To all whom it may concern:

Be it known that I, GEORGE J. KOSTERS, a citizen of the United States, and a resident of Covington, county of Kenton, and State of Kentucky, have invented a new and useful Improvement in Operating Means for Doors, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to a means for the locking, opening and closing of doors, particularly of such doors as the sliding doors of prison cells. In such institutions as prisons, jails, and divers others of a similar character, where many separate cells or compartments are provided for the incarceration or safe keeping of persons or animals, it is customary, for the purpose of guarding against oversight in the locking or unlocking of any one or more cells, as well as to facilitate the performance of such duties, to operate the doors and locks of a number of cells from a single station.

In the ordinary arrangement of cells in prisons and jails, they are placed in rows, the doors of all opening upon a corridor in front of the cells. For the purpose above mentioned, all the doors of a row are operatively connected, the operating station being located at the end of the row. In the use of the means at present employed to effect this operative connection, however, the number of cells in each row, or operative unit, is limited, and therefore it is found necessary to have a number of such operating stations; and in large institutions the number of such stations is so multiplied that the advantage over the old method of separately operating each door, is purely relative, a large risk of oversight or error still remaining.

To overcome this difficulty is the chief object of my invention, and this I accomplish by the use of means, hereinafter fully described, whereby the operation of all such doors and locks comprised in an entire prison or other similar institution, however large the number thereof may be, may be effected at a single station, thus enabling one operator in a single operation to assure the desired result throughout the entire institution.

A further object of my invention is to provide means whereby the cell doors will become automatically locked in either open or closed position, and to simplify the construction and lower the cost of production of the means for operating and locking such doors.

In the drawings: Figure 1 is a front elevation showing my invention as applied to two of a series of doors; Fig. 2 is an enlarged view of the upper part of one of said doors; Fig. 3 is a section on line 3–3 of Fig. 2; Fig. 4 is a perspective of one of the operating parts; Fig. 5 is a perspective of the coupling arm; Fig. 6 is a diagrammatic sketch of the switch board and several electrical circuits employed in the operation of doors in accordance with my invention; Fig. 7 is a diagrammatic view of the motor circuits for opening and closing the doors.

The numeral 1 indicates the door of a cell; this door has rollers 2 whereby it is adapted to ride on the track 3 in the ordinary manner either to open or close said door. Forming the jamb of said door is a hollow post within which is mounted the lock-bar 4; said bar is adapted to vertical movement in said post, and has openings 5 by means of which it engages notched lugs 6 on the door, when said door is closed, to lock the same. The openings 5 and the lugs 6 may be dispensed with, however, as I lock my doors automatically in both open and closed positions by the mechanism hereinafter fully described.

Attached to the front wall of the cell, above the door, is a frame 7, in which are loosely mounted, on pivots 8 and 9, the arms 10 and 11 of a toggle joint 12. On the upper end of the lock-bar 4 is a lug 13 which is perforated to receive a stud 14 on the arm 10 of the toggle, at a point near the free end of said arm and beyond the pivot 8. It will thus be seen that the raising or lowering of the lock-bar will produce a corresponding movement in the free ends of the arms 10 and 11 of the toggle. The free ends of said arms extend beyond the ends of the frame 7, slots in the end plates thereof being provided for the movement of said arms, as shown, and said free ends are provided with lifting lugs 15 and 16 just beyond the ends of said frame. Pivotedly mounted on the upper part of the door 1 is a coupling arm 17; said coupling arm is bell crank in shape and has on its free end a dog 18 which is adapted to rest on either of the lifting lugs 15 or 16 according as the.
door is closed or open. The upper side of the frame 7 forms a table, or slideway, 19, upon which the dog 18 is adapted to ride during the opening or closing of the door, to hold said dog at an elevation for the purpose hereinafter set forth. When the door is either open or closed and the lock-bar down, the dog 18, resting on either one of the lifting lugs 15 or 16, will abut against one end of the frame 7, and thus, independently of the locking mechanism comprising the opening 5 and lugs 6, lock the door in either open or closed position. The raising of the engaged lifting lugs, however, will lift the dog 18, so that with the movement of the door it will glide onto the table 19.

Slidably mounted in hangers 20 above the mechanism described, is an operating bar 21, adapted to movement in the same directions as those traversed by the door in opening and closing. Said bar extends approximately the whole length of a row of cells, and has a notch 22 for each door. The notch 22 is adapted to receive the dog 18 on the coupling arm 17, when said dog is lifted by the raising of the lock-bar 4, as above described. When the operating bar is thus brought into engagement with the coupling arm, and through said arm, with the door, by means of the dog 18 and notch 22, the operating bar is moved either to the right or to the left, according as it is sought to open or close the door. As soon as the door is moved slightly in either direction, the dog 18 will ride on the table 19, as above set forth, and will thus remain in its elevated position where it will continue in engagement with the notch 22, even though the lifting lug by which it was initially raised is again lowered by reason of the dropping of the lock-bar. When the door reaches the end of its movement, & c., when it is either fully opened or closed, the dog 18 will leave the table 19, and rest on the opposite lifting lug, where it will be in position again to be raised upon the raising of the lock-bar and to be placed in engagement with the operating bar to return the door to its original position.

In the actuation of the several functions of my device as above described, I prefer to employ a combination of electrical means hereinafter described, but it will be understood that that portion of my invention thus far disclosed is susceptible of other, mechanical, actuation, the method and means of which will be readily apparent to one skilled in the art, and therefore I do not claim any mechanical actuation as above set forth, but contemplate, also, the mechanical actuation of the mechanism above described.

Secured to the front wall of the cell, higher than the door, and in such position that the upper end of the lock-bar may reciprocate between its two coils, is a solenoid magnet 23, which, when magnetized, lifts the armature 24, which reciprocates in the hollow cores of the coils in the ordinary manner. The armature is secured to a cross-piece 25 attached to the lock-bar, and thus the lifting of the armature raises the lock-bar, unlocking the door, and throwing into engagement the door and operating bar as above described. A motor 26 is provided at the end of each section or series of cells, and the same is suitably located so that a worm 27, attached to the end of the operating bar 21 may move back and forward through the hollow armature shaft of the motor. Secured to the armature shaft is a threaded drum or nut 28, which works in a bearing 29, and operates the worm 27 in the usual manner, thus communicating to the operating bar the appropriate movements for opening and closing the door of the several cells.

In Fig. 6 of the drawings, I have shown diagrammatically the several electrical circuits required in the operation of my invention, together with the means for properly making and breaking such circuits. It will be understood that in the management of such institutions as jails, it is necessary at times to open or close only a single cell; at other times, a number of cells variously located, and at still other times, it is desirable to open and close all cells simultaneously. Furthermore, in the operation of my device, it is essential that the doors shall lock automatically when either opened or closed; and it is also essential properly to limit the period of movement of the operating bar. All of these ends are attained by me in the following manner. A switchboard is provided in the warden's office, or at any other suitable and convenient place where it may be adequately protected from persons not entitled to access thereto. Said switchboard is provided with buttons 30, there being one such button for each cell to be operated from said switchboard, or, if the one station is to serve the entire institution, one button for each cell therein. These buttons are numbered, the numbers corresponding with the numbers of the cells. Each of these buttons makes contact between a wire 31 leading to one of the magnets 23, which operates the lock-bar of the cell bearing the same numeral as the button, and a wire 32 leading to the battery 33. The opposite pole of the battery is connected by means of a wire 34 to each of the magnets 23. It will thus be seen that by closing the button 30 designated as "1," for example, the magnet 23 over the door of cell "1" will be energized, the lock-bar of said door will be lifted and the door unlocked. Similarly with any one, or any series of said
buttons; the magnets, when more than one
door is to be unlocked simultaneously, be-
ing, in the system of wiring shown, con-
nected in parallel. For the purpose of un-
locking all doors at once and at the same time
without the necessity of closing all of the
buttons, a multiple-contact button 35 is
provided, a wire 36 leading from each of the
wires 31, and the terminals of said wires
being insulated from each other. Thus, by
closing the button 35, marked "All", each
one of the magnets 23 will be simultaneously
energized.

The buttons 30 and button 35 work in
spring catches 37, the shank of the button
engaging in a notch in the catch to continue
the contact after the circuit has been closed
by the operator. Each of these spring
 catches is attached to a bar 38, said bar be-
ing attached to the armature 39 of the sole-
noid 40. One pole of the said solenoid is
connected by means of a wire 41 to the bat-
dy 42. The opposite pole of the battery
42 is connected by a wire 43 to a contact
post 44 on the operating bar 21. The oppo-
site pole of the solenoid is connected by the
wire 45 to a contact plate 46 on the wall of
the cell; the post 44 and the plate 46 being
adapted to contact during the movement of
the operating bar 21. The bar 38 is held
in tension by means of the springs 47, so
that the catches 37 will be normally in posi-
tion to secure the shanks of the buttons 30
and button 35. The energizing of the sole-
noid 40, however, will cause a receding
movement of the armature 39, and with it,
of the bar 38, against the tension of the
springs 47, and the buttons will be thereby
released. Springs 48 are provided to open
the buttons when thus released. It will
now be seen that upon the closing of one or
circuits by the operation of one or
more of the buttons, the latter will be
held, by means of the catches 37, in position
to continue the circuit through the magnets
23 until the post 44 contacts with the plate
46, when the solenoid 40 will become ener-
gized, withdrawing the catches 37 and allow-
ing the buttons 30 or button 35 to be thrown
open to the position by means of the spring
or springs 48. The magnets 23 will thus
be demagnetized by the breaking of the cir-
cuits, and the buttons 30 and button 35 will
again be in position to close any desired cir-
cuit or circuits for the unlocking of any
door or doors which it is desired to open or
close. An arm 49, attached to the bar 38,
is provided so that in case of error in the
closing of any button, the said button may
be released without the necessity of energiz-
ing the solenoid 40.

The switch arm 50 controls the motor cir-
cuit for the operation of the motor 26 where-
by the operating bar 21 is moved; and the
polarization of said motor circuit may be
changed for the purpose of reversing the
movement of the operating bar in the man-
ner hereinafter set forth. The length of the
stroke, or movement, of the operating bar,
must, however, be limited, so that the notches
22 will at all times be in position to receive
the dogs 18, and also to prevent injury to
the worm or other parts of the mechanism
hereinbefore described. For this purpose,
the switch arm 50 is returned to its open
position by either one of the springs 51,
one of which is placed under tension by
either the forward or reverse throw of the
switch arm. To hold the circuit closed dur-
ing the necessary operation of the motor,
a lug 52 on the switch arm 50 is adapted to
engage a notch in the bar 53; said bar is
mounted on the armature 54 of the solenoid
55; springs 56 bear on the bar 53 and hold
it in tension so that it will engage the lug
52 to hold the switch arm 50 against the
tension of one of the springs 51. When the
solenoid is energized, the bar 53 is with-
drawn, against the tension of the springs
56, releasing the lug 52 and allowing the
switch arm to be returned by the spring 51.
On the opposite side of the switch arm 50
is a second notched bar 53, mounted on
armature 57 of a solenoid 58, and held in
tension by springs 56. Thus when the
switch arm is thrown to the right, in oper-
ating the motor to open the doors, it will
be held by a bar 53 and will be released
by energizing the solenoid 58; similarly, when the arm is thrown
to the left, in closing the doors, it will be
held by a bar 53 and will be released by
energizing the solenoid 55. The circuits
through the solenoids 55 and 58 are com-
pleted as follows: On the switchboard, on
opposite sides of the arm 50, are contact
plates 59 and 60, adapted to bear on con-
tacts 61 and 62 respectively on the switch
arm 50 when said arm is thrown to the right
or left. One pole of the battery 42 is con-
nected by wires 63 and 64 with the contact
plate 60 and solenoid 55 respectively. The
opposite pole of battery 42 is connected by
wire 43 to the contact post 44 on the operat-
ing bar as heretofore explained. On the
wall of the cell, at points where the post 44
will rest upon one or the other when the
operating bar 21 has reached the limit of
its motion in either direction, are contact
plates 65 and 66. Contact 65 is connected by
a wire 67 with the solenoid 58; the opposite
pole of said solenoid being connected by
wire 68 with the contact 62. Plate 66 is
connected by wire 69 with plate 59. Solen-
oid 55 and contact 61 are connected by wire
70. Post 44 rests on contact 65 when the
operating bar is in position to open the
doors, or, in other words, when said bar
has reached the limit of its movement in
closing the doors; in this position it is
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shown in Fig. 6. To open the doors, the switch arm 50 is thrown to the right; this, at the same time that it starts the motor, makes contact between contact point 61 and plate 65; the plate 65, however, not being in the circuit with plate 60 and contact 61, the solenoid 55 is not energized, though the post 44 rests thereon at the time the contact is made between plate 49 and point 61, and the switch arm is held in position by bar 53 and lug 52. When, however, the operating bar reaches the limit of its opening movement, and the doors are open, the post 44 will rest on plate 60, and, the latter being in the circuit with plate 59 and contact 61, the solenoid 55 will be energized, thus releasing the switch arm and permitting its return by spring 51; this will break the motor circuit at the proper time, and will also break the circuit through solenoid 55, by breaking the contact between plate 59 and contact 61, thus preventing a continuous current through the solenoid 55 while the doors are open and the operating bar is at the limit of its opening movement.

To close the doors, the arm 50 is thrown to the left, starting the reverse movement of the motor and making contact between plate 59 and point 62. Now, the plate 60 is not in the circuit with plate 60 and contact 62; hence the making of the contact between the same while post 44 and plate 66 are contacting, will not energize the solenoid 58, and the arm will therefore be held in its position by lug 52 and bar 53. The contacting of post 44 and plate 65, however, when the doors are fully closed, plate 65 being in the circuit with plate 60 and contact 62, will energize the solenoid and release the arm 50, which will stop the motor and break the circuit through the solenoid by discontinuing contact between plate 60 and contact 62.

To close the opened doors, it is only necessary to reverse the motor, and for this purpose the switch arm 50 is thrown to the left instead of to the right, as above stated. The forward and reverse motor circuits are shown in diagram in Fig. 7, which, as stated above, is a diagram of the motor circuits for opening and closing the doors. Pivotally attached to the switch arm 50 is a cross-arm 71. Similarly attached to the ends of said cross-arm are auxiliary arms 72 and 73; each of said arms being also pivotally mounted on the switchboard. The free ends of said auxiliary arms 72 and 73 are adapted to contact with plates 74 and 75 respectively. The arm 50, besides being adapted to contact with the points 76 of the rheostat, has a depending finger 77 adapted to contact with contact points 78 and 79 on the board. The battery 80 is connected by a wire 81 to both the forward and reverse coils of the rheostat. The other pole of the battery is connected to the auxiliary arms 72 and 73 by a wire 82. Contacts 74 and 79 are connected by a wire 83, as are also contacts 75 and 78 by a wire 84. Wires 85 and 86 lead to the motor 40. It will now be seen that, by throwing the arm 50 to the right, the finger 77 will make contact with the point 79 and auxiliary arm 73 with the plate 75. The current will then pass from the battery to the forward, or opening, contact points 76, through the arm 50, contact point 79 and wire 83 to the motor; returning over wire 86, point 78, wire 84, plate 75, auxiliary arm 73 and wire 82 to the battery. To reverse the motor, the arm 50 is thrown to the left, when the current passes from the battery over wire 81 to the reverse, or closing, contact points 76, over arm 50 to point 78, and over wire 86 to the motor; returning over wire 85, point 79, wire 83, plate 74, auxiliary arm 72 and wire 82 to the battery.

The operating mechanism over the doors is enclosed in a box or casing 87, as shown in Fig. 8, to protect it from being tampered with. In Fig. 1 I have shown, instead of the electric motor, a crank arm 88 and chain and sprocket gear 89 for the manual actuation of the operating bar 21.

The operation of my invention is as follows: The operator first presses the buttons 30 of such doors as he desires to open, or, if he desires to open all, the button so marked; the contacts thus effected energize the magnets 23 over the desired doors. The lock-bars are thus raised, and, with them, the dogs 18, which are placed in engagement with the operating bar 21. The doors thus unlocked and coupled with the operating bar as above explained, remain so, as the circuit through the magnets 23 is continued by the locking of the buttons 30 or button 35. The operator next throws the arm 50 to the right; this starts the motor and closes one of the gaps in the circuit through solenoid 55. As soon as the motor starts, the operating bar begins to move and the doors to open, the dogs 18 gliding from the lifting lugs 15 onto the tables 19, where they are continued in engagement with the bar 21 as above set forth. Midway the stroke of the operating bar, the post 44 contacts with the plate 40, thus energizing the solenoid 40 and permitting the buttons 30 or button 35 to snap open, breaking the circuit of magnets 23; the lock-bars, and with them the lifting lugs 15 and 16, are thus permitted to drop. When the doors are fully open, the lifting lugs 15 having fallen, the dogs 18 will drop from the tables 19, out of engagement with the operating bar, and rest upon said lugs, and lock the doors in their open position by their abutment against the ends of the frames 7, as herefore explained. At this point, also, i.e., when the doors are fully opened, the other
1,046,608 gap in the circuit of solenoid 55 is closed by the contact between post 44 and plate 66, and the motor circuit is broken, as is also, simultaneously, the circuit of the solenoid 55, in the manner above set forth. To close the opened doors, the buttons 30 of the doors desired to be closed are pressed; or, if it is desired at once to close all doors which may have been opened, the button "All" is pressed, this latter furnishing a valuable check and security in penal institutions in assuring the closing and locking of all cells at the proper times; the switch arm 30 is then thrown to the left when the several circuits will be made and broken at the proper times to effect the closing and locking of the doors, the return of the buttons to their open positions, and the stopping of the motor. It will be understood, of course, that, where certain cells have already been opened, the uncoupling of the doors from the operating bar, in the manner above described, will permit the return of the bar to open other doors without the closing of the doors already opened, the latter remaining locked in their open position during the operation.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a device of the character specified, the combination with a door and an operating bar, of a coupling arm pivotally mounted on said door, a dog on said coupling arm, means whereby said dog is adapted normally to lock said door when the same is either in closed or open position, an electromagnet, and means whereby, upon the energizing of said electromagnet, said door will be unlocked and said coupling arm will be thrown into engagement with said operating bar.

2. In a device of the character specified, the combination with a door and an operating bar, of a coupling arm pivotally mounted on said door, an electromagnet, means whereby, upon the energizing of said electromagnet said coupling arm will be thrown into engagement with said operating bar, means to continue the engagement of said coupling arm and said operating bar during the opening or closing of said door, whereby said door and said operating bar are automatically uncoupled and said door locked when in either open or closed position.

3. In a device of the character specified, the combination with a door and an operating bar, of a coupling arm pivotally mounted on said door, means for automatically deenergizing said electromagnet during the movement of said door, whereby said door and said operating bar are automatically uncoupled and said door locked when in either open or closed position.

4. In a device of the character specified, the combination with a door and an operating bar, of a coupling arm pivotally mounted on said door, an electromagnet, lugs operatively connected with said electromagnet, and adapted to throw said coupling arm into engagement with said operating bar upon the energizing of said electromagnet, means to continue the engagement of said coupling arm and said operating bar during its passage between said lugs, and means for automatically deenergizing said electromagnet during the movement of said door, whereby said door and said operating bar are automatically uncoupled when in either open or closed position.

5. In a device of the character specified, the combination with a door and an operating bar, of a toggle, the arms of said toggle being pivotally mounted adjacent said door at points intermediate the ends of said arms, a coupling arm pivotally mounted on said door and adapted to be actuated by either of the arms of said toggle according as said door is either closed or open, to couple together said door and said operating bar, and means for the actuation of said toggle arms.

6. In a device of the character specified, the combination with a door and an operating bar, of a frame adjacent said door, a toggle, the arms of said toggle being pivotally mounted in said frame at points intermediate the ends of said arms, the free ends of said arms extending beyond the ends of said frame, a coupling arm pivotally mounted on said door, the free end of said coupling arm being adapted to rest upon the free ends of the arms of said toggle alternately when said door is opened and closed, and means for the actuation of said toggle arms to throw said coupling arm into engagement with said operating bar.

7. In a device of the character specified, the combination with a door and an operating bar, of a coupling arm pivotally mounted on said door, a frame mounted adjacent to said door, the upper side of said frame being adapted to serve as a slideway to maintain a coupling between said door and said operating bar during the opening and closing of said door, a toggle, the arms of said toggle being pivotally mounted in said frame at points intermediate the ends of said arms, the free ends of said arms extending beyond the ends of said frame and being normally lower than said slideway, said free ends be-
ing adapted to support the free end of said coupling arm when said door is in either closed or open position, a dog on said coupling arm adapted to abut against the ends of said frame to lock said door in either of said positions, and means for the actuation of said toggle arms to lift the end of said coupling arm to throw the same into engagement with said operating bar and to permit said dog to glide onto said slideway during the movement of said door.

8. In a device of the character specified, the combination with a door and an operating bar, of a coupling arm pivotally mounted on said door, a frame mounted adjacent said door, the upper side of said frame being adapted to serve as a slideway to maintain a coupling between said door and said operating bar during the opening and closing of said door, a toggle, the arms of said toggle being pivotally mounted in said frame at points intermediate the ends of said arms, the free ends of said arms extending beyond the ends of said frame and being normally lower than said slideway, said free ends being adapted to support the free end of said coupling arm when said door is in either closed or open position, a dog on said coupling arm adapted to abut against the ends of said frame to lock said door in either of said positions, means for the actuation of said toggle arms to lift the end of said coupling arm to throw the same into engagement with said operating bar and to permit said dog to glide onto said slideway during the movement of said door, and means to release said toggle arms during the movement of said door, whereby said coupling arm is permitted to drop out of engagement with said operating bar when said door is in either open or closed position automatically locking said door.

In witness whereof, I have hereunto set my hand at Cincinnati, Ohio, this 18th day of February, 1912.

GEORGE J. KOSTERS.

Witnesses:

ARTHUR H. EWALD,

FRED'K J. WENDEL.