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Railway-Signals.

No. 162,369. Patented April 20, 1875.

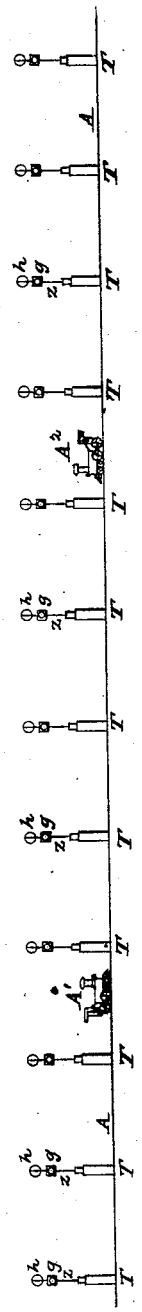

FIG. 1.

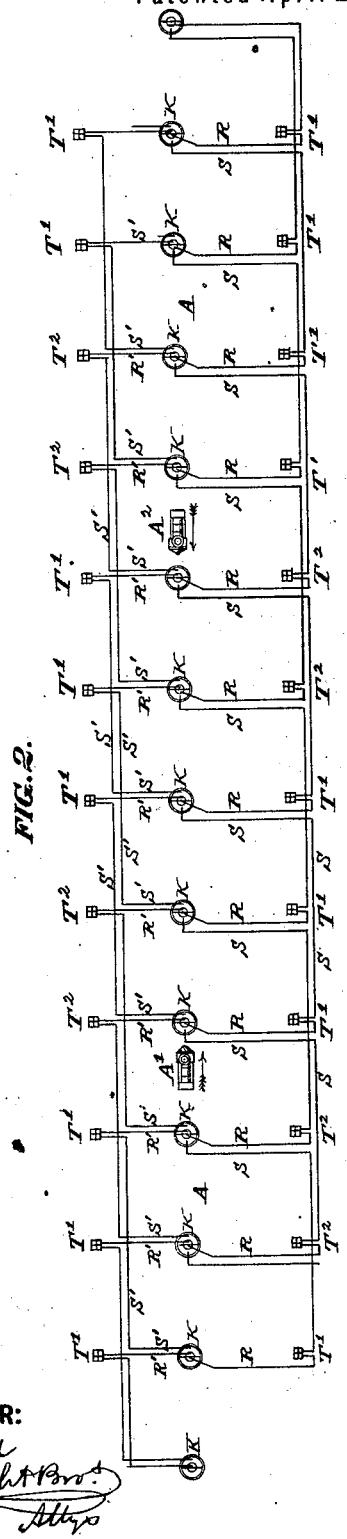

FIG. 2.

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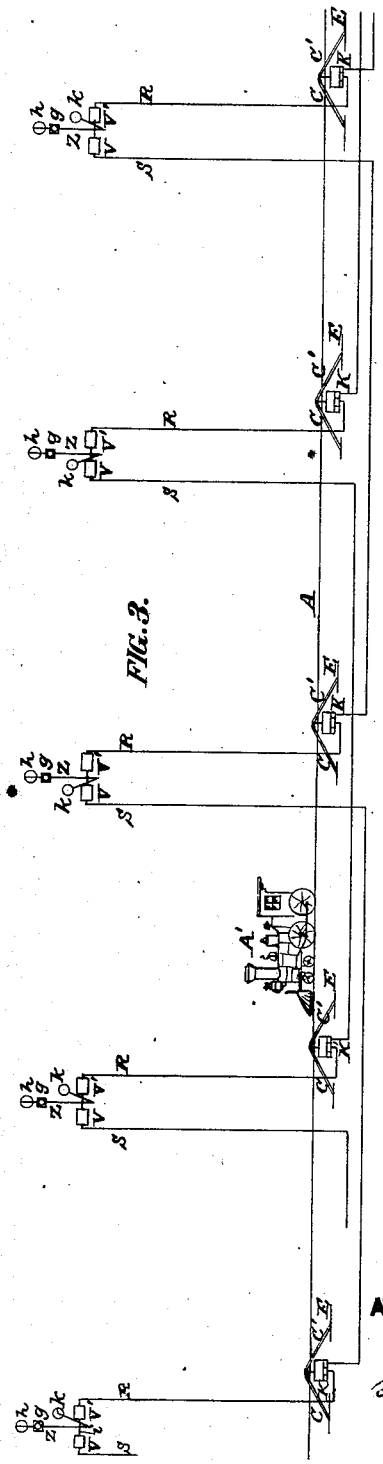

FIG. 3.

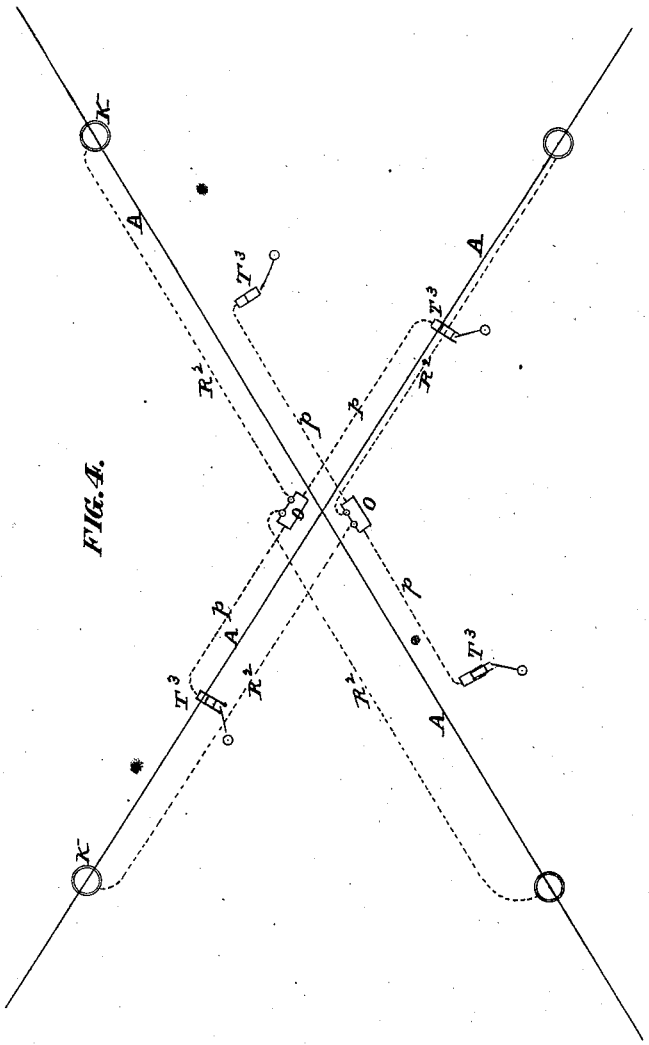

FIG. 4.

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FIG. 5.

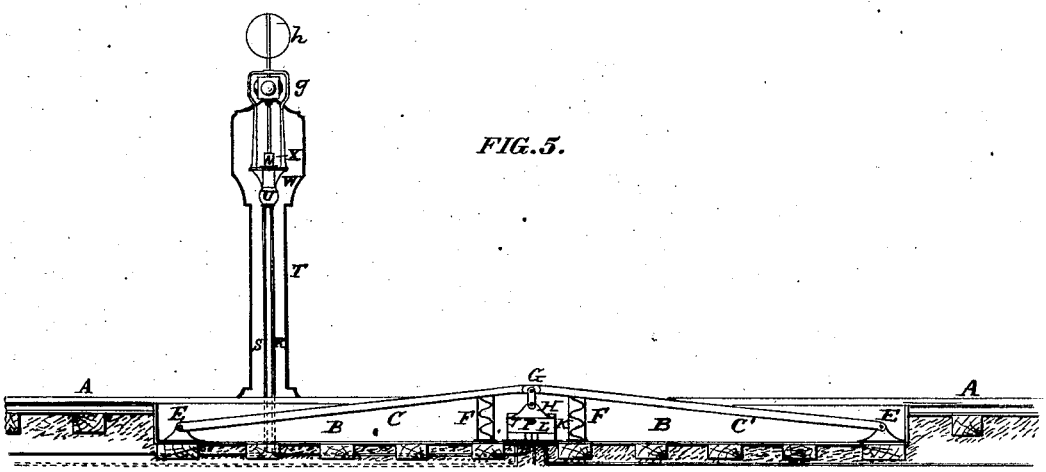

FIG. 6.

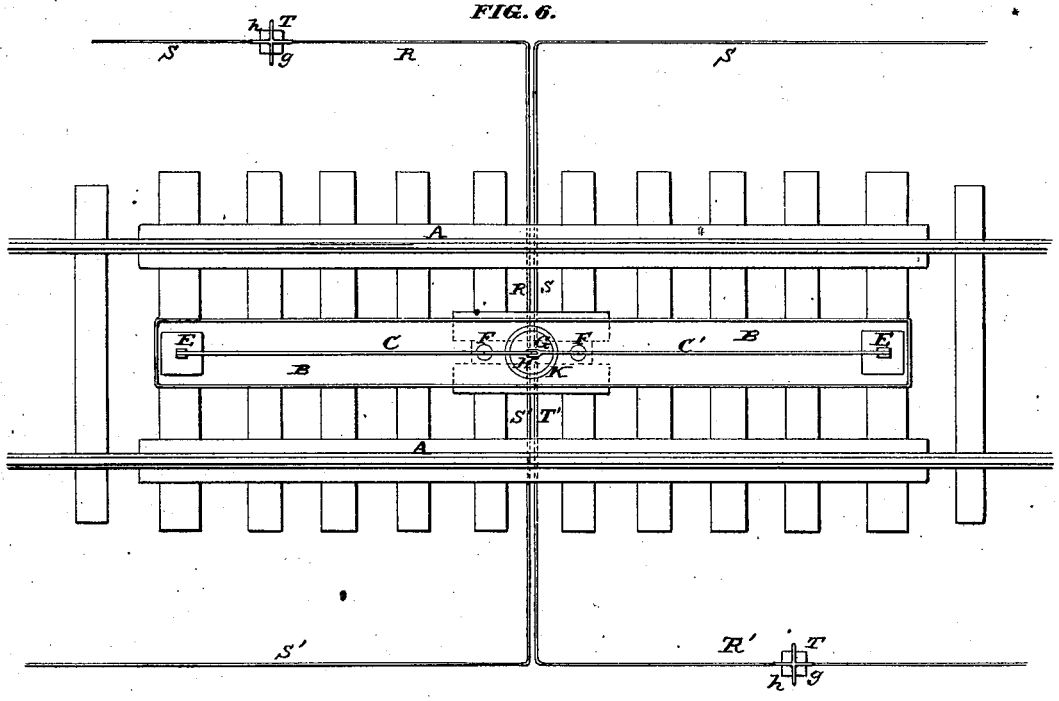

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FIG. 9.

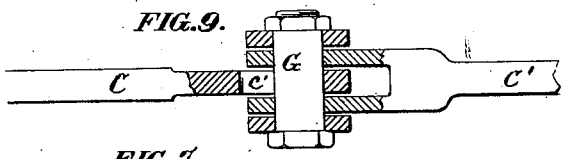

FIG. 7.

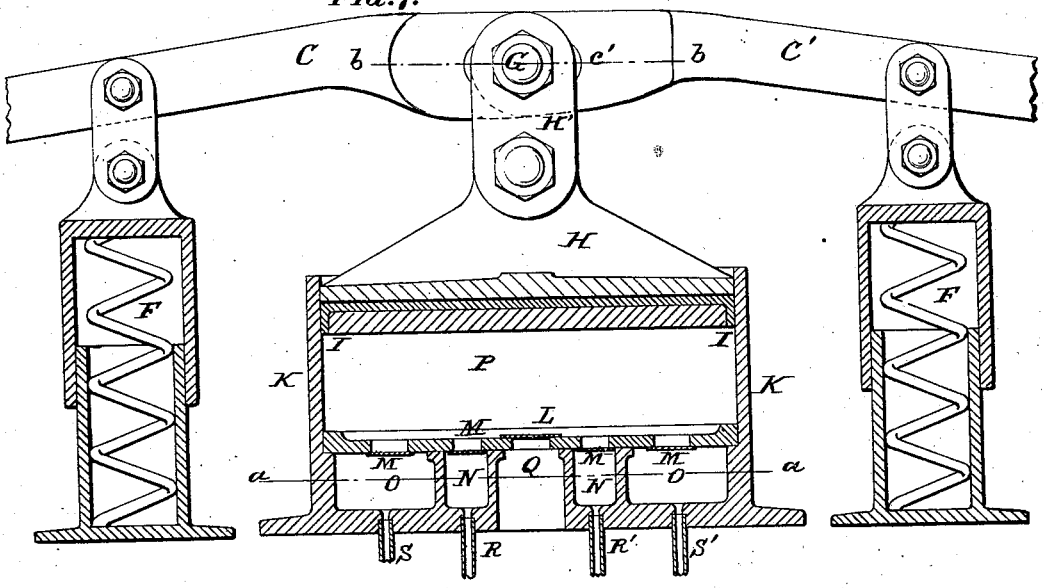

FIG. 8.

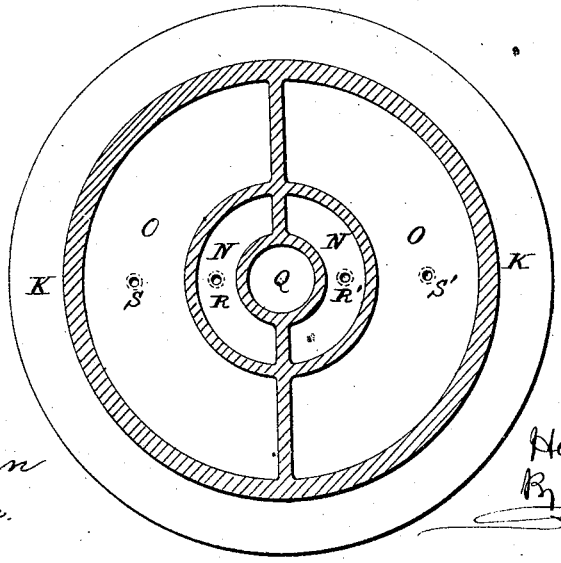

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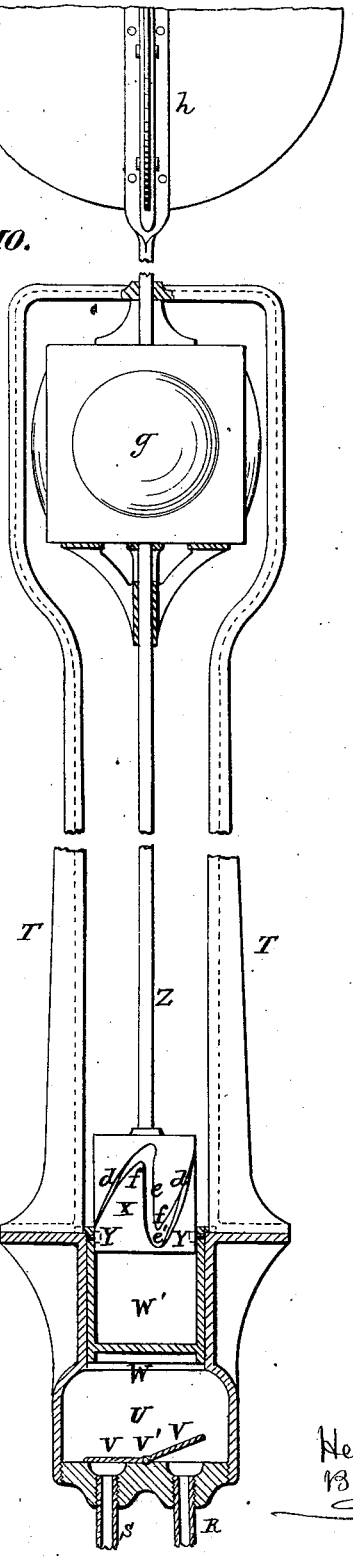
FIG. 10.



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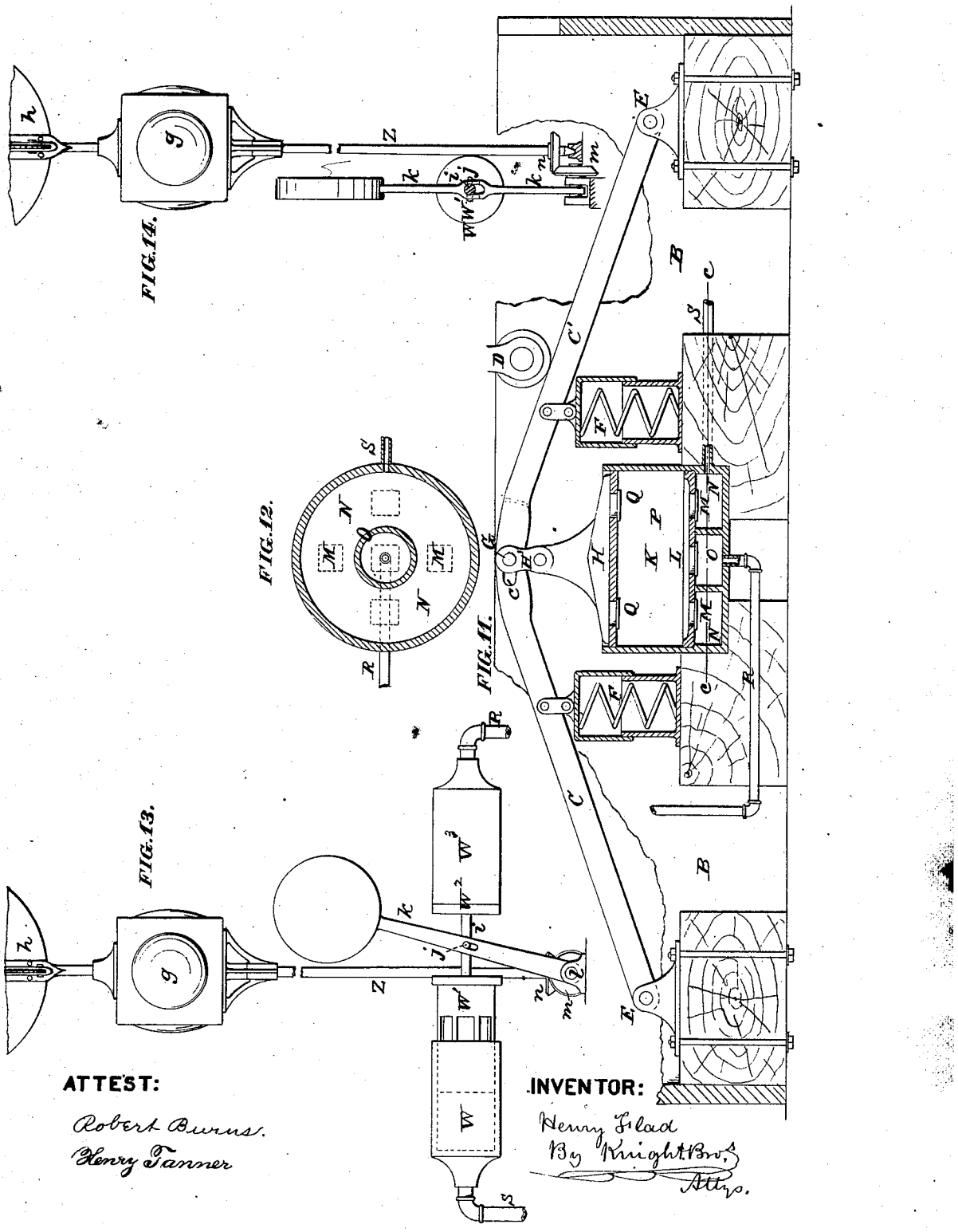

FIG. 14.

FIG. 12.

FIG. 11.

FIG. 13.

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UNITED STATES PATENT OFFICE.

HENRY FLAD, OF ST. LOUIS, MISSOURI.

IMPROVEMENT IN RAILWAY-SIGNALS.

Specification forming part of Letters Patent No. **162,369**, dated April 20, 1875; application filed Septemb r 8, 1874.

To all whom it may concern:

Be it known that I, HENRY FLAD, of St. Louis, St. Louis county, State of Missouri, have invented certain new and useful Improvements in Safety-Signals for Railways, of which the following is a specification:

My improvement consists in supplying a railway with signals placed at intervals along its sides, the said signals being so constructed as to be operated at a distance by a signalman, or by the passing train, in the manner hereinafter set forth.

For a double track, (where the trains only run in one direction on each track,) the signal abreast of the train is set to indicate danger, (to a train following,) and the signals are left standing at danger for a sufficient distance in the rear of the train, but are set to indicate safety, after the train has proceeded a given distance, by connection with the same mechanism by which the signals are set to indicate danger. At least one signal in condition indicating danger is at all times left to the rear of the train, the train reversing the second signal to its rear, so that in case of an accident between signal-stations the train following would have sufficient warning. For single-track railways, (on which the trains run in both directions,) the construction of the signal apparatus is such that upon each side, abreast of the engine, the signals are reversed by the passing train, and simultaneously the signal two stations ahead, upon the left side, is set to danger, while upon the right side the signal two stations to the rear is set to safety, so that a train either following or meeting the first will be warned about two stations from the train first mentioned. Thus, it will be understood, the train does not act on the signal at the station next in advance or to the rear, but upon signals more distant, so as to always leave at least one danger-signal in advance and one to the rear of the train, and at sufficient distance for warning to another train. This is what I denominate my system of overlapping signals, as the pipes or other means of communication, between the train and distant signals, overlap or run past each other, as is fully explained hereafter by reference to the diagrams.

In the drawings, Figure 1 is a diagram in elevation illustrative of the invention. Fig. 2 is a diagram in plan, illustrative of the invention, both as applied to a single track, (on which the trains run in both directions.) Fig. 3 is a diagram in elevation, illustrative of the application to a double track, (on which the trains run only in one direction on each track.) Fig. 4 is a diagram in plan, illustrating the manner of signaling for cross-tracks. Fig. 5 is a longitudinal section, showing the application of the device to a single track, and a plan of the same is shown in Fig. 6. Fig. 7 is an axial section through the air-pump and the springs, by which the plunger and levers are raised after depression. Fig. 8 is a horizontal section through the air-pump at line *a a*, Fig. 7. Fig. 9 is a section through the lever-hinge at line *b b*, Fig. 7. Fig. 10 is an enlarged sectional view of the signal proper and the preferred devices for turning the same. Fig. 11 is a vertical section through an air-pump, having only two air-chambers beneath the diaphragm. This form is applicable to each of the tracks of a double-track line, (on which the cars run in one direction only.) Fig. 12 is a horizontal section at *c c*, Fig. 11. Figs. 13 and 14 are diagrams, showing, respectively, a side and edge elevation of the local operating mechanism of the signal in a modified form.

A is the railway-track. C C′ are inclined levers, so placed as to be depressed by a roller, D, (see Fig. 11,) or other device secured to the locomotive A′ or some car in the train. The levers are inclosed in a box, B, having only sufficient opening at top to admit the roller by which the levers are depressed, the box preventing the accidental depression of the levers by a person stepping thereon or by other means than the said roller, or its equivalent appliance projecting from the train. The levers are fulcrumed at E, and beneath the levers are springs F, tending to raise them and hold them in their upper position ready for the impact of the said depressing device D, projecting from the locomotive or car. G is a cross-pin, secured in the ears at the end of lever C, and passing through the slot *c′* in the end of the lever C′, the pin working in

the slot as the levers rise and fall. The pin G is connected to the plunger H of an air-pump, of which K is the cylinder. The connection may be made by a link, H′. The plunger may have any suitable packing, I, to render it air-tight. L is a diaphragm supplied with valves M, opening downardly into separate air-chambers N O, or N N O O. The upper chamber P has valve-opening Q, for air-supply, either through the bottom, as shown in Fig. 7, or through the plunger, as shown in Fig. 9. R R′ are air-pipes, communicating with the chambers N N, and S S′ are pipes communicating with the chambers O O, these pipes leading to the signal apparatus.

I will first describe the devices by means of which the air passing through the pipes R S, &c., operates the signals, and then describe the course of the pipes from the air-pumps to the signals. T is the signal-post, that may be made the height of the eyes of the engineer, or have a greater elevation. R R′ S S′ are the air-pipes, extending from the air-pumps H K. These pipes discharge into the chamber U, forming the lower part of the cylinder W. The openings into the chamber U are covered by valves V V, connected together and set angularly with each other, as shown, so that the opening of one, by the passage of air, will close the other (the valves oscillating on a central hinge, V′.) In the cylinder W works a hollow piston, W′. This piston is open at top and forms a cylinder, in which is a turning cylindrical block or head, X, having upon its side a cam-groove, in which work studs Y (carrying anti-friction rollers) projecting inward from the inside of the piston W′. This cam-groove has inclined portions *d* and vertical portions *e*, the latter ending in a short incline, *e′*, just sufficient to carry the center of the stud Y past the corner *f*. The arrangement is such that at each rise of the piston W′ the signal-spindle Z shall receive nearly one-fourth of a rotation, (say, eighty degrees,) which one-fourth shall be completed by the passage of the stud Y over the incline *e′* to carry the point *f* past the center of the stud, so that on the next rise of the piston W′ the stud Y may pass up through the part *d* of the cam-groove, and again turn the signal-spindle Z in the same direction as before, (so as to reverse the signal.) This device is to convert the rectilinear motion in the piston W′ into rotary motion in the spindle Z. The device admits of various modifications; for instance, the cam-groove *d e e′* may be cut in the interior of the piston W′, and the stud Y project from the head X, or directly from the spindle Z. The spindle Z carries a lantern, *g*, with two red lights and two lights of another color placed alternately on the four sides of the lantern, (red opposite red,) in the usual manner, so that a one-fourth turn reverses the signal. Above the lantern is a target, *h*, having two disks at right angles with each other, so as to show alternately (as turned) red faces to indicate danger, and faces of another color to indicate safety, the color changing with each one-fourth rotation. The piston W′ should not be closely fitted in its cylinder, as there will be abundant supply of air to work it, and the surplus air escapes betwen the piston and the cylinder. After the piston has been raised, and as the air escapes, it settles down by force of gravity and is ready for another stroke.

Any suitable device may be used to prevent the rotation of the piston W^1, so that its action on the turning-head X shall be positive.

In Figs. 3, 13, and 14 is shown a modification of the local signal mechanism—that is, the mechanism through which the air acts on the signal. This mechanism is applicable where a double track is used, in which case the trains runs only in one direction on each track. In this modification the air-pipes R S enter, respectively, cylinders W and W^3, in which are pistons W^1 W^2, connected together by a rod, *i*, having a cross-pin, *j*, working in a slot in the weighted lever *k*, so that a pressure of air in the cylinder W pushes over the lever *k* to the right, and on the air being forced into the cylinder W^3 the lever is carried over to the left. This lever is supported on a rock-shaft, *l*, which forms its fulcrum, and which carries a bevel-wheel, *m*, engaging a similar wheel, *n*, at the foot of the spindle or staff, Z, so that, by the reversal of the lever *k*, the lantern *g* and target *h* of the signal-spindle shall receive a one-fourth rotation, so as to reverse the signals.

In Figs. 1 and 2 are exhibited the course of the air-pipes and the system of signaling. In these figures the signals standing in position indicating safety are marked T^1, and those indicating danger marked T^2. The track is a single track, on which the trains run in both directions. The engineer is supposed to regard only those signals upon his right hand. A locomotive, A^1, (or a car in its train,) carrying the shifting-roller D, (or other device,) will depress the air-pump in passing over it, and will force the air through the pipes so as to reverse the signals. On the train A^1 arriving at a signal-station, the air passing through the pipe R will set the signal at the right side, abreast of the train, to "danger." The air through the pipe S will set the signal two stations back, to "safety." The air passing through the pipe R^1 will set the signal at the left, abreast of the engine, to "safety," and the air through pipe S′ will set the signal two stations ahead, on the left side, to "danger." With the engine A^2 the air through pipe R sets the signal abreast of the train, upon its left side, to "safety." The air through pipe S will set the signal two stations ahead, upon the left side, to "danger." The air through pipe R^1 will set the signal abreast of the train, upon the right side, to "danger," and through the pipe S^1 the signal two stations to the rear, upon the right side, will be set to "safety."

With this arrangement the engineer upon each of the trains would see the signals of the approaching train in advance of the same, and a train following another would see the signals of danger to the rear of the same.

In the case of a double track, as upon each track all the trains run in one direction, it is only necessary that each track should be supplied with a single set of signals, which would be placed always upon the same side of the track, (say, to the right hand,) so that the engineer may know to which side to look for the signals. These signals need be made only at the rear of the engine, as collisions can only take place from a fast train running into the rear of a slower one, and this would be avoided by the danger-signals at the rear of the first train. Thus in a double track those chambers N and O in the air-pumps in communication with pipes R^1 and S^1, and also the signals on the left side of each single track, and in connection with said pipes, can be dispensed with.

In Fig. 4 is shown the system of signals for a railway-crossing. In this, as a train passes an air-pump, K, the air is carried by a pipe, R^2, into a distributing-chamber, *o*, and from this chamber the air passes through pipes *p* to the two signals T^3 on the cross-tracks, so as to indicate the approach of a train to a train coming in either direction on the cross-track. This system would be entirely independent of the main system upon the lines, and is intended only to warn trains approaching upon the other or intersecting line.

Telegraph wires and rope have been used as a medium of communication between the locomotive and a signal at a distance; and when the signals are operated by the signal-man, work well. Water or glycerine may be used in pipes for the same purpose in such case; but when the signals are set by the train in motion neither ropes nor wires nor an inelastic fluid will work well.

Ropes stretch by the force of the blow given by a fast-traveling train, and will not communicate motion to a signal at a distance, either with promptness or regularity. Such ropes or wires have to be carried upon sheaves and around curves, and require to be boxed the whole distance, and require particular arrangements to eliminate the effects of temperature. Tubes filled with liquid, such as glycerine or water, are free from these disadvantages, but on the other hand they necessitate special appliances to compensate for the effects of leakage, which latter can hardly be avoided altogether. It is also necessary that some elastic medium, such as air, should be interposed to ease the blow from the train; for if said blow were communicated directly to the liquid it would cause the bursting of the pipes. For these reasons I concluded to use air as a medium of communication, which, besides being free from disadvantages present in all non-elastic or slightly elastic mediums, has this special advantage, that it can be taken in freely at the air-pump end and discharged at the signal end, and can be used in superabundance, so as to insure the movement of the signal, (the quantity in excess of that needed being allowed to escape freely through the joint between the cylinder W and piston W^1 or W^2,) and, from this last consideration, it will be seen that an exact adjustment of the size of the air-pumps to the length of pipe between the signals and the pumps is not required; neither is necessary any other arrangement to compensate for leakage. The air-pumps would be made of sufficient size to furnish the requisite amount of air to operate the signal.

Many forms of air-pumps would be suitable for use, the requirement being that each depression of the levers C C′ shall furnish the requisite amount of air, under pressure, to operate the two or the four signals, as the case may be, and that the compressed-air chambers N N O O, in communication with the two or the four pipes, R S, &c., (leading to the several signals,) should have capacity in proportion to the length of pipe, modified by capacity of the signal-cylinders. The tubes or pipes may be placed beneath the surface of the ground, to prevent the freezing of moisture in them.

Small vessels with cocks may be inserted at the lowest points of the tubes or pipes, to allow the escape of condensed moisture.

Although short bends may be made in the tubes, yet they should be avoided as much as possible, as they impede the passage of the air.

The movement of the signal may be easily combined with the sounding of a gong, which would be operated by the vertical pendulum or lever *k*, or otherwise. This would serve to indicate to the engineer that the air-pump had operated, and at the same time call his attention to the signal-station; or the gong might be struck by an independent arrangement, say, one hundred or two hundred feet from the signal-stations, for the purpose of indicating the approach of the train.

A signal at a distance may be worked by a watchman, by means of a local signal apparatus and connecting air-pipes; and, to give signals at several points distant from him, he would be provided with a number of small air-pumps with long stroke, and a false bottom or diaphragm with valve-openings would not be required, if the signals are in sight; but if the signals are out of his sight, he should have two pumps — a smaller and a larger one—worked simultaneously by the same lever, the small pump to operate the signal close at hand, which would indicate when the distant signal or signals were set, the larger pump or pumps operating the signal or signals at a distance, whose movements would be synchronous with those of the signal near at hand.

The device D for operating the air-pump may extend from the locomotive, tender, or either

of the cars. To operate the signals from a car at the rear end of the train would have the advantage that the whole train would have passed a given station before the signal of danger to stations back would be changed to safety, and the signal abreast from safety to danger, and that if a few cars got separated from the train in motion the following train would find the danger-signal, thus preventing the last-named train from running into the detached cars.

Signals under the system known as the "Block system" are worked by men stationed at equidistant points along the line, each man, by means of telegraph or other means, signaling the station next behind a moving train that the track is clear when the train has passed the station. But suppose that after a train has passed a station, and a signal been given for a following train to proceed, and the first train breaks down after passing the station, yet far enough to be out of sight of the signal-man, then the second train, although finding a signal of danger at the station, might not be warned in time to avoid a collision. Whereas with my system of overlapping signals (which is the main principle of my invention) this dangerous contingency could not occur.

It is evident that each of the pipes R S or R R′ S S′ may communicate with a separate air-pump, or the pump might be so simplified that the pipes would all communicate with the same chamber in the air-pump, but this latter would not give as certain results, and the former would involve unnecessary duplication and expense.

I do not confine myself to the means of communication shown between the train and the distant signal, as this may vary without essential change in the novel principle involved in the invention; neither do I confine myself to the described air-pump by which the train acts on the said means of communication; nor do I confine myself to the form of engine described, by which the signal is directly operated.

I have described my preferred means of carrying out my invention; but very considerable modification may be made in the said means without at all affecting the principle of the invention. For instance, in place of the air-pumps, air-pipes, and air-engines, water pumps, pipes, and engines may be used, and other liquids than water may be used in them; or the train may act on a lever or other device that will move the signals through a cable or other mechanical communication between the train and the signal; or the communication between the train and signal may be by electricity, the closing or opening of the circuit setting in motion mechanism by which the signals are reversed.

I claim as new and of my invention—

1. The method herein described of signaling, whereby overlapping signals at a distance from the train are reversed, while other signals, between the former signals and the train, remain at rest, to be reversed in their turn, all substantially as and for the purpose set forth.

2. The combination of signals T T, pipes R S, and lever C with the air-pump K K, divided into two or more chambers, N O P, by diaphragm L, having valves M, and the chamber or chambers N O, in communication with the pipes R S, all substantially as and for the purpose set forth.

3. In combination with the pipes R S and cylinder U W, the piston W′, spindle Z, head X, cam-groove *d e*, and stud Y, substantially as and for the purpose set forth.

HENRY FLAD.

Witnesses:

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