J. W. BRYCE.

RECORDING LOCK SYSTEM.

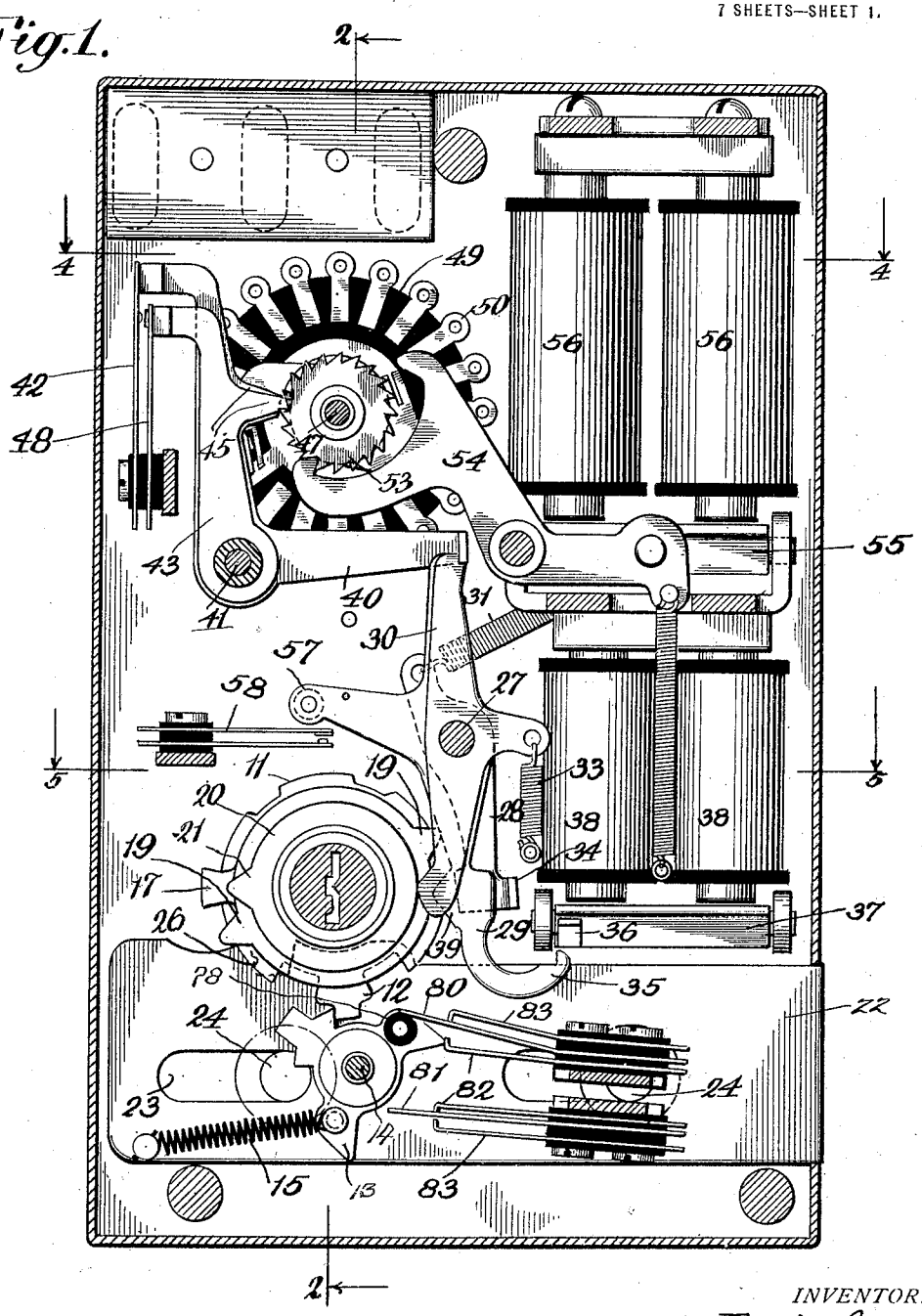
APPLICATION FILED JULY 16, 1919.

1,390,017.

Patented Sept. 6, 1921.

7 SHEETS—SHEET 1.

Fig. 1.



INVENTOR.

James W. Bryce

BY

Kerr, Page, Cooper & Hayward

ATTORNEYS.

J. W. BRYCE.

RECORDING LOCK SYSTEM.

APPLICATION FILED JULY 16, 1919.

1,390,017.

Patented Sept. 6, 1921.

7 SHEETS—SHEET 2.

Fig. 2.

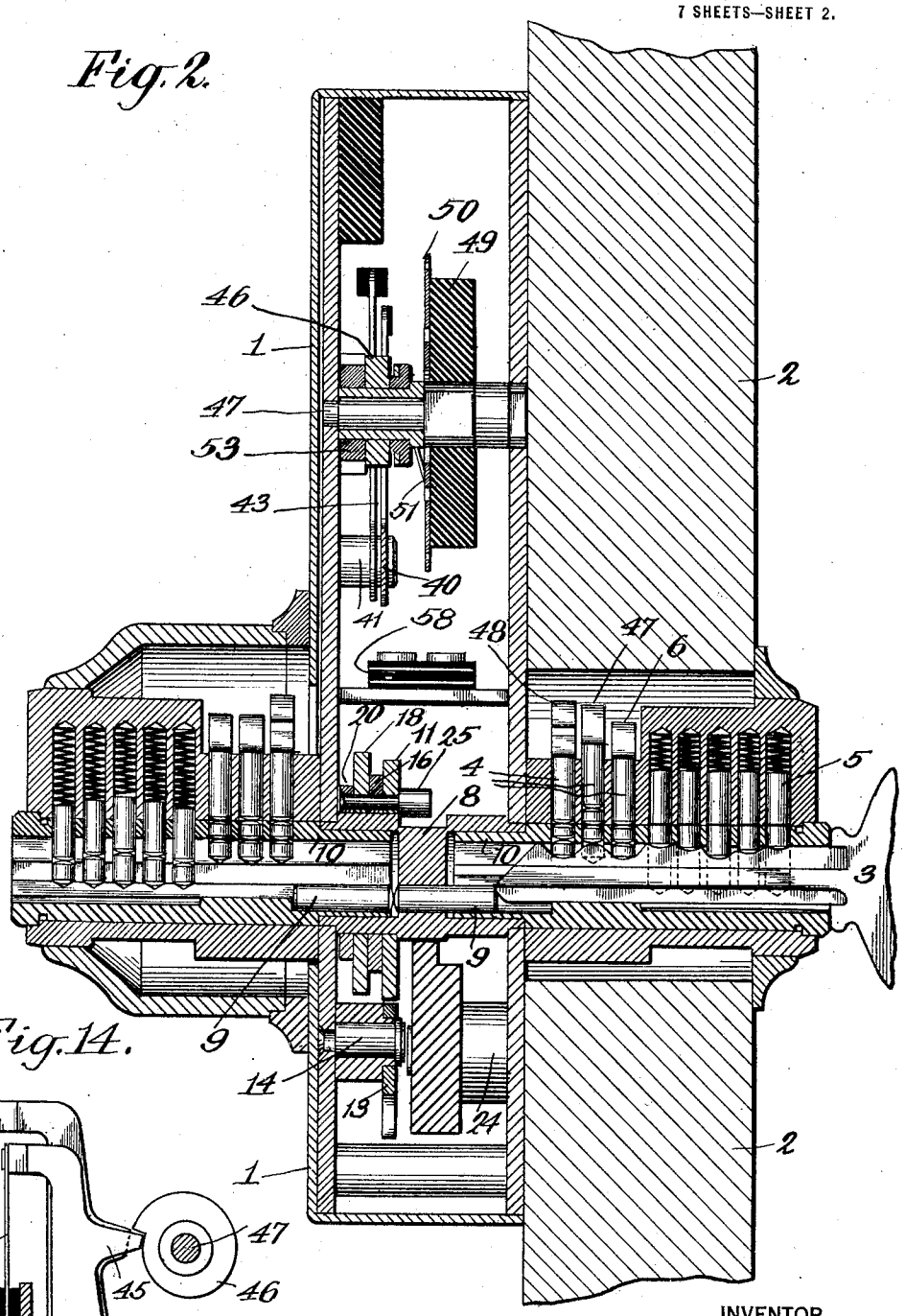


Fig. 14.

INVENTOR

James W. Bryce

BY

Kerr, Page, Cooper & Hayward

ATTORNEYS

J. W. BRYCE.

RECORDING LOCK SYSTEM.

APPLICATION FILED JULY 16, 1919.

1,390,017.

Patented Sept. 6, 1921.

7 SHEETS—SHEET 3.

Fig. 3.

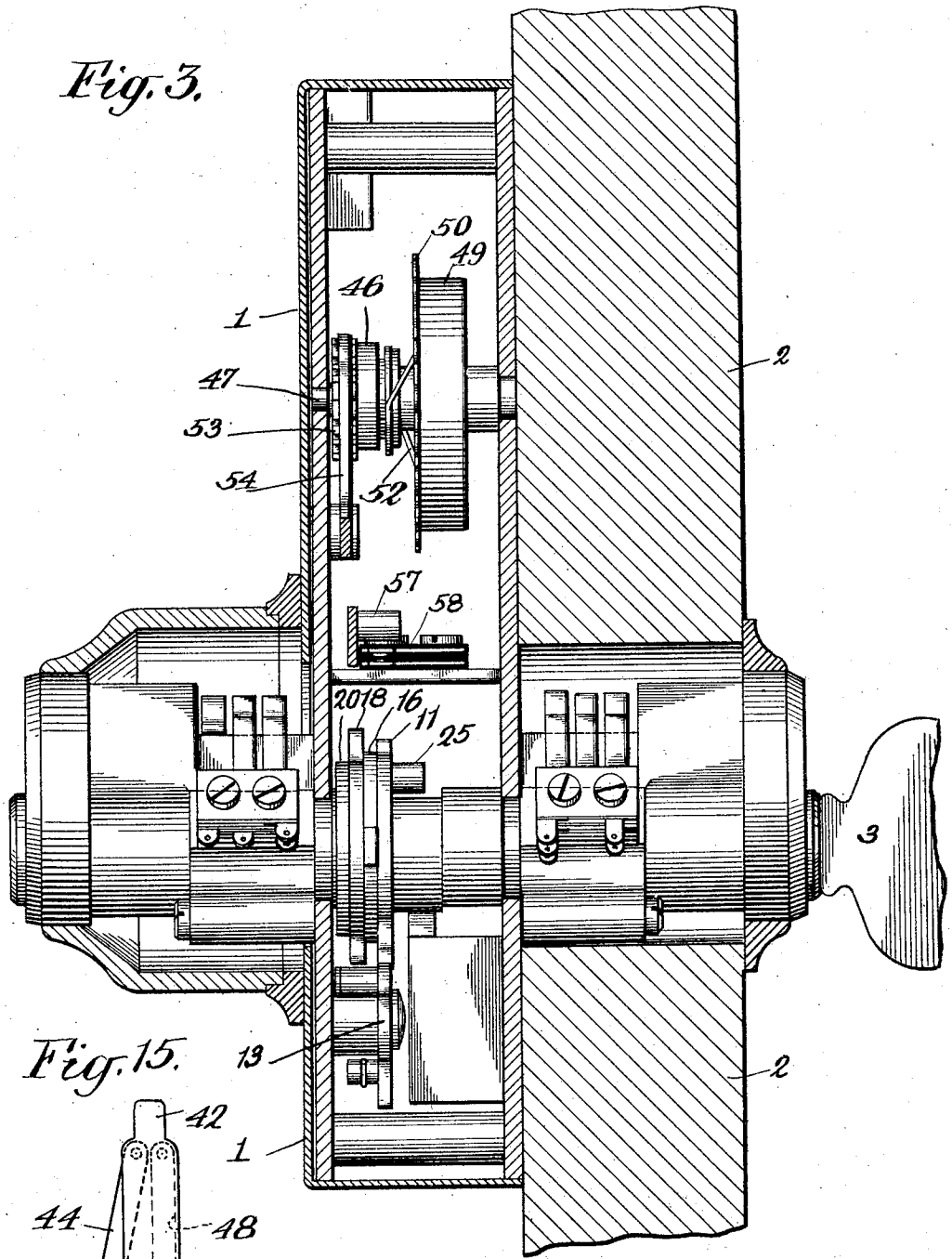


Fig. 15.

INVENTOR

James W. Bryce

BY

Kerr, Page, Cooper & Hayward

ATTORNEYS

J. W. BRYCE.

RECORDING LOCK SYSTEM.

APPLICATION FILED JULY 16, 1919.

1,390,017.

Patented Sept. 6, 1921.

7 SHEETS—SHEET 4.

Fig. 4.

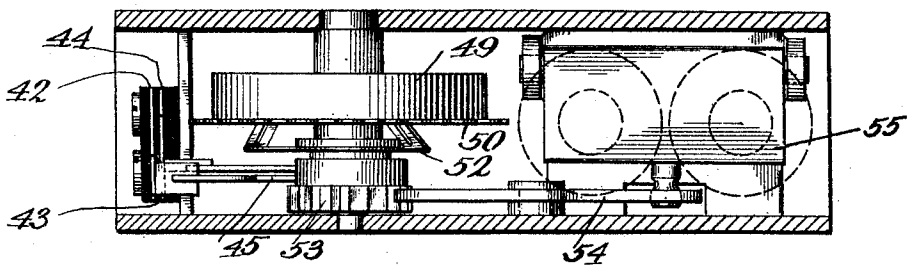
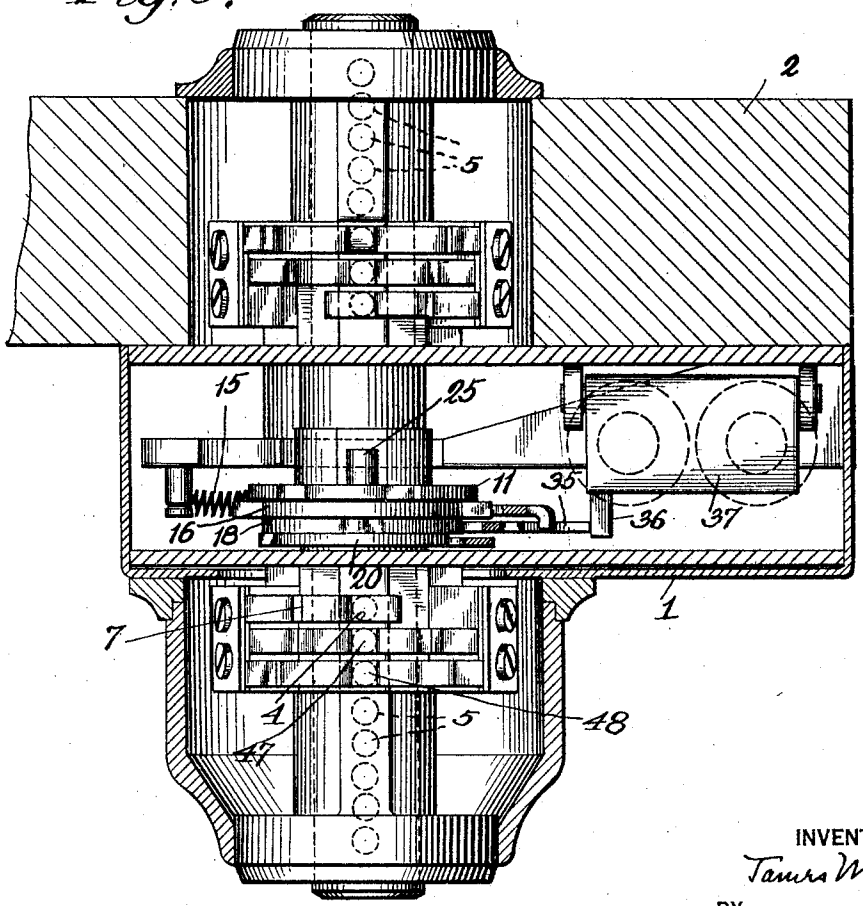


Fig. 5.



INVENTOR

James W. Bryce

BY

Kerr, Page, Cooper & Hayward

ATTORNEYS

J. W. BRYCE.

RECORDING LOCK SYSTEM.

APPLICATION FILED JULY 16, 1919.

1,390,017.

Patented Sept. 6, 1921.

7 SHEETS—SHEET 5.

Fig. 6.

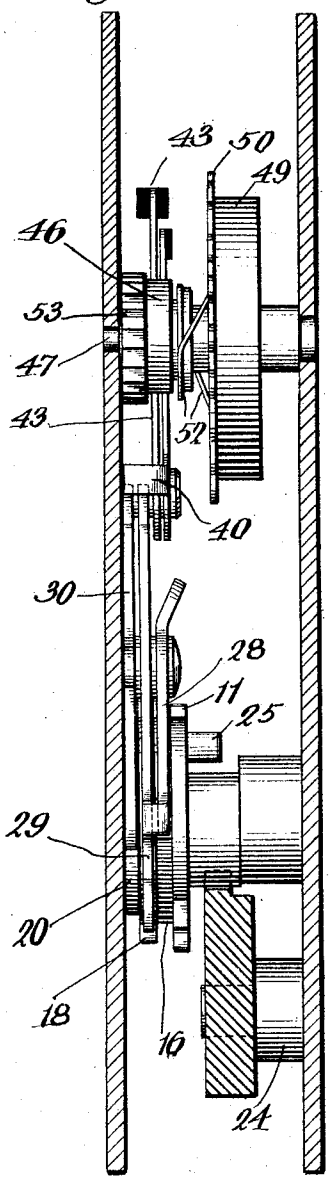
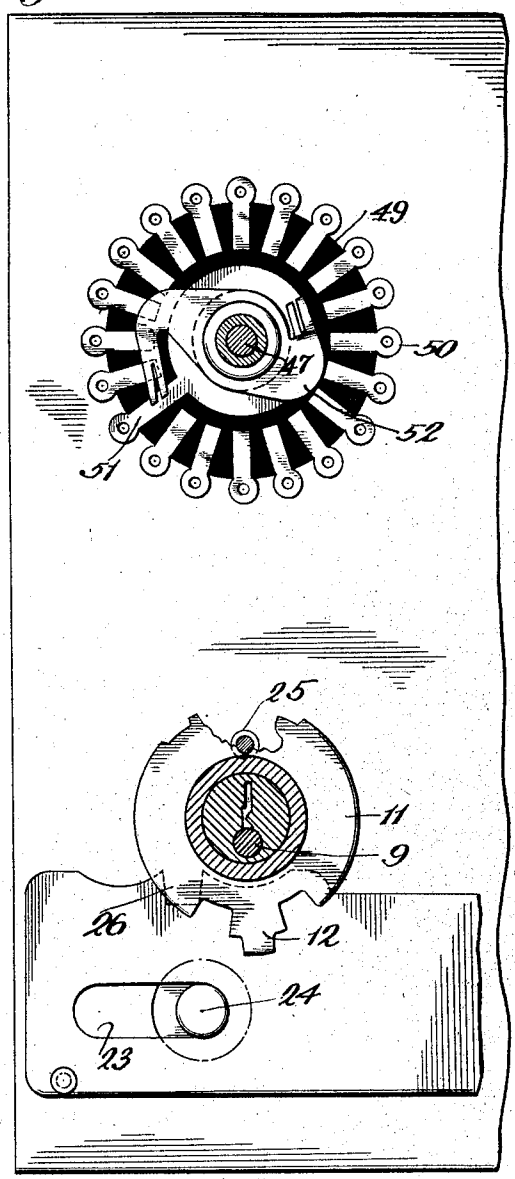


Fig. 7.



INVENTOR

James W. Bryce

BY

Kerr, Page, Cooper & Haywood

ATTORNEYS

J. W. BRYCE.

RECORDING LOCK SYSTEM.

APPLICATION FILED JULY 16, 1919.

1,390,017. Patented Sept. 6, 1921.

7 SHEETS—SHEET 6.

Fig. 8.

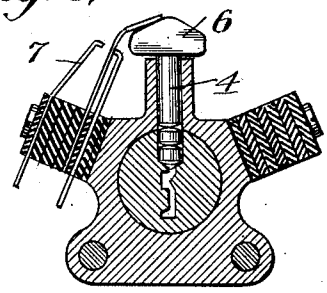


Fig. 9.

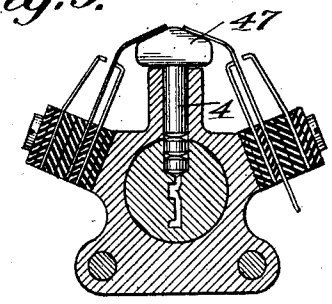


Fig. 10.

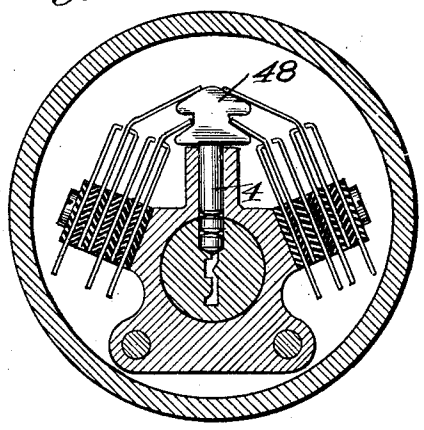


Fig. 11.

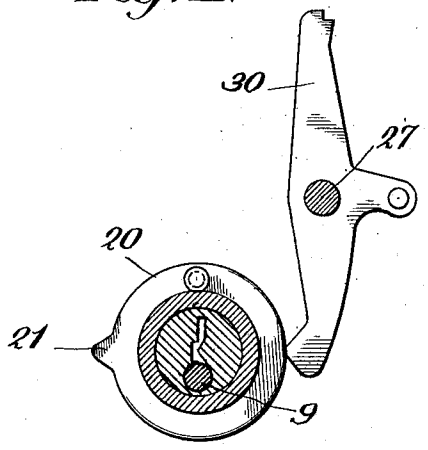


Fig. 12.

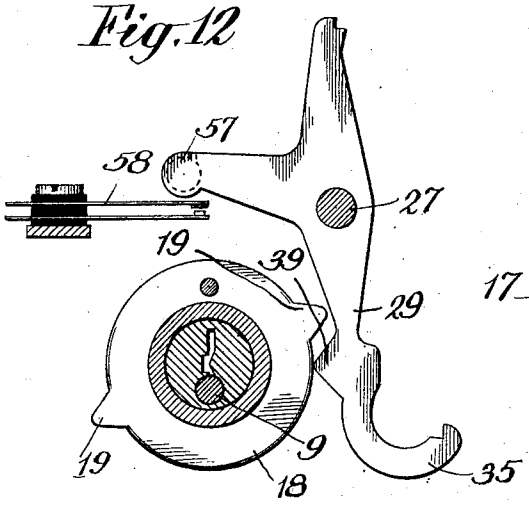
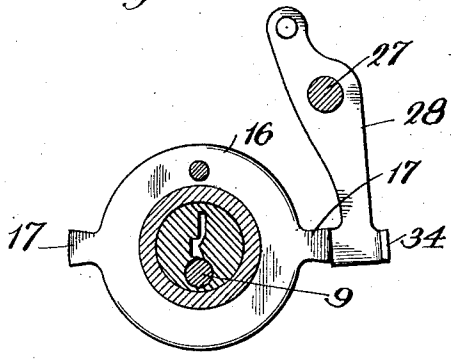


Fig. 13.



INVENTOR

James W. Bryce

BY

Kerr, Page, Cooper & Hayward

ATTORNEYS

J. W. BRYCE.

RECORDING LOCK SYSTEM.

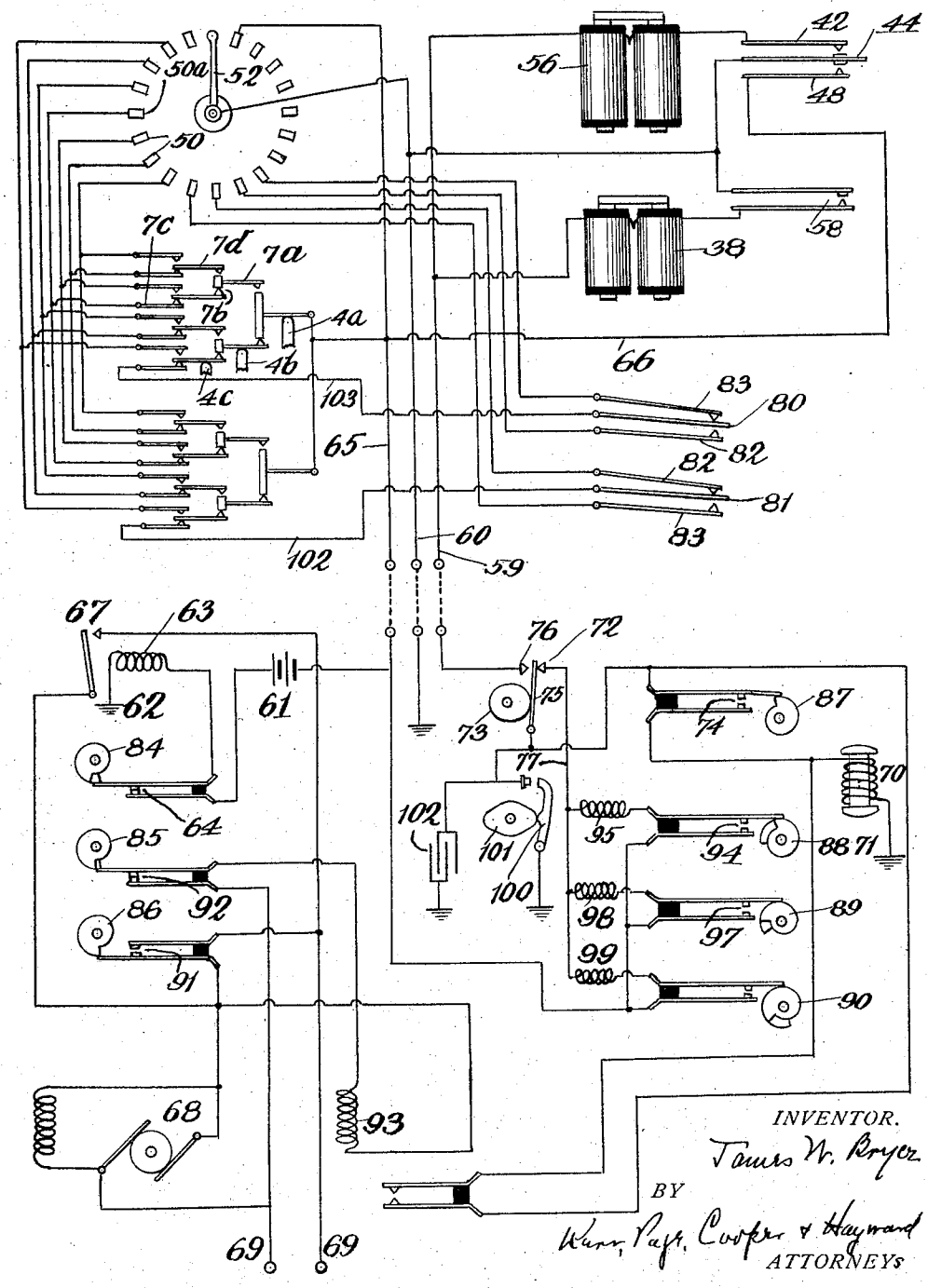
APPLICATION FILED JULY 16, 1919.

1,390,017.

Patented Sept. 6, 1921.

7 SHEETS—SHEET 7.

Fig. 16.



INVENTOR.

James W. Bryce

BY

Wm. Pafe, Cooper & Hayward

ATTORNEYS

UNITED STATES PATENT OFFICE.

JAMES W. BRYCE, OF BINGHAMTON, NEW YORK.

RECORDING-LOCK SYSTEM.

1,390,017. Specification of Letters Patent. Patented Sept. 6, 1921.

Application filed July 16, 1919. Serial No. 311,120.

To all whom it may concern:

Be it known that I, JAMES W. BRYCE, a citizen of the United States, residing at Binghamton, in the county of Broome and State of New York, have invented certain new and useful Improvements in Recording-Lock Systems, of which the following is a full, clear, and exact description.

In the specification which follows I shall describe an invention for which I now seek protection by Letters Patent, which is an improvement in what are now generally known as recording locks. These locks are designed to record in permanent form certain information with regard to their use or operation, such as the time at which the lock was operated, either for unlocking or locking the door to which it is attached, whether it was operated from the outside or the inside, the number of the key and the like.

At the present time such locks as are used for this purpose are so designed and constructed that the insertion and turning of a key therein will operate through means of suitable mechanism incorporated with or forming a part of the lock itself, to send over properly arranged circuits current impulses to a recorder which prints the data corresponding to such impulses on a paper sheet or strip. Heretofore, however, these locks have been of too complicated a character and have had associated with them mechanism of various kinds which required more space than an ordinary lock usually affords, and in general have been required to perform a number of operations which could be more effectively and profitably carried out by the recorder itself. It has been mainly my purpose to simplify their construction and to reduce the number of parts which they involve.

With this object in view I have devised the lock herein shown and claimed. I have not illustrated herein in detail the recorder for use with the system, for the general nature of such instrumentalities is known, but I have shown the essential parts diagrammatically and shall show and describe its construction and operation more fully in another application hereafter to be filed.

In the case at hand the drawings show the details of the lock proper, and illustrate its operation by means of certain diagrams.

Figure 1 is a view in elevation of a complete lock the side of the inclosing casing being removed to exhibit its interior.

Fig. 2 is a vertical section on the line 2—2 of Fig. 1.

Fig. 3 is a side view of the lock mechanism proper.

Fig. 4 is a cross section on line 4—4 of Fig. 1.

Fig. 5 is a similar view on the line 5—5 of Fig. 1.

Fig. 6 is a vertical section of the lock mechanism similar to Fig. 2, but on a line farther to the right.

Fig. 7 is a view of the inner side of one of the plates of the lock with the parts attached thereto.

Figs. 8, 9 and 10 are sectional views of the key controlled contact mechanism.

Figs. 11, 12 and 13 are details of certain key controlled levers.

Figs. 14 and 15 are detail views of certain cam controlled contacts, and

Fig. 16 is a diagram of the system as a whole showing the circuit connections in and between the lock and the recorder.

Similar reference numerals indicate corresponding parts in the several figures.

The lock which I prefer to employ is of the general style and plan of construction of a Yale lock and the key is of the character usually provided for such locks, with certain modifications hereinafter to be described. Such a lock and key are shown in Fig. 2 of the drawings. The casing 1 is assumed to be secured to a door 2 and to be double, one side being accessible from the outside and the other from the inside of the door. The key 3 is of the usual pattern, but is made somewhat longer than would be necessary for the operation of the lock proper, in order that it may operate upon a certain number, preferably three, of tumblers 4 which are provided for controlling circuits to the recorder.

When the key 3 is inserted into the lock, say from the outside of the door, it sets the tumblers or plungers 5 to operate the lock, while the extended end of the key sets the three additional tumblers 4, raising any one, two or all of the same, as the case may be, and thereby closing corresponding circuits by the means shown in Figs. 8, 9 and 10.

In these figures the plungers 4 are shown as provided with heads 6 which on being raised separate two and bring together two of three contacts 7 and thus break one or more and complete one, two or more circuits, which remain closed as long as the key is in the lock and whether it is turned or not, following in this respect the action of the key tumblers 5.

As the key may be inserted from either side of the lock, it is necessary for the proper operation to turn the central member 8, for which purpose this part is provided with a transverse perforation and two sliding pins 9 are placed in line therewith which by the insertion of a key are forced into such perforation to connect the member 8 with either the right or the left hand part of the lock.

The central member 8 has its ends hollowed out to constitute two sleeves which fit over the tubular key holders 10 so that it is turned only by that lock or key holder which is connected with it by one or the other of the pins 9, and it carries a disk 11 which is formed with a projection 12, Figs. 1 and 7, which engages with a full stroke pawl 13 pivoted at 14 to the lock frame and retracted by a spring 15.

The left hand cylindrical part or sleeve of said member 8 also carries a second disk 16 having two projections 17 extending from diametrically opposite points of its periphery. A third disk 18 secured alongside the others to the member 8 has two diametrically opposite pointed projections 19 extending from its periphery, while a fourth disk 20 is also secured beside disk 18 and this has a single pointed projection 21.

The lock bolt 22 contains two longitudinal slots 23 through which project the guiding pins 24. From the side of disk 11 projects a stud 25 that is adapted to engage with a notch 26, Fig. 7, in the top of the bolt, so that when the key is turned the bolt by such engagement is thrown.

Pivoted at 27 are three levers 28, 29 and 30. A spring 31 is connected with lever 28, a spring 32 with lever 29 and a spring 33 with lever 30, by means of which these levers are actuated. The lever 28 has a turned up end 34 adapted to engage with the second or middle lever 29, and this latter has a hooked end 35, adapted to engage with a stop 36 on the armature 37 of an electro-magnet 38. The said lever 29 has also a pointed projection 39 that rides on the periphery of the disk 18.

The upper ends of levers 29 and 30 engage with the turned up end of a lever 40 pivoted at 41 and having an insulating end that is adapted to encounter one of three contacts 42, see Figs. 14 and 15. About the same center 41 also turns a lever 43 with an insulating end that encounters another of the said contacts 44. Both levers 40 and 43 have projections 45 that bear on a cam 46, Fig. 16, on the shaft 47. These parts are so designed that when levers 29 and 30 engage with lever 40 the contacts 42 and 44 are in engagement and contact 42 also touches the third contact 48, Fig. 15, with the result to be described.

Surrounding the shaft 47 is an annular insulating disk 49 carrying twenty conducting segments 50 and a circular plate 51, Fig. 7. The shaft carries a contact 52 one end of which sweeps over the circular series of segments 50 and the other over the circular plate 51. The shaft also carries a ratchet wheel 53 adapted to be operated step by step by a driving fork 54 oscillated by the armature 55 of an electro-magnet 56.

Referring now to Fig. 16, when a key is inserted in the lock it raises any one or more of the plungers 4 and closes the circuits controlled thereby, and these circuits remain closed as long as the key is allowed to remain in the lock. The first result of inserting and turning a key through a short arc is to bring one of the projections 19 on cam 18 into engagement with the lever 29 and throw the hooked end of that lever over to the right. If magnet 38 is at that moment energized, the hooked end of the lever does not engage with the stop 36 on armature 37 and the lever therefore immediately falls back into a position where one of the projections 17 of the disk 16 engages with a projection on lever 28 which returns to the left with the lever 29. This locks the disks and prevents the key from being turned any farther in the lock. The magnet 38 is what is known as the non-interference magnet and whenever any other lock in the system is being operated and current on the line, this magnet will be energized so that the lock with which it is associated cannot be operated until after such other lock has been used.

On the other hand, should magnet 38 not be energized, which means that no other lock in the system is being operated, its armature 37 is in its lowermost position, and when the lever 29 is shifted by the key its hooked end engages the stop 36 and is held up thereby, and retains lever 28 in position where it does not interfere with the free movement of the lock.

The operation of the non-interference magnet 38 is controlled by the lever 29 in the following manner. When the said lever is shifted on the initial movement of the key by one of the points 19 on disk 18 a stop 57 at its upper end engages and brings together two contacts 58 which close a path through the magnet 38 from one side of line circuit 59 to the common return wire 60. Hence if there is any lock being operated on any other part of the circuit which is in multiple with this, the current thereby

caused to flow will also pass through magnet 38 and energize it. If no such current be flowing the magnet 38 is not affected by the closing of contacts 58.

Assuming that the line conditions are such as to permit the key to be turned, after it has been turned through 90° the single projection 21 on the disk 20 engages the lever 30 and throws it out of engagement with lever 40 and as at this moment the lever 29 locked up by the stop 36 is also out of engagement with the said lever 40, the latter is released and a circuit is established between contacts 42 and 44 and thus throws the stepping magnet 56 into a circuit between the grounded common return wire 60 and one of the line wires 59.

At the recorder a battery 61 is normally grounded at 62, through a circuit controller 64 and a relay magnet 63, hence when contacts 42, 44 and 48 are together, the current from battery 61 starting at ground 62 flows over wire 65 and wire 66 to contact 48 and thence by contact 44 and wire 60 back to ground. The relay magnet 63 is thus energized and closes contacts 67 which throw a motor 68 into a power circuit the wires of which are marked 69.

The motor 68 drives a magneto 70 which produces alternating currents. One terminal of this magneto is grounded at 71 and the other is connected through a circuit controller 74 with a swinging contact arm 75 adapted to be oscillated between two contacts 72 and 76 in such manner by an eccentric or cam 73 on the shaft of the magneto that positive impulses of current from the magneto will be sent to line and through the stepping magnet 56 and the negative impulses to a wire 77. The positive current impulses received by magnet 56 cause that magnet through its armature 55 and the pawl 54, to rotate the ratchet wheel 53 and the contact arm 52 step by step over the circular series of contacts 50.

The negative current impulses during the low portion of the wave pass to ground through a contact arm 100, reciprocated by a double cam 101 on the magneto shaft, but the crests of the waves pass through contact 72 to wire 77, when their influence will be exerted in the manner hereinafter to be described. A condenser 102 is connected with the contact 75 and grounded to modify the impulses in the well understood way.

In every operation of a lock, one of the segments 50 which indicates the particular key used, will be rendered live or active during the first part of the cycle; another which indicates whether the key was inserted from the inside or outside will be rendered active during the second part of the cycle; and a third which indicates the particular lock used will be permanently connected in a circuit which is active during the last part of the cycle; so that as the contact 52 sweeps over the segments the proper circuits will be closed to record this data. These operations will be effected by the means to be now described. I have shown three controlled tumblers or plungers 4 and by means of a plurality of combinations may be obtained which will connect up with an active circuit any one of a plurality of segments to indicate any of eight different keys, and these combinations are effected in the following manner. By reference to Fig. 8 it will be seen that one plunger 4 makes one contact and breaks one. The plunger shown in Fig. 9 makes two contacts and breaks two, while that of Fig. 10 makes four and breaks four. Bearing this in mind and turning to the diagram Fig. 16 if the first plunger indicated by 4^a be raised it makes only one contact so that the circuit is partly made from the common return wire 60 to the contact arm 52 and is completed from wire 65 to contact 7^a then through contact 7^b to contact 7^c to segment 50^a and to the contact arm when it reaches that segment.

In a similar manner each plunger carries the circuit to one of the other segments, and more than these segments may be connected to the line by simultaneously raising two or more plungers. For example, suppose plunger 4^a and 4^b both be raised. Then the current will flow to contact 7^a but not from there to 7^b as the contact there is broken by 4^b, but to 7^d where contact has been made by 4^b.

Thus it will be seen that each key sets up its combination by which one of the first group of segments corresponding to it is connected to the circuit, so that a current may be caused to flow when the contact 52 reaches that segment, and this current may be utilized in any well known way to set a type wheel to indicate the number or letter designating such key.

There are two sets of plungers 4, one being the lettered set shown in the diagrammatic view which is effective when the key is inserted from the outside and the other lower unlettered set being indentical with the first set and effective when a key is inserted from the inside. Both these sets of contacts are connected in multiple to the line 65 through wire 66 and wire 104. Either set upon being operated selectively connects a particular segment 50^a to line 65 in accordance with the key number.

In addition to the key number setting devices, means are provided for selectively connecting certain segments to determine circuits which show whether the key is operated to lock or unlock the door and whether it has been inserted from the inside

or outside. For this purpose four segments are used. The means for determining the unlocking or locking status will now be described. The pawl 13, Fig. 1, carries an insulating stud 78 which on the movement of the pawl engages with one or the other of two central spring contacts 80 and 81, and shifts them from their normal engagement with contacts 82 into engagement with contacts 83. Following now the diagram, Fig. 16, and assuming that the key is inserted and turned to lock the door it moves the contact 80 from contact 82 to contact 83. On the other hand, if the key be turned to unlock the door, then contact 80 will drop onto contact 82, and contact 81 will be forced into engagement with contact 83.

The center contacts 80 and 81 are connected respectively by wires 103 or 102 with the lowermost contacts of the key number combination devices so that either line 103 or 102 is always in circuit with line wire 65. If a key be inserted from the outside and turned the upper lettered combination of contacts will be actuated by the key and the circuit from line 65 to wire 103 will be interrupted by one or another of the lettered contacts. However, with the key outside the lower contact devices are in the position shown and a circuit is established from wire 65 through 66, wire 104 through the unlettered lower (inside) contact combination devices to wire 102. Similarly if the key is inserted from the inside wire 102 will be dead and wire 103 will be alive. The foregoing connections establish live circuit conditions for contact 80 and open circuit conditions for contact 81 when the key is operated from the inside and the opposite circuit conditions when the key is operated from the outside. From the contacts 83—80, 80—82, 82—81 and 81—83 four wires lead to the four segments 50^a which respectively correspond to the following respective door lock conditions: locked outside, unlocked outside, locked inside, unlocked inside. The circuits traced all extent from wire 65.

The main or motor shaft of the recorder carries seven cams which are designated 84, 85, 86, 87, 88, 89 and 90, and these cams have the following functions. Cam 84 is that which closes the circuit of battery 61 through the relay magnet 63, and is known as the starting relay cam; it is in a position to close this circuit at the beginning of a cycle, and the path for the current impulses which the relay magnet receives through it will be from ground 62 through the contacts 64, the battery 61, wire 65, wire 66, contacts 48 and 44 to the common return wire 60. It will be observed that the motor is not to be started until a key has been inserted and turned in the lock, but such turning completes the circuit which energizes the starting relay, and the cam 84 opens immediately after the motor is started, and does not close again until just before the end of the cycle.

The cam 86 is known as the motor control cam. Normally the motor is on open circuit, but by the starting relay the power circuit is closed for a brief period to start it in operation. Immediately after the beginning of the cycle the motor cam closes and stays closed until near the end of the cycle, and this maintains the motor in the power circuit through the contacts 91.

The cam 85 is known as the clutch cam. It closes a circuit from one of the power circuit wires 69 through contacts 92 and electro-magnet 93 which throws in the clutch (not shown) and thence to the other power circuit wire through the relay contacts 67. The cam 85 closes this circuit before relay 63 is deënergized and breaks it immediately afterward, and the clutch controlled by magnet 93 is of the one cycle variety, that is to say, it remains operative for one revolution after it is once thrown in. The closing of the clutch magnet circuit is timed to take place just after the motor is started in motion.

Cam 87 is the magneto circuit controlling cam, which closes contacts 74 near the beginning of each cycle and opens them near its close.

Cam 88 is that which controls contacts 94 by means of which negative impulses of current are sent to line through an electro-magnet 95 which sets the type wheel that indicates the particular key used. These impulses, it will be seen, come from one pole of the magneto through contact arm 75, the back contact 72, pass through the magnet 95 and the contacts 94 which, by the cam 88, are kept closed only during the first part of the cycle, and from thence flow by wire 65 to one or another of the first group of contacts 50, which represent keys.

Cam 89 is that which controls contacts 97, and by them completes the circuit through the magnet 98 that sets the type wheel to indicate whether the key was inserted from the outside or the inside, and whether it was used to lock or to unlock the door. This cam keeps the circuit through magnet 98 closed through the second part of the cycle only.

Cam 90 is that which keeps the circuit closed through magnet 99 to the contact 50 that indicates the lock used, and is operative for this purpose during the latter part of each cycle only.

It will be understood that the closing of the contacts controlled by cams 88, 89 and 90 is effected out of phase. This will be understood by referring to the diagram and considering all of the cams as being located

caused to flow will also pass through magnet 38 and energize it. If no such current be flowing the magnet 38 is not affected by the closing of contacts 58.

Assuming that the line conditions are such as to permit the key to be turned, after it has been turned through 90° the single projection 21 on the disk 20 engages the lever 30 and throws it out of engagement with lever 40 and as at this moment the lever 29 locked up by the stop 36 is also out of engagement with the said lever 40, the latter is released and a circuit is established between contacts 42 and 44 and thus throws the stepping magnet 56 into a circuit between the grounded common return wire 60 and one of the line wires 59.

At the recorder a battery 61 is normally grounded at 62, through a circuit controller 64 and a relay magnet 63, hence when contacts 42, 44 and 48 are together, the current from battery 61 starting at ground 62 flows over wire 65 and wire 66 to contact 48 and thence by contact 44 and wire 60 back to ground. The relay magnet 63 is thus energized and closes contacts 67 which throw a motor 68 into a power circuit the wires of which are marked 69.

The motor 68 drives a magneto 70 which produces alternating currents. One terminal of this magneto is grounded at 71 and the other is connected through a circuit controller 74 with a swinging contact arm 75 adapted to be oscillated between two contacts 72 and 76 in such manner by an eccentric or cam 73 on the shaft of the magneto that positive impulses of current from the magneto will be sent to line and through the stepping magnet 56 and the negative impulses to a wire 77. The positive current impulses received by magnet 56 cause that magnet through its armature 55 and the pawl 54, to rotate the ratchet wheel 53 and the contact arm 52 step by step over the circular series of contacts 50.

The negative current impulses during the low portion of the wave pass to ground through a contact arm 100, reciprocated by a double cam 101 on the magneto shaft, but the crests of the waves pass through contact 72 to wire 77, when their influence will be exerted in the manner hereinafter to be described. A condenser 102 is connected with the contact 75 and grounded to modify the impulses in the well understood way.

In every operation of a lock, one of the segments 50 which indicates the particular key used, will be rendered live or active during the first part of the cycle; another which indicates whether the key was inserted from the inside or outside will be rendered active during the second part of the cycle; and a third which indicates the particular lock used will be permanently connected in a circuit which is active during the last part of the cycle; so that as the contact 52 sweeps over the segments the proper circuits will be closed to record this data. These operations will be effected by the means to be now described. I have shown three controlled tumblers or plungers 4 and by means of a plurality of combinations may be obtained which will connect up with an active circuit any one of a plurality of segments to indicate any of eight different keys, and these combinations are effected in the following manner. By reference to Fig. 8 it will be seen that one plunger 4 makes one contact and breaks one. The plunger shown in Fig. 9 makes two contacts and breaks two, while that of Fig. 10 makes four and breaks four. Bearing this in mind and turning to the diagram Fig. 16 if the first plunger indicated by 4^a be raised it makes only one contact so that the circuit is partly made from the common return wire 60 to the contact arm 52 and is completed from wire 65 to contact 7^a then through contact 7^b to contact 7^c to segment 50^a and to the contact arm when it reaches that segment.

In a similar manner each plunger carries the circuit to one of the other segments, and more than these segments may be connected to the line by simultaneously raising two or more plungers. For example, suppose plunger 4^a and 4^b both be raised. Then the current will flow to contact 7^a but not from there to 7^b as the contact there is broken by 4^b, but to 7^d where contact has been made by 4^b.

Thus it will be seen that each key sets up its combination by which one of the first group of segments corresponding to it is connected to the circuit, so that a current may be caused to flow when the contact 52 reaches that segment, and this current may be utilized in any well known way to set a type wheel to indicate the number or letter designating such key.

There are two sets of plungers 4, one being the lettered set shown in the diagrammatic view which is effective when the key is inserted from the outside and the other lower unlettered set being indentical with the first set and effective when a key is inserted from the inside. Both these sets of contacts are connected in multiple to the line 65 through wire 66 and wire 104. Either set upon being operated selectively connects a particular segment 50^a to line 65 in accordance with the key number.

In addition to the key number setting devices, means are provided for selectively connecting certain segments to determine circuits which show whether the key is operated to lock or unlock the door and whether it has been inserted from the inside

or outside. For this purpose four segments are used. The means for determining the unlocking or locking status will now be described. The pawl 13, Fig. 1, carries an insulating stud 78 which on the movement of the pawl engages with one or the other of two central spring contacts 80 and 81, and shifts them from their normal engagement with contacts 82 into engagement with contacts 83. Following now the diagram, Fig. 16, and assuming that the key is inserted and turned to lock the door it moves the contact 80 from contact 82 to contact 83. On the other hand, if the key be turned to unlock the door, then contact 80 will drop onto contact 82, and contact 81 will be forced into engagement with contact 83.

The center contacts 80 and 81 are connected respectively by wires 103 or 102 with the lowermost contacts of the key number combination devices so that either line 103 or 102 is always in circuit with line wire 65. If a key be inserted from the outside and turned the upper lettered combination of contacts will be actuated by the key and the circuit from line 65 to wire 103 will be interrupted by one or another of the lettered contacts. However, with the key outside the lower contact devices are in the position shown and a circuit is established from wire 65 through 66, wire 104 through the unlettered lower (inside) contact combination devices to wire 102. Similarly if the key is inserted from the inside wire 102 will be dead and wire 103 will be alive. The foregoing connections establish live circuit conditions for contact 80 and open circuit conditions for contact 81 when the key is operated from the inside and the opposite circuit conditions when the key is operated from the outside. From the contacts 83—80, 80—82, 82—81 and 81—83 four wires lead to the four segments 50^a which respectively correspond to the following respective door lock conditions: locked outside, unlocked outside, locked inside, unlocked inside. The circuits traced all extent from wire 65.

The main or motor shaft of the recorder carries seven cams which are designated 84, 85, 86, 87, 88, 89 and 90, and these cams have the following functions. Cam 84 is that which closes the circuit of battery 61 through the relay magnet 63, and is known as the starting relay cam; it is in a position to close this circuit at the beginning of a cycle, and the path for the current impulses which the relay magnet receives through it will be from ground 62 through the contacts 64, the battery 61, wire 65, wire 66, contacts 48 and 44 to the common return wire 60. It will be observed that the motor is not to be started until a key has been inserted and turned in the lock, but such turning completes the circuit which energizes the starting relay, and the cam 84 opens immediately after the motor is started, and does not close again until just before the end of the cycle.

The cam 86 is known as the motor control cam. Normally the motor is on open circuit, but by the starting relay the power circuit is closed for a brief period to start it in operation. Immediately after the beginning of the cycle the motor cam closes and stays closed until near the end of the cycle, and this maintains the motor in the power circuit through the contacts 91.

The cam 85 is known as the clutch cam. It closes a circuit from one of the power circuit wires 69 through contacts 92 and electro-magnet 93 which throws in the clutch (not shown) and thence to the other power circuit wire through the relay contacts 67. The cam 85 closes this circuit before relay 63 is deënergized and breaks it immediately afterward, and the clutch controlled by magnet 93 is of the one cycle variety, that is to say, it remains operative for one revolution after it is once thrown in. The closing of the clutch magnet circuit is timed to take place just after the motor is started in motion.

Cam 87 is the magneto circuit controlling cam, which closes contacts 74 near the beginning of each cycle and opens them near its close.

Cam 88 is that which controls contacts 94 by means of which negative impulses of current are sent to line through an electro-magnet 95 which sets the type wheel that indicates the particular key used. These impulses, it will be seen, come from one pole of the magneto through contact arm 75, the back contact 72, pass through the magnet 95 and the contacts 94 which, by the cam 88, are kept closed only during the first part of the cycle, and from thence flow by wire 65 to one or another of the first group of contacts 50, which represent keys.

Cam 89 is that which controls contacts 97, and by them completes the circuit through the magnet 98 that sets the type wheel to indicate whether the key was inserted from the outside or the inside, and whether it was used to lock or to unlock the door. This cam keeps the circuit through magnet 98 closed through the second part of the cycle only.

Cam 90 is that which keeps the circuit closed through magnet 99 to the contact 50 that indicates the lock used, and is operative for this purpose during the latter part of each cycle only.

It will be understood that the closing of the contacts controlled by cams 88, 89 and 90 is effected out of phase. This will be understood by referring to the diagram and considering all of the cams as being located

upon the same shaft. The cams have the high points thereof displaced angularly relative to each other.

I have now described the chief essential features of the system and given so much of the mode of operation that the improvement will be fully understood by any one skilled in the art. It remains therefore to point out certain details that are used, and possibilities of the system when in actual use or operation.

It will be borne in mind that after the lock mechanism has been set in proper operative condition and the motor started by turning the key, that the stepping magnet to operate the contact arm over the segments 50 is energized by positive impulses, while the proper segments are rendered active and the type wheel setting magnets are actuated by negative current impulses. It has been pointed out that the two contact controlling levers 40 and 43 have projections 45 that ride on a cam—see Fig. 16—on the shaft 47. On the first step or movement of the shaft 47 these levers drop from the high point of this cam, with the result that connection between contacts 44 and 48 is broken, but the circuit is left complete between contacts 42 and 44. If this were not done, all of the magneto impulses would pass through the magnet 56 and also through the commutator and the key combination circuits which would be undesirable. The lever 43 is not released by levers 29 and 30 although lever 40 is, but said levers 40 and 43 are so designed and arranged that while both are raised and lowered by the cam on the shaft 47 they preserve such relation to each other as to secure the result above set forth.

In systems of this kind it is usual to provide for means for recording the time of the operation of a lock, and such means may of course be used with this lock, but as this is something well understood in the art it is not illustrated or discussed. Again it is usual to combine with the lock an autograph recorder, which requires certain modification of the circuits; as far as possible I have omitted in the illustrations such modifications, as these also form a well-known part of the prior art.

The character of the mechanical details employed in this system is of relatively little importance, provided the functions set forth are capable of being performed. Machines both in this and kindred arts are well known and in more or less extensive use, and from the prior art any devices may be adopted that will accomplish the results herein described. This applies to all parts of the system with the exception of the lock mechanism which in itself is novel, and for purposes of the case had to be specially designed.

What I claim is:

1. In a recording lock the combination with the lock-controlling tumblers of a plurality of circuit-controlling tumblers adapted to be set in position by a key inserted in the lock to establish by permutations and combinations of conducting paths made and broken thereby any one of a number of circuits greater than the number of the tumblers and each corresponding to a given key.

2. In a recording lock the combination with two sets of lock-controlling and two sets of circuit-controlling tumblers adapted to be set respectively by a key inserted from the outside or the inside of a door to which the lock may be applied, of circuit-controllers actuated by the circuit-controlling tumblers and adapted to establish by permutations and combinations of conducting paths any one of a number of circuits greater than the number of the tumblers in a set, each of said circuits corresponding to a given key.

3. In a recording lock the combination with a set of circuit-controlling tumblers adapted to be set in positions determined by the character of the key inserted into the lock, of circuit-controllers operated by said tumblers and varying in number for each tumbler, whereby by permutations and combinations of conducting paths a number of circuits may be established greater than the number of tumblers, each of said circuits corresponding to a different key.

4. In a recording lock a series of insulated segments and a contact arm adapted to be moved over the same, in combination with a set of tumblers, circuit-controllers actuated thereby and adapted when the tumblers are set in position by a key inserted in the lock by permutations and combinations of conducting paths to establish a circuit to any one of said segments, such segment and the circuit thus established corresonding only to the particular key used.

5. In a recording lock a series of insulated segments and a contact arm adapted to be moved over the same, in combination with means actuated by the insertion of a key into the lock for establishing to any one of a given number or group of such segments a circuit corresponding only to the key used, and means controlled by the rotary movement of the key in opposite directions for completing a circuit to any one of another group of said segments corresponding to the direction in which the key is turned for locking or unlocking the lock.

6. In a recording lock a series of insulated segments and a contact arm adapted to be moved over the same, in combination with means actuated by the insertion of a key into the lock for establishing to any one of a given number or group of such segments a circuit corresponding only to the key used, and means controlled by a key inserted from

the outside and other means controlled by a key inserted from the inside of said lock and by the rotary movement of said key in opposite directions, for completing a circuit to one of another group of said segments corresponding to the side from which the key was inserted and the direction in which it was turned for locking or unlocking the door.

7. In a recording lock system the combination of a lock, a recorder and line circuit connections between the same, a series of insulated segments, a contact arm, a magnet for moving the same step by step over the segments, means actuated by a key for connecting the line to one of said segments corresponding to the particular key used, these parts being located in the lock, a motor, a magneto, means controlled by the movement of a key in the lock for starting the motor, and a recording magnet in circuit with a path through any one of the insulated segments and the movable contact arm, these parts being located in the recorder, whereby the movable arm will be caused to rotate by impulses from the magneto and the recording magnet will be operated when such arm reaches the segment connected to line.

8. In a recording lock system, line circuit connections, a lock and the following elements contained therein; a series of insulated segments, an arm adapted to sweep over the same, a magnet for moving said arm, and means actuated by the insertion of a key into the lock for connecting to line that insulated segment which corresponds to the particular key used, in combination with a recorder and the following elements contained therein; a motor, a magneto, a recording magnet and means controlled by the key for starting the motor and operating the magneto, causing it to send impulses over the line to the lock magnet that operates the contact arm, and to the insulated segment connected to line, whereby the recording magnet will be operated when the contact arm reaches the line segment.

9. In a recording lock system, line circuit connections, a lock and the following elements contained therein; a series of insulated segments, an arm adapted to sweep over the same, a magnet for moving said arm, means actuated by the insertion of a key in the lock for connecting one of a group of such segments to line, and means actuated by the rotary movement of a key for connecting a segment of another group to line, in combination with a recorder and the following elements contained therein; a motor, means controlled by the insertion of a key for starting the same, a magneto for sending impulses over the line to the magnet and to the segments connected to line, and recording magnets in circuits through the movable arm and the live segments whereby the said recording magnets will be operated by the contact of said arm with the live segments.

10. In a recording lock system a line circuit, a lock and the following elements contained therein; a series of insulated segments, an arm adapted to sweep over the same, a magnet for moving said arm, means actuated by a key for connecting one or more of said segments to the line, in combination with a recorder and the following elements contained therein, a motor, means for starting the same controlled by a key, a magneto driven by the motor, means for directing the impulses of one direction from the magneto over the line to the arm moving magnet, and the impulses of opposite direction to the live segments, and recording magnets in circuits through said live segments, the movable arm and the line, adapted to be operated when the arm touches one of the said live segments.

11. In a recording lock system, a line circuit, a lock and the following elements contained therein; a series of insulated segments, a contact arm movable over the same, a magnet for moving said arm and means actuated by the insertion and rotary movement of a key for connecting any one of several groups of said segments to the line, in combination with a recorder and the following elements contained therein; a motor, a line-controlled starting means therefor, a magneto driven by the motor, and adapted to send current impulses over the line to the contact arm moving magnet and to the live segments, recording magnets and means controlled by the motor for connecting said magnets successively with the groups of segments during different portions of each cycle of operation of the recorder.

12. In a recording lock system a lock, a line circuit, a recorder and the following elements combined and arranged for operation in the manner herein set forth, a device in the nature of a commutator in the lock with insulated segments in groups corresponding respectively to the particular key used, the direction of its insertion, the direction of its rotation and other data, and means for connecting the proper segments to line when a key is inserted and turned in the lock, an electrically operated contact arm connected to line and sweeping over said segment, means in the recorder for operating said contact arm and recording magnets operated by the engagement of such contact arm with the live segments as set forth.

13. In a lock recording system the combination of a lock, a line circuit and a recorder, a device in the lock in the nature of a commutator with insulated segments and a contact arm sweeping over the same,

a magnet for operating the arm and means for connecting to line such of the segments as correspond to the particular key used in the lock, the direction of its insertion and rotation and the like, of a magneto in the recorder adapted to be operated when a key is inserted and turned in the lock to send impulses to line, and means controlled thereby for directing the impulses of one direction over the line and through the contact arm controlling magnet and impulses of the opposite direction to the live segments of the commutator.

14. In a recording lock system the combination of the following elements; a lock, a line circuit and a recorder, a device in the lock in the nature of a commutator with insulated segments and a contact arm sweeping over the same, a magnet for operating said arm, and means for connecting to line such of the segments as correspond to the particular key used in the lock, the direction of its insertion and rotation and the like, of a magneto in the recorder adapted to be operated when a key is inserted and turned in the lock, to send impulses to line, a means controlled by the magneto for directing impulses of one direction through the contact arm moving magnet and impulses of the opposite direction to the live commutator segments, recording magnets adapted to be connected over the line with the live segments and means for completing the connection of each magnet with said segments during different portions of the cycle of operation of the recorder.

15. In a recording lock system the combination with a lock, a line and a recorder of a series of contact points in the lock, means controlled by the insertion and operation of a key for establishing connections between certain of said contact parts and one side of the line, and an electromotive device for connecting with said contacts parts successively, the other side of the line, a means in the recorder for operating said magnetic motive device, recording magnets and connections from the same to line of such nature that they will be operated when the line circuit is completed through them and the insulated contact parts connected to line.

16. In a recording lock system the combination with a lock, a line and a recorder, groups of contacts in the lock certain of which are adapted to be connected by the operation of the key to one side of the line, and means for successively connecting all of said contacts to the other side of the line, of means in the recorder for operating said connecting means in the lock by current over the time-recording magnets and means for connecting them during different parts of the cycle with said groups of contacts over the line.

In testimony whereof I hereunto affix my signature.

JAMES W. BRYCE.