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J. BAIRD.

STEAM ENGINE.

No. 434,497. Patented Aug. 19, 1890.

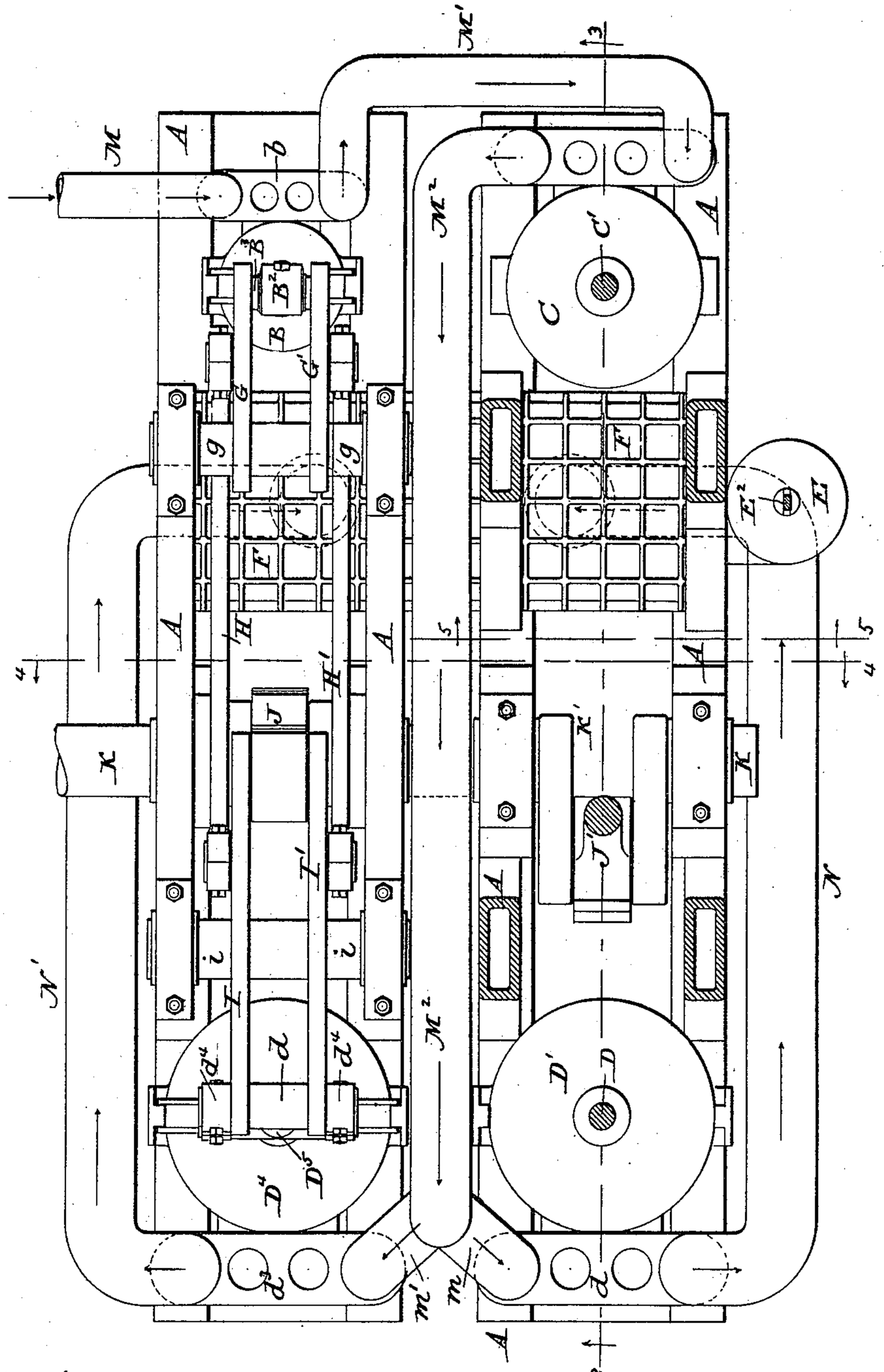

Fig. 1.

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Sidney P. Hollingsworth

Baltus De Long.

Inventor

John Baird

by his attorneys.

Baldwin Davidson & Wright

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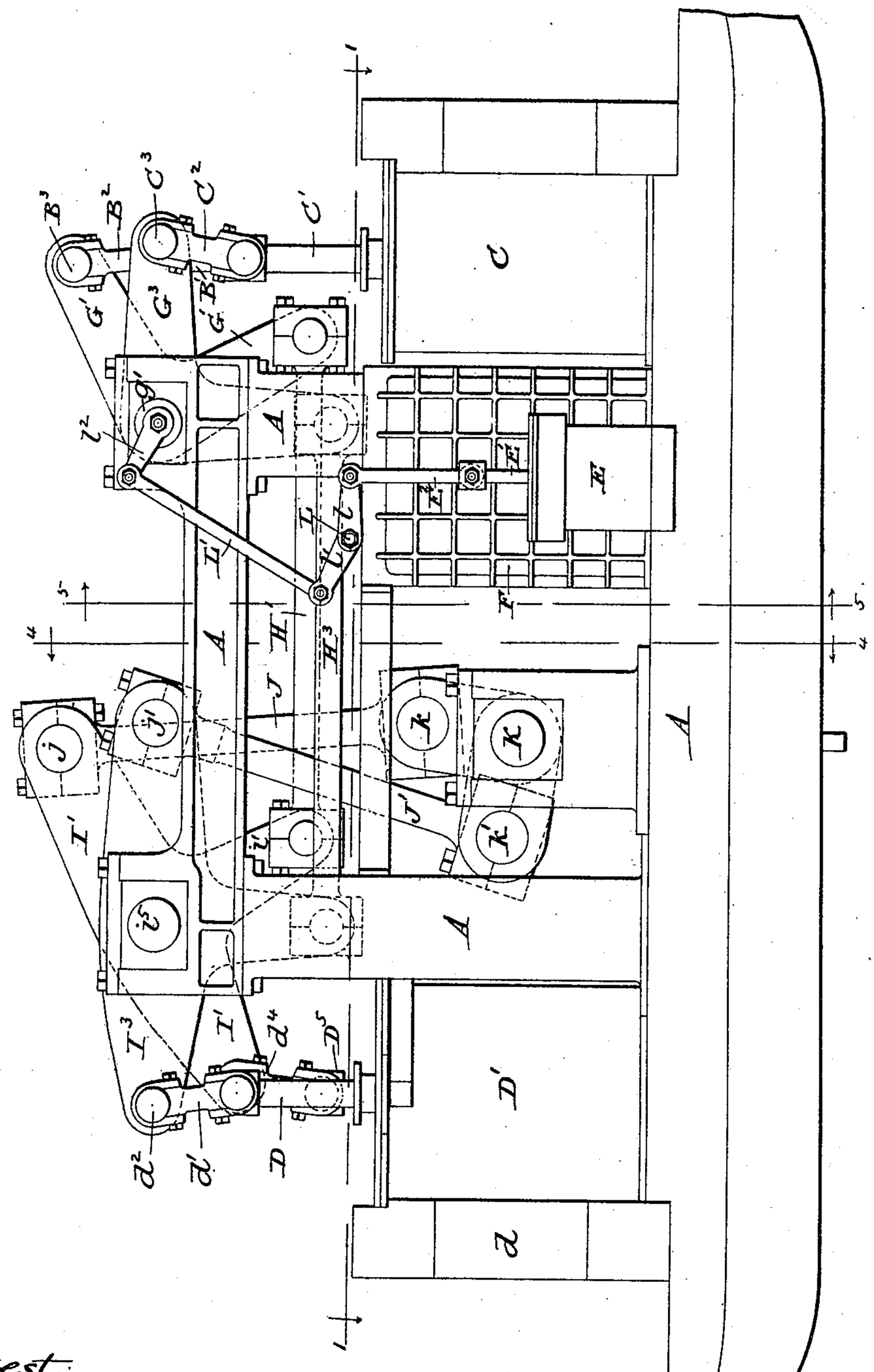

Fig. 2.

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Baltus D. Long.

Inventor;

John Baird,

by his attorneys

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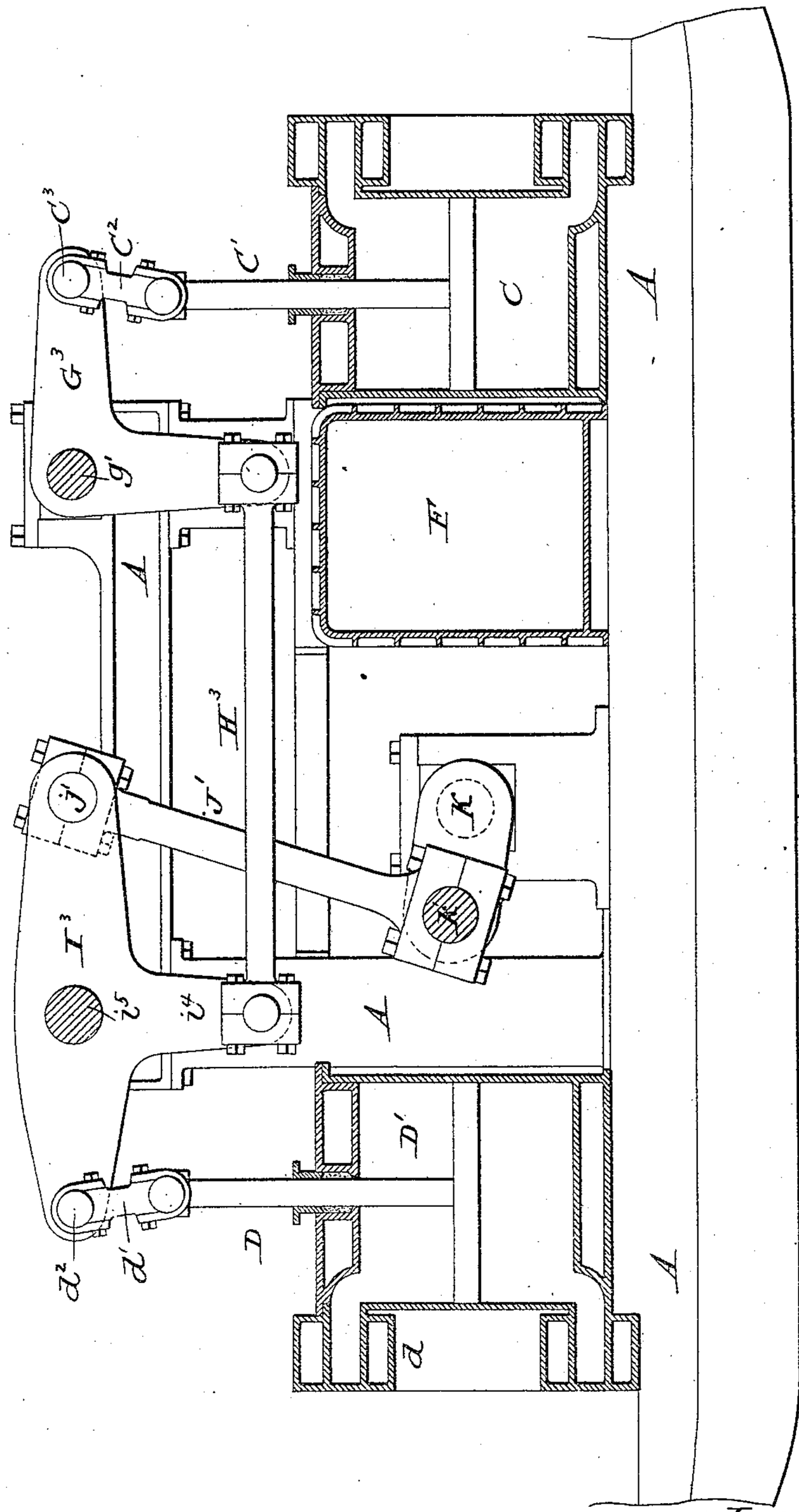

Fig. 3.

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Sidney P. Hollingsworth

Baltus De Long.

Inventor;

John Baird,

by his attorneys

Baldwin, Davidson & Wright

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Fig. 5.

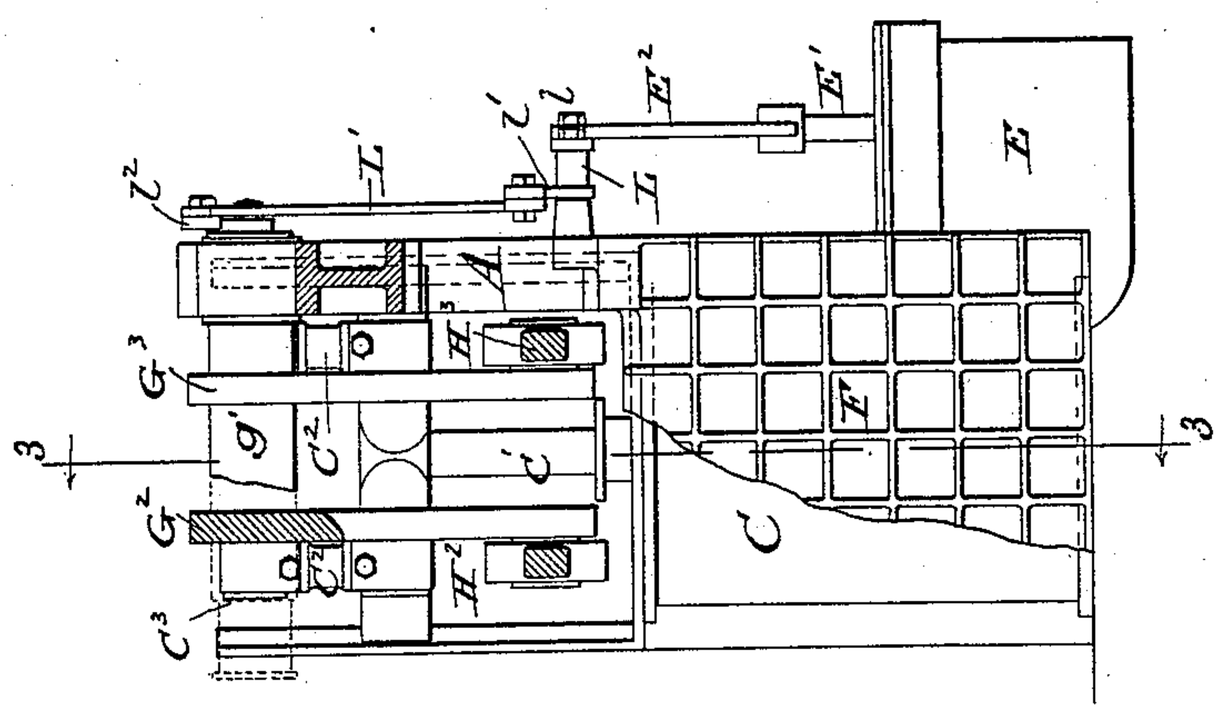

Fig. 4.

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Sidney P. Hollingsworth

Baltus D. Long.

Inventor;

John Baird,

by his attorneys

Baldwin Davidson & Wright

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Fig. 1.

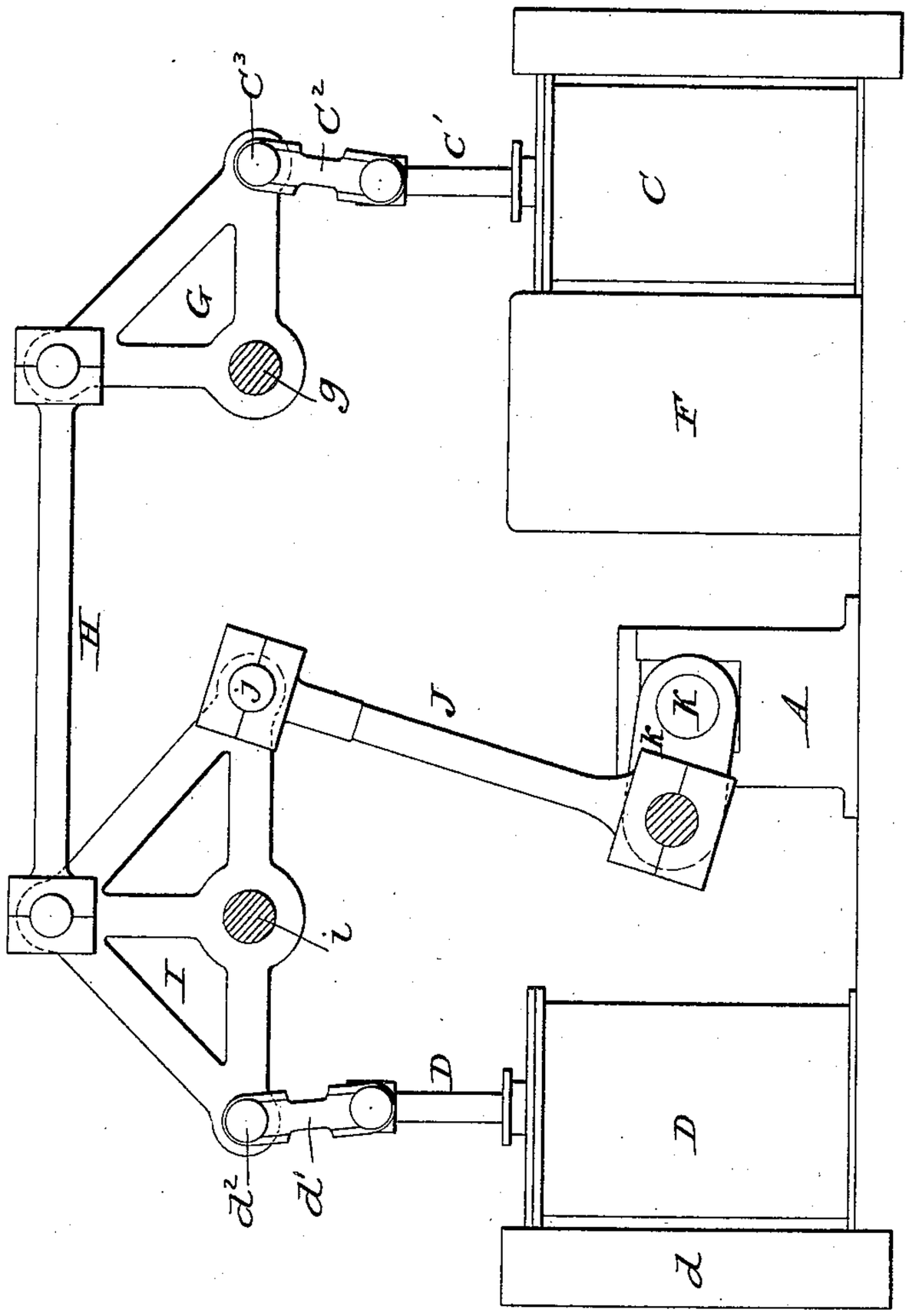
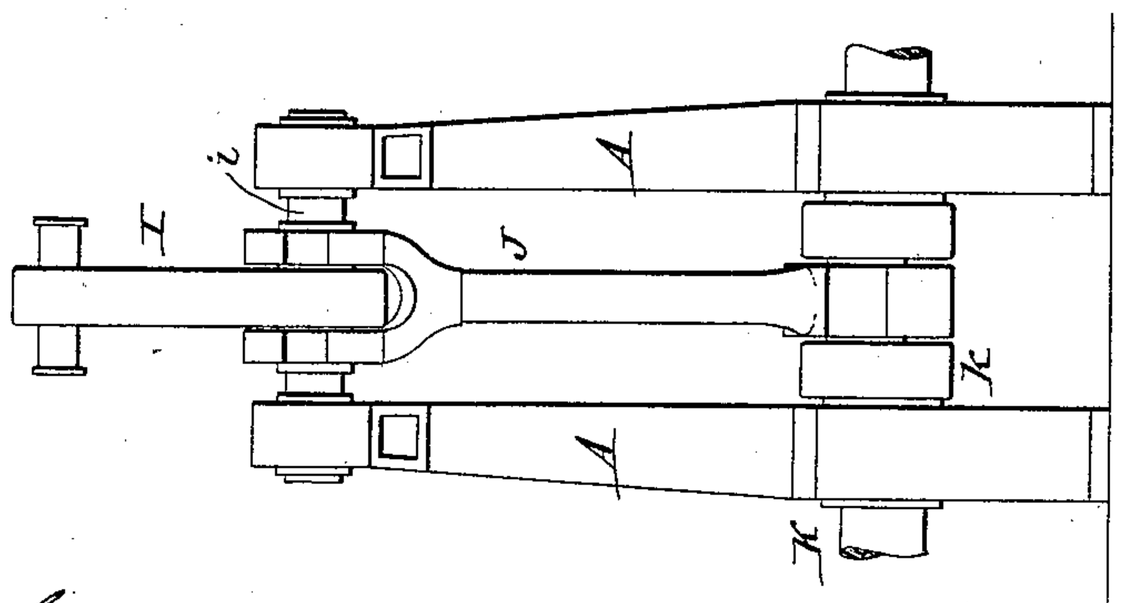


Fig. 6.



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Sidney P. Hollingsworth

Baltus D. Long.

Inventor;

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by his attorneys

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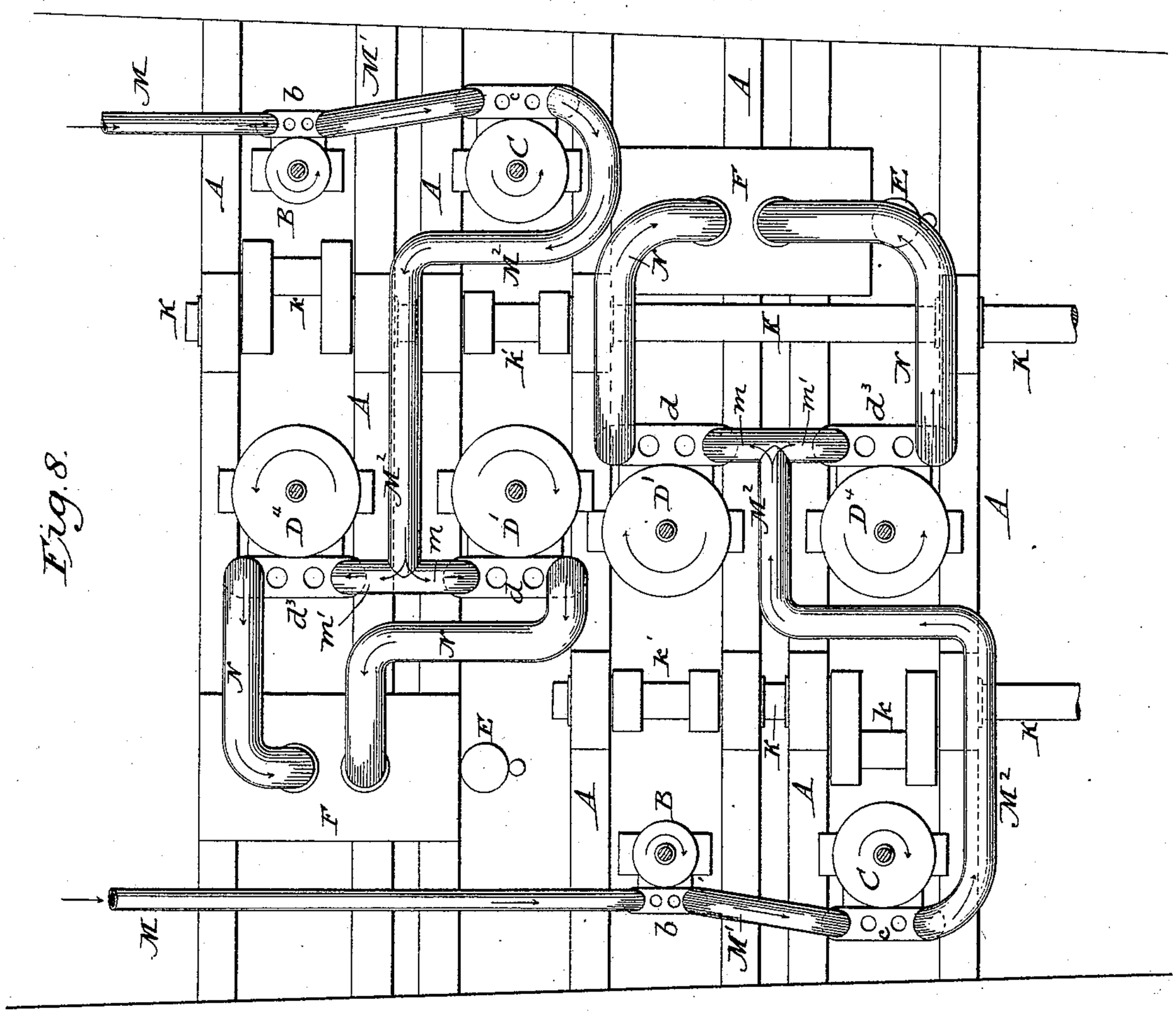
STEAM ENGINE.

No. 434,497. Patented Aug. 19, 1890.

Fig. 8.



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Sidney P. Hollingsworth

Baltus D. Long.

Inventor

John Baird

by his attorneys.

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STEAM ENGINE.

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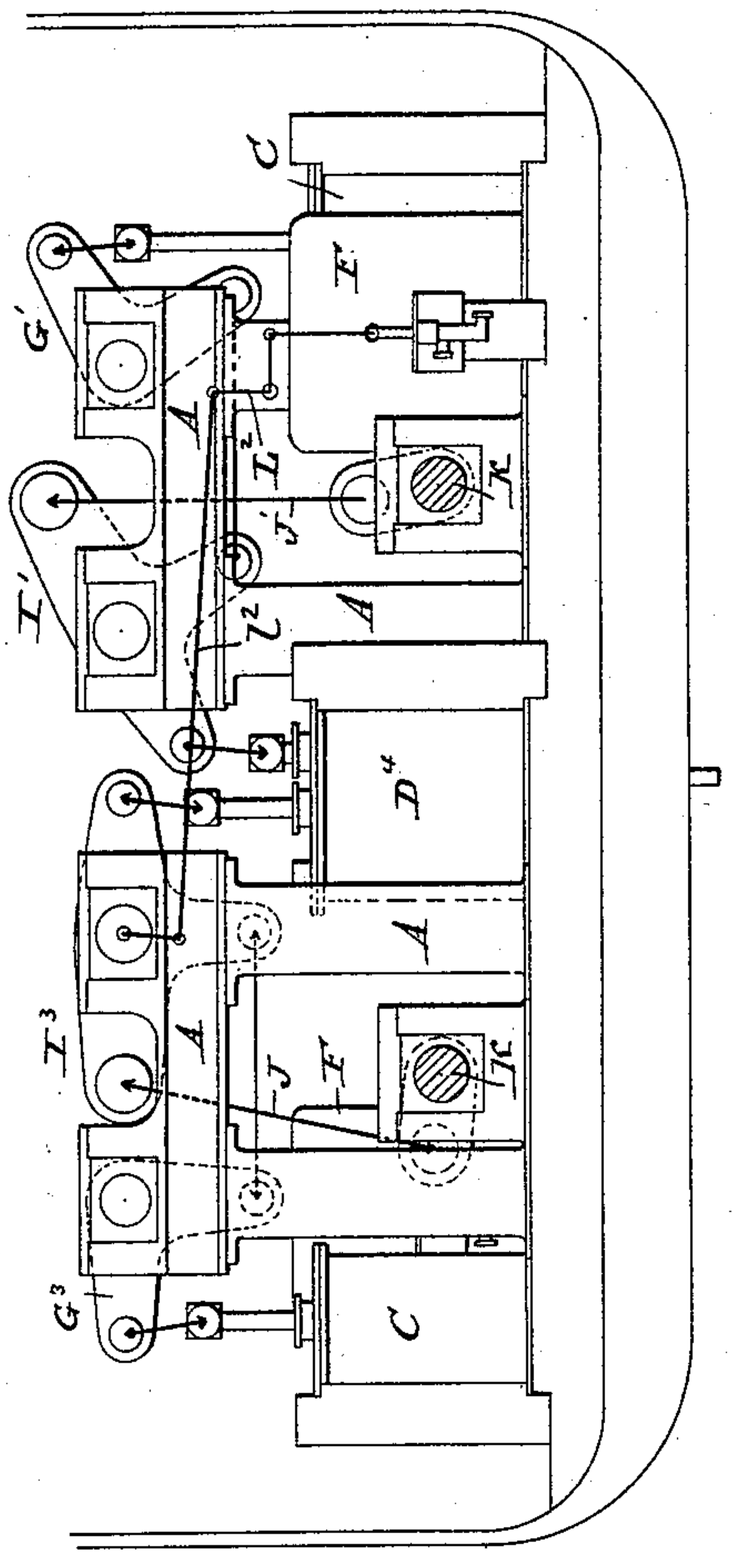
Fig. 9.



Attest.

Sidney P. Hollingsworth

Baltus De Long.

Inventor;

John Baird,

by his attorneys

Baldwin Davidson & Wright.

UNITED STATES PATENT OFFICE.

JOHN BAIRD, OF NEW YORK, N. Y.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 434,497, dated August 19, 1890.

Application filed April 12, 1890. Serial No. 347,659. (No model.)

To all whom it may concern:

Be it known that I, JOHN BAIRD, mechanical engineer, a citizen of the United States, and a resident of the city, county, and State of New York, have invended certain new and useful Improvements in Steam-Engines, of which the following is a specification.

These improvements consist of new and useful arrangements of the principal parts of steam-engines, especially adapted for marine engines, but also suitable for stationary engines.

The essential principle of my invention consists in balancing the weight of the moving parts of a steam-cylinder by the weight of the corresponding parts of another steam-cylinder on the opposite side of the crank-shaft, these moving parts being connected to each other by suitable bell-crank or elbow levers and links, so that when the piston and its attachments of one cylinder are going in one direction the piston and its attachments of the other cylinder are going in the opposite direction.

These improvements are especially intended for the improved construction of compound engines, triple-expansion engines, and quadruple-expansion engines.

Economy in the use of steam and reduction of the size and weight of the parts of steam-engines are secured by expanding steam of a high initial pressure to a low terminal pressure while doing its work, as well as by a high velocity of piston and increased frequency of revolution. To attain these ends it is of the first importance that the moving parts should counterbalance each other, and that the weight of vertically-reciprocating parts—such as pistons and their attachments—should be counterbalanced by the weight of similar parts having the same kind of motion, but in an opposite direction. Vertically-reciprocating pistons and their attachments are frequently counterbalanced by parts having a revolving motion. This causes side strains in the shafts, producing a wabbling, unsteady motion, hastening the wear of shaft-journals and causing them to get out of line. This is a serious difficulty in the case of large engines, the moving parts of which are necessarily heavy and the consequent strain thereon great.

My improvements effectually eradicate these defects, as in my plan the weight of the large piston and its attachments is counterbalanced by the weight of a smaller piston and its attachments plus the weight of the connecting-rod, and by using proper discretion in the construction and proportions of these moving parts a close approximation to perfect counterbalancing can be secured.

My improvements have the great and important advantage of enabling me to place the cylinders low down on the level of the foundations of the pillow-blocks of the crank-shaft journals, which is desirable for all marine engines, particularly for those of naval vessels.

The accompanying drawings show triple-expansion engines having a high-pressure cylinder, an intermediate-pressure cylinder, and two low-pressure cylinders of equal capacity, the stroke of the crank being greater than that of the piston, which contributes materially to an easy motion in passing dead-centers. That part of the engine at which the steam enters the high-pressure cylinder I call the "outer" or "front" end; the opposite the "rear" end. That portion on the left of a person standing at the front of the engine, as above defined, and facing it, I call the "left" or "front" side; the opposite the "right" or "rear" side.

Figure 1 represents a plan or top view of one form of my improved engine with the front section thereof partly in horizontal section on the line 1 1 of Fig. 2; Fig. 2, a front elevation thereof with the parts omitted in Fig. 1 in place; Fig. 3, a vertical longitudinal section through the front section of the engine on the line 3 3 of Figs. 1, 4, and 5, including the parts shown in Fig. 2, and looking to the right or rear; Fig. 4, a vertical transverse section on the line 4 4 of Figs. 1 and 2; Fig. 5, a similar section on the line 5 5 of Figs. 1 and 2, through the front section of the engine. The darts in these figures indicate the direction in which the views are shown, while the arrows indicate the course of the steam Fig. 6 represents a partial end

view, and Fig. 7 a side view, partly in vertical longitudinal section, illustrating a modification of the engine, in which the elbow-levers, walking-beams, and their connecting-links extend above the fulcrum on which they rock, instead of below it, as in the organization shown in the preceding Figs. 1 to 5, both inclusive. Fig. 8 represents a diagrammatic plan view illustrating the adaptation of my improved engine to the propulsion of two parallel shafts, such as those of twin screw-propellers; and Fig. 9, a similar side view of apparatus illustrating the same adaptation.

The various parts are shown as connected with or mounted in a bed-plate and frame A. A high-pressure cylinder B and its valve-chest *b* are shown as mounted on the outer rear part of the bed-plate. Its piston-rod B′ is connected by a link B^2 with a pin B^3, projecting therefrom at both ends and passing through the parallel rocking arms G G′ of an elbow-lever, which rock on a pivot *g* on the main frame. The other ends of these rocking arms are respectively connected by link-rods H H′ with the pendent crank-arms i' i^2 of a walking-beam, consisting of parallel arms I I′, rocking on a fulcrum *i* on the main frame. A pin *j* connects the inner or forward ends of these walking-beam arms, and a connecting-rod J connects this pin with a crank-pin *k* on a crank-shaft K, which may also be the propeller-shaft. The opposite outer or rear ends of the walking-beam arms are connected by a pin d^5 and link d^4 with a piston-rod D^5 of a low-pressure cylinder D^4, having the usual valve-chests d^3, &c.

The intermediate or first low-pressure cylinder C is preferably placed near the high-pressure cylinder B and has the usual valve-chests *c*. The piston-rod C′, link c^2, and pin c^3 connect this cylinder, in a manner similar to that hereinbefore described, with the rocking arms G^2 G^3 of elbow-levers rocking on a pivot g' and connected by link-rods H^2 H^3 with the pendent crank-arms i^3 i^4 of the arms I^2 I^3 of a walking-beam rocking on a fulcrum i^5, and connected at their inner or front ends by a pin j' and connecting-rod J′ with another crank k' on the crank-shaft K. The opposite ends of these walking-beams are connected by a pin d^2 and link d' with the piston-rod D of a low-pressure cylinder D′, having the usual valve-chests *d*, &c. The ends of the bell-crank and walking-beam arms connected with the cylinders are of equal radius, while the walking-beam arms connected with the cranks are of slightly-greater radius, the result of which is to give the crank a stroke greater than that of the pistons, and consequent ease of motion in passing the dead-centers.

The construction above described secures a very compact organization, as short walking-beams and elbow-levers can be used, the parts counterbalanced, and all the working-connections are below the fulcra on which they move.

The mechanism above described may be said in a sense to constitute a double engine with the two parts side by side, the cylinders of each section being on opposite sides of the crank-shaft, united by link-rods crossing that shaft, and all co-operating in actuating it.

An air-pump E is connected by a piston-rod E′ and link E^2 with a crank-arm *l* on a rock-shaft L, provided with an oppositely-projecting arm l', connected by a link L′ with an arm l^2, rocking on the shaft or pivot g' of the elbow-levers G^2 G^3. A condenser F is shown as extending across the frame or bed-plate close to the cylinders B C.

Fig. 1 shows my preferred plan of working this engine. Steam from the boiler passes through a pipe M and a high-pressure cylinder B, thence through pipes M′ to the intermediate cylinder C, thence through pipes M^2 to the opposite end of the engine, where branch pipes *m m′*, respectively, connect with the valve-chests *d* d^3 of the second and third low-pressure cylinders D′ D^4, which are preferably of equal area, but larger than the intermediate cylinder C. After doing its work in these cylinders D D^4 the steam is conducted, by pipes M M′ on opposite sides of the engine, to the condenser F, which it enters at opposite ends, as shown.

The foregoing description applies more particularly to the engine shown in the first five figures of the drawings.

Figs. 6 and 7 show a modification in which the elbow-levers, walking-beams, and their connecting-links are arranged above their fulcra, instead of below them, as in the organization first described.

Like parts being correspondingly lettered in all the figures, their arrangement will readily be understood.

This last-described plan, while not so compact as the other, has the compensating advantage of simplifying the organization, as it admits of the use of a single elbow-lever and walking-beam with forked connecting-rods embracing them, instead of double arms to straddle the connecting-links, as in the first plan.

Figs. 8 and 9 show an advantageous plan of working two parallel crank-shafts—such, for instance, as those of twin screw-propellers. Two triple-expansion engines are shown as arranged side by side in reverse order, the high-pressure cylinders being on the outer sides and the larger low-pressure cylinders lying between the crank-shafts. In this case duplicate sets of air-pumps and condensers are used, and at the opposite end of the engines from the plan first described. Each air-pump may be worked from the walking-beam fulcrum by a long link l^2 and bell-crank L^2, instead of from the elbow-levers. I thus secure a very compact and convenient organization, and still keep all the connecting-rod pivots of the walking-beams directly over the crank-shaft.

Except as hereinbefore stated, the details of construction of the various parts consti-

tute no part of the subject-matter claimed, and may be greatly varied within certain limits in well-known ways without departing from the spirit of my invention.

I claim as of my own invention—

1. The combination, substantially as hereinbefore set forth, of a crank-shaft, a steam-cylinder on each side thereof, two separate bell-cranks or elbow-levers, to opposite ends of one of which are connected the piston-rod of one of the cylinders and a connecting-rod directly actuating the crank-shaft, the other of which bell-cranks is connected with the piston of the other cylinder, and a link directly connecting the bell-crank and elbow-lever.

2. The combination, substantially as hereinbefore set forth, of a crank-shaft, a steam-cylinder, and a bell-crank or elbow-lever connected with the moving parts of the steam-cylinder on each side of the crank-shaft, a link-connection between the elbow-levers crossing the crank-shaft, and a connecting-rod uniting the crank-shaft with one of the elbow-levers between their fulcra, the organization being such that the weight of the moving parts is counterbalanced.

3. The combination, substantially as hereinbefore set forth, of a crank-shaft, a steam-cylinder on each side thereof, an elbow-lever connected with the moving parts of one of the cylinders, a bell-crank walking-beam connected with the corresponding parts of the other cylinder and having arms of unequal length, a connecting-rod uniting the crank-shaft with the longer arm of the walking-beam, and a link connecting the elbow-lever and walking-beam, the organization being such that the moving parts of the steam-cylinders always traverse in opposite directions, the weight of the moving parts is counterbalanced and the stroke of the crank is greater than that of the piston.

4. The combination, substantially as hereinbefore set forth, of a high-pressure cylinder, an elbow-lever directly connected with the moving parts thereof, a separate walking-beam, a link directly connecting it to the elbow-lever, a low-pressure cylinder having its moving parts directly connected with the walking-beam on one side of its fulcrum, a crank-shaft, and a connecting-rod uniting the crank-shaft with the walking-beam on the opposite side of its fulcrum.

5. The combination, substantially as hereinbefore set forth, of a high-pressure cylinder, a bifurcated elbow-lever connected with its moving parts, a bifurcated bell-crank walking-beam, links connecting the bifurcations of the elbow-lever and walking-beam, a low-pressure cylinder, its moving parts connected with the walking-beam, a crank-shaft, and a connecting-rod pivoted on the crank at one end and between the bifurcations of the walking-beam at the other and straddled by the connecting-links below their fulcra.

6. The combination, substantially as hereinbefore set forth, of a high-pressure cylinder, an intermediate cylinder into which steam passes direct from the high-pressure cylinder, elbow-levers connected directly with the moving parts of these cylinders, a separate bell-crank lever walking-beam, a link-connection between the elbow-levers and the walking-beam, a low-pressure cylinder, the connections between its moving parts and the walking-beam, a crank-shaft, and a connecting-rod uniting the crank-shaft and the walking-beam.

7. The combination, substantially as hereinbefore set forth, of a high-pressure cylinder, its moving parts, an elbow-lever connected therewith, a walking-beam, a link-connection between the elbow-lever and walking-beam, a cylinder, an elbow-lever walking-beam, connecting-links, and a connecting-rod, its moving parts connected with the walking-beam, a crank-shaft, and a connecting-rod uniting the walking-beam and crank-shaft with a duplicate engine having two low-pressure cylinders connected with the same crank-shaft as the other engine.

8. The combination, substantially as hereinbefore set forth, of a high-pressure cylinder, an intermediate cylinder of larger area, and two low-pressure cylinders of still larger area with duplicate separate elbow-levers and walking-beams, links directly connecting the walking-beam and elbow-levers of each set, and connecting-rods connected with the walking beams and acting on the cranks of a common crank-shaft and constituting a triple-expansion engine.

9. The hereinbefore-described triple-expansion engine, consisting of the combination, substantially as hereinbefore set forth, of a high-pressure cylinder, an intermediate cylinder of larger area, two still larger low-pressure cylinders of equal area with duplicate separate elbow-levers and walking-beams, links directly connecting the walking-beams and elbow-levers, and connecting-rods connected to the walking-beams acting on the cranks of the same crank-shaft, a steam-passage connecting the high-pressure and intermediate cylinders, and a branch steam-passage therefrom to the other low-pressure cylinders.

10. The combination, substantially as hereinbefore set forth, of a high-pressure cyinder, a larger intermediate cylinder, two larger low-pressure cylinders, separate elbow-levers and walking-beams, links directly connecting the walking-beams and elbow-levers, and connecting-rods connected with the walking-beams and connecting the moving parts of these cylinders in pairs with a common crank-shaft, a condenser, and an air-pump.

11. The combination, substantially as hereinbefore set forth, of a high-pressure cylinder, an intermediate cylinder of larger area, two other larger low-pressure cylinders of equal area, separate elbow-levers and walking-beams, links directly connecting the walking-

beams and elbow-levers of each set, and connecting-rods connected with the walking-beams and uniting the moving parts of these cylinders in pairs with a common crank-shaft, and an air-pump and link-connections for working it from the fulcrum or shaft of one of the elbow-levers or walking-beams.

12. The combination, substantially as hereinbefore set forth, of a high-pressure cylinder, a low-pressure or intermediate cylinder of larger area adjacent thereto, two larger low-pressure cylinders of equal area, interposed separate elbow-levers and walking-beams, links directly connecting the walking-beams and elbow-levers, and connecting-rods connected with the walking-beams and uniting the moving parts of these cylinders in pairs with a common intermediate crank-shaft, a condenser, and steam-passages entering it at opposite ends from the larger cylinders.

13. The duplex twin screw triple-expansion engine hereinbefore described, consisting of the combination of two duplicate engines, their separate walking-beams and elbow-levers, links connecting them with their largest low-pressure cylinders between the crank-shafts, their high-pressure and intermediate cylinders outside the crank-shaft, and their elbow-levers and walking-beams on opposite sides of their respective crank-shafts.

14. The combination, substantially as hereinbefore set forth, of two parallel crank-shafts, a high and an intermediate cylinder outside of the crank-shafts, two low-pressure cylinders between the shafts, separate elbow-levers and walking-beams, links connecting them, and connecting-rods uniting the moving parts of these cylinders with the crank-shaft between them, a generator outside the other crank-shaft, and steam-passages connecting the cylinders in series with the generator.

In testimony whereof I have hereunto subscribed my name.

JOHN BAIRD. [L. S.]

Witnesses:
B. L. M. BATES,
W. H. H. YOUNG.