No. 656,697. Patented Aug. 28, 1900.

A. MALLET.

FOUR CYLINDER LOCOMOTIVE ENGINE.

(Application filed Jan. 9, 1900.)

(No Model.) 3 Sheets—Sheet 1.

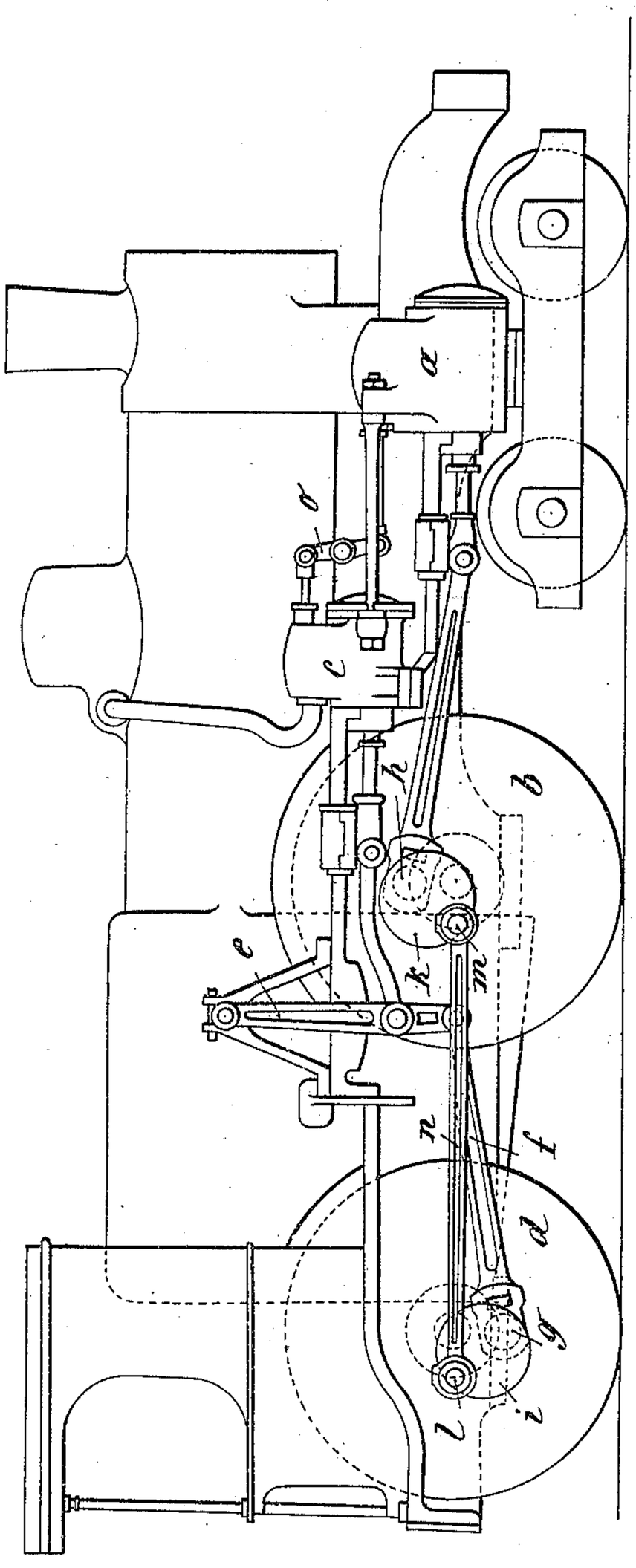

FIG. 1.

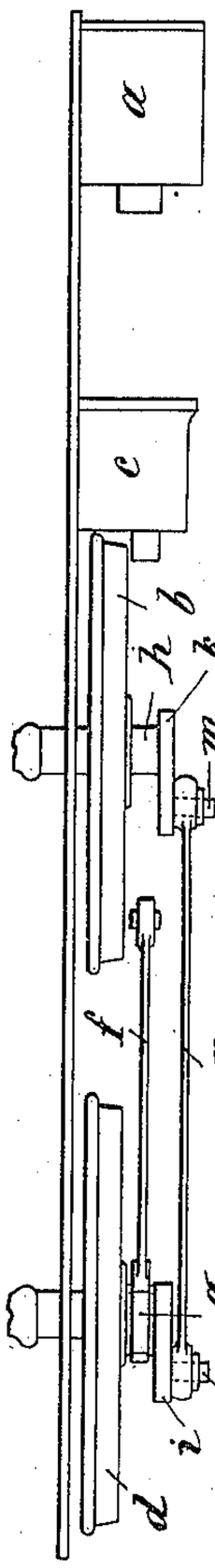

FIG. 2.

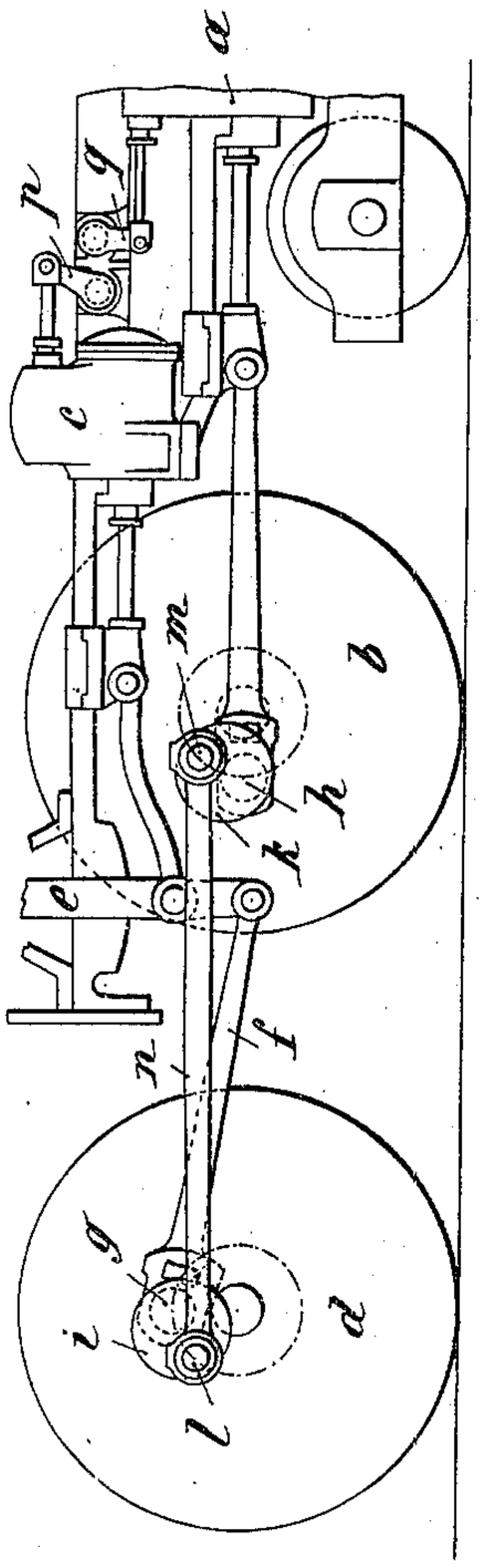

FIG. 3.

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FIG. 4.

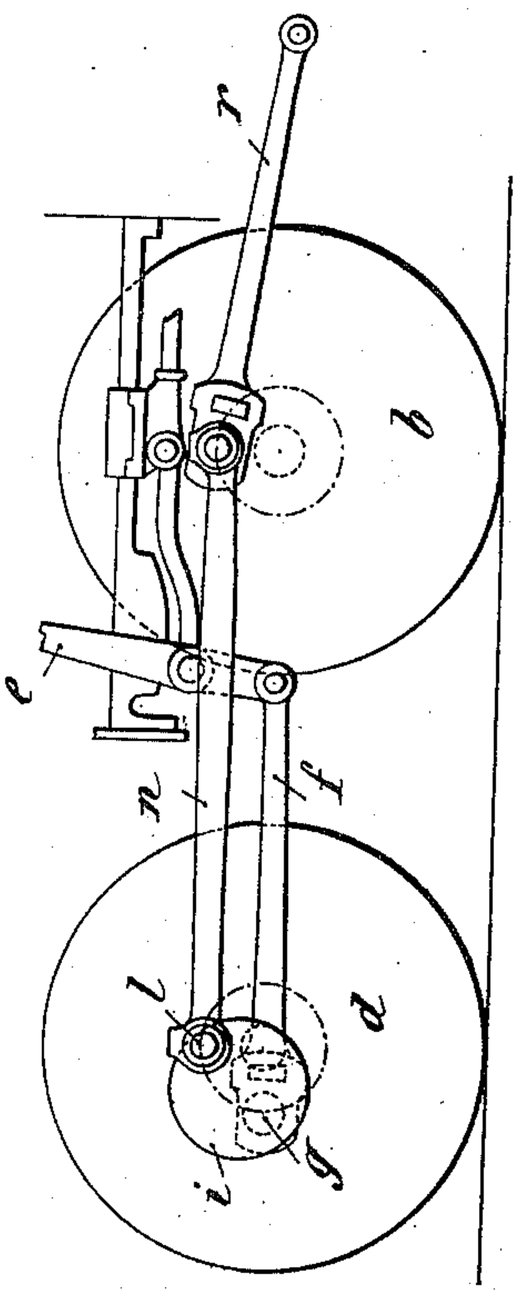

FIG. 5.

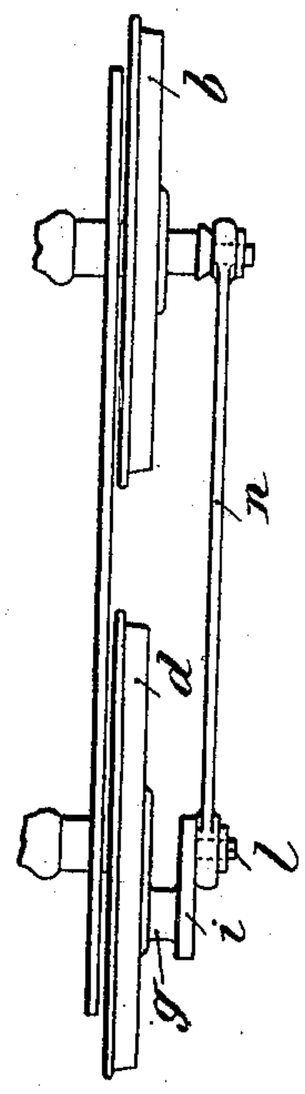

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FIG. 6.

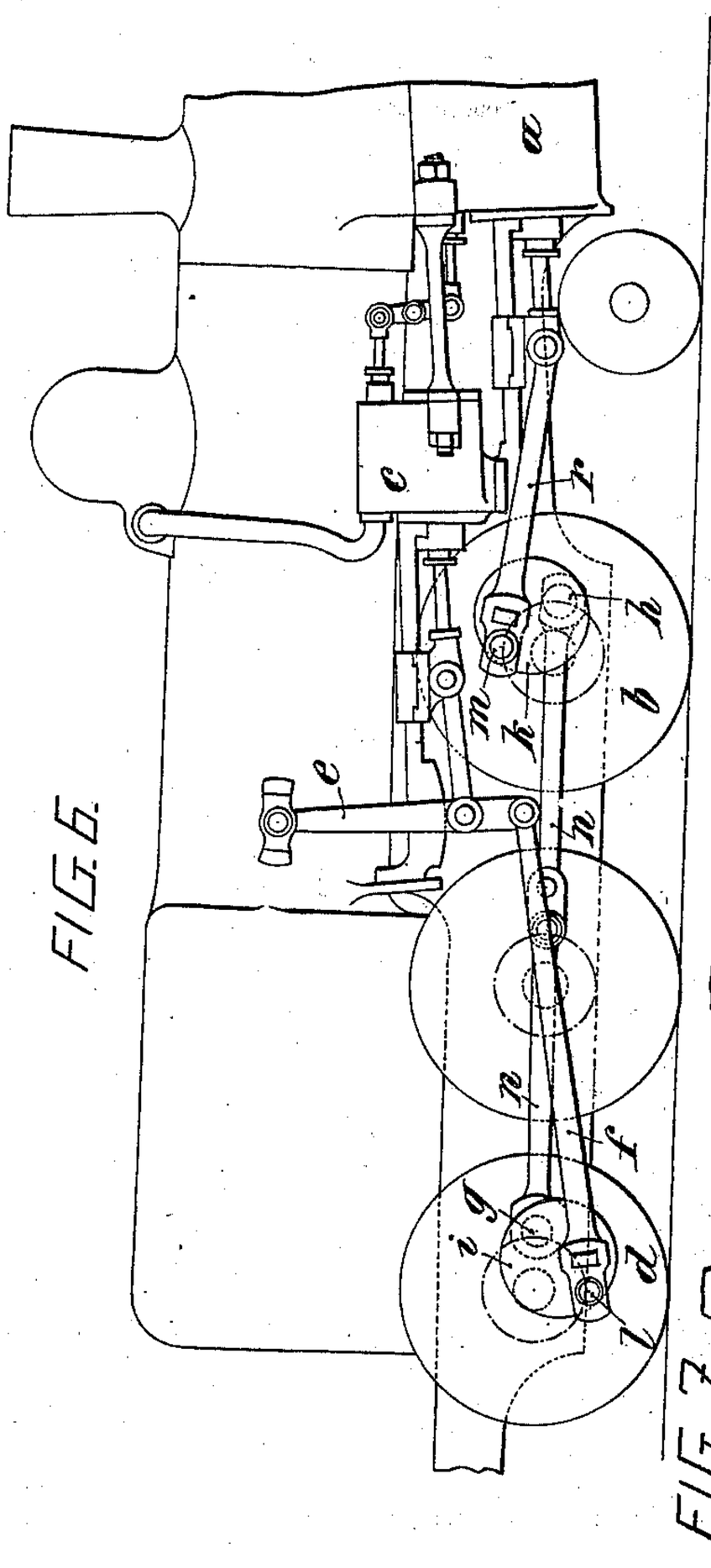


FIG. 8.

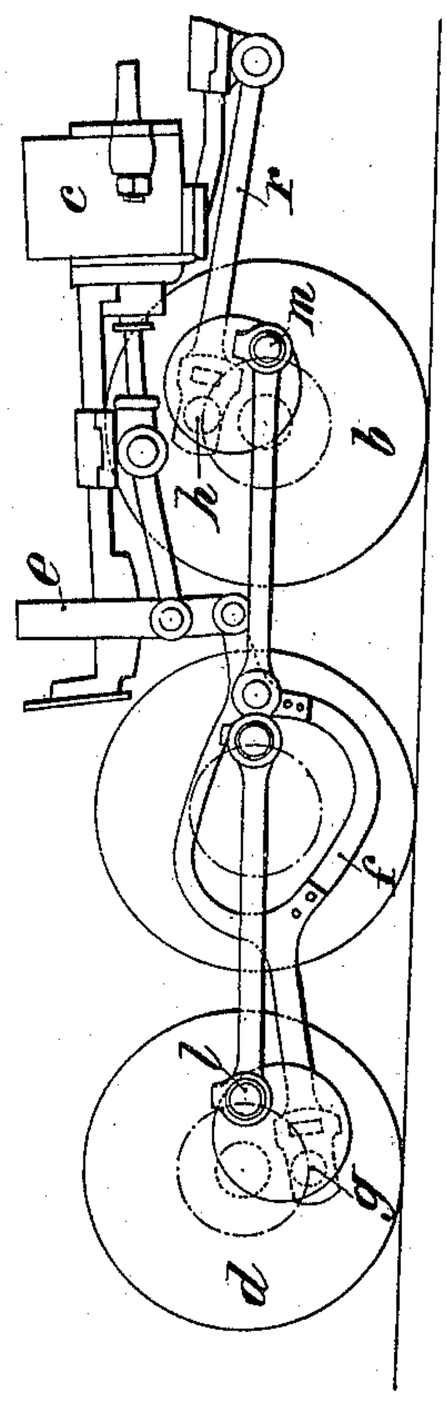
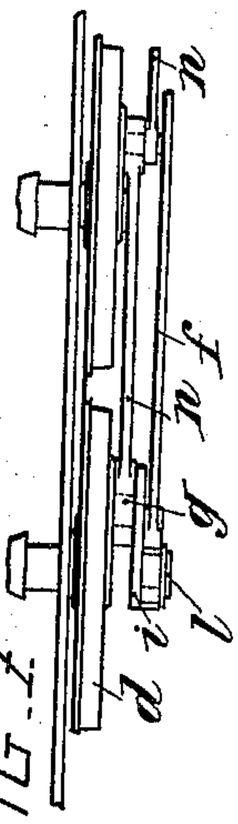


FIG. 7.



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UNITED STATES PATENT OFFICE.

ANATOLE MALLET, OF PARIS, FRANCE.

FOUR-CYLINDER LOCOMOTIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 656,697, dated August 28, 1900.

Application filed January 9, 1900. Serial No. 861. (No model.)

To all whom it may concern:

Be it known that I, ANATOLE MALLET, engineer of arts and manufactures, of 30 Avenue Crudaine, in the city of Paris, Republic of France, have invented an Improvement in Four-Cylinder Locomotive-Engines, of which the following is a full, clear, and exact description.

Compound locomotive-engines are now made, since several years, in which four cylinders are carried by a single frame in such a manner that two of the cylinders are placed inside, while the other pair is located outside. The use of inside or inner cylinders is inconvenient in many points, chiefly because it imparts the use of cranked axles. According to my present system all the cylinders of the locomotive are placed outside, and to this end I have invented some devices which I will describe in reference to the annexed drawings, in which the same letters of reference indicate similar parts in all the figures.

Figures 1 and 2 show an elevation and partial plan view of my invention as applied to a four-coupled-wheel engine with bogie-frame in front. Fig. 3 is a modified detail. Figs. 4 and 5 are detail views of modified arrangements embodying two axles. Figs. 6 and 7 are views showing this form adapted for three axles. Fig. 8 is a view of a still further modification.

The fore cylinders *a*, which are generally the low-pressure cylinders, are mounted in the usual manner and drive directly the front driving-wheels *b*, while the high-pressure cylinders *c*, mounted in front of the fore-coupled wheels, drive the aft driving-wheels *d* through the agency of a third-class lever *e* and a driving-rod *f*, which allow the cylinders to be placed above the level of the axles.

In Figs. 1 and 2 the crank-pins *g h*, placed on each side of the engine, are set to an angle of one hundred and eighty degrees to each other, so that the two pistons mounted on the same side of the engine are moved in opposite directions.

In Fig. 3 the corresponding crank-pins *g h* are set to an angle of ninety degrees. Of course any other angle may be used.

As shown in the drawings, the crank-pins carry secondary or outer cranks *i k*, which are represented under the form of circular disks, but might be made according to any other shape or pattern. The pins *l m* of these outer cranks are pivoted in the heads or blocks of the side rods *n*, and they are set to an angle of ninety degrees from the driving-pins when the latter are set to one hundred and eighty degrees from each other. These secondary pins are set to an angle of forty-five degrees from the driving-pins when these latter are set to ninety degrees from each other. It may be noticed at once that the advantages of such a disposition, comparatively, to the ordinary inner and outer cylinders are as follows:

First. The distance apart of the two coupled axles is decreased because the cranked axle is suppressed. The consequences of this reduction of distance, which may be stated to be about O^m40 or O^m45, are to decrease the weight and general bulk of the engine. Moreover, when the ordinary distance apart is maintained the length of the fire-box between the axles may be accordingly increased of O^m40 or O^m45. That corresponds to an increase of about $O^{m2}, 5$ of the grate-surface in the case of an ordinary track, $1^m, 45$ in width.

Second. Both axles are exactly similar in every respect, so that the number of patterns of interchangeable pieces is lessened.

Third. The axis of both cylinders on the same side of the engine being situated in the same vertical plane, the equilibrium or balance of moving parts is more easily realized.

Fourth. The delicate and costly cranked axle is suppressed.

I will remark that when the corresponding cranks of the coupled axles are set to either one hundred and eighty degrees or ninety degrees from each other the steam-valve motion may be highly simplified by employing only one driving mechanism on each side of the engine. For instance, with the one-hundred-and-eighty-degree cranks the slide-valve of the fore cylinder is connected with the slide-valve of the aft cylinder by means of a lever *o*, which causes these slide-valves to move in opposite directions, and only one of the cylinders bears a driving mechanism. With the ninety-degree cranks the slide-valve of the right fore cylinder is driven by the valve motion of the aft left cylinder, and

vice versa, through the agency of levers *p g*, mounted upon transverse shafts, as shown in Fig. 3.

When it is not desired to have two similar and interchangeable driving-axles, the construction of the engine may be greatly simplified by employing the disposition shown in Figs. 4 and 5. In this case only one of the axles is provided with secondary or outer crank-pins *i*, the side rod *n* and the driving-rod *z* being pivoted with the other crank on the same pin.

When the cranks are set to one hundred and eighty degrees or ninety degrees, the balance or equilibrium of the movable pieces will be realized by means of counterweights. This last device is more simple than the first-described arrangement; but its efficiency is not so great and it is not to be so highly recommended.

Of course the above arrangements, described as applied to two-coupled-axle engines, may be applied to three-coupled-axle engines, as shown in Figs. 6 and 7.

The drawings represent an engine in which the side rods *n n* bear upon the inner crank-pin *g h*, while the driving-rods *f r* bear upon the secondary or outer crank-pins *l m*. This arrangement allows the ordinary distance between the axis of the cylinders to be maintained. The driving-rods *f r* may also be connected with the inner crank-pins *g h*, as shown in Fig. 8; but in that case it is necessary to use in connection with the aft axle a link-shaped driving-rod *f*, which is not, however, seriously objectionable. All that has been stated above concerning the angle of the cranks, the valve motions, and the simplified arrangement in which only one axle with secondary or outer crank-pin is employed applies also in this latter case. Moreover, a fourth axle may be coupled with the aft driving-axle in order to obtain a four-coupled-axle engine, which may be applied in certain cases where a large distance between the axles is not an objection.

I claim—

In a locomotive with coupled axles, the combination of four cylinders, all placed on the outside and arranged in two groups, each arranged to actuate a different axle, the two cylinders at each side of the engine being arranged one before the other at different heights and having their axis on the same vertical plan, an ordinary pitman connecting the front cylinder *a* to its axle *b* and a connection from piston of the rear cylinder *c* to its axle *d* comprising a lever of the third order *e*, which brings the piston-rod of this cylinder over the revolving parts of the front driving-axle, while the two driving-axles at either side may have their cranks keyed at any position in relation to each other, as described.

The foregoing specification of my improvements in four-cylinder locomotive-engines signed by me this 29th day of December, 1899.

ANATOLE MALLET.

Witnesses:
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