7 Sheets—Sheet 1.

A. G. CUMMINGS.

Interlocking Switch and Signal Apparatus.

No. 226,499. **Patented April 13, 1880.**

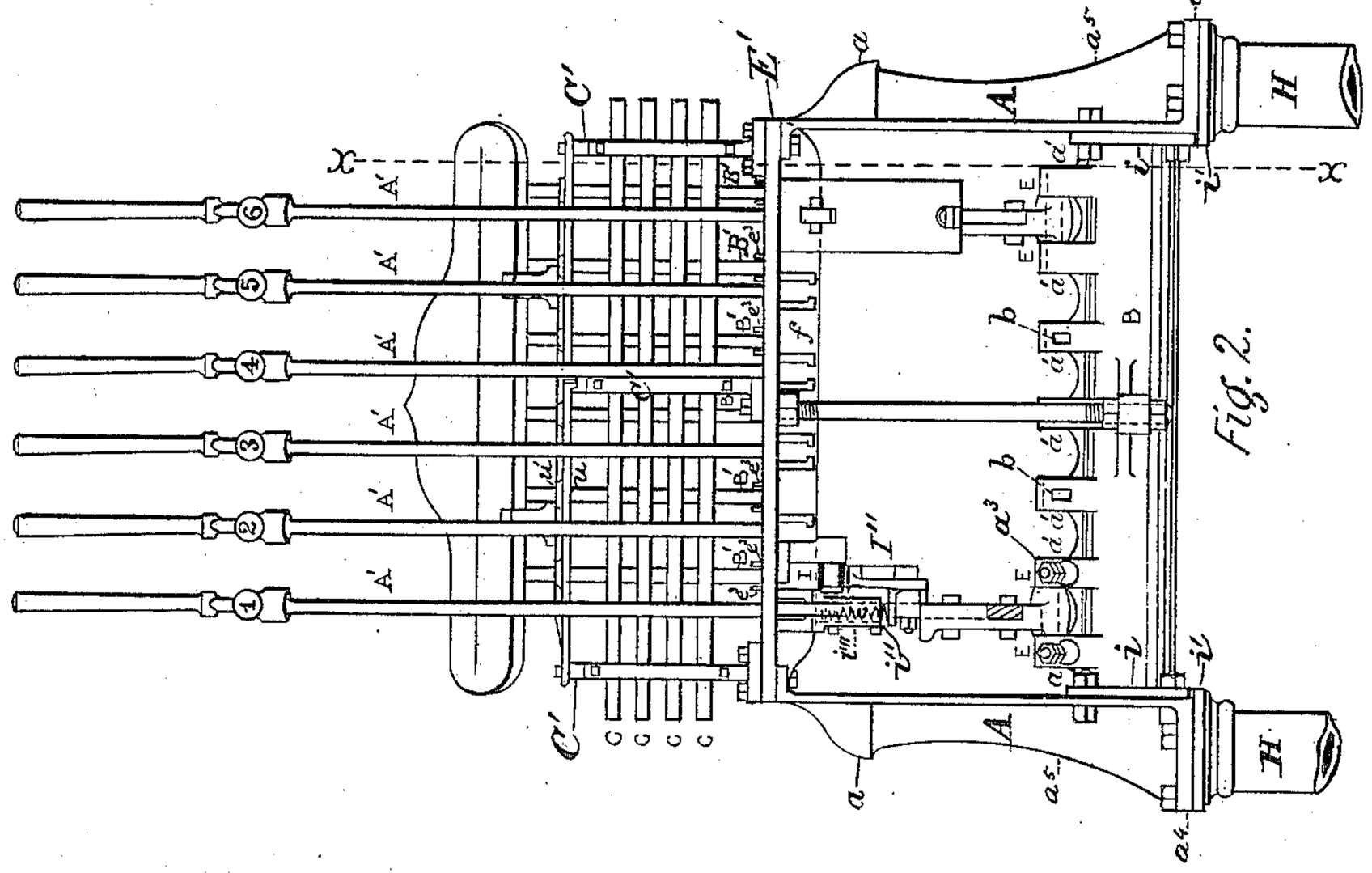

Fig. 2.

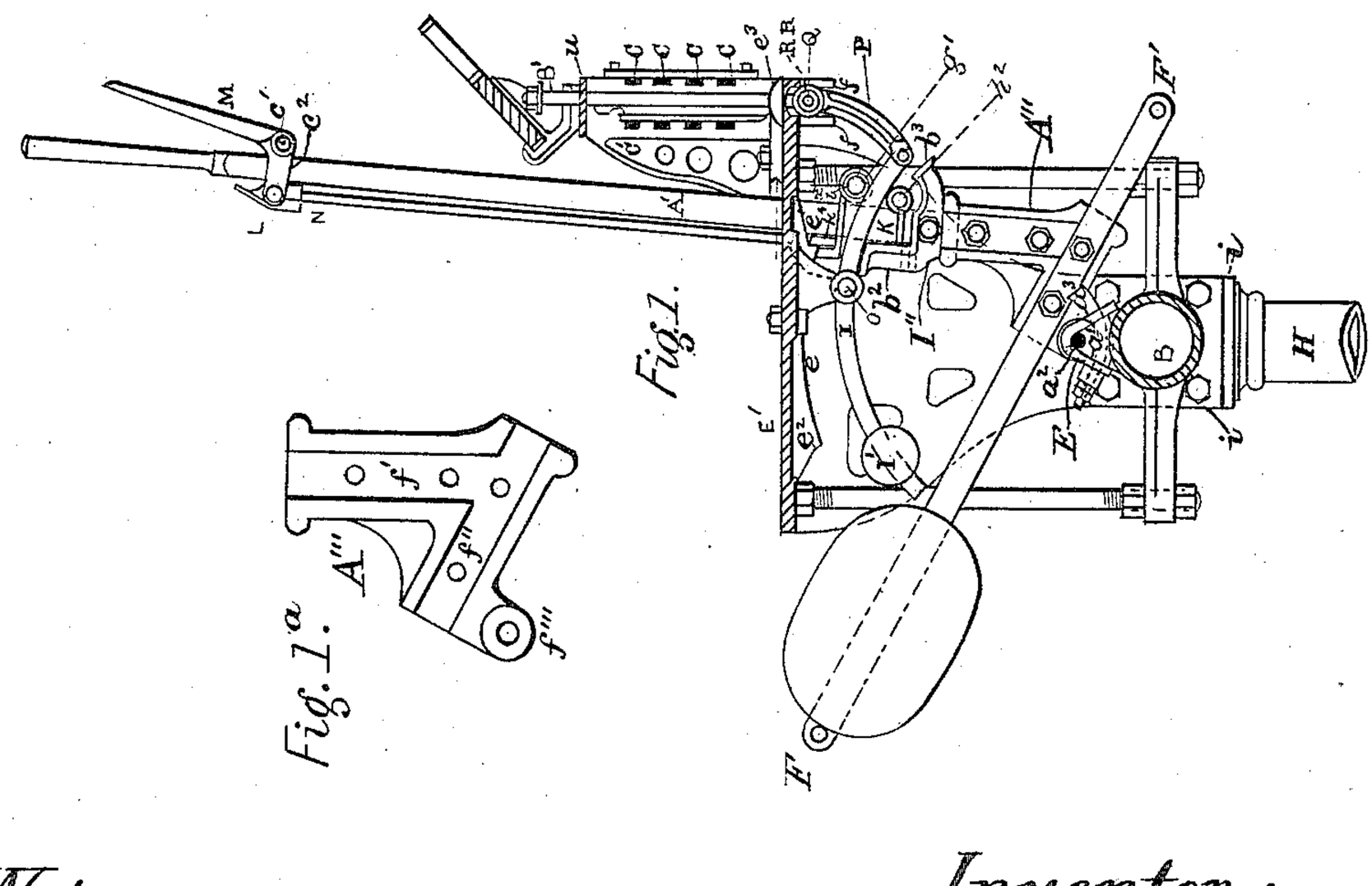

Fig. 1.

Fig. 1.a

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A. G. CUMMINGS.

Interlocking Switch and Signal Apparatus.

No. 226,499. **Patented April 13, 1880.**

Fig. 4ª

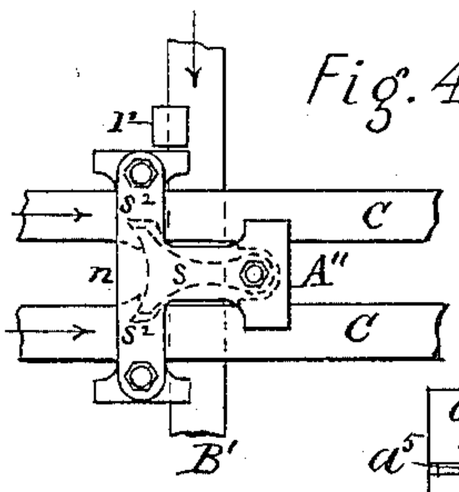


Fig. 3.

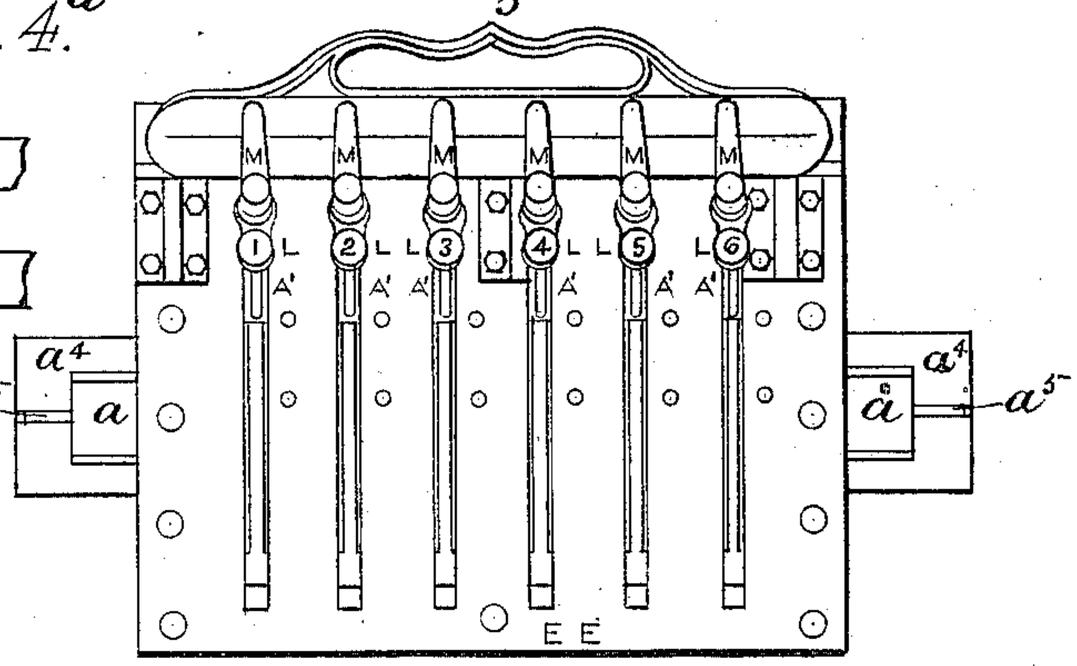


Fig. 4

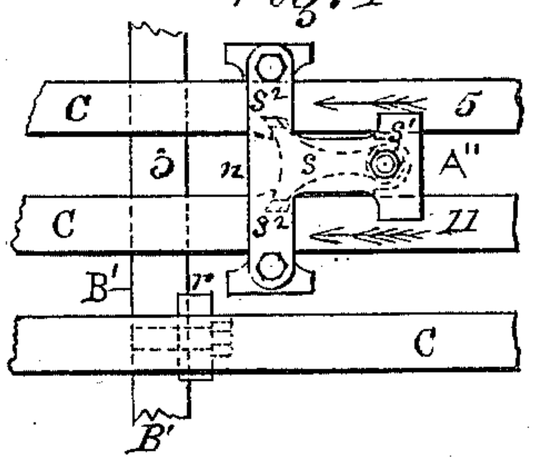


Fig. 5

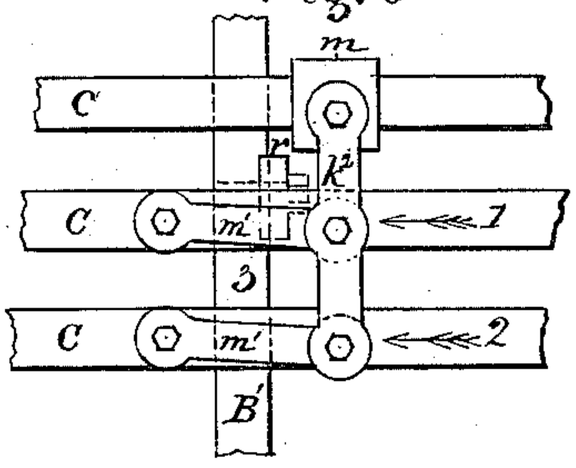
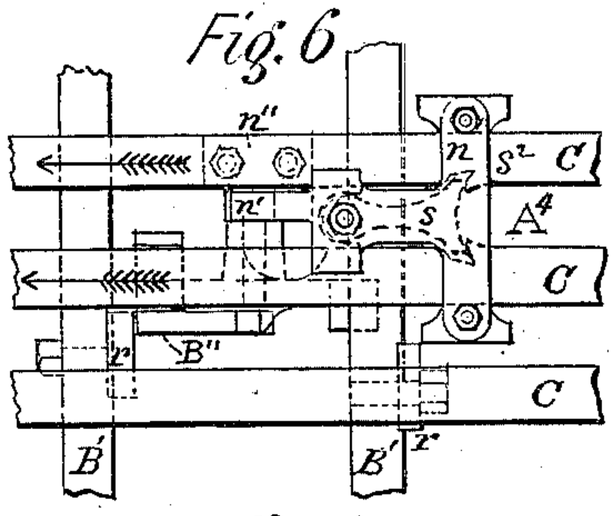


Fig. 6



Figs. 7 and 8.

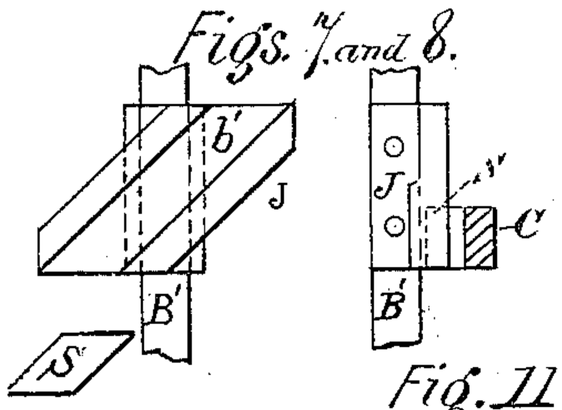


Fig. 9.

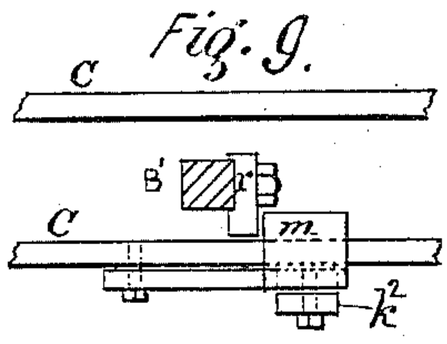


Fig. 10

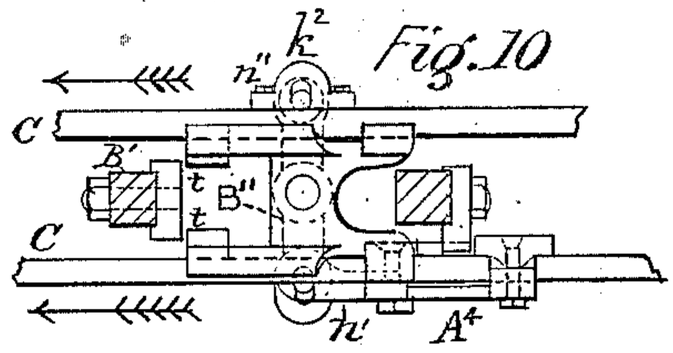


Fig. 11

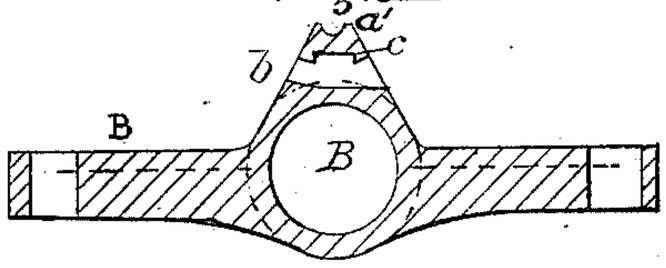
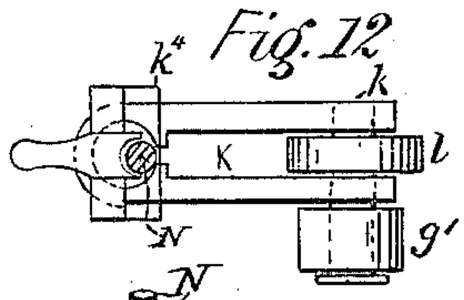


Fig. 12



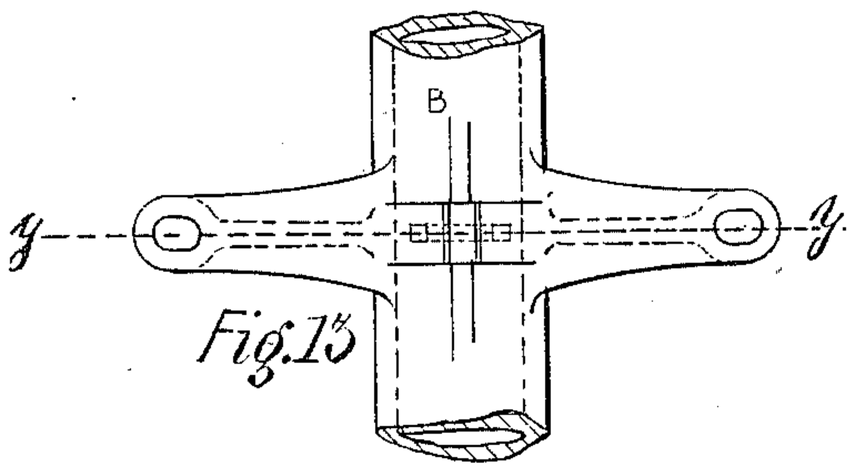


Fig. 13

Fig. 14

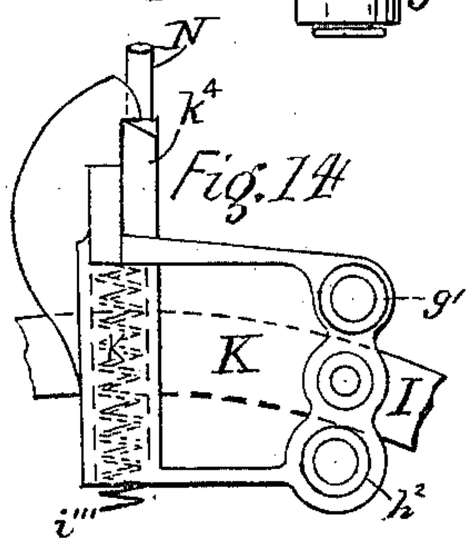
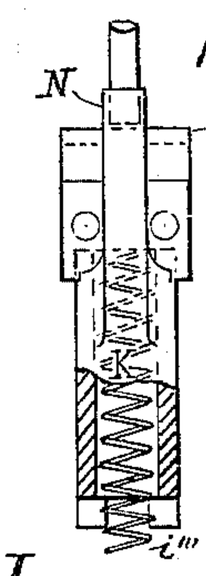


Fig. 15.



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7 Sheets—Sheet 3.

A. G. CUMMINGS.

Interlocking Switch and Signal Apparatus.

No. 226,499. Patented April 13, 1880.

Fig. 16.

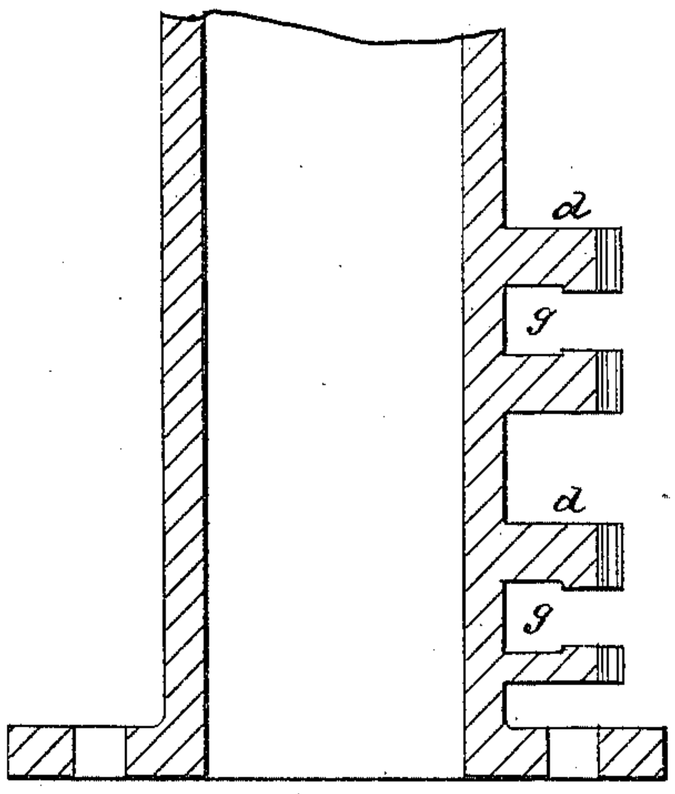

Fig. 19

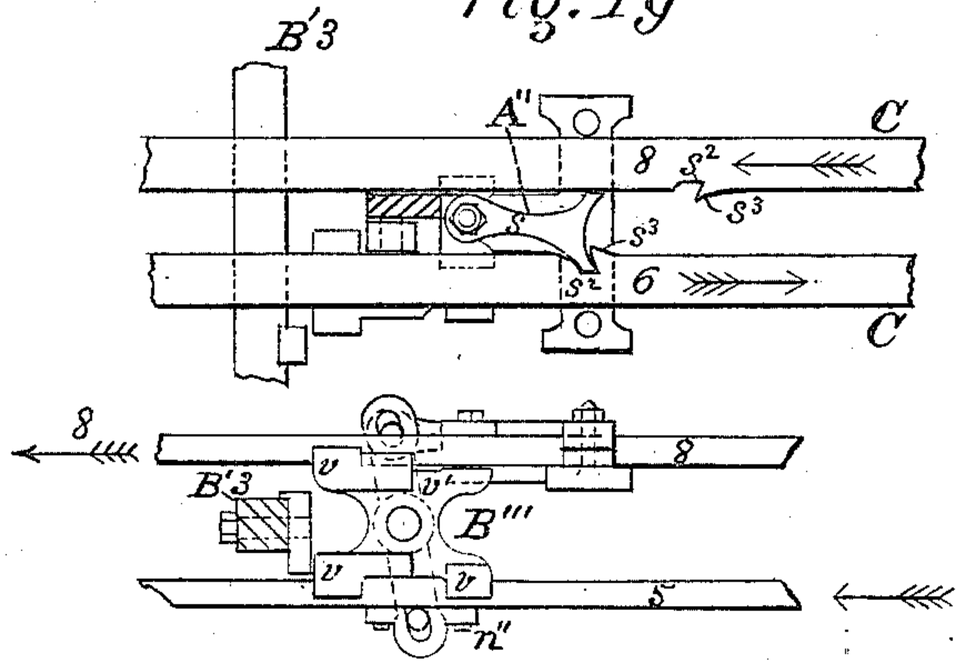

Fig. 20

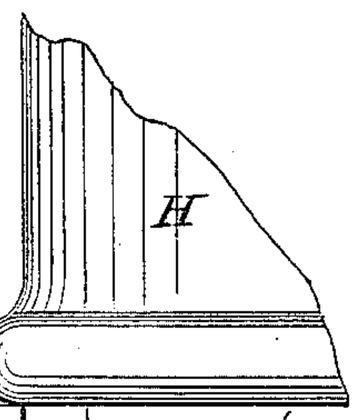

Fig. 17.

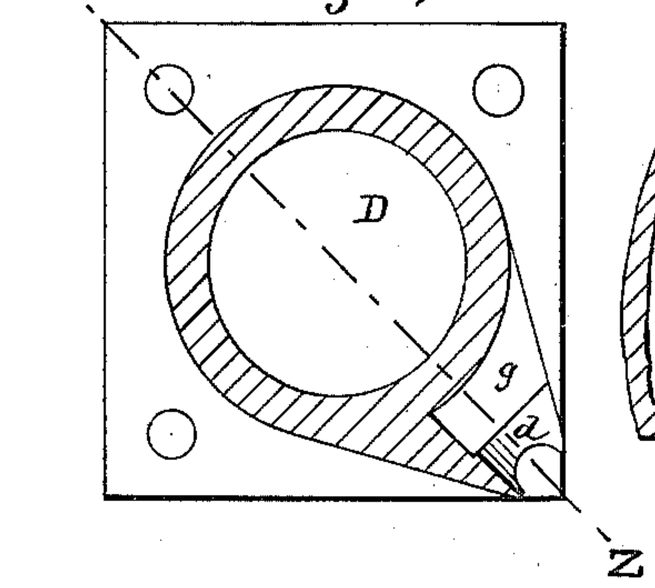

Fig. 18

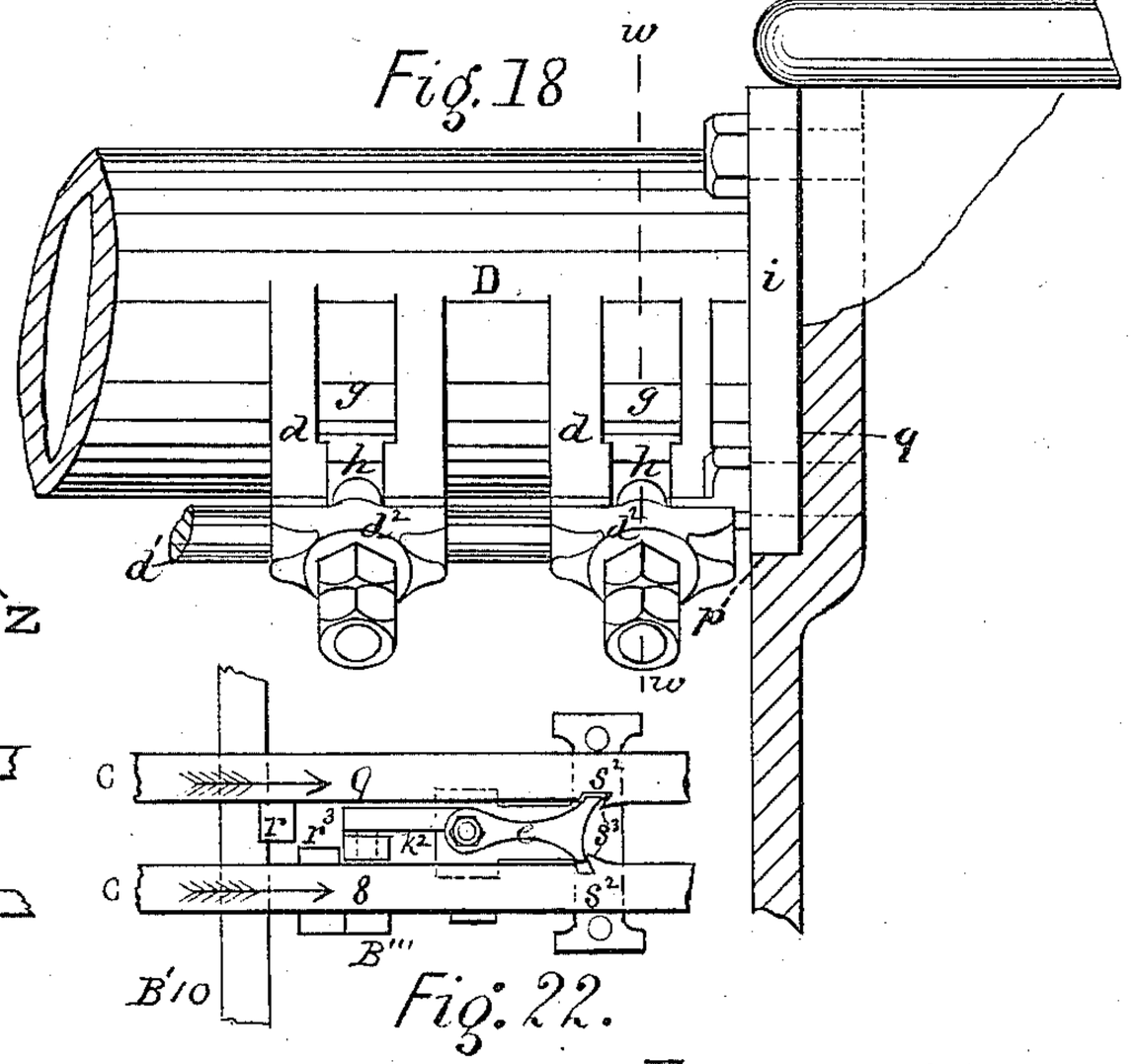

Fig. 21

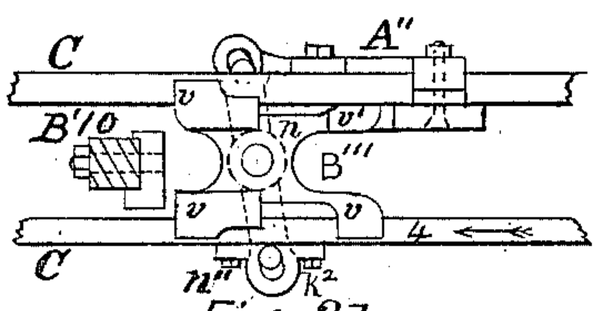

Fig. 22.

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7 Sheets—Sheet 4.

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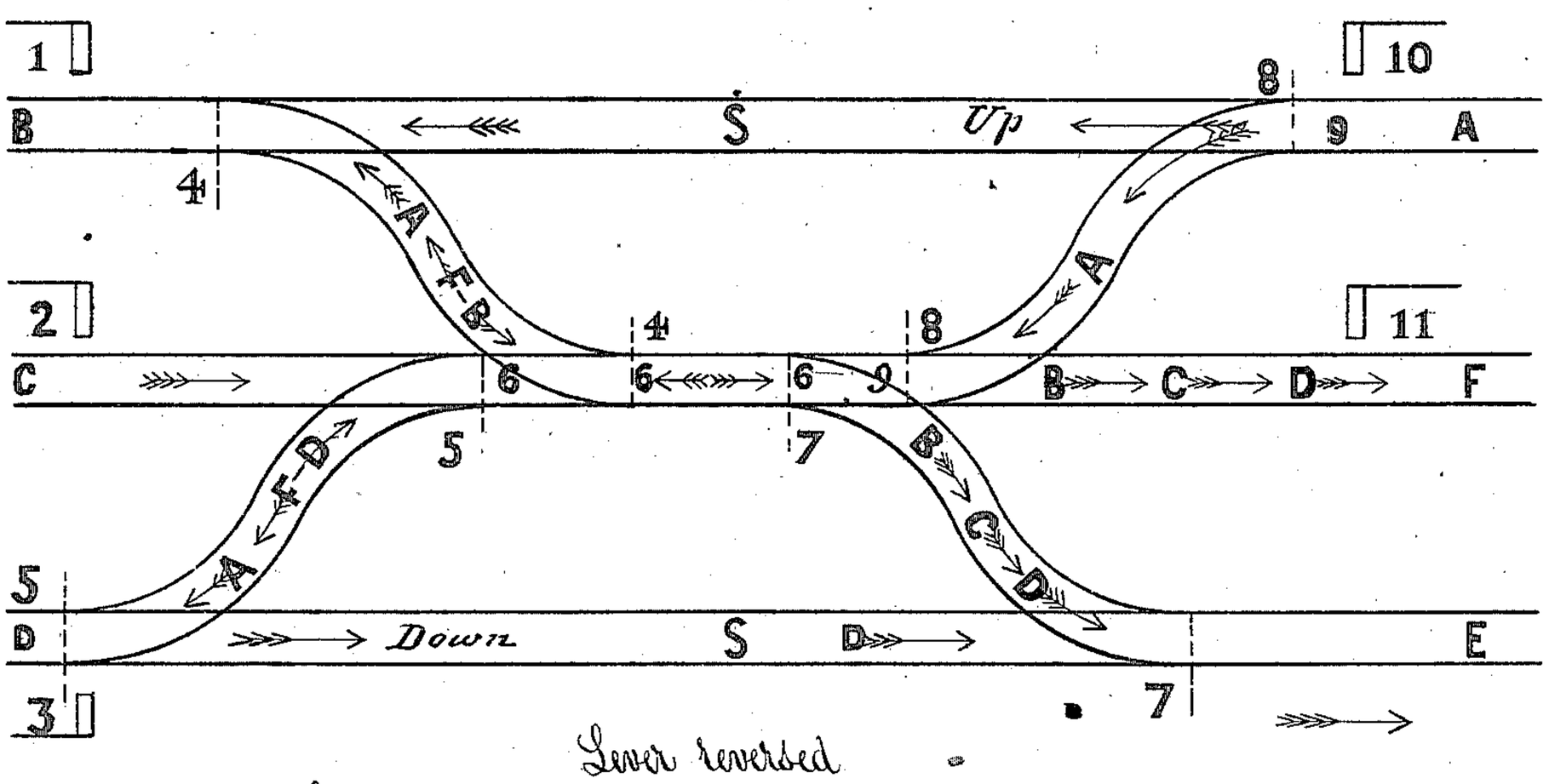
Interlocking Switch and Signal Apparatus.

No. 226,499. **Patented April 13, 1880.**

Fig. 23



Lever reversed

No.	Releases	Locks
1		10, 11
2		4, 5, 8, 11, 6, 9
3		
4		2, 5, 6 During stroke of 4
5		2, 4, 6 " " " 5
6	2, 8, 11.	4, 4, 5, 5, 7, 7
7		8, 11, 6 During stroke of 7
8		1, 2, 7, 11, 6, 9 " " " 8
9	10, 11.	8, 8
10		1, 9
11		1, 2, 7, 8, 6, 9.

Fig 24.

Combination and Special Locks

4 & 6 release 1		1 locks 4 and 6	
5 & 6 " 3		7 " 3	3 locks 5, 6 & 7
8 & 9 " 10		4 " 10	10 locks 4, 8 & 9.
9 " 3		5 " 3	3 locks 5 & 9 or 5 or 9
5 locks 3-6 unlocks 3		8 relocks 3	or 11 relocks 3.
6 or 7 releases 9		6 & 7 lock 9	
7 or 9 " 1 & 2.		1 or 2 locks 7 or 9	

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7 Sheets—Sheet 5.

A. G. CUMMINGS.

Interlocking Switch and Signal Apparatus.

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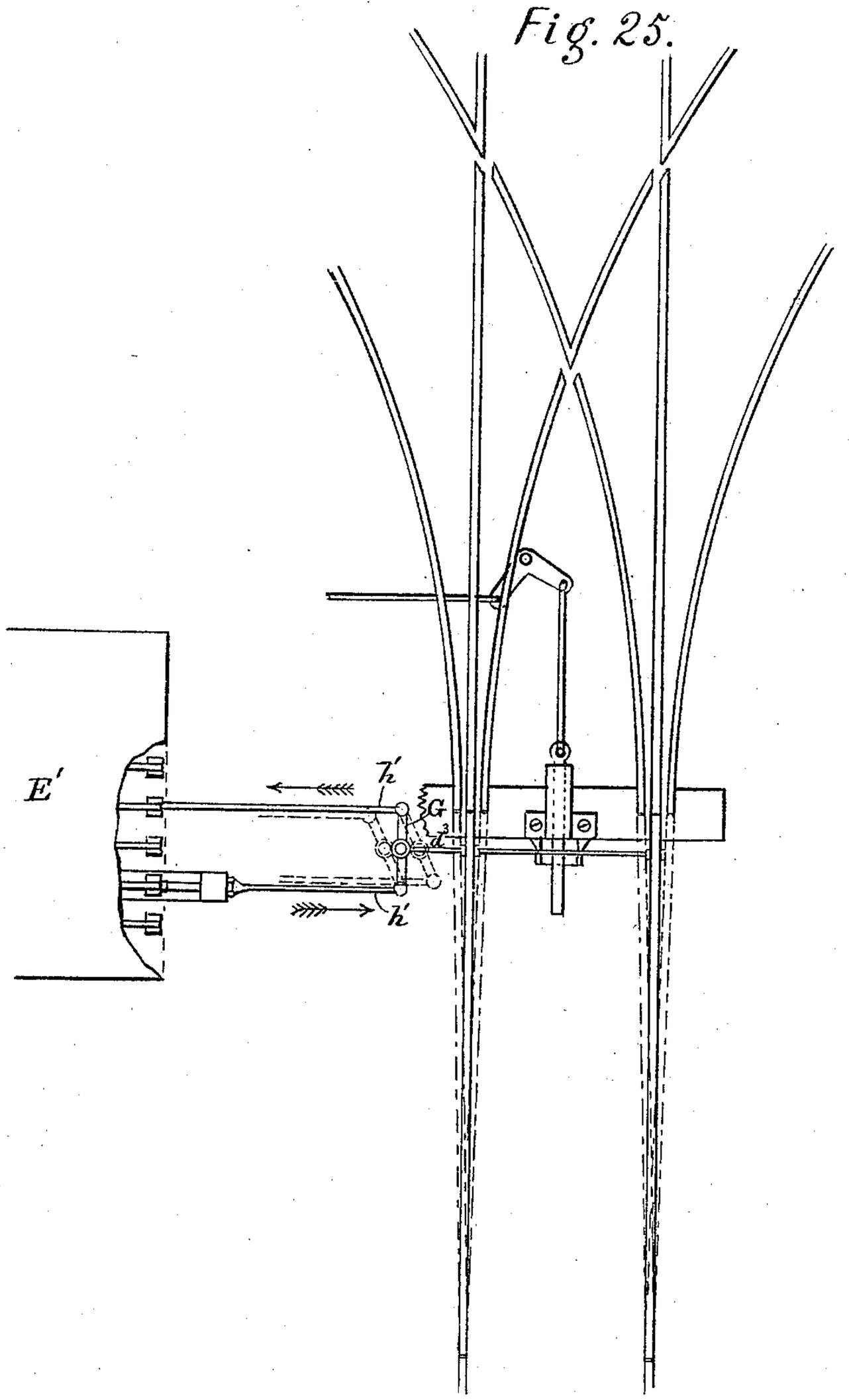
Fig. 25.



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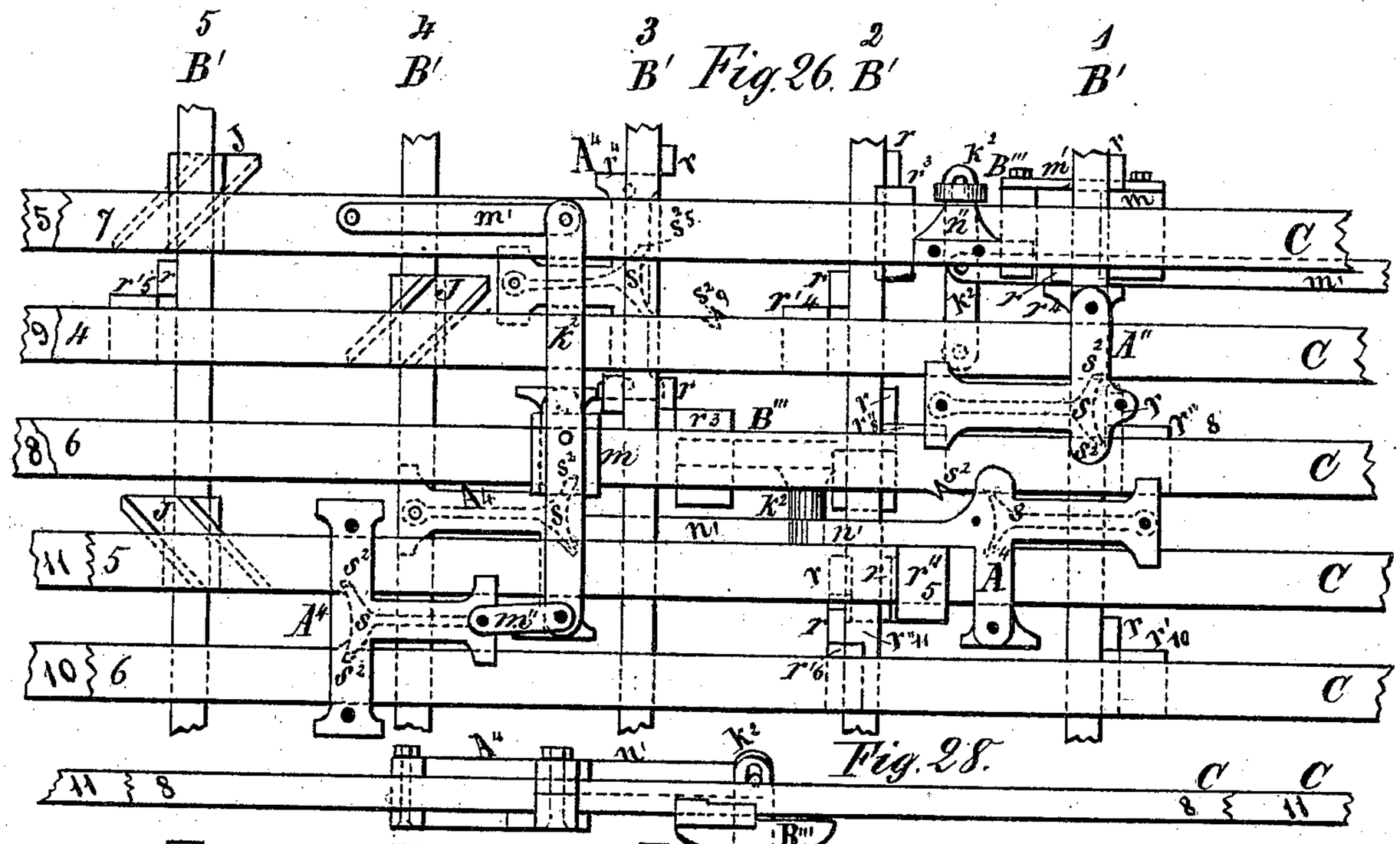
7 Sheets—Sheet 6.

A. G. CUMMINGS.

Interlocking Switch and Signal Apparatus.

No. 226,499. Patented April 13, 1880.



7 Sheets—Sheet 7.

A. G. CUMMINGS.

Interlocking Switch and Signal Apparatus.

No. 226,499. Patented April 13, 1880.

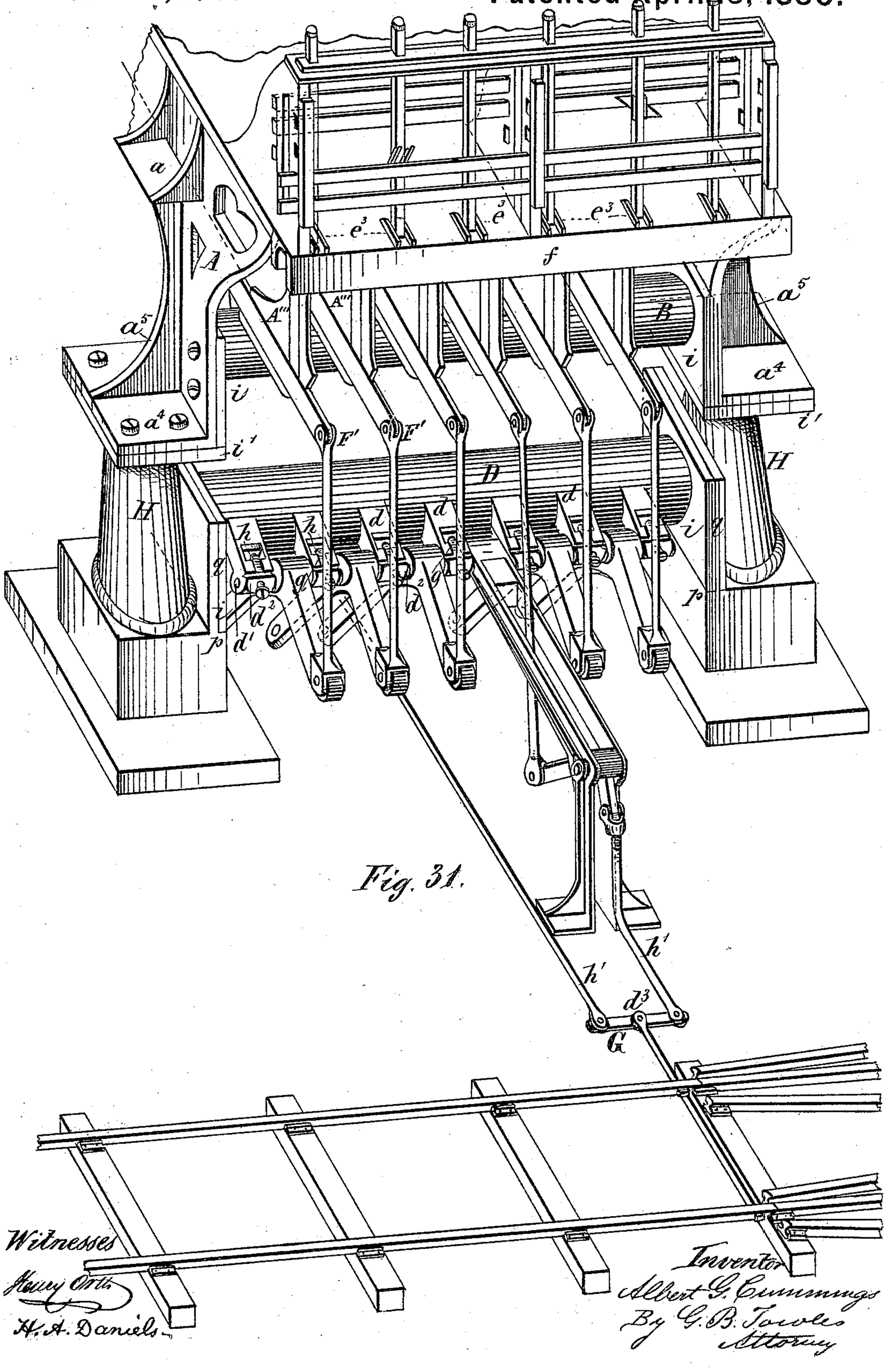


Fig. 31.

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H. A. Daniels

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Albert G. Cummings
By G. B. Fowles
Attorney

UNITED STATES PATENT OFFICE.

ALBERT G. CUMMINGS, OF HARRISBURG, PENNSYLVANIA, ASSIGNOR TO PENNSYLVANIA STEEL COMPANY.

INTERLOCKING SWITCH AND SIGNAL APPARATUS.

SPECIFICATION forming part of Letters Patent No. 226,499, dated April 13, 1880.

Application filed November 7, 1879.

To all whom it may concern:

Be it known that I, ALBERT G. CUMMINGS, of Harrisburg, in the county of Dauphin and State of Pennsylvania, have invented certain new and useful Improvements in Interlocking Switch and Signal Apparatus; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

My invention relates to the interlocking of railroad switches and signals for the purpose of preventing the liability of the collision of two trains occasioned by a switch-operator showing by signals two interfering lines of track open at the same time.

Numerous devices and systems for these purposes have been in use for a number of years.

By the "interlocking system" applied to switches and signals is to be understood, in general, that the setting of the switch or switches with their appropriate signal or signals to open a certain line of tracks locks all conflicting switches, and locks in position indicating danger all signals conflicting with said line.

The objects aimed at in such systems are that nothing may be left to the judgment of the switch-operator; that following the obvious safety rule in opening a given course of moving switches first, locking the same next, and, last of all, setting the signals to go ahead, the said movements shall lock fast all the levers operating conflicting signals, so that they cannot be operated; that a certain course of track being indicated to the operator to be opened for the passage of a train, the changing of switches and signals may, so far as possible, begin at the point farthest from said train and end with the signal nearest to it; and that in all cases said signal shall be locked to indicate danger until the course of track to be opened shall be in order and said signal be set for the train to proceed, and that the setting of said signal to proceed shall lock to danger all conflicting signals not already locked.

My invention consists of improvements in the construction, arrangements, and combinations of interlocking devices, as hereinafter fully described, and shown in the drawings, in which—

On Sheet 1, Figure 1 is a transverse vertical section on line *x x* of Fig. 2. Fig. 2 is a rear elevation, showing the hand-levers and interlocking bars. Fig. 1ª is a side view of a shoe detached.

On Sheet 2, Fig. 3 is a top view of the floor-plate and hand-levers. Figs. 4ª, 5, and 6 are side elevations detached, showing the special locks attached to locking-bars, which move in only one direction in operating the interlocking devices. Fig. 7 is a face view of the plate attached to one of the upright bars, which plate is provided with a diagonal slot to receive a diamond-shaped piece, S, attached to one of the horizontal locking-bars. Fig. 8 is an edge view of the plate J, shown in Fig. 7, with the bar C in section and part S attached thereto. Figs. 9 and 10 are top views of the bars and locks shown in Figs. 5 and 6, respectively. Fig. 11 is a transverse section of the girt B on line *y y* of Fig. 13, which is a top view of the middle portion of the girt B, showing the arms for the stays of the foot or floor plate. Fig. 12 is a top view, and Figs. 14 and 15 are edge and side views, respectively, of the catch-guide with its attachments.

On Sheet 3, Fig. 16 is a longitudinal section of a portion of the girt D on line *z z* of Fig. 17, which is a cross-section of girt D on line *w w* of Fig. 18, which is a front view of a portion of that girt and its supporting-column. Figs. 19 and 20 are side and top views, respectively, of special locks attached to the bars, which move in different directions in operating the locking devices. In Fig. 19 the outside plate is removed. Figs. 21 and 22 are top and side views respectively, of the locking-bars with the same locking devices (with the outer plate removed) applied differently.

On Sheet 4, Fig. 23 is a diagram of railroad-tracks, in which 1, 2, 3, 10, 11 represent semaphores, which are to be noticed only from the outside of the shunting-area protected by said signals. Fig. 24 is a table showing the action of the interlocking devices in opening the several courses indicated in the diagram.

The numbers used thereon indicate the numbers of the levers, and their position—inclined to the right or left—indicates the position of the levers, as vertical or reversed.

On Sheet 5, Fig. 25 is a plan view of a three-throw switch, showing the compound switch-lever, its connecting-rods, and the switch-locking bolt.

On Sheet 6, Figs. 26 and 27 are two parts of one figure, showing certain applications and operations of my special and combination locks. The right-hand portion of Fig. 27 joins the left-hand portion of Fig. 26. Fig. 28 is a plan view, showing bars 6, 8, 5, and 11, and a combination of locks arranged thereon. Fig. 29 is a plan view, showing the mode of arranging the locking-projections upon the vertical and horizontal bars. Fig. 30 is a vertical section of a bar, C, with a locking-projection so attached as not to interfere with other moving parts.

On Sheet 7, Fig. 31 is a perspective view, showing the connection of the levers with the bell-cranks and with the compound lever for moving a switch.

My interlocking apparatus is mounted on columns and plates properly bolted together and connected by cylindrical girts.

In the drawings, A A represent end plates supported by and bolted to the columns H H, and secured to the ends of the connecting-girt B by bolts or screws through suitable flanges *i*, provided for that purpose. Each of these plates is provided with a bracket having a pocket, *a*, Figs. 1 and 3, to receive and hold the ends of floor-joists, to avoid the use of heading or trimming joists for the floor around the apparatus.

The girt B supports and forms the fulcrum for the hand-levers A′, and is provided with a number of projections, *a′*, extending upward and supporting the pivot-pins a^2, which pins are held in place in the projections by the straps E and the keys a^3, extended through slots *b* in the projections, (shown in Fig. 11 of the drawings.) Each of these slots is provided with a recess, *c*, and the keys are curved so that they bear only for a short distance inwardly from each end of the slots, and each key is secured and tightened by a nut on the small end working against a sleeve placed on the key between the nut and the strap E, which sleeve covers surplus screw-threads for the required adjustment. If preferred, said keys and keyways may be made straight. Each projection *a′*, except the two at the ends of the girt, supports one end of each of two pins, a^2, which are made separate for each lever-shoe, instead of one continuous rod, for the purpose of allowing each lever to be removed and adjusted separately without disturbing the other levers. The ends of girt B are provided with flanges *i*, which rest on the flanges *i′* of the columns H and are bolted to the end plates, A.

The girt D, Fig. 31, forms the fulcrum for the bell-cranks by which the switches and signals are moved, and this girt is provided with projections *d*, which support the pivotal pins *d′*, held in place by clamps d^2, which are secured by bolts *h* in the slots *g* in the projections *d*, which slots are formed with suitable angular projections to receive and hold the heads of the bolts, all as shown in Fig. 18.

I do not herein claim this form of girt, but reserve the same as subject-matter for a future application.

The two methods described of holding the pins in the two girts may be used interchangeably, or other immovable pivots for the levers and bell-cranks may be secured in place by any other suitable devices, and the angle determining the figure of the projection *a′ d* may be varied from sixty degrees, which I have preferred.

Girts of other than cylindrical forms, having projections of the requisite lengths to allow the movements of the levers and bell-cranks, will serve the same purposes as the girts B D.

In an apparatus having a large number of levers requiring longer girts the requisite additional strength to sustain the strain of the levers may be obtained, when the girt is tubular, by decreasing the size of the core at the center, thus increasing the thickness of the metal in the center of the girt, or by constructing the girt with a web on the line of the greatest strain. In either case the exterior of the girt will be the same size, and if the span is so great as to require it, additional supports therefor may be employed.

A‴ is the shoe, having a vertical groove, *f′*, to receive the lower part of the lever A′, and having an inclined groove, *f″*, to receive the counterbalance-lever F, when employed, or such portion thereof, F′, as is needed to form a projection for attaching the connecting-rods. The shoe is also provided with the boss *f‴* at one end and edge to receive the pivotal pin a^2, as shown in Fig. 1.

The object of this construction of the shoe is to use one bar, when desirable, for the counterbalance-lever F and connecting-bar F′.

Heretofore the shoe has been pivoted near its horizontal center, requiring the pivot to be raised a greater distance above the girt than is required with my shoe to allow clearance of the shoe for the movement of the lever.

It will be readily seen that by pivoting the shoe at one end, as I have shown and described, the pivot may be much nearer the girt, and still the shoe will have the requisite clearance to allow the movements of the lever; also, by my construction of the shoe the lever A′ is in nearly a vertical position when normal or forward, without the necessity of constructing it with a bend or bends, as required with other shoes; also, by constructing the shoe with the groove *f″* above the pivotal bolt the groove may be extended entirely across the shoe, and the one groove answers for the balance-lever and connecting-bar, dispensing with one of the grooves required in the shoes pivoted at the center.

This shoe may be constructed with the re-

quired strength of less metal than those made as heretofore.

Where the counterbalance-lever F is not required the connecting-bar F′ need not be extended rearward beyond the shoe.

The floor-plate E′ is provided on the upper side with the lugs e^3, forming side guides to the lower ends of bars B′, and on the under side with the flanges *f f* and the arcs *e*, which arcs form the bearings for the catches k^4, and these arcs are provided with the shoulders *e′* near the front ends and e^2 near the back ends to catch the guide K and hold the levers A′ in the normal and reversed positions respectively.

I is the segment-lever, formed solid from a simple bar of metal, and pivoted at *o*, near its center, under the floor-plate E′, and extending between friction-rollers on the catch-guide K, to be described, is connected to one of the lock-bars B′ by a connection-arm, P. This form is much more simple and easy of construction than the slotted link heretofore used.

By placing the segment-lever under the floor-plate the mechanism for operating the interlocking devices is out of the way of the feet and removed from the grit and dirt, that would work into and injure the working parts if above the floor-plate.

I″ is a locking device consisting of a piece having the two arms b^2 b^3 permanently fastened to the lever A′ above the shoe. These arms are constructed of the requisite length and shape to form bearings to the under edge of the segment-lever I when vibrated by the downward movement of the catch-guide, for the purpose of holding the segment-lever, and by it the locking-bar B′, in a stationary position during the stroke of the lever A′. This piece I″ is provided with a lateral lug, *i″*, (seen in Fig. 2,) forming the lower bearing of the spiral spring *i‴*, which is adjusted in a socket in the lower part of the catch-guide, the upper end of which spring bears against the lower end of the catch-rod to move the rod upward, forcing the catch into notches *e′* e^2 on the arcs *e* on the bottom of the plate.

It will be seen that during the movement of the lever the two arms b^2 b^3 form a bearing on each side of its pivotal bearing *o*, preventing the segment from moving till both arms have passed said pivotal bearing, when it is free to move.

The hand-levers A′ are connected to the interlocking mechanism as follows: K is the catch-guide, secured to the lower end of the catch-rod N, and is constructed to slide upon the hand-lever A′, and is provided with an anti-friction roller, *l*, (see Fig. 12,) which revolves on a pin, *k*, between the sides of the guide, and bears against the front of the lever. The catch-guide is provided with two anti-friction rollers, *g′* and h^2, (shown in Figs. 1, 12, and 14,) one over and the other under the segment-lever I, so as to allow the guide to pass freely on said segment-lever and cause every vertical movement of the guide to actuate the segment-lever.

M is a handle pivoted on the pin *c′* in an eye near the top of the lever A′, and is provided with an angular arm, c^2, pivoted to a connecting-block provided with a number-plate, L, and a socket having screw-threads to receive the screw on the upper end of the catch-rod N, which by the screw may be adjusted to the required length. The rod operating by thrust, it is essential to arrange the number-plate upon the block instead of upon the handle.

One end of the segment-lever is hinged to the lower end of the connecting-arm P, and the upper end of this arm is connected to the lock-bar B′ by a pin, Q, which carries the anti-friction rollers R R—one on each side of the arm P—which rollers are arranged to work freely between the two flanges *f f* of the plate E′, guiding the bar B′, and preventing its turning by the resistance encountered in moving the locking-bars.

In the interlocking systems heretofore employed the levers governing the switches and signals have been locked by simple projections arranged upon horizontal sliding or rocking bars, said projections engaging either the levers themselves, to prevent movement thereof, or other bars connected to the levers or their catches. (See Figs. 26 and 30.)

The locking mechanism of my apparatus consists, in addition to these devices, of the special and combination locks, hereinafter described, adjusted on sliding bars C, arranged in the case shown—one series in front and another series in the rear of the short lock-bars B′—and extending lengthwise of the apparatus the requisite distance to connect any two or more levers. These bars C are placed at a sufficient distance from the lock-bars B′ to allow the use of projections (where heretofore notches have been used) on the bars C of both series, to engage with similar projections on any bar B′. The object of this last-named arrangement is to allow of using special and combination locks between or upon one set of horizontal bars, so as to engage with projections on such another set of vertical bars, or the converse, as require to be interlocked.

I am aware that interlocking bars have been arranged on both sides of the lock-bars and at a suitable distance therefrom in certain conditions of said lock-bars; but in other conditions, by a lateral vibration thereof, they are brought so near the interlocking bars as to interfere with the use of special and combination locks on the latter. I use lock-projections on the lock-bars in lieu of such vibration.

The mechanism for actuating the bars C by the bars B′ consists of a piece, J, Figs. 7 and 8, provided with a diagonal slot, *b′*, fastened to the bar B′ in any suitable manner, (though I have shown for that purpose two flanges upon its rear side,) and a diamond-shape piece, S,

fastened to the bar C and adjusted to slide in the slot, as shown in Fig. 8.

If desirable, more than one bar C may be attached to a bar, B′, by using additional connections J S for each, or a bar, B′, may simply have a lock-projection without a bar-connection, J S, as the conditions of the case may require.

Various other modes of actuating the locking-bars may be employed; but for the present I prefer the mode described and shown.

Should the number of levers require more bars C than could well be placed in a single stand, C′, the apparatus can be made to use a double stand with four series of locking-bars. In such case the counter-weight I′ on the segment-lever may be dispensed with, and a short lever attachment may be made either at the top or bottom end of the bars B′, so that when one bar B′ is raised the one attached to the opposite end of the lever is lowered.

The stand C′ may be extended upward, so as to admit more bars C, as the case may require. The upper parts of these stands are stayed in position by the tie-plates *u*, having top guides, *u′*, to bars B′, which plates are provided with projections on the inner ends to fit in a groove in the top of the middle stand, and the plates are fastened to the top of the stands by screws or bolts.

The combination-lock shown in Figs. 5 and 9 consists of a sliding sleeve, *m′*, on one of the bars C, operated by a lever, k^2, pivoted to the sleeve and to the connecting-bars *m′*, each of which is pivoted to one of the bars C. Either of these connecting-bars may be attached to a special lock, A^4, and thus the lever k^2 and sleeve *m* may be operated by either of more than two bars, if desired, thus enabling the machine to operate a greater number of combinations, all as hereinafter more fully described. In such an apparatus, as usually constructed, by reversing the levers from a normal or forward position all of the bars C on one side of the bars B′ move in one direction, and all of the bars C on the other side of the bars B′ move in the opposite direction; and in those apparatus heretofore constructed a bar, B′, locked by the movement of a bar, C, is unlocked by the reverse movement of the same bar C.

The object of my combination-lock above referred to is to lock the bar B′ by the movement of one of the bars C, and unlock that bar by the movement of another bar C, both of these bars moving in the opposite direction, as will be hereinafter described.

This combination-lock may be changed by placing the sleeve at the center of the lever k^2 and attaching the connecting-bars *m′* to the ends of the lever k^2. The effect of this arrangement may be that the movement of either of the bars C will lock the bar B′, or the movement of one may lock it and that of the other unlock it, or that of one may bring the sleeve to such a point that the movement of the other will lock it, all according to the spaces and positions in which the device is placed upon the bars C.

The connecting-bars *m′* may be dispensed with by providing the ends of the lever k^2 with slots to receive pins projecting horizontally from the bars C.

The special lock A″, Figs. 4 and 4^a, consists of two plates, *n n*, arranged one on each side of two of the bars C, and fastened together by bolts, as shown in Fig. 4. The inner one of these plates *n* has its upper and lower ends widened and formed into rectangular nibs or shoulders adapted to engage and disengage with the locking-projections on a bar, B′. Hence I call them "special locks." Between these plates is a double oscillating pawl, *s*, pivoted on the middle bolt at *s′*.

The free oscillating end of the pawl is bifurcated, and constructed and arranged to catch in the notches s^2 in the bars C. In forming these notches the bars are widened, as shown at s^3 in Fig. 19, sufficiently to catch the points of the pawl to prevent the liability of its passing the notches, the width of this bifurcated end of the pawl being equal to the space between the inner edge of one of the bars and the bottom of the notch in the other bar, so that the pawl will always remain in one or both of the notches.

The notches in the bars and the catching ends of the pawl are shaped, as shown in the drawings, so that in the movement of the bars C the pawl will readily catch in the notches and move the locks.

By reference to Fig. 4 it will be seen that the special lock therein shown is apparently the same as that shown in Fig. 4^a; but by its application, as in said Figs. 4 and 4^a, to pairs of bars C, moving, respectively, one pair to the left and the other pair to the right, the result is reversed—that is, as applied in Fig. 4^a either of the two bars moves the lock and its connections. As applied in Fig. 4 the movement of both bars is needed, either at once or one after the other, to move the lock and its connections. By this arrangement one of said bars may still be used in other combinations without disturbing the lock, the pawl thereby being merely thrown into the notch of the other bar.

The special lock just described may be combined with a riding lock, the whole forming a combination-lock, as follows: B″ and B‴ are riding locks, and are constructed to ride between two horizontally-opposite bars, and are provided with three grooved bearings, *v v v*, adapted to receive and slide on the bars C, and one flat bearing, *v′*, adjusted to bear against the inner side of one of the bars C. This riding lock is combined with the special lock by attaching one end of the lever k^2 to the extension *n′* on the lock A^4. In this combination the center of the compound lever k^2 is attached to the riding lock, and the other end of the lever is connected to one of the bars C,

horizontally opposite to the bars carrying the special lock, or that end of the lever may be attached to another special lock and operated by the movement of either of two bars C on that side of the stand. Thus the riding lock may be operated by either of four bars C, as shown in Figs. 26 and 28. The movement of all of these bars operating the special and combination lock may be in one direction, as shown in Figs. 6 and 10, for locking and unlocking the bar B′; or one bar C, marked 4, may move in the same direction aforesaid to lock bar B′, and the bars C marked 8 and 9 may move in an opposite direction to unlock bar B′, as seen in Figs. 21 and 22, in which case, while the movement of bar 4 locks bar B′, both 8 and 9 are required to unlock the same.

The lock B″ (shown in Figs. 6 and 10) is constructed the same as the lock B‴, (shown in Figs. 20 and 21,) except that B″ is provided with projections *t t*, and this B″ is used where the bars all move in one direction to lock and unlock bar B′, in which case, by the combination of the special lock A^4 with the riding lock B″ or B‴. the bar B′ may be locked by the movement of either of the two bars C, carrying the special lock, and the same bar B′ may be unlocked by the movement of the opposite bar C, bearing the end of lever k^2.

The combination of the locks shown in Figs. 19 and 20 differs from that shown in Figs. 6 and 10 and in Figs. 21 and 22 in this particular only—viz., that the movement of bar 5 in one direction (shown by the arrow) locks the bar B′, the movement of bar 6 in the opposite direction (shown by the arrow) unlocks the same bar B′, and the movement of the bar 8 in the same direction with bar 5 (shown also by the arrow) relocks bar B′.

G represents a compound switch-lever pivoted in the center to the end of a rod, d^3, attached to the switch, as seen in Figs. 25 and 31. The connecting-rods *h′ h′* are pivoted to the ends of the lever G, the bell-crank operating one of said rods having a supplementary support, and being reversed to reverse the movement; and they are arranged so that by the full stroke in reversing either of the levers attached to the connecting-rods the switch will be set to one of the sidings, thus avoiding the necessity of stopping the lever in the middle of the stroke to set the switch to the middle track, (as would be the case if but one lever were used,) which middle position of the lever would prevent the complete operation of the interlocking devices. By arranging this lever G near the apparatus I am able to avoid duplicating the connections *h′* of the apparatus with remote switches. The lever and its connections are also applicable to the operating of two signals by a single connection, d^3.

The new operations and results obtained in interlocking by these special and combination locks are hereinafter fully set forth.

It is sometimes advantageous to use one distant signal—that is, a "caution" signal—in connection with two home signals for a junction of a main track with a branch track, and in such cases it is important that the distant signal should interlock with either of the home signals, that it may show safety when either of them shows safety, and its lever be free after either of the home signals has indicated safety. For this purpose a special lock, A″, Fig. 4^a, may be used. Thus, in said figure bar B′ is operated by the catch of the distant signal-lever, and is locked to caution by the special lock A″ engaging the projection *r* upon the said bar; but either of the bars C, which are operated by the catches of the levers of the two home signals, will unlock the bar B′, so that the distant signal may be set to safety, and other applications of the same device are desirable to make a complete system and secure control of the hand-levers. I do not, however, claim, broadly, liberating a distant signal-lever by mechanism connected with either of two home signals. It is, however, the practice of some railroad officials to use but one home signal to indicate either danger or safety for a main and branch line, allowing the switch-target to indicate to the locomotive-engineer the direction in which the switch is set.

The object of my special and combination locks is to enable, in like manner, a lesser number of such signals to be employed where a greater complexity of tracks and switches exists—as, for instance, at railway terminals—and at the same time to secure positive safety in the moving of trains by a complete system of interlocking, and to operate the same with a correspondingly limited number of levers. These locks enable me to modify an existing interlocking combination very quickly and without the necessity of reaching the same by way of other intermediate combinations, as will be hereinafter explained in connection with a diagram of tracks.

To explain my meaning, I submit a diagram of tracks, Fig. 23, numbered to correspond with numbers that may be used by an interlocking apparatus having eleven or more levers, with arrows and letters to indicate the point from which trains may be run at the same time, having all the switches and signals thoroughly interlocked by my devices of special and combination locks. Of the eleven levers involved in operating the system indicated in Fig. 23, Nos. 4, 5, 7, and 8 are switch-moving levers, each lever moving the two switches at the junctions of a cross-over with two straight lines—that is, lever 4 moving the two switches marked 4, lever 5 the two marked 5, and so on. Nos. 6 and 9 are switch-locking levers—that is, levers which govern lock-bolts in the track, as shown in Fig. 25, acting directly upon the rails of certain switches over which trains pass at a considerable speed. These locks are devices additional to and separate from the interlocking mechanism, which latter also locks the levers operating them as

well as the switch and signal levers. Lever No. 6 operates locks securing the three switches marked 4, 5, and 7, and lever 9 operates locks securing the two switches marked 8.

A terminal station being considered as placed at the left of Fig. 23, and trains coming and going over the road at the right of said figure, and always keeping the right-hand track, it is evident that switches 4, 5, and 7 will be passed at a slow speed, and consequently require no locking beyond that obtained by the interlocking apparatus.

Hereinafter, in the explanation of Fig. 23, when a switch is spoken of as locked the switch lock-bolt is referred to, and when a lever is spoken of as locked the interlocking mechanism is referred to. Levers numbered 1, 2, 3, 10, and 11 are signal-levers, 1, 2, and 3 being signals for trains moving down, and 10 and 11 signals for trains moving up.

In the arrangement as shown, when the levers are all normal or forward, the switches are all set for the straight lines, the switch-locks are disengaged, and all signals are at danger. Therefore, before trains can pass, the switch-lock levers must be drawn or reversed, which releases the proper signal-levers, and then they may be reversed.

In order to move a lever, either to reverse it or return it to a normal position, the catch must be depressed to release the lever, and the depression of the catch will always cause a partial movement up or down of its corresponding bar B′; and at the end of either movement of a lever the catch will be raised by its spring to make fast the lever, which will complete the said movement of its bar B′. The reversing of a lever occasions the depression of its bar B′, and the return of a lever to the normal position causes a rise of its bar B′.

First operation: Let us suppose an up-train to be approaching the station from A to B. Switches 4 and 8 must be set to the main line and switch 8 locked, and signal 10 set to safety. Switch-levers 4 and 8 remain forward. Lock-lever 9 will be reversed to lock switch 8, and switch-lever 8 normal, and release signal-lever 10, which will then be reversed, which, in turn, will lock the lock-lever 9 reversed and the switch-lever 4 normal.

Referring now to Figs. 26 and 27, in which parts marked with letters and figures inclining to the left are arranged in the rear of bars B′, or from the observer, and parts marked by letters and figures inclining to the right are arranged upon the front of bars B′, or toward the observer, and all the parts are in the position occupied when the levers are all normal, it will be seen that depressing bar B′ 9 will, by means of its piece J, cause C 9 to move to the left, and said movement of C 9 will cause the block r'' 9 to pass under the block r on bar B′ 8, so locking switch-lever 8 normal. The same movement of bar B′ 9 also removes the block r from beside r' 10 on bar C 10, so releasing bar B′ 10, and consequently signal-lever 10. Then reversing signal-lever 10 causes block r' 10 to move to the left over block r on bar B′ 9, so locking it down, which locks lock-lever 9 reversed. The same movement of bar B′ 10 causes the block r thereon to fall into engagement with the shoulder r^3 of riding lock B‴, thus preventing said lock from moving to the right; and since the riding lock carries the lever k^2, one end of which is connected to C 4 and its other end to the rearward projection of special lock A^4, if said special lock is held fast, it is obvious that C 4 is locked. Now, said special lock is held fast by the reversing of lever 9, which, by the consequent movement of C 9 to the left, causes pawl s to fall in the notch s^2 of C 8, which, as aforesaid, is locked normal. All parts are now set to permit the train to pass from A to B, Fig. 23.

Second operation: Let it be desired to take a train from A to B, Fig. 23, around an obstruction, S. First, switch-lever 4 must be reversed, which sets switches 4 to the cross-over. It also locks signal-levers 2 and 10 normal—that is, to danger—and retains the latter so locked until the lock-lever 9 is reversed. It also locks switch-lever 5 normal. Then switch-lock lever 6 is reversed, locking switches 4 to the cross-over and 5 and 7 to the straight line, and locking switch-levers 4 reversed and 5 and 7 normal, and releasing switch-lever 8 and lock-lever 9. Switch-lever 8 is then reversed, which locks the lock-lever 6 reversed. Lock-lever 9 is now reversed, which locks switches 8 and switch-lever 8 reversed, and releases signal-lever 10, which is then reversed, locking lock-lever 9 reversed.

Referring now to Figs. 26 and 28, reversing lever 4, by means of J upon bar B′ 4, causes bar C 4 to move to the right and engage block r' on bar C 4 under block r on bar B′ 2, so locking signal-lever 2 to danger. The same movement of bar C 4 in like manner engages bar B′ 5, locking switch-lever 5 normal. It also carries the front end of lever k^2 to the right, and with it the shoulder r^3 of riding lock B‴ under block r on bar B′ 10, so locking signal-lever 10 normal—that is, to danger. Said movement of C 4 also carries block r' thereon entirely past block r on bar B′ 6, locking said B′ 6 during its movement only. Next, reversing lever 6 to lock switches 4, 5, and 7, Fig. 23, as above required, depresses B′ 6, locking lever 4, by the downward engagement of block r on bar B′ 6 with r' on bar C 4, which has already passed to the right of said block r. The aforesaid movement of bar B′ 6 causes block r thereon to engage the left side of block r' on lower bar, C 5, so locking switch-lever 5 normal, (for it is to be observed that in the present case vertical bars B′ 5 and B′ 6 move two horizontal bars, C, each.) The same movement of bar B′ 6 also causes the upper bar, C 6, to move to the right, carrying block r'' thereon under block r on bar B′ 7, so locking lever 7 normal. The same movement of bar B′ 6 also moves lower bar, C 6, to the left, which carries block

r' thereon clear of block r on bar B 8, so releasing switch-lever 8. The same movement of bar B′ 6 also releases lock-lever 9, as hereinafter described in the third operation, in connection with the working of bar B′ 6. Switch-lever 8 is then reversed. Lever 6 being already reversed, and block r' on lower bar, C 6, being already to the left of block r on bar B′ 8 to release the same, the reversing of lever 8 causes block r on bar B′ 8 to fall upon the right side of said block r', and so locks lever 6 reversed. The reversing of lever 8 before mentioned, causing bar C 8 to move to the left, caused the double pawl s of the lock A^4 to entirely engage the notch s^2 of bar C 9, connecting said block with said bar. Now the reversing of lever 9 to lock switches 8, causing bar C 9 to move to the left, both locks lever 8 reversed—that is, block r on bar B′ 8 having already dropped below block r'' 9 on bar C 9, is locked down by block r'' 9 moving to the left over it—and releases lever 10 by reason of the bar C 9 carrying the lock A^4 with it, and so withdrawing the shoulder r^3 of the riding lock B‴ from the block r on bar B′ 10, whereby the signal-lever 10 is released. The latter is now reversed, and bar B′ 9 being already depressed by reversal of lever 9, and having carried block r on said bar B′ 9 below r' 10 on bar C 10, is locked in such position by the movement of bar C 10 to the left. Lever 9 is also locked by reversing lever 10 by block r on bar B′ 10 falling in the track of shoulder r^3 on riding lock B‴, which riding lock is now in connection with bar C 9 through the medium of lock A^4 and lever k^2, as above set forth.

One illustration of the advantage of my special and combination locks appears in the operation just described, in which the first movement of switch-lever 4 having at outset locked signal-lever 10 to danger, said signal-lever 10 is afterward unlocked by lock-lever 9, all intermediate changes having been made, and the entire combination being in readiness to disclose signal 10 at safety. I thus avoid the necessity of two signals near A, one to indicate the condition of the straight line, the other to indicate that of the curved line from A to B; for whereas, under the simple block system heretofore used, switch-lever 4, being reversed in the beginning, would lock signal 10 to danger and hold it there, and so necessitate an additional signal to indicate that the curved line was clear when all switches and locks were set therefor, by my improvement the same signal 10, though locked while the changes are making, is unlocked when all the rest are complete, and may then itself be used to indicate safety over the curved line.

Third operation: Let it be desired to take a train from A to D, Fig. 23. First switch-levers 4 and 7 being left normal, switch-lever 5 must be reversed, locking switch-lever 4 normal, signal-lever 2 to danger, and signal-lever 3 to danger, also, until lock-levers 6 and 9 are reversed. Said lock-lever 6 being then reversed locks switches 5, 4, and 7, switch-lever 5 reversed, and switch-levers 4 and 7 normal, and releases switch-lever 8, lock-lever 9, and signal-lever 3 from itself, (lever 6.) Switch-lever 8 being next reversed relocks signal-lever 3, and also locks signal-lever 11 to danger and lock-lever 6 reversed. During its stroke also lock-lever 9 is also locked, but is released at the end of said stroke. Then reversing lock-lever 9 locks switches 8 and switch-lever 8 reversed, and releases signal-lever 10 and signal-lever 3 from itself, (lever 9.) Signal-lever 10 being then reversed locks lock-lever 9 reversed.

Referring now to Figs. 26 and 27, first, reversing lever 5 carries block r on bar B′ 5 down to arrest the movement of block r' on bar C 4 to the right, so locking lever 4 normal. The same movement of bar B′ 5 also moves lower bar, C 5, to the left, carrying block r''' thereon under block r, attached to bar B′ 2, so locking signal-lever 2 normal—that is, to danger. Same movement of said bar C 5 carries special lock A^4 with it by reason of double pawl s being confined in notch s^2 of said bar C 5, the extension n' of said lock A^4 being connected with front end of lever k^2, (see Fig. 28,) which lever is centrally pivoted upon the riding lock B‴, and at its rear end is connected to the extension n' of another special lock, A^4, upon rear bars, C 8 and C 11.

It will now be seen that the movement of lower bar, C 5, to the left, above referred to, carries special lock A^4 and the front end of lever k^2 to the left, which must communicate one-half of said motion to riding lock B‴, whose shoulder r^3 thereby passes under block r on bar B′ 3, locking the same and lever 3 normal—that is, to danger—the rear end of lever k^2 being held fast by reason of bars C 8 and C 11 being not yet unlocked.

The above-described movement of special lock A^4 extends to the notch in upper bar, C 6, when the farther travel of lower bar, C 5, causes the double pawl to leave said bar C 5 and engage said bar C 6 in readiness for the action of lock-lever 6 to withdraw block r^3 on bar C 6 from under block r on bar B′ 3, and so release signal-lever 3 by the action of lever 6. Likewise the movement at the same time of upper bar, C 5, to the right carries the special lock A^4 by means as just described, and its nib r^4 under the block r on bar B′ 3, also locking signal-lever 3 to danger, and in like manner, as before explained, the farther travel of upper bar, C 5, forces the double pawl s out of its notch s^2 5 and into the notch s^2 9 in bar C 9 in readiness for the movement of bar C 9 to withdraw special lock A^4 and its nib r^4 from said block r on bar B′ 3, in like manner as before explained, so releasing signal-lever 3 by the action of lever 9. Next, reversing switch lock-lever 6 locks switches 5 to the cross-over and switches 4 and 7 to the straight line. It also, by depressing bar B′ 6, carries block r thereon down on the right of block r'

on lower bar, C 5, said block and bar having already been moved to the left by the reversing of lever 5. Thus lever 5 is locked reversed by lever 6. The same movement of B′ 6 carries block *r* thereon down to the right of block *r′* on bar C 4, so locking switch-lever 4 normal. By movement of upper bar, C 6, to the right, caused by said downward movement of bar B′ 6, the block *r″* on said bar C 6 is carried under block *r* on bar B′ 7, so locking lever 7 normal. Depression of bar B′ 6 also moves lower bar, C 6, to the left, causing *r′* 6 thereon to pass clear of block *r* on bar B′ 8, so releasing switch-lever 8; also, movement of upper bar, C 6, to the right, caused by depression of bar B′ 6 by means of connection *m′*, causes the lower end of lever k^2 to move to the right twice its own movement, thereby causing the sleeve *m* on lower bar, 6, to move clear of block *r* on bar B′ 9, so releasing lock-lever 9, the upper end of lever k^2 being held fast by bar C 7 locked.

It is obvious that the said sleeve *m* will lock B′ 9 normal only when levers 7 and 6 are normal; for if 7 be reversed and 6 is normal sleeve *m* is clear at the left of block *r* on bar B′ 9. If 7 be normal and 6 reversed *m* is clear at the right of *r*, and if both 7 and 6 are reversed *m* is also clear at the right of *r* on bar B′ 9. The purpose of this is that switch-locks 9 may be held out of engagement when switches 7 are set to the straight lines, and switch-locks 6 are not in engagement and free at all other times; for when switches 7 are so set (normal) as to carry a train to F, and locks 6 (normal) have not been thrown, it must not be possible to throw locks 9, for, according to the rule that the changes must proceed in a direction toward and not from the train, locks 6 must be thrown before locks 9; but at all other times—that is, when switch-lever 7 is set (reversed) to the cross-over and 6 is (normal) not thrown, or when 7 is set (normal) to the straight line and 6 is (reversed) thrown, or when both 7 is set (reversed) to the cross-over and 6 is (reversed) thrown—in either of these cases lock-lever 9 must be free to lock switches 8. Further, the reversing of lock-lever 6 releases signal-lever 3 from said lever 6 by withdrawing shoulder r^3 of riding lock B‴ from under block *r* on bar B′ 3, as before explained in this combination, and in connection with the operation of lower bar, C 5, and upper-bar, C 6, upon special and combination locks, shown in Fig. 28. Said signal-lever 3 is, however, in like manner relocked by the next movement—viz., the reversing of switch-lever 8; for said movement causing bar C 8 to move to the left, said bar carries with it the special lock A^4 on bars C 8 and C 11, the double pawl thereof engaging the notch s^2 in said bar C 8, and said special lock, by its extension *n′*, carrying to the left the rear end of lever k^2, and consequently riding lock B‴, the shoulder r^3 thereon is made to engage under block *r* on bar B′ 3, so relocking signal-lever 3, the special lock A^4 on bars C 5 and C 6 (whose extension *n′* is now the fulcrum of lever k^2) being held fast by reason of upper bar, C 6, which is now holding the special lock, being itself locked. The same reversing of switch-lever 8 locks signal-lever 11 to danger by means of block *r* on bar B′ 8 sinking to the left of block *r″* on bar C 11. It also locks the lock-lever 6 reversed, since in that case block *r′* 6 on lower bar, C 6, being already passed to the left of block *r* on bar B′ 8, the fall of said block *r* upon the right of it locks it in such position. It also, during its stroke, locks lock-lever 9, inasmuch as block *r* on bar B′ 8, in passing vertically by the flange of the block *r″* 9 on bar C 9, forbids any movement of said bar C 9 till it shall have completely passed said flange. Next, reversing lock-lever 9 releases signal-lever 3 from lever 9 by moving nib r^4 of special lock A^4 to the left from under block *r* on B′ 3, which is done by bar C 9 moving to the left and carrying with it the double pawl *s* and lock A^4, the pawl being already in engagement with the notch s^2 in said bar C 9 by the action of upper bar, C 5, already described. The reversing-lever 9 at the same time locks switches 8 and switch-lever 8 reversed, and releases signal-lever 10, which being reversed locks lock-lever 9 reversed.

These last-mentioned changes being also the last changes involved in the second operation, fully described above, reference is made to that description as explaining the completion of the present operation. In this operation, also, as switch-lever 4 remains normal, the reversing of switch-lever 8 and lock-lever 9 has upon combination-lock A^4 and B‴, arranged on bars C 4, C 8, and C 9, the effect only of moving it to the left entirely away from its point of action, whereby it is simply idle in the entire operation.

It will be seen that in the above operation signal-lever 3 is doubly locked at first by action of switch-lever 5, and when released by lever 6 it is still held by lever 9, and before it is released by lever 9 it is again locked by lever 8 reversed, so that lever 3 is held locked throughout the operation both of opening the course from A to D and of restoring the same to the straight lines.

With respect to the combination-lock shown in Figs. 26 and 28, it is obvious that the like effects are produced when bar C 11 is moved to the left as have been before explained to occur when bar C 8 is so moved.

Fourth operation: Let it be desired to take a train from C to F, Fig. 23, or vice versa. In this operation, the switches being all set to the straight lines, all switch-locks are disengaged and all signals set to danger, as above mentioned. First lock-lever 6 is reversed, which locks switches 4, 5, and 7 and their levers normal, and releases lock-lever 9, which is then reversed, locking switches 8 and their levers 8, and releasing signal-levers 2 and 11, the former of which is then reversed, locking

lock-lever 9 reversed if the train is to pass from C to F, or the latter also locking lock-lever 9 reversed if the train is to move from F to C. Pursue, now, the operation last described, omitting, of course, the reversing of switch-lever 5 and the changes consequent thereon, and the reversing of lock-lever 6 will lock switch-levers 4 and 7, as before described. It will also lock lever 5 normal by the falling of block *r* on B′ 6 to the left of block *r′* on bar C 5. It will also release lock-lever 9, as before described. The reversing, then, of lever 9 locks switches 8 and switch-lever 8, as described in the first operation, and releases signal-lever 2, as follows: Depressing bar B′ 9 carries bar C 9 to the left, and with it the lower extremity of compound lever k^2, the center of which has a fixed fulcrum in the end of bar *m′*, secured rigidly to the stand C′. A movement to the right is thus given to the upper end of said lever k^2 and to the rear end, connected therewith, of a second lever, k^2, which lies horizontally above bars C 5 and C 7, and is centrally pivoted to a riding lock, B‴, playing between said bars C 5 and C 7. The front end of the second lever k^2, just mentioned, is connected to bar C 7 by pintle *n″*, which forms a fixed fulcrum therefor, said bar C 7 being for the present locked. Consequent upon the last-mentioned movement of horizontal lever k^2, the riding lock B‴ and its shoulder r^3 are moved to the right from under block *r* on bar B′ 2, so releasing signal-lever 2, whereupon, said lever being reversed, lock-lever 9 is locked reversed by the block *r* on bar B′ 2 falling to the left of shoulder r^3 of riding lock B‴, the same, through its connections with bar C 9, holding the latter reversed.

The reversing of lever 2 sets signal 2 to safety and permits the train to pass; or, if the train be desired to pass from F to C, instead of reversing signal-lever 2, signal-lever 11, which also was released by the reversing of lever 9, by reason of block *r* on bar B′ 9 falling entirely below and clear of the flange of block *r″* on bar C 11, will be reversed, which, in turn, will lock lock-lever 9 reversed by the said flange moving to the left over said block *r* on bar B′ 9. The reversing of lever 11 will also lock signal-lever 2 to danger by carrying the flange of block *r″* 11 to the left under block *r* on bar B′ 2, and will also set signal 11 to safety and permit the train to pass from F to C.

The fourth operation, of sending a train from C to F, just before explained, may be modified to send the train (operation fifth) from C to E by first reversing lever 7 to set the switches 7 to the cross-over, which locks switch-lever 8 normal by carrying block *r′* 7 on bar C 7 to the right and under block *r* on bar B′ 8, and also lock signal-lever 11 normal—that is, to danger—by carrying a similar block, *r′* 7, on bar C 7 to the right and under block *r* on bar B′ 11, and also releases signal-lever 2 by the same movement of bar C 7 to the right, which, by reason of the pintle *n″* thereon, connecting it with horizontal lever k^2, carries riding lock B‴ and its shoulder r^3 from under block *r* on bar B′ 2. Reversing switch-lever 7 and consequent movement of bar C 7, also through the medium of bar *m′* and lever k^2, arranged thereon, causes the sleeve *m* on bar C 6 to move under block *r* on bar B′ 3, so locking signal-lever 3 to danger. Next, reversing lock-lever 6, as described in the last operation, locks switch-levers 4 and 5 normal and 7 reversed by carrying flange of block *r″* on upper bar, C 6, to the right and over the block *r* on bar B′ 7, which is at present depressed, switch-lever 7 being reversed. Finally, reversing lock-lever 6 releases signal-lever 2 by removing block *r′* 6 on lower bar, C 6, from under block *r* on bar B′ 2, and signal-lever 2 being now reversed to set the said signal to safety, train may pass from from C to E.

It will be seen that reversing of lever 6, just described, will not disturb the locking of lever 3, above described, for the reason that the said movement of lower bar, C 6, will affect special lock A^4, arranged thereon, only to the extent of forcing the double pawl *s* into the notch s^2 in lower bar, C 5. The fulcrum, therefore, of lever k^2, in the movement therein referred to, will not be disturbed.

Sixth operation: To take a train from B to E, Fig. 23, switch-lever 5 remains normal and switch-lever 7 is reversed, which locks switch-lever 8 normal and signal-levers 11 and 3 normal—that is, to danger—and releases signal-lever 2 by the means described in the last operation. It also releases signal-lever 1 by removing the sleeve *m* on upper bar, C 5, from under the block *r* on bar B′ 1, said sleeve being rigidly connected by bar *m′* to the riding lock B‴ on said bar C 5 and bar C 7, and deriving its movement from it, as described in the last operation. Now, reversing switch-lever 4 to set the switches 4 to the cross-over locks lever 5 normal by carrying block *r′* on bar C 4 to the right under block *r* on bar B′ 5, so holding switches 5 to the straight lines. It also locks in the same manner signal-lever 2 to danger; also forces pawl *s* of special lock A″, arranged on it, into the notch s^2 of upper bar, C 6, thereby attaching said lock to said bar, (in readiness for bar C 6 to release bar B′ 1 by removing nib r^4 of lock A^2 from under block *r* on bar B′ 1, as will be hereafter required when the reversing of lock-lever 6, locking switches 7, 4, and 5, shall complete the combination, and leave only signal 1 to be cleared.) Reversing switch-lever 4, also by movement of bar C 4 to the right, locks signal-lever 10 to danger, as already described in the second operation, bar C 8 being already locked normal by switch-lever 7, and, in connection with special lock A^4, holding the fulcrum of horizontal lever k^2 fast. It may also be observed that reversing switch-lever 4 during its stroke locks lock-lever 6 normal in a manner already set forth. Now, reversing lock-lever 6 locks switches 7, 4, and 5 in the posi-

tions already indicated, and their switch-levers 7, 4, and 5, by the means already described, and releases signal-lever 1 by the movement of upper bar, C 6, as described in the clause (inclosed) above. Finally, reversing signal-lever 1 locks switch-lever 4 reversed and lock-lever 6 reversed, (the former being already locked by the latter, as already described,) by reason of the block *r* on bar B′ 1 falling to the left of nib r^4 of special lock A″, said lock having already moved to the right by the reversing of switch-lever 4 and lock-lever 6, and its pawls *s* being in same position, as shown, and preventing the return of either. The reversing of lever 1 also locks signal-lever 10 by block *r* on bar B′ 1 falling to the left of block *r′* 10 on bar C 10, and sets signal 1 to safety, so that the train may now pass.

It will be seen that the combination of special lock A^4, lever k^2, arranged upon lower bars, C 4 and C 5, and bar C 7, is substantially identical in structure and operation with the like combination arranged upon bars C 4, C 8, and C 9, the former being arranged vertically and the latter horizontally, and the former employing a sliding sleeve, *m*, and the latter a riding lock.

The above-explained are the most complicated of the operations involved in Fig. 23.

These combination and special locks may be applied to the most complicated system of running trains with absolute safety.

The space on bars C may sometimes be occupied at the point where a special combination-lock should be placed, and to avoid trouble in such cases I use the small sliding sleeve *m* (shown in Fig. 5) upon any bar that affords the necessary space, and place the combination-lock at any available point on its own bars C, and then connect the two locks by a supplementary bar.

Figs. 6 and 10 show a modification of my combination-lock which may be used when all of the locking-bars C move in the same direction, the end of the lever k^2 being moved first, locking the bar B′, which is released again upon movement of the opposite end of the same lever k^2 in the same direction, which is effected by either of the other locking-bars. The last-mentioned result may be accomplished by using the lever k^2, attached to a lock, or one end of another lever, k^2, as desired.

From the foregoing description it is obvious that my special and combination locks may be applied in a great variety of positions and relations upon sets of bars traveling vertically and horizontally; that they may themselves, both in part and in whole, be joined and combined for purposes and effects, as plainly above indicated; that the movement of one or both sets of bars may be by rotation or oscillation instead of longitudinally sliding so long as the movement of either one of the sets may act as a check and release upon the movement of the other.

It is also obvious that the movement of the bars may be actuated by the levers themselves instead of by the catches; but I prefer the latter.

A girt of cylindrical figure embodies the same capacity for support and resistance as the girts of rectangular figure heretofore used, but enables the shoes to be arranged thereon and all the parts to be brought together in a more compact form, and admits of their extension in large machines without modification of their exterior figure. Similar advantages may be gained by a girt of rectangular figure placed with two of its diagonally-opposite corners in a vertical plane and two in a horizontal plane.

What I claim as new, and desire to secure by Letters Patent, is—

1. In an interlocking switch and signal apparatus, a cylindrical girt between its supporting columns or standards, provided with pivotal bearings, in combination with bell-cranks or levers, substantially as and for the purposes set forth.

2. A girt having projections *a′*, with slots *b* and recesses *c*, in combination with pins a^2, keys a^3, and straps E, substantially as and for the purposes set forth.

3. The end plates, A, having an angular base, a^4, in combination with and bolted to the flanges *i′ i* of columns H and girt B, the base of said plates being constructed to leave a ledge or rest on flange *i′* for the support of flange *i* of girt B, substantially as shown and set forth.

4. The end plates, A, having an angular base, a^4, provided with a web or webs, a^5, for affording the requisite strength to the plates, in combination with and bolted to the flanges *i′ i* of columns H and girt B, substantially as shown and set forth.

5. The base of the column H, having a recess, *q*, forming a shoulder, *p*, below, to receive and support the flange *i* of bell-crank girt D in a line flush with the inner side of the base, substantially as and for the purposes set forth.

6. The shoes A‴, having slots *f′* and *f″* formed therein at less than a right angle with relation to each other, *f″* being continuous through the shoes, and the boss *f‴* located at or near the rear angle of the shoes, whereby said shoes may be pivoted low upon the girt and have full clearance of other parts, and the levers, when normal, stand at or near a vertical position, substantially as and for the purposes set forth.

7. The combination, with a girt, B, of the shoes A‴, having the through-slot *f″*, constructed with relation to the pivotal connection of the shoe with the girt, whereby a continuous bar, F F′, may be used for counterweight and signal-connection, and the shoes, when normal, may overhang the girt, substantially as and for the purposes set forth.

8. The combination, with a girt, B, of the shoe A‴, provided with the slots *f′ f″*, to receive the lever and connecting-bar, and hav-

ing the boss f''' at or near the rear angle, as shown, and for the purposes set forth.

9. The locking devices I″, having arms b^2 b^3, permanently fastened to the hand-levers A′, in combination with the segment-levers I, substantially as and for the purposes set forth.

10. In an interlocking switch and signal apparatus, the solid segment-levers I, pivoted to the floor-plate, in combination with the hand-levers, substantially as and for the purposes set forth.

11. The catch-guide K, provided with friction-rollers l g' h^2 and spiral springs i''', in combination with segment-levers I, catch-rods N, and hand-levers A′, substantially as and for the purposes set forth.

12. The combination of the arcs e on the under side of the floor-plate with the catch-guides K and hand-levers A′, substantially as and for the purposes set forth.

13. The combination of the shoes A‴, catch-guides K, locking devices I″, hand-levers A′, and segment-levers I, substantially as and for the purposes set forth.

14. The combination of the lock-bars B′ and segment-levers I by means of connecting-arms P and friction-rollers R R, substantially as and for the purposes set forth.

15. The floor-plate E′, provided with flanges f f and lugs e^3, in combination with lock-bars B′, substantially as and for the purposes set forth.

16. The combination of the connecting-block carrying the number-plate L with the rod N and handle M, substantially as and for the purposes set forth.

17. In an interlocking apparatus, the combination, with lock-bars B′, having locking projections, of interlocking bars C, arranged in series on both sides of bars B′, and placed at a sufficient distance from the lock-bars B′ to allow the use of projections on both series of bars C, whereby special and combination locks may be used between and upon the bars, to engage with the bars only which require to interlock, substantially as set forth.

18. The lever k^2, in combination with interlocking bars, whereby the movement of one interlocking bar may modify the operation and effect of another interlocking bar, substantially as and for the purposes set forth.

19. The lever k^2, in combination with the riding lock B″ and interlocking bars, substantially as and for the purposes set forth.

20. The lever k^2, in combination with the riding lock B‴ and interlocking bars, substantially as and for the purposes set forth.

21. The lever k^2, in combination with the sliding sleeve m and interlocking bars, substantially as and for the purposes set forth.

22. The lever k^2, having connecting-bars m' m', in combination with the sliding sleeve m and interlocking bars, substantially as and for the purposes set forth.

23. The lever k^2, in combination with the special lock A^4 and one or more of the interlocking bars C, substantially as and for the purposes set forth.

24. The double pawl s, in combination with the interlocking bars C, provided with the notches s^2, to receive the pawl, substantially as and for the purposes set forth.

25. The lock A″, provided with the double pawl, in combination with the interlocking bars having the notches s^2, substantially as and for the purposes set forth.

26. The lock A^4, having the extension n', and provided with the pawl s, in combination with the bars C, having the notches s^2, substantially as and for the purposes set forth.

27. The lock A^4, in combination with the lock B″ and the interlocking bars C, substantially as and for the purposes set forth.

28. The lock A^4, in combination with the lock B‴ and the interlocking bars C, substantially as and for the purposes set forth.

29. The lock A^4, in combination with the locking-sleeve m, lever k^2, and interlocking bars C, substantially as and for the purposes set forth.

30. The lock A^4, in combination with the locking sleeve m, connecting-bars m', lever k^2, and the interlocking bars C, substantially as and for the purposes set forth.

31. A special lock provided with vibrating angular points, in combination with interlocking bars, in such manner and in such relation to the direction of their movement that moving in one direction either of two bars will move the lock, and moving in the other direction both of two bars will be requisite to move the lock, substantially as and for the purposes set forth.

32. The combination, with interlocking bars, of a special lock consisting of a lever, k^2, and a sliding lock or sleeve so arranged on said bars and in such relation to their movement that the movement of one bar in one direction shall lock, and that of another in the opposite direction shall release, (or the converse,) a lever, substantially as and for the purposes set forth.

33. The combination, with interlocking bars and a lever, k^2, of a special lock and a riding lock so arranged on said bars and in such relation to the direction of their movement that the movement of one bar shall lock a lever, another shall release, and another shall relock the same lever, substantially as and for the purposes set forth.

34. The combination, with interlocking bars and a lever, k^2, of riding and special locks so arranged thereon and in such relation to their direction of movement that one of said bars shall lock, another release, and either of two others relock (or the converse) a lever, substantially as and for the purposes set forth.

35. The combination, with interlocking bars and a sleeve, m, of a special lock, in such manner that said sleeve shall partake of the movement of said special lock, substantially as and for the purposes set forth.

36. The combination, with interlocking bars,

of a sleeve, *m*, and a riding lock, in such manner that said sleeve partakes of the movement of said riding lock, substantially as and for the purposes set forth.

37. A locking-piece arranged and adapted to ride upon one or more interlocking bars, in combination with a lever, k^2, substantially as and for the purposes set forth.

38. A locking-piece arranged and adapted to ride opon one or more interlocking bars, in combination with a special lock, A″, substantially as and for the purposes set forth.

39. The combination, with two interlocking bars adapted to move in the same direction and provided with notches and with points s^3, inclining in the same direction, of a special lock, A^4, arranged thereon and provided with a double pawl adapted to engage said points, whereby either of said bars may move said lock, substantially as and for the purposes set forth.

40. The combination, with two interlocking bars adapted to move in the same direction and provided with notches and with points s^3, inclining in a direction opposite to the movement of said bars, of a special lock, A″, arranged thereon and provided with a double pawl adapted to engage said points, whereby the movement of both said bars is requisite to move said lock, substantially as and for the purposes set forth.

41. The combination of a lever or levers, k^2, with a riding lock and interlocking bars, substantially as and for the purposes set forth.

42. The switch-lever G, pivoted at the center to the connection d^3, and having its ends connected with the hand-levers of an interlocking switch and signal apparatus, all combined to operate switches or signals, substantially as and for the purposes set forth.

43. The tie plates and guides *u u′*, in combination with the lock-bars B′ and stands C′, the tie-plates being provided with angular projections on their inner ends to fit in a groove in the top of the middle stand, and fastened to the top of the stands by screws or bolts, substantially as and for the purposes set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 25th day of October, 1879.

ALBERT G. CUMMINGS.

Witnesses:

GILBERT THOMPSON,

W. C. DUVALL.