(No Model.) 4 Sheets—Sheet 1.

J. HUGHES.

PROPULSION OF STREET, TRAMWAY, OR OTHER RAILWAY CARS OR CARRIAGES.

No. 466,415. Patented Jan. 5, 1892.

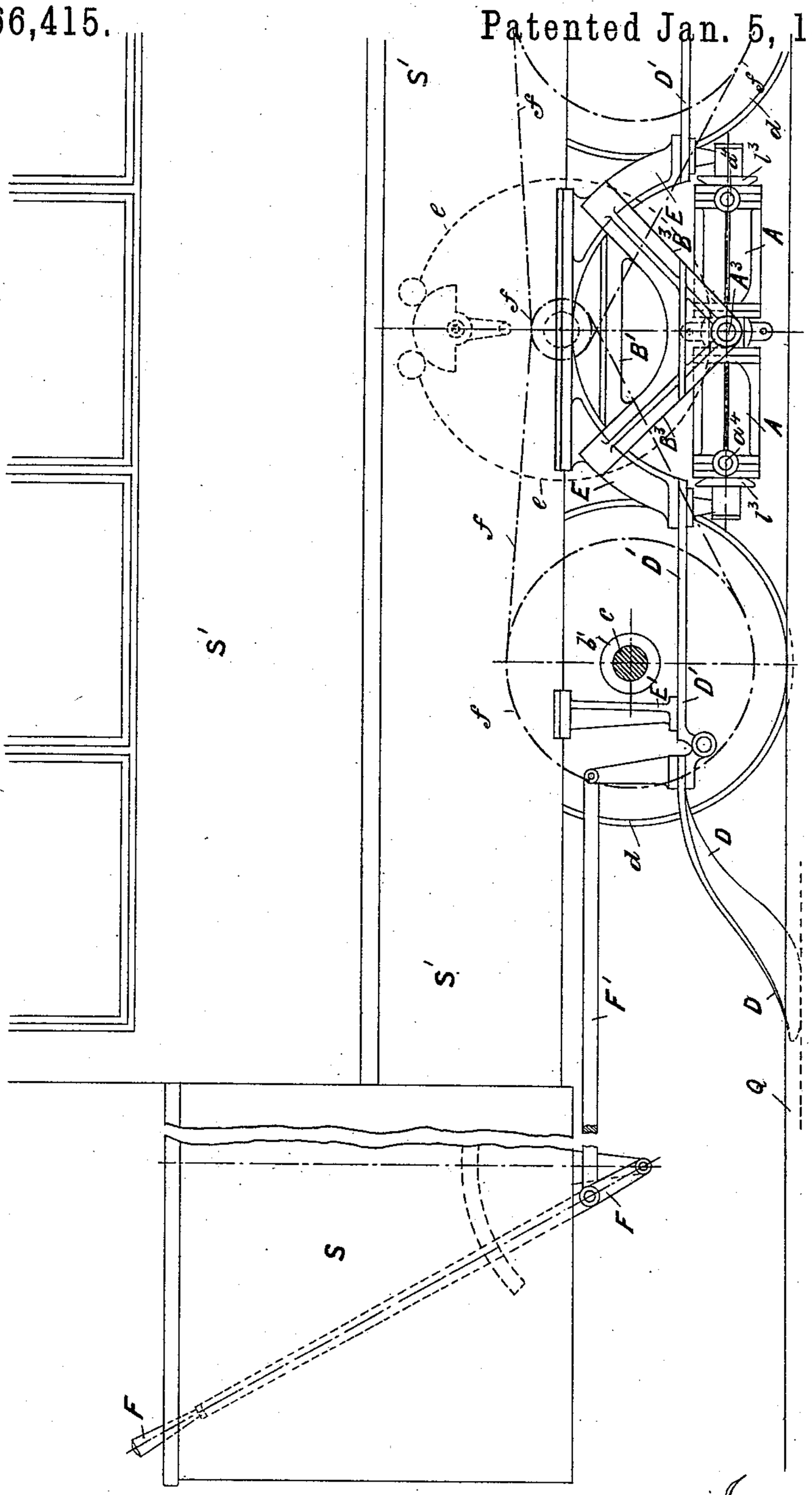

FIG. 1.

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(No Model.) 4 Sheets—Sheet 2.

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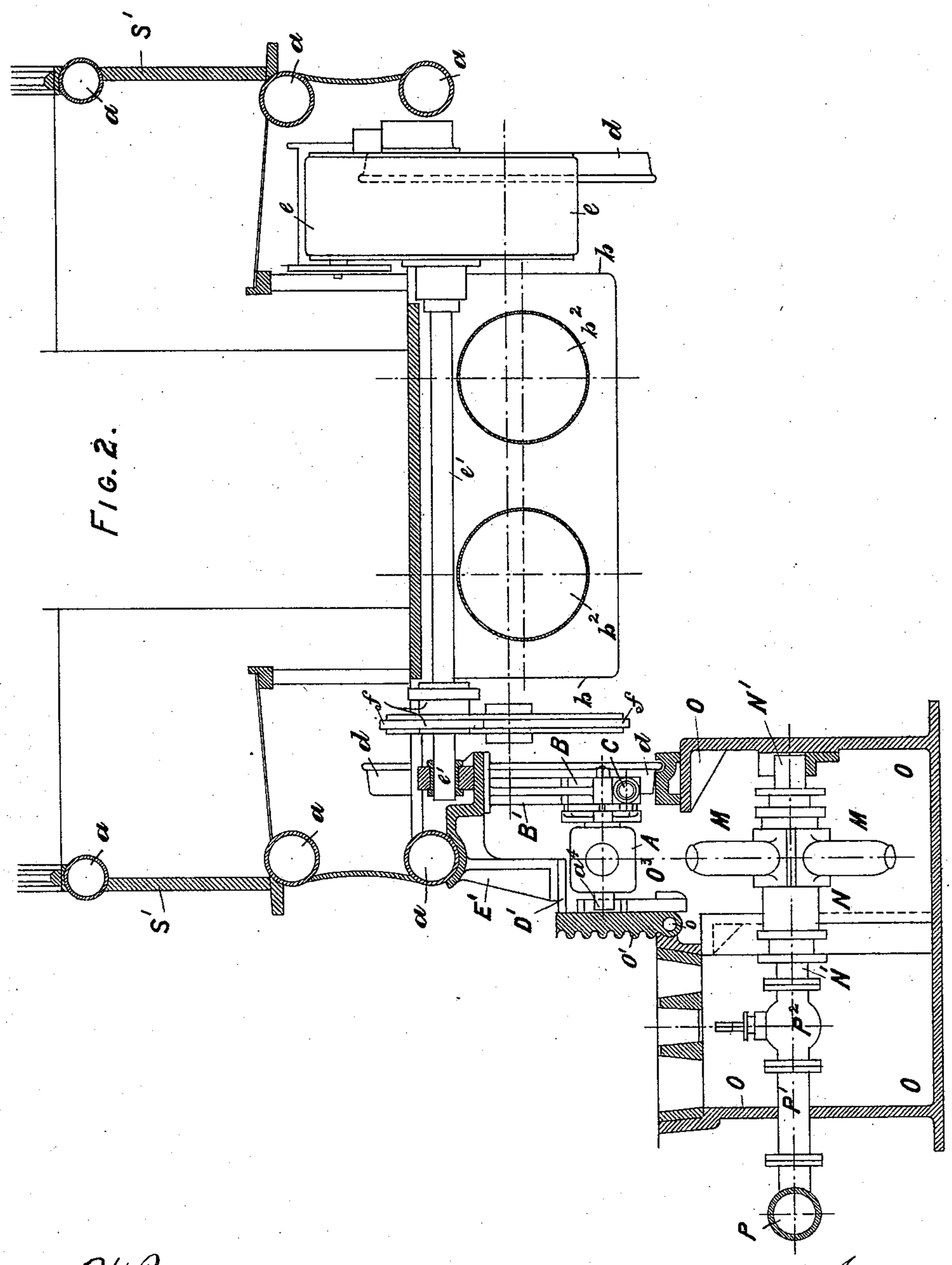
PROPULSION OF STREET, TRAMWAY, OR OTHER RAILWAY CARS OR CARRIAGES.

No. 466,415. Patented Jan. 5, 1892.

FIG. 2.



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(No Model.) 4 Sheets—Sheet 3.

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PROPULSION OF STREET, TRAMWAY, OR OTHER RAILWAY CARS OR CARRIAGES.

No. 466,415. Patented Jan. 5, 1892.

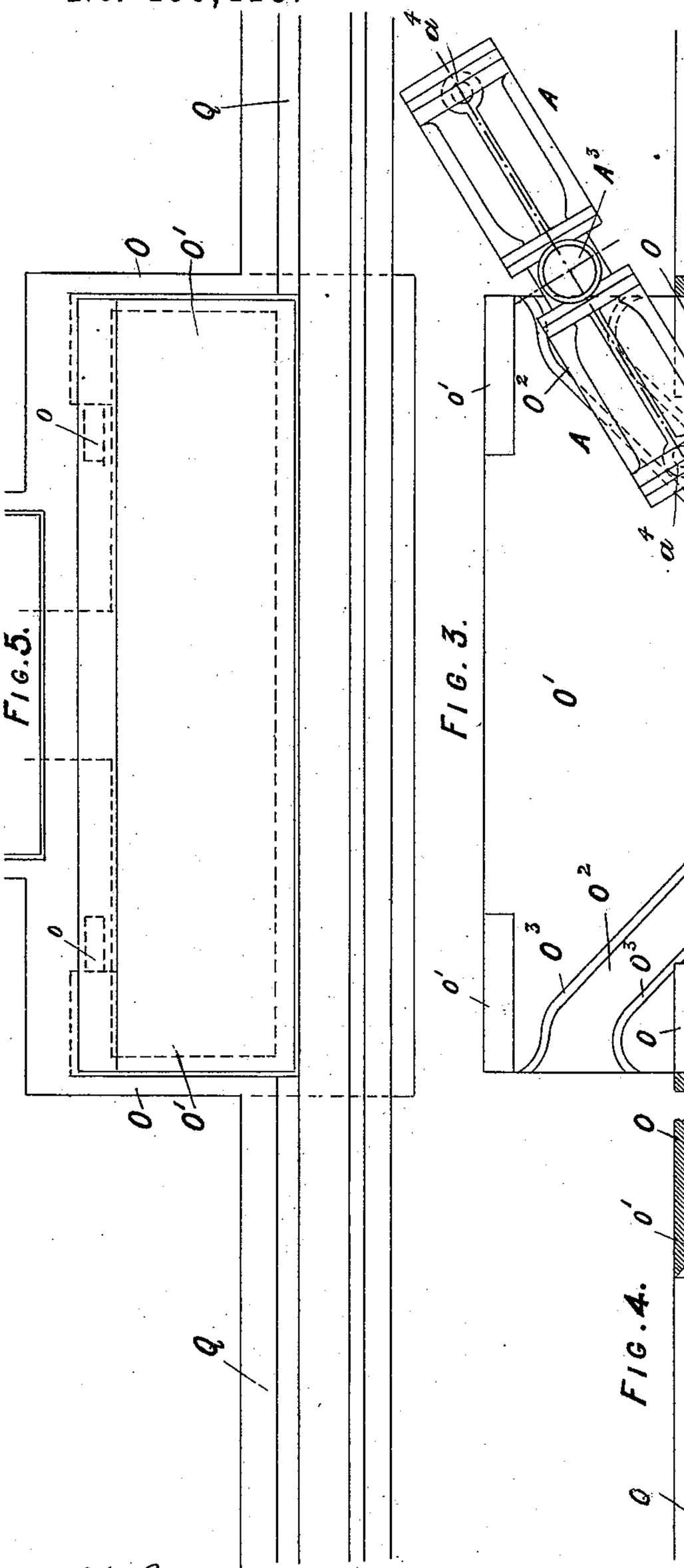

FIG. 5.

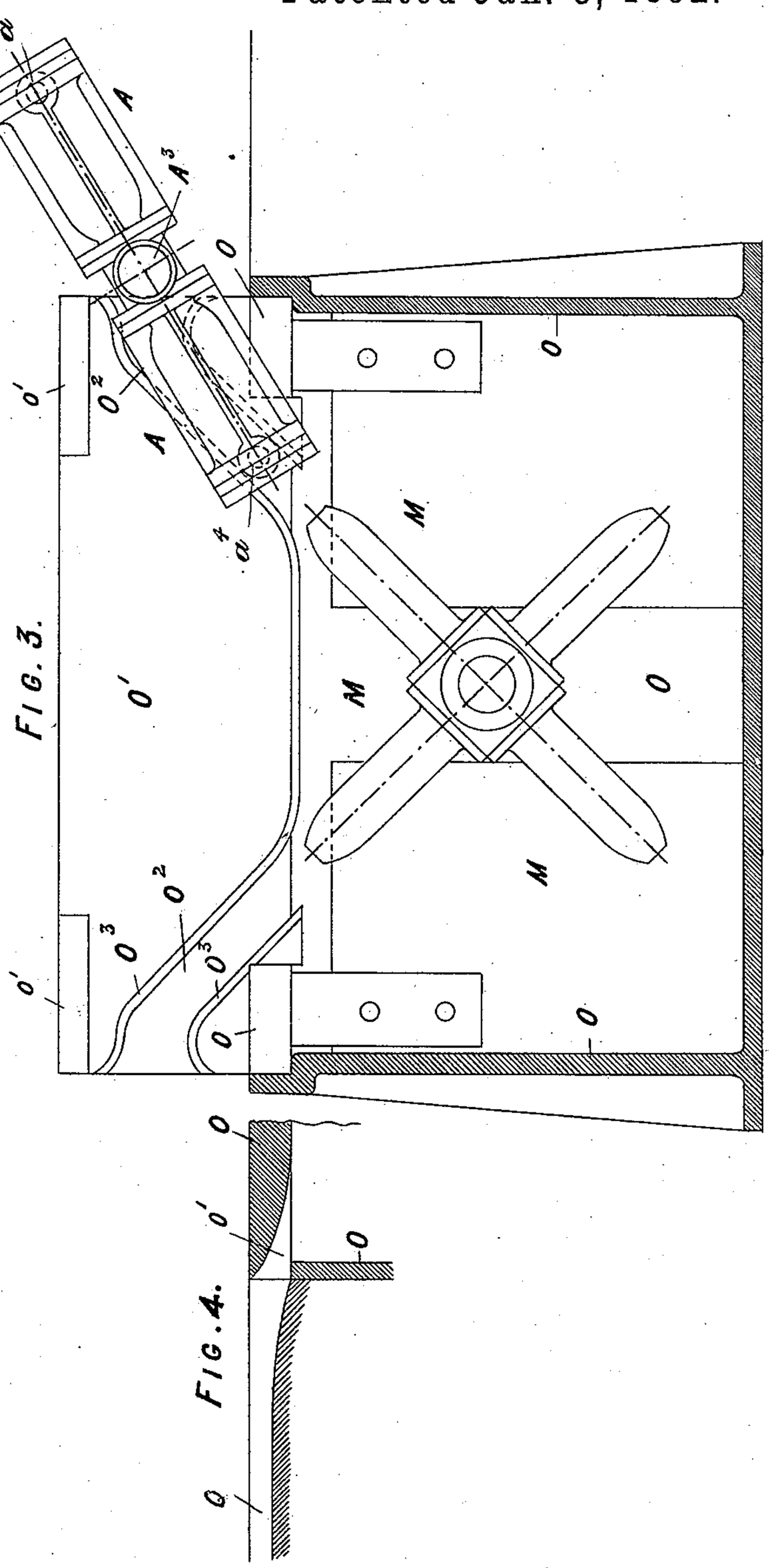

FIG. 3.

FIG. 4.

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PROPULSION OF STREET, TRAMWAY, OR OTHER RAILWAY CARS OR CARRIAGES.

No. 466,415. Patented Jan. 5, 1892.

FIG. 6A.

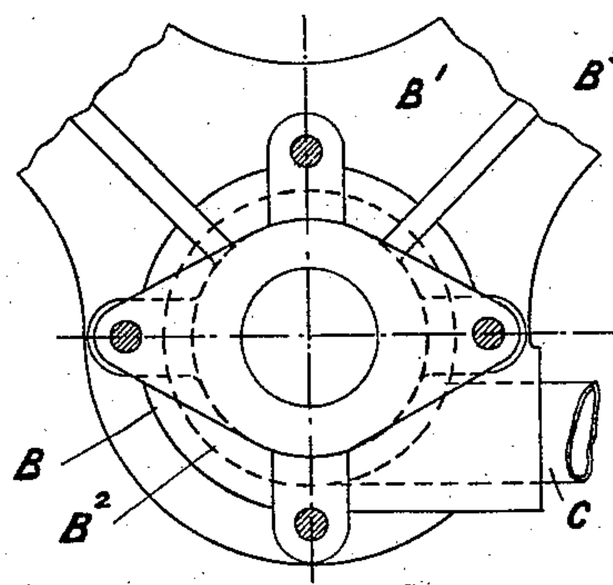

FIG. 6.

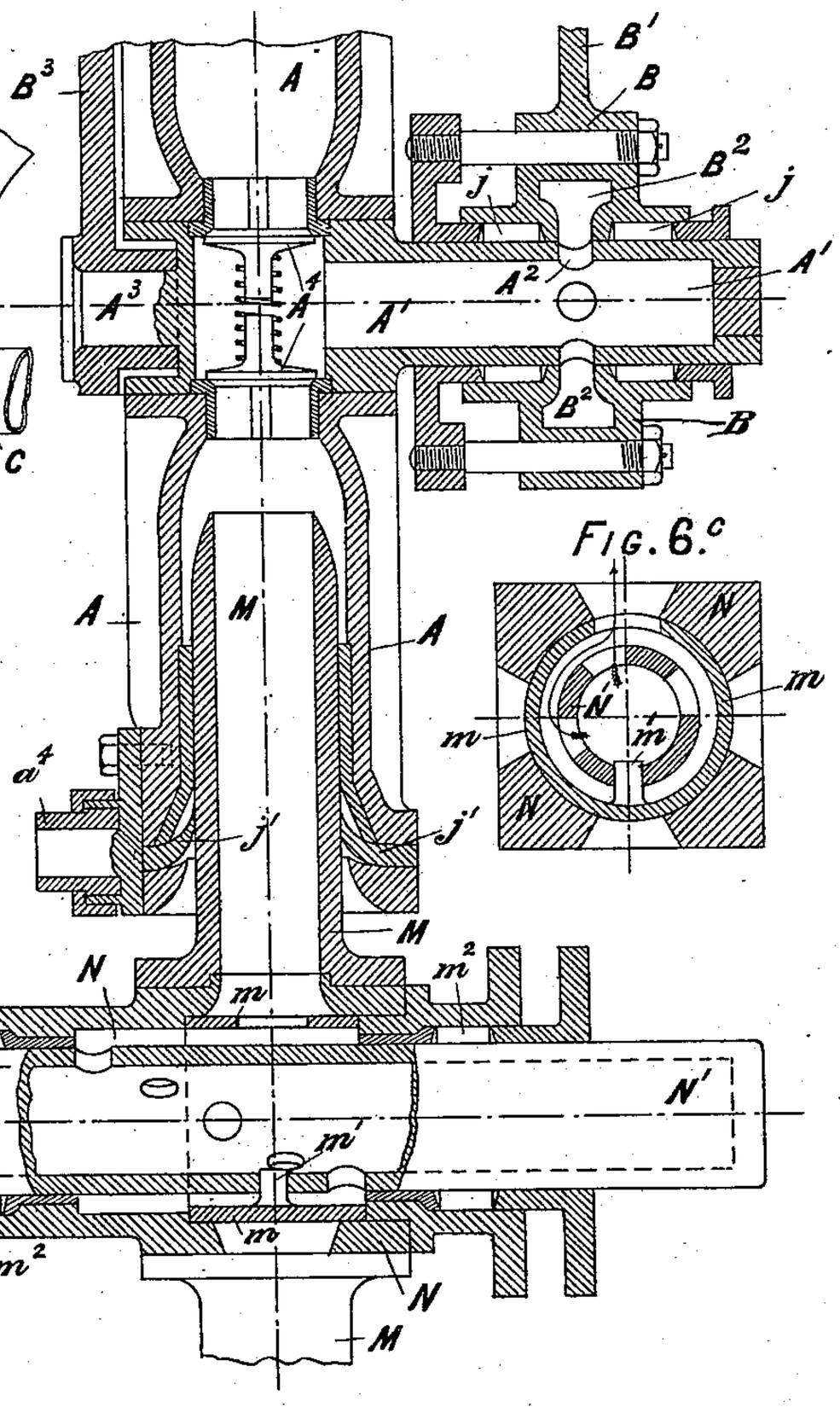

FIG. 6B.

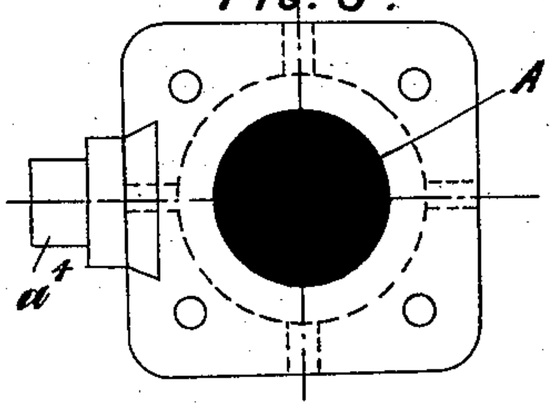

FIG. 6C.

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UNITED STATES PATENT OFFICE.

JOHN HUGHES, OF CHESTER, ENGLAND.

PROPULSION OF STREET, TRAMWAY, OR OTHER RAILWAY CARS OR CARRIAGES.

SPECIFICATION forming part of Letters Patent No. 466,415, dated January 5, 1892.

Application filed September 25, 1889. Serial No. 325,017. (No model.) Patented in England November 22, 1888, No. 16,991; in France July 26, 1889, No. 199,833; in Belgium July 27, 1889, No. 87,168; in Italy July 30, 1889, XLI, 383; in Germany August 24, 1889, No. 51,397; in Spain October 28, 1889, No. 9,884, and in Austria-Hungary February 17, 1890, No. 32,401 and No. 62,476.

To all whom it may concern:

Be it known that I, JOHN HUGHES, a subject of the Queen of Great Britain and Ireland, residing at Chester, in the county of Chester, England, have invented new and useful Improvements in and Connected with the Propulsion of Street, Tramway, or other Railway Cars or Carriages, (for which I have obtained Letters Patent in Great Britain, No. 16,991, dated November 22, 1888; in France, No. 199,833, dated July 26, 1889; in Belgium, No. 87,168, dated July 27, 1889; in Germany, No. 51,397, dated August 24, 1889; in Austria-Hungary, No. 32,401 and No. 62,476, dated February 17, 1890; in Italy No. XLI, 383, dated July 30, 1889, and in Spain, No. 9,884, dated October 28, 1889,) of which the following is a specification.

This invention mainly relates to those systems of propelling street-tramcars and other railway-cars in which compressed air is the motor-fluid used and wherein such compressed air is "laid on" in pipes or conduits along the route in contiguity to the track and the air used by the motors is supplied to their reservoirs for feeding the motors at certain points along the said route.

In applying compressed air to the above purpose it has heretofore among other modes been proposed to store up the compressed air in reservoirs or receivers carried on a separate locomotive-engine or on a special form of car at a sufficiently high pressure to last out the whole journey and back to the starting-place, or to lay a continuous air-main along the route provided with valves at frequent intervals, from which the reservoirs on the car are recharged, when necessary, by stopping the car close to the nearest valve and making connection between the reservoirs and the main by means of a flexible pipe, the reservoirs so charged and the valves being then closed and the pipe disconnected by an attendant on the car.

The mode or system of operating or working tramway-cars and other railway cars or engines and the means and mechanisms or apparatus employed therein involving my invention consist as follows:

The mode of operating the tram or other cars or carriages consists in making connections between the air conduit or main and the air-reservoirs of the car or engine and charging or replenishing the reservoirs from the compressed-air conduit at points at certain intervals apart along the route, and then breaking such connections, the making or breaking connection being effected by the motion of the car itself. It will therefore be seen that instead of having to stop the car at the charging-valves and make and unmake connection with the air-main by hand we effect such connection or break it automatically—*i. e.*, by the action or movement of the car. By these means the loss and inconvenience of frequent stoppages to make connection by hand in order to recharge the reservoirs is avoided, the car being thus enabled to run its course, picking up the compressed air for the replenishing of the receivers on its way as required. The means by which these operations are effected consist of automatic connecting and disconnecting devices, one of which is placed and works on the car and communicates with the reservoir and the other is placed on the air main or conduit. These two devices are so formed and operate that they form a substantially air-tight connection when connected with each other. At certain intervals along this air-main we provide devices provided with valves, which for convenience of description we hereinafter call "supply" devices. Upon the car or in connection with the receivers, which are attached to or form a part thereof, we also provide devices provided with valves which we call "receiving" devices. These devices are so constructed that as the car continues running the receiving devices may be caused at the will of the driver to engage with the supply devices and so form a temporary connection between the air-main and the receiver, disengaging themselves immediately afterward as the car moves forward. One form of apparatus by which this connection is or may be made consists of a hollow trunk or trunks, say, of cylindrical form, one or more of such trunks being arranged on or in connection with the compressed-air conduit, that or those on the car or engine and that or those arranged in con-

nection with the air-conduit being so constructed that it or they can slide upon or within the other and so disposed and arranged relatively to each other that while the car is in motion this sliding connection is first made and then broken or unmade. The trunks would be made or mounted in such a manner that they may adjust their altering relative positions or inclinations themselves during the action of making and breaking connection, said alteration of position being due to the movement of the car or engine. Both the trunks on the car or engine and those in connection with the air-conduit would also be provided with suitable valves operated automatically by the connecting-trunks or by the movement or the car or other suitable means, by which direct connection would be formed between the conduit and the reservoirs.

For street or road tramways it is necessary that the air-mains and supply devices should be so arranged as not to interfere with the other traffic on the roadway, and to effect this we therefore lay the air-mains below the surface of the street and covered on and by the road metalling, and we place the supply devices in boxes or chambers sunk below the level of the street and closed by lids level with the street, and we cause these lids to be automatically opened by the car in passing to enable it to make connection with the supply device below. These lids are raised by means of a device such as a "scoop" carried on the car and suitably shaped, say, somewhat after the manner of a plowshare, and so arranged that it can be lowered as the car approaches the box containing the supply device. The scoop enters and inserts itself under the lid, and raises it as the forward movement of the car drives the scoop farther under the lid until the box is fully opened. The lid is then retained in its open position during the passage of the car by a light bar or bars or other device carried along the car, and drops back into its shut position as soon as the car passes clear.

Instead of the car-trunk device being operated as just described, it may be a fixture below the car, in which case it would be arranged to run in a gutter by the rails, and the supply device would be arranged horizontally on the air-main.

In cases where the nature of the route allows it the supply-valves, instead of being placed in boxes underneath the roadway, may be fixed in boxes at the side, or on elevated pillars with arms projecting far enough to reach the receiving-valves placed near the top of the car.

Having thus specified generally the nature and effects of the invention, I will now proceed to describe it with reference to the accompanying drawings, which illustrate examples of apparatus according to the invention, and show means for carrying the invention into practical effect as an ordinary tramway, such means at the same time constituting examples of apparatus constructed and adapted to operate according to the invention.

Figure 1 is an elevation, and Fig. 2 a cross-section, showing a part of a tramway-car with details of the automatic connecting compressed-air-supply mechanisms. Figs. 3, 4, and 5 show in sectional elevation and plan further details of the automatic connecting mechanisms shown in Figs. 1 and 2; and Figs. 6, 6^A, 6^B, and 6^C are details of same to a larger scale.

With reference to the drawings, *a* are the side-frame members of the car, consisting of tubes.

b are tubular vessels placed underneath the car and surrounding the axles *c* of the wheels *d*, the axles *c* passing through internal tubes *b'* and having clearance for the rise and fall of the car on its springs. These vessels *b* form annular reservoirs round the axles and are connected together by tubes b^2 at right angles to them, and they may also be connected with tubes extending under the end platform of the car.

e is the engine for driving the car. It is of the revolving type, such as "Riggs's" or "Wilson's" revolving engine. The engine *e* works a shaft *e'*, carried across the car and geared to the two axles *c* by chain and chain-wheels *f*. The engine is a reversing one, regulating-levers being connected to levers fixed on the platforms of the car at both ends, so that the engine can be controlled from either end thereof.

Referring to Figs. 1, 2, 3, and 6, A is a hollow trunk of duplex form and adapted to move about its axis and engage automatically with the device M, hereinafter described. B is a bearing supported by the bracket B' to the body of the car, and B^3 is a bracket in which, respectively, the hollow trunnion A' and the solid journal A^3 of the receiving device A are placed and work. B^2 is an annular passage in the bearing B, communicating with the interior of the hollow trunnion A' by ports A^2 in said trunnion, and C is the pipe, which communicates between the passages B^2 and the air-reservoir at any suitable point. M is the supply device with which the trunks A engage automatically, and consists, mainly, of four hollow pistons mounted on the hollow body N, which is adapted to revolve upon the hollow trunnion N'. O is a box, the upper surface of which lies even with the surface of the street. P is the compressed-air main. P' is the pipe communicating between the main P and the trunnion N', and P^2 is a stop-valve on said pipe P'. D is a scoop device adapted to engage with and open the door or lid O' of the box O, and is hinged to the plate D', which is supported to the body of the car by brackets E', said scoop being operated by the lever F and rod F' from the car-platform. A scoop D, plate D', bracket E', and lever and rod F and F' are provided in double-ended cars in duplicate—that is,

on each half of the car—as in Fig. 1. The plates D′ support brackets E, which in turn support the bracket B^3 for receiving the journal of the receiving device A. The lid O′ is hinged at *o* and is provided with channels O^2, formed by projecting bars O^3, which are adapted to receive the rollers a^4 on the trunk A and guide the same. Q is a grooved rail provided for a certain distance on each side of the box O, in which the toe of the scoop D slides as it approaches the box O, the door of which is cut away at its leading edges at *o′*, Figs. 4 and 5, to receive the toe of the scoop.

The detailed construction of the receiving and supply devices A and M are shown in Figs. 6, 6^A, 6^B, and 6^C, and Fig. 6 shows these devices engaged with each other and in the position in which communication is formed between the air-main P and the car-reservoirs. In the position shown in Fig. 3 no air can flow from the main up the arm M—that is, it is cut off. This cutting off and supply is effected by the movement of the device by means of the valve *m*, in which a port is provided in the top, (see Figs 6 and 6^C,) so that as soon as the openings of the arms M come opposite the valve openings or port by the rotation of the device upon the trunnion N′, air is admitted to said arms and upon a further movement is cut off. The valve *m* is fixed by the pin *m′*, and the joint between the body N and the trunnion N′ is kept air-tight by the packing m^2. The trunnion A′ of the device A is made air-tight with the socket or bearing B by packings *j*, and air is prevented from escaping by way of the device from the pipe C and reservoir by the non-return valves A^4. The joint between the arms and the trunks A is effected by a cup-leather *j′*.

In the operation of charging the reservoirs of the car the scoop D is lowered by the lever F just before the car arrives at the box O into the groove of the rail Q, (this being done by placing the lever F into the position shown in Fig. 1,) and as the nose of the scoop D becomes inserted within the cut-away portion *o′* of the lid O′ and presses against the metal of it, it is raised as the car moves forward and assumes the position shown in Fig. 2. In this position the lid O′ is held by the bar D′ until all the operations presently described are completed, when it falls down of itself and closes the box. In the open position of the lid O′ the rollers a^4 of the trunks A will lie in line with the entrance of the channel O^3 of the lid and will enter same; and as the car moves still farther forward the trunk A is, owing to the channel O^3 and roller a^4, caused to move about its axis and to assume the position shown in Fig. 3, and eventually to engage with one of the arms M, the axis of which lies in line with the direction of the channel O^3 when the lid is up. The receiving and supply devices A M having become engaged with each other, the continued movement of the car forward will cause the device M also to move about its axis, and in so doing admitting air to and allowing it to flow from the main P up one of the arms M, and so on past the valve A^4 of the trunk A into the car-reservoir. If a number of trunks A—say three—be provided on a car or the supply devices M be placed sufficiently frequently along the route, or the size of the air-passages of these devices be made large enough, or any combination of these things be provided, the car may be charged with compressed air without stopping at all; but if the desired volume and pressure of air cannot flow quickly enough from any cause while the car is in motion, then it must be stopped, and at a point when the devices A and M are in about the position shown in Fig. 6.

In the action of breaking the connection of the devices A and M the roller a^4, which entered the leading channel O^3 when making connection, now passes upward through the channel at the opposite end of the lid O, and in so doing causes the arms M to be left in the correct position for another engagement—namely, that given in Fig. 3. This roller and guide also brings the device A into the position shown in Fig. 1, in which position they are locked by the spring-retained catches l^3, which fit in the mouth of the hollows of the trunks A, and so arranged that they are easily pressed back when the rollers a^4 enter or leave the guides O^3. After the device A and the scoop D are clear of the door O′ the door O′ falls down and closes the box.

Having now particularly described and ascertained the nature of this invention and in what manner the same is to be performed, I declare that what I claim in respect of the herein-described invention is—

1. The combination of a conduit-pipe or air-main located along a line of railway-track, said conduit-pipe being provided at intervals with stationary multi-trunked valved air-supply devices, with a traveling vehicle upon said track, and a rotary multi-trunked and valved air-receiving device or connection-wheel carried by the vehicle, said supply and receiving devices adapted to make and break an automatic telescopic and air-tight connection with each other while the vehicle is in motion.

2. The combination of an underground conduit-pipe or air-main located along a line of railway-track, said conduit-pipe being provided at intervals with stationary multi-trunked valved air-supply devices, with an opening through the pavement to said air-supply devices, a lid adapted to cover said opening, a car or locomotive, and means on the car adapted to raise said lid as the car passes over said opening.

3. The combination of a conduit-pipe located along a line of railway-track, said conduit-pipe being provided at intervals with a series of valves, with a traveling vehicle upon said track, a motor carried upon and having driving connection with the track-wheels of the vehicle, a reservoir carried by the vehicle

and having connection with the motor, a rotary multi-trunked and valved air-receiving device carried from the bottom of the car and having connection with the reservoir, said rotary multi-trunked and valved air-receiving device being adapted to make and break connection with the valves of the conduit-pipe while the vehicle is in motion, substantially as specified.

4. The combination, in a railway system, of a conduit-pipe located underneath the street-surface along a line of railway, said pipe being provided at intervals with a series of valves, an opening through the pavement to said valves, lids adapted to cover said opening, and a foot depending from a moving car and adapted to open said lids as the car passes over said opening, substantially as specified.

5. In combination with the underground air-main of a pneumatic railway, valved devices for charging the cars or locomotive with air from said main, movable covers for said devices, means for operating said covers, and means borne upon said covers for guiding the air-receiving devices of the car or locomotive into engagement with said valved charging devices, substantially as set forth.

6. In combination with the underground air-main of a pneumatic railway, valved devices for charging the cars or locomotive with air from said main, movable covers for said devices, means borne upon said covers for guiding the air-receiving devices of the car or locomotive into engagement with said valved charging devices, a car or locomotive carrying valved devices for drawing air from said valve-charging devices, and a device for opening said covers, substantially as set forth.

7. The combination of a surface railway, an underground compressed-air main, valved devices located at intervals along said main and below the street-surface for supplying air to the cars, and movable covers located over said valved devices and provided with means for guiding the valved receiving devices of the car into engagement with said supplying devices, with a car or locomotive and a valved air-receiving device thereon, and means for operating the covers of the air-supply devices, substantially as set forth.

8. In a pneumatic railway, the valved air-supply devices located at intervals along the line and having covers provided with guiding devices located contiguous to said supply devices for moving the air-receiving devices of the car into junction with said supply devices, in combination with means for operating said covers, and a movable valved air-receiving device carried by the car or locomotive and acted upon by said guiding devices, substantially as set forth.

9. In a pneumatic railway, the valved air-supply devices located at intervals along the line and guiding devices located contiguous to said supply devices for moving the air-receiving devices of the car into junction with said supply devices, in combination with a rotatable trunked valved air-receiving device carried by the car and acted upon by said guiding devices, substantially as set forth.

10. The pneumatic railway consisting of a track, a compressed-air main provided at intervals along the line with a series of rotatable multiple-trunked air-supply devices mounted upon axes and located under the track, in combination with a car having a rotatable duplex-trunked valved air-receiving device adapted to connect with said air-supply devices and carried upon the under portion of the car, substantially as described.

11. The combination of the movable trunked air-receiving device A, borne by the car and provided with rollers a^4, with the air-supply devices and the covers for the same, said covers having channels O^2 to receive and guide said rollers a^4, substantially as set forth.

12. The combination, with the grooved rails and the covers O′, having their leading edge cut away, of the scoop D upon the car, substantially as set forth.

13. In a pneumatic railway, the combination of an underground air-main, a stationary multi-trunked valved air-supply device connected with the air-main, a box in which said air-supply device is located, a lid for said box, a car or locomotive, a multi-trunked air-receiving device on the car or locomotive adapted to have an air-tight telescopic engagement with the air-supply device, and means for raising the lid of the box from the car, substantially as described.

14. In a pneumatic railway, the combination of an air-main, a multi-trunked and valved air-supply device connected with said air-main, a car or locomotive provided with air-reservoirs, and a rotary multi-trunked and valved air-receiving device carried by the car or locomotive, said supply and receiving devices adapted to have an automatic telescopic and air-tight engagement with each other, substantially as described.

15. In a pneumatic railway, the combination of an underground air-main, an underground multi-trunked and valved air-supply device connected with said main, a box inclosing said air-supply device, a hinged lid for said box, a car or locomotive having a scoop to raise said lid, a rotary multi-trunked and valved air-receiving device carried by the car, rollers on said receiving device, and guides on the lid of the box to cause the air-receiving device to be automatically engaged with and disengaged from the air-supply device, substantially as described.

16. In a pneumatic railway, the combination, with the air-reservoirs *b* of a car, the rotary multi-trunked air-receiving device A, having a hollow trunnion A′, provided with ports A^2, the annular passage B^2, communicating with said ports and having a pipe C, leading to the air-reservoir *b* on the car, of

the rotary multi-trunked air-supply device M, and an air-main P, connected with said supply device, substantially as described.

17. In a pneumatic railway, the combination of the air-main P, the box O, having lid O′, the multi-trunked and valved air-supply device M, located in said box and connected with the air-main, a car provided with the rotary multi-trunked and valved air-receiving device A, adapted to have an automatic telescopic engagement with the air-supply device, the scoop D, carried by said car to raise the lid O′, and levers for operating said scoop from the car, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN HUGHES.

Witnesses:

FRED MOODY,

ARTHUR H. DAVIES,

Clerks to Messrs. Parry, Gannon & Farmer, Solicitors and Notaries, Chester.