^4 arranged above the flues f and leading out of the boiler, the connection f^1 between flues f and f^2, and the connection f^3 between flues f^2 and f^4, substantially as described.

5. The combination of the removable grate and locking device with a slotted bucket for inserting and removing the grate and coals, substantially as described.

6. The combination of the funnel-shaped air-draft flue K with the register k^2 and the boiler-furnace, arranged under the car, substantially as described.

7. In a locomotive steam-engine boiler, the combination of a single steam dome and two or more tubular connections extending therefrom within the boiler to the opposite extremities of the steam-space thereof, whereby the steam can pass through either connection to the dome when the other connection is closed by the water, substantially as described.

E. H. ANGAMAR.

Witnesses:
F. McKENNY,
M. CHURCH.