

(No Model.)

3 Sheets—Sheet 1.

A. LECKIE.
STEAM ENGINE.

No. 453,866.

Patented June 9, 1891.

FIG. 1.

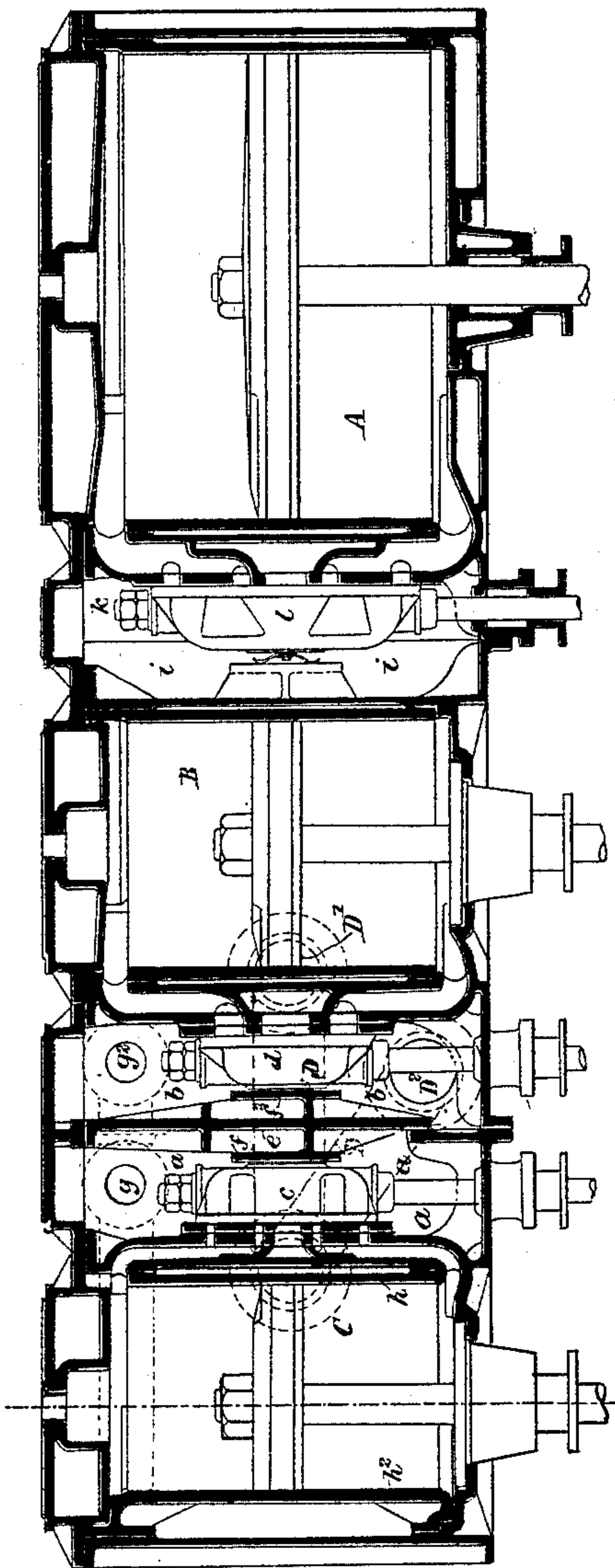
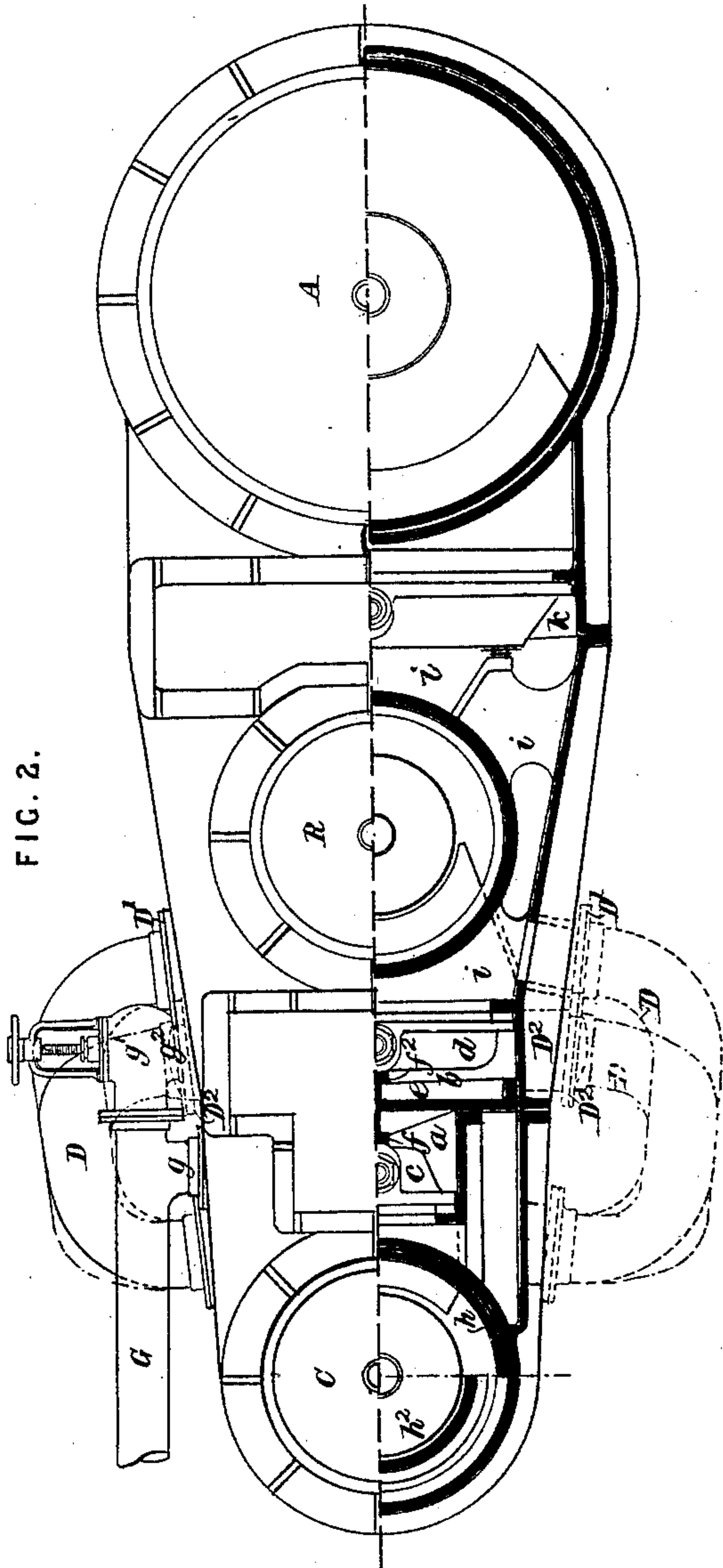


FIG. 2.



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his Attorney

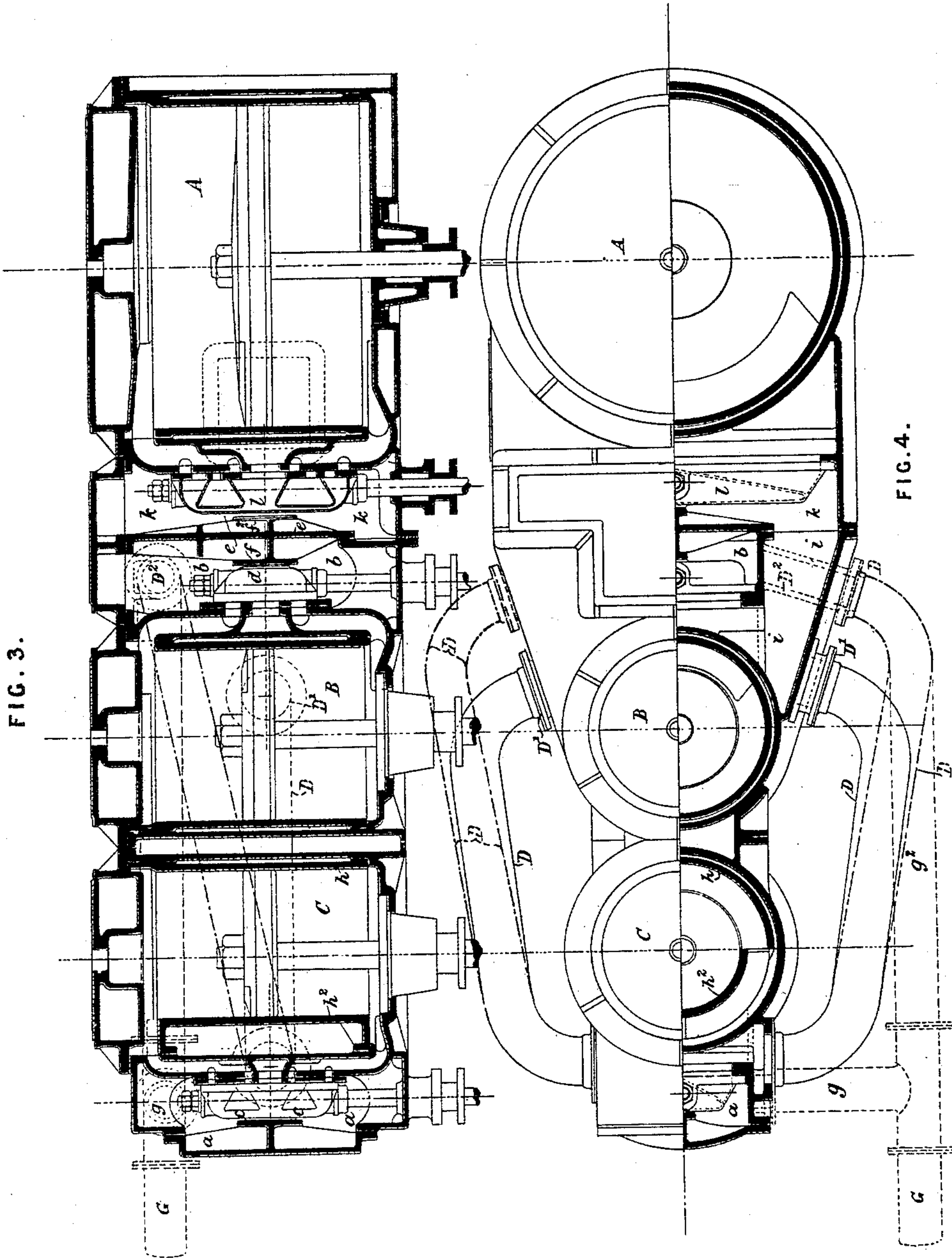
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Patented June 9, 1891.



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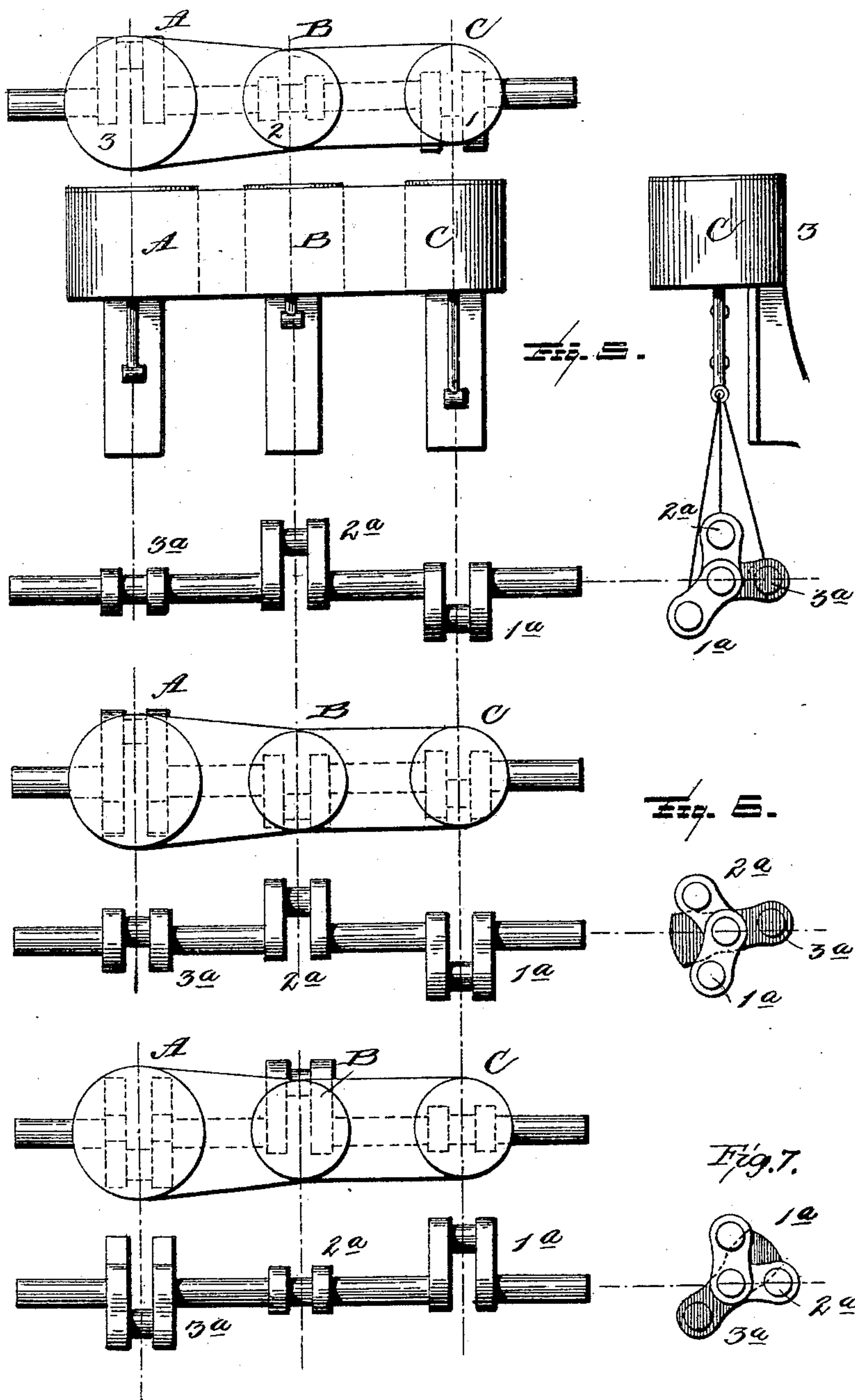
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STEAM ENGINE.

No. 453,866.

Patented June 9, 1891.



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UNITED STATES PATENT OFFICE.

ANDREW LECKIE, OF WEST HARTLEPOOL, ENGLAND.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 453,866, dated June 9, 1891.

Application filed October 7, 1889. Serial No. 326,186. (No model.) Patented in England May 30, 1889, No. 8,998; in France August 23, 1889, No. 200,363; in Belgium August 24, 1889, No. 87,493; in Italy September 20, 1889, No. 178, and in Spain February 1, 1890, No. 10,152.

To all whom it may concern:

Be it known that I, ANDREW LECKIE, engineer, a subject of the Queen of Great Britain, residing at Cambridge Terrace, West Hartlepool, in the county of Durham, England, have invented certain Improvements in Steam-Engines, (for which I have obtained Letters Patent in England, No. 8,998, dated May 30, 1889; in France, No. 200,363, dated August 23, 1889; in Belgium, No. 87,493, dated August 24, 1889; in Italy, No. 178, dated September 20, 1889, and in Spain, No. 10,152, dated February 1, 1890,) of which the following is a specification.

My invention relates more especially to marine steam-engines, but is not restricted thereto.

According to my invention I provide, in combination with the cylinders of the ordinary compound engines, an additional high-pressure cylinder, both of the high-pressure cylinders receiving steam direct from the steam boiler or boilers either by a separate pipe or passage or by a branch from the same pipe, and both cylinders exhausting into the slide-valve casing of the low-pressure cylinder. The two high-pressure cylinders may be supplied with steam from one slide-valve casing common to both cylinders, or each cylinder may have a slide-valve casing of its own. The additional high-pressure cylinder may or may not at first be provided with a liner capable of being removed when desired. Where such liner is inserted, the space between it and the cylinder walls is suited for use as a steam-jacket. The said additional cylinder may afterward be lined with or have the original liner replaced by a liner of smaller diameter and be supplied with a corresponding piston, so as to convert the engine into a triple-expansion engine—for instance, when a new boiler is or new boilers are to be employed and increased boiler-pressure is to be used—the exhaust from the additional high-pressure cylinder being then passed into the original high-pressure-cylinder slide-valve casing instead of direct into the low-pressure-cylinder slide-valve casing, the engine then working as a triple-expansion engine. The additional high-pressure cylinder may be set in any position relatively to the other high-

pressure and low-pressure cylinders; but its piston works on a separate crank, which may be set at an equidistant angle from the two other cranks worked by the pistons of the other cylinders respectively, the three cranks being arranged at such angles as to best equalize the strain upon and balance the pistons, rods, and cranks. By this arrangement I permit a greater degree of expansion being used in the two high-pressure cylinders, which expansion may be governed by any convenient means, so that there will be a large reduction in the quantity of steam used for the power developed and a much more steady motion of the engine than in the ordinary compound engine. The additional high-pressure cylinder may be provided with two exhaust branches or ports so arranged that connection therewith may be formed with either the low-pressure valve-casing or at such time as the engines are to be worked with extra high-pressure steam with the valve-casing of the other high-pressure cylinder, according to the way the engines are to be used—that is to say, either both high-pressure cylinders will exhaust into the low-pressure slide-valve casing, or the steam from the additional cylinder may be caused to enter the intermediate cylinder valve casing when so required, and in this latter case the exhaust from the intermediate cylinder will of course be led to the valve-casing of the low-pressure cylinder. When the boilers of triple-expansion engines require reducing the pressure through age or other cause, the engines may be converted into compound engines, having two high-pressure cylinders and one low-pressure cylinder, by inserting a liner of a diameter suited to the pressure to be used in the intermediate cylinder and altering the steam-passages so as to conduct the steam into the two smaller cylinders direct from the boiler and from both of the said cylinders into the low-pressure cylinder.

In order that my said invention may be fully understood, I shall now proceed more particularly to describe the same, and for that purpose shall refer to the figures on the annexed drawings, the same letters of reference indicating corresponding parts in all the drawings.

Figures 1 and 3 are longitudinal sections

through the cylinders of two engines having different arrangements of the slide-valve casings. Figs. 2 and 4 are plans of the cylinders of the compound engines shown in Figs. 1 and 3, respectively. Figs. 5, 6, and 7 are diagrammatic views showing the positions assumed by the cranks when the apparatus is in operation.

Both engines are constructed and arranged according to my invention, A being the low-pressure cylinder, B the ordinary high-pressure cylinder, and C the additional high-pressure cylinder. The cylinders B and C are shown in Figs. 1 and 2 as having each independent valve-chests b a , respectively, but, if desired, the valves d c for both cylinders may be contained in one and the same chest. In Figs. 3 and 4 the valve-chests are disposed differently, those for the cylinders A and B being in close proximity and the valve-chest a for the cylinder C being arranged to the left hand of that cylinder, as shown. The valve-chests a b , Figs. 1 and 2, and the valve-chests k b , Figs. 3 and 4, are separated by a partition e , provided with faces f f^2 , against which the backs of the valves c d , Figs. 1 and 2, or d l , Figs. 3 and 4, work. The valves may be double or single ported or piston valves, as preferred. Live steam from the boilers is conducted into the valve-chests a b by a pipe G, having branches g g^2 , leading, respectively, into the said valve-chests a b . The branch g^2 may or may not be provided with a cock or valve g' , Fig. 2, for cutting off the supply of steam to the chest b when required. The additional cylinder C may at first be fitted with or may remain without a liner and may be of the capacity usual for the high-pressure cylinder of triple-expansion engines, as shown at h^2 ; but I prefer to make it of greater diameter and fit therein a larger removable liner, as at h , of such diameter as to leave a space between it and the cylinder, which cylinder then constitutes a jacket to prevent or reduce loss of heat by radiation.

The cylinder C is shown in the drawings with two liners h h^2 of different diameters, that shown at h being employed when both cylinders B and C receive high-pressure steam from the boilers direct and that shown at h^2 (which is of less diameter) being substituted for h when the engine is to be worked as a triple-expansion engine, the piston of course being changed to correspond to the diameter of the liner employed. When the cylinders B and C both receive high-pressure steam direct, they both exhaust into the space i or exhaust-chamber, which surrounds the cylinder B, or may exhaust into the low-pressure-cylinder slide-valve casing by a pipe direct, the steam from the cylinder C being conducted into the said space by the exhaust-pipes D D. The space i is in communication with or forms part of the valve-chest k of the low-pressure cylinder A, and the passage of steam from this space to the said cylinder is governed by the slide-valve l . After the

steam has done its work in the cylinder A it may exhaust into a condenser or into the atmosphere, if desired.

The arrangement of pipes or passages for the steam to and from the cylinders may be varied, as required, to suit different arrangements of the cylinders, and may be provided with cocks or valves for directing the steam in the required direction.

When the engine is to be worked as a triple-expansion engine, the liner h is removed from the cylinder C and the liner h^2 fitted in place thereof, which is of smaller diameter proportional to the new boiler-pressure intended to be used, and the valve g' in the branch g^2 , leading to the valve-chest b of the cylinder B, is closed, or (where no valve is employed, as in Figs. 3 and 4, the pipe connection with the valve-chest b is removed) the connections of the exhaust-pipes D with the space i are broken at D' and connected, as shown by dot-and-pick line, to a passage at D² with the slide-valve chest b . Steam from the boiler is conducted by the branch pipe g into the valve-chest a , and after doing work in the cylinder C exhausts by the pipes D and passage D² into the valve-chest b of the cylinder B, in which it then works expansively, and after doing its work therein passes into the valve-chest k , and thence by the valve l into the low-pressure cylinder A, wherein it acts by further expansion on the piston therein, and finally exhausts into a condenser or into the atmosphere.

In Figs. 5, 6, and 7, 1^a, 2^a, and 3^a designate the pistons of the cranks, connected, respectively, with the additional high-pressure cylinder, ordinary high-pressure cylinder, and low-pressure cylinder.

Instead of altering the connections of the exhaust-pipes, as hereinbefore described, the said pipes may be provided with valves and branch pipes for directing the steam in the course required; but as the necessity for altering the course of the steam is not frequent the arrangement hereinbefore described and illustrated is preferred on account of economy in cost.

The intermediate cylinder of triple-expansion engines may be readily converted into a high-pressure cylinder by inserting therein a liner and piston of the required diameter for pressure to be used and suitably altering the steam-passages, so as to admit live steam from the boiler into the said cylinder, as well as into the ordinary high-pressure cylinder, and causing both cylinders to exhaust into the low-pressure-cylinder valve casing or casings according to my invention.

By means of my invention the necessity for providing new boilers when those in use are only partially worn and too weak to be employed with triple-expansion engines is obviated, while the expense of adding the third cylinder and converting the engine is comparatively light, it being simply necessary to provide this third cylinder with pis-

ton-connecting rod, valve gear, and extra crank shaft and pin, and to alter the connections of the steam-passages, substantially as hereinbefore described.

5 Having now described and particularly ascertained the nature of my invention, I wish it to be understood that, as this invention is intended for the improvement more particularly of existing engines, I do not restrict myself to the arrangement of the cylinders, as
10 shown in either of the drawings, nor to the details of construction described and illustrated, as variations may be made therein without departing from the nature of my invention; but
15

What I claim is—

1. A compound engine with three cylinders, one of the said cylinders being provided with a removable liner, and the steam-passages
20 being so arranged that the engine may be worked either with two high-pressure cylin-

ders or as a triple-expansion engine, substantially as hereinbefore described.

2. A compound engine having three cylinders, two of said cylinders being supplied with
25 high-pressure steam direct from the boilers and exhausting into the third or low-pressure cylinder, one of said cylinders being provided with a removable liner, and the pistons of the three cylinders being connected to separate
30 cranks arranged at different angles on the same crank-shaft, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ANDREW LECKIE.

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