Sept. 23, 1958 F. ADAM 2,853,291

JAIL LOCKING DEVICES AND THE LIKE

Filed Dec. 14, 1955 5 Sheets-Sheet 1

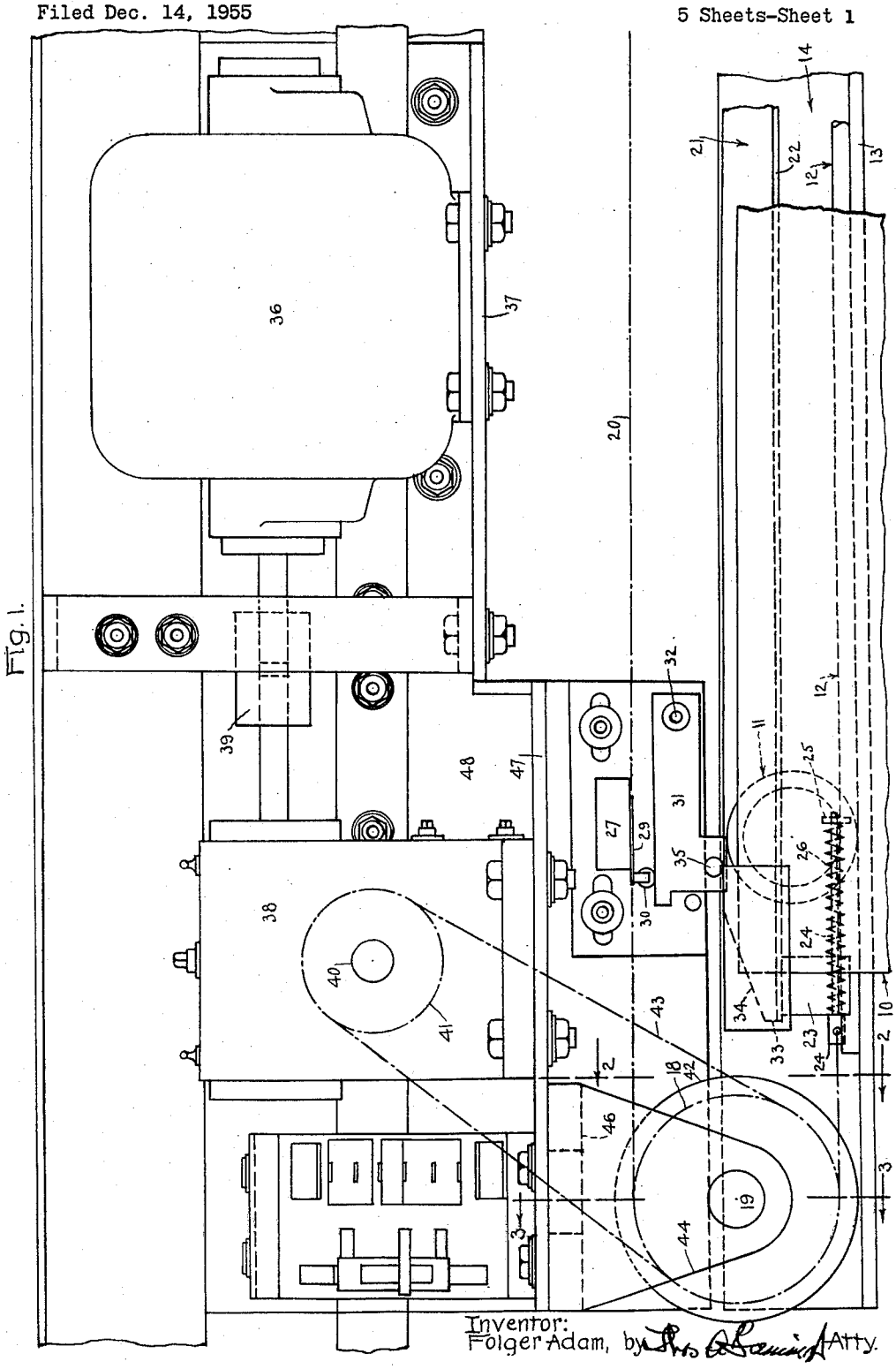


Fig. 1.

Inventor:
Folger Adam, by [signature] Atty.

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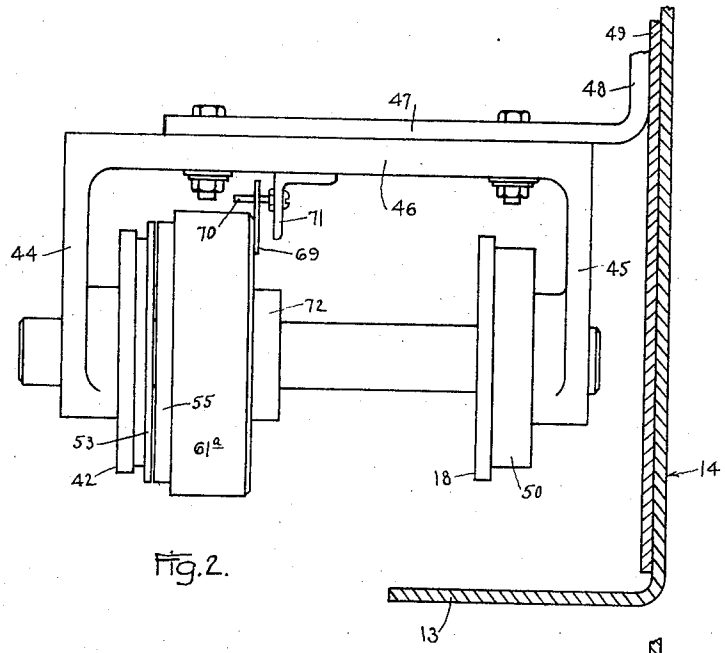


Fig. 2.

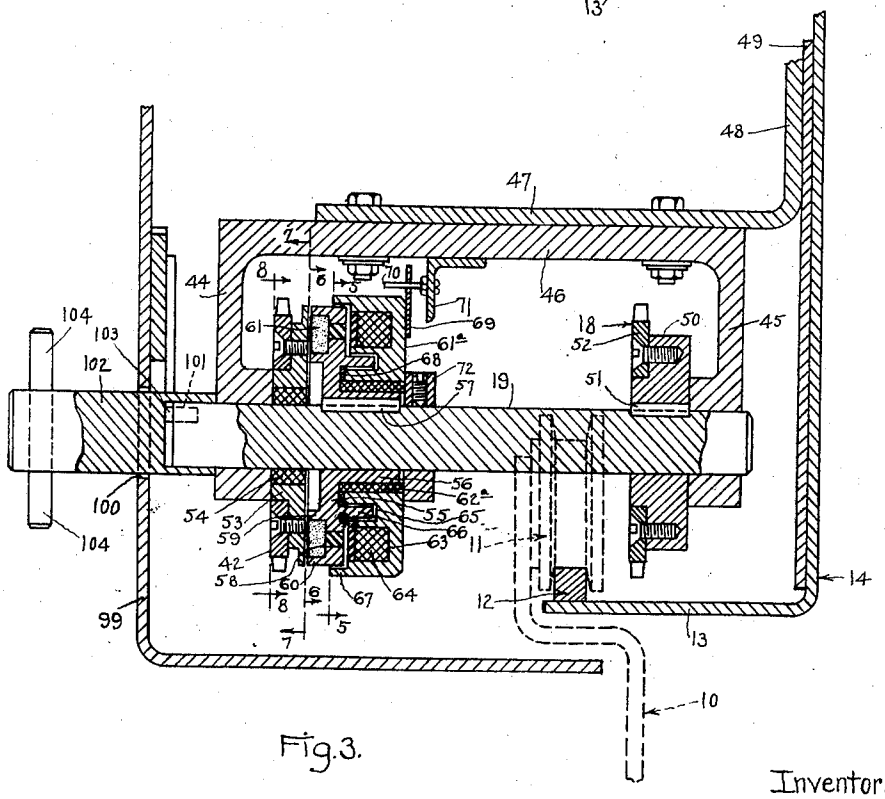


Fig. 3.

Inventor:
Folger Adam,
by Thos. A. Kennedy Jr.
Atty.

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JAIL LOCKING DEVICES AND THE LIKE

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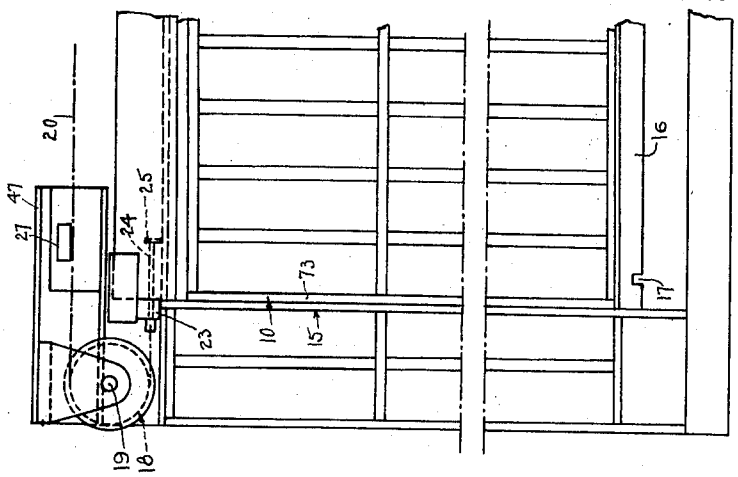


Fig. 4.

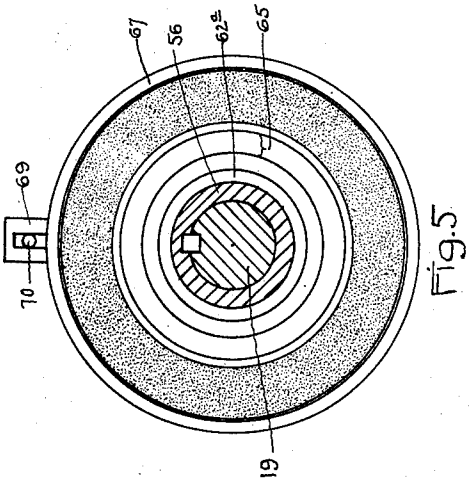


Fig. 5

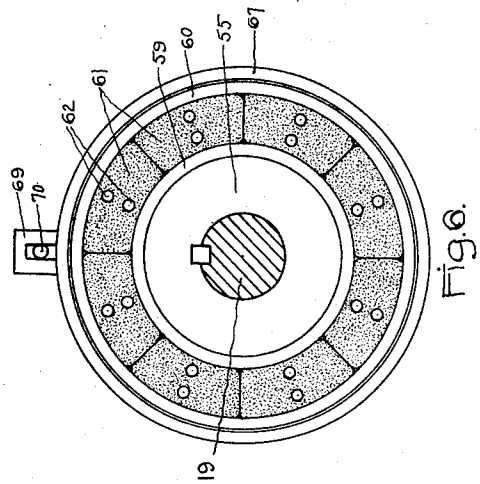


Fig. 6.

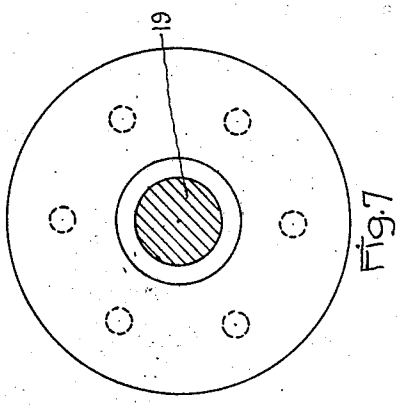


Fig. 7

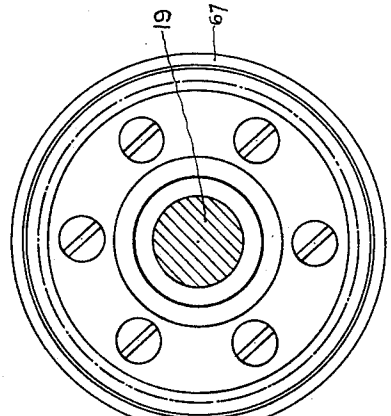


Fig. 8.

Inventor: Folger Adam,
By Thos. A. Kennedy Atty.

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JAIL LOCKING DEVICES AND THE LIKE

Filed Dec. 14, 1955

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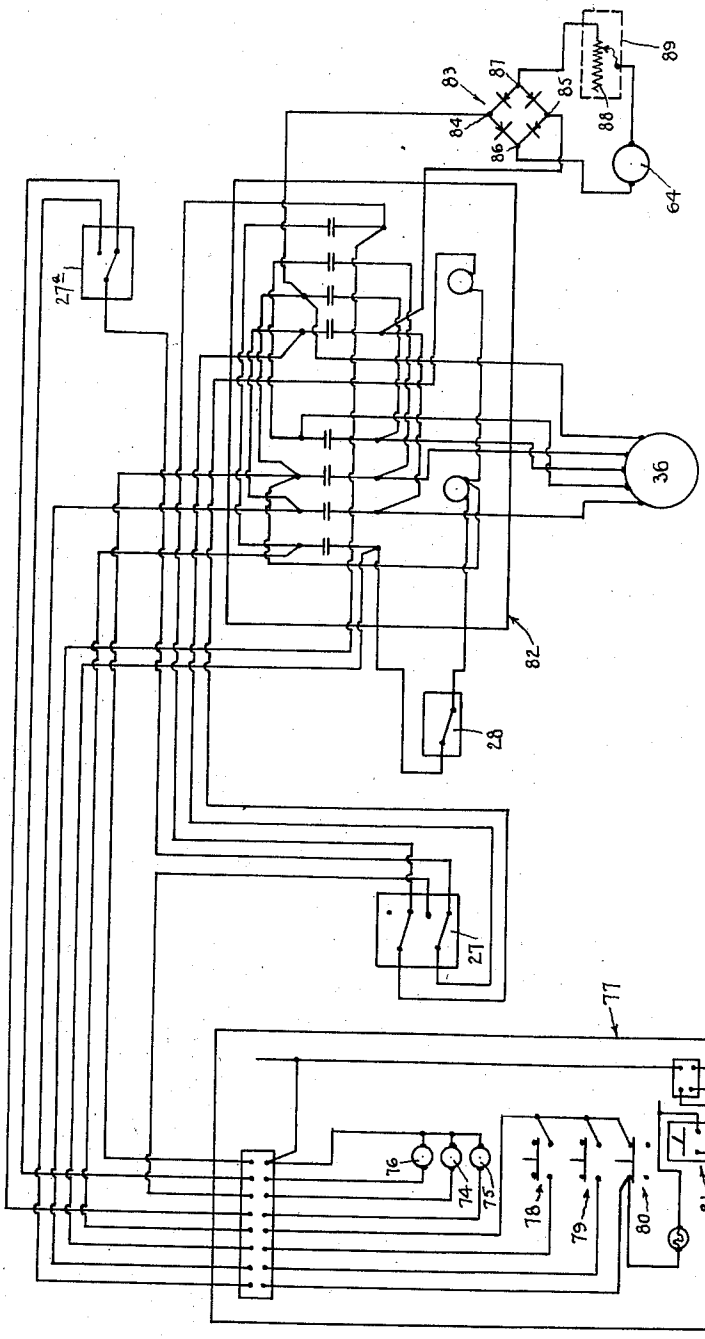


Fig. 9.

Inventor:
Folger Adam,
by Thos. A. Cunningham
Atty.

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JAIL LOCKING DEVICES AND THE LIKE

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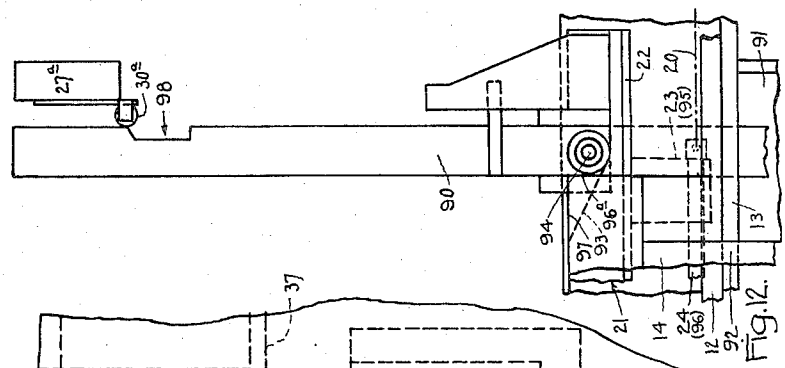


Fig. 12.

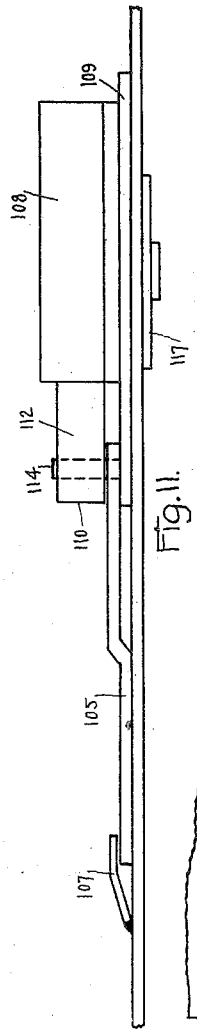


Fig. 11.

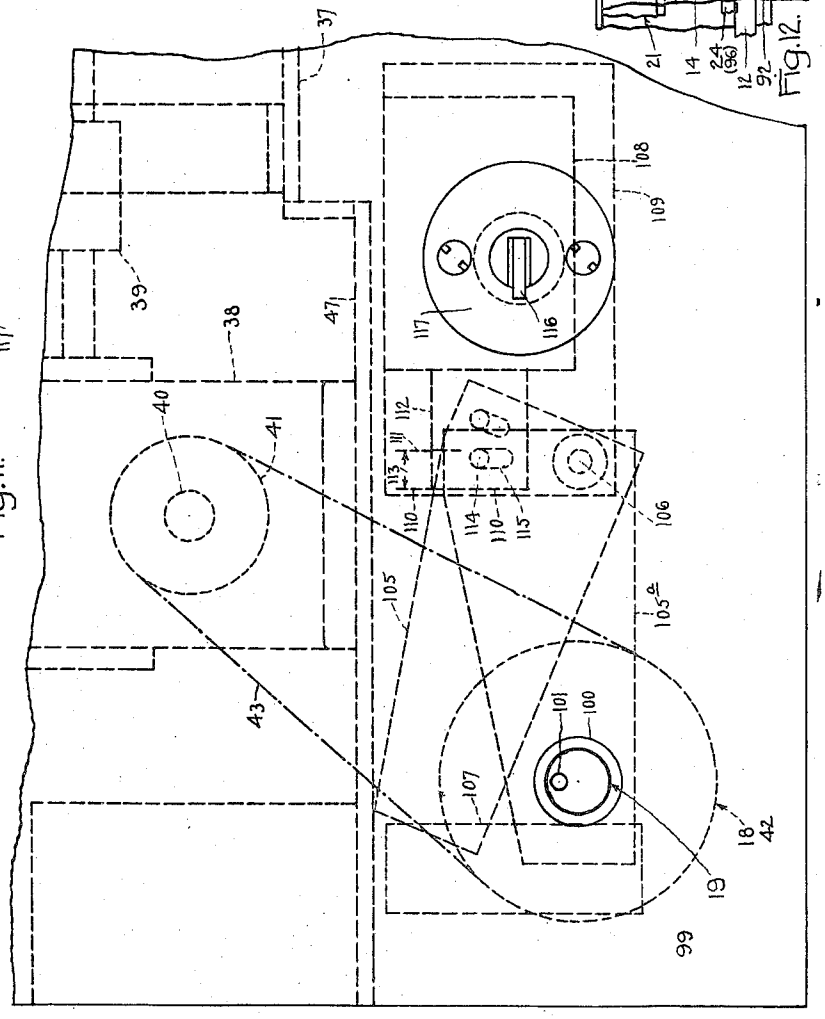


Fig. 10.

Inventor:
Folger Adam,
by
Atty.

United States Patent Office 2,853,291
Patented Sept. 23, 1958

2,853,291

JAIL LOCKING DEVICES AND THE LIKE

Folger Adam, Joliet, Ill.

Application December 14, 1955, Serial No. 553,081

5 Claims. (Cl. 268—53)

This invention relates to improvements in jail locking devices, and the like. The improvements herein disclosed have to do primarily with electrically controlled and operated jail lock and door moving installations. More particularly, said improvements concern such installations in which there are provided motor drives for the individual doors, be they cell doors, or other jail and/or prison doors, each such door being provided with its individual electric motor for door drive in either direction as required; together with operating and controlling connections between each such motor and its associated door. The present improvements have to do with said operating and controlling connections, and include certain safety features to protect both the installation and individuals or objects which may be trapped between the closing door and the abutment at the door closed position, so that damage will not be done to such object or compressive force due to the continued drive of the door's compresive force due to the continued drive of the door's motor.

This application discloses said features particularly as embodied in that form of door controlling and operating mechanism disclosed in my co-pending application for Letters Patent of the United States, Serial No. 386,231, filed by me October 15, 1953, but I wish to make it clear that the present improvements are not to be understood as limited to that earlier type of construction, except as I may limit myself to the same in the claims to follow.

In order to better understand the present features of invention and their relation to other elements of the installation, the following statement is in order:

In that earlier application I have provided for each door a drive motor individual thereto, and located substantially at the location of its door. This motor drives a sprocket or other driving element for a tension member, through a suitable gear speed reducer (if needed), and through a clutch element, generally of electrically operated type. The electric circuits are so constituted that the clutch, which is normally disengaged, is drivingly engaged when and during the time that current is supplied to the motor, so that during such motor current supplying operation the clutch is also engaged to effect drive to the door operating mechanism. In that earlier application such clutch comprises that type in which the driving and driven clutch elements are provided with cooperating clutch teeth which are normally disengaged from each other under urge of a spring so that under these conditions the door may be moved back and forth readily under manual force for door opening and/or closing, and without need of simultaneously driving the motor through said gear speed reducer. In that earlier application such clutch is of such design that drive between the motor and the door operating mechanism, or such driving connection, will occur at all times during which the clutch is electrically energized to bring its driving and driven elements into co-ordination. Thus, in case of presence of an obstacle or a human body, such as an arm or a leg, between the advancing door edge and the abutment or pilaster at the door closed position, an amount of compressive force will be exerted against such obstacle or such human body as will be required to "stall" the motor under the current supply conditions then obtaining. Such compressive force will generally be severe so that serious bodily injury to the individual might be produced; and additionally, the stalling of the motor with full voltage being applied thereto would probably result in serious damage or burning out of the motor, even in cases where such protective elements as fuses might be provided for protection against such an emergency. It is also to be noted, that once a compressive force had been developed against such object, the discontinuance of current supply to the motor would not serve to release continuance of such compressive force, since such release would require backing up the motor through the gear reducer train which is generally irreversible, that is, cannot be driven through force applied to its driven end.

The foregoing objections to such arrangements as are disclosed in that earlier application are supplemented by the following further feature:

In such installations as are provided with individual driving motors it is customary, and generally necessary, to provide "limit switches" adjacent to the door closed and door open limited positions. These switches are so constituted and so related to the door structure or elements carried thereby that when the door reaches its intended limit of movement the corresponding limit switch is operated, thus cutting off current from the motor (and from the clutch, which clutch is then moved to its disconnected position by such spring). But such limit switch will not thus function until the door reaches its intended limited movement position. Therefore, in case of presence of an obstruction or human body between the door edge and the abutment or pilaster at the door closed position, so that complete door closing movement could not be effected, it is seen that the door closed limit switch would not function, and current would not be cut off from the motor and clutch. Thus, the provision of such limit switch at the door closed position would not serve as a protection against the continuance of current delivery to the motor, nor against continuance of the clutch engagement.

It is also to be noted that even when current supply to the clutch is discontinued simultaneously with discontinuance of current supply to the motor, the disengagement of the driven and driving elements of the clutch does not necessarily occur immediately, nor until torque which has been developed between these elements has been released. This is especially true in the case of tooth type clutches in which one of the elements is movable axially towards and from the other element during the clutching and declutching operations. Accordingly, experience has shown that frequently, when such tooth type clutches are used in such installations as the present, namely operating and controlling cell or other prison door movements, the discontinuance of current delivery to both the motor and the clutch will not result in declutching, so that manual movement of the door backwardly cannot be produced to release the trapped object or human body, due to the irreversibility of the gear speed reducer.

The present disclosures include provision of a type of clutch in such installations, which clutch is of such design and operation that all of the foregoing objections to previously used and included forms of clutch are overcome and greatly improved operations are produced. The clutches herein disclosed for such installations and purposes and operations are of a type which may be designated as a frictional and magnetic face engaging

type. These clutches are provided with two co-operating elements, one the driving element, and the other the driven element. One of these constitutes the field element and the other constitutes the armature element. Provision is made for energizing the field element to produce the needed magnetic flux which acts through a magnetic circuit including both the field element and the armature element, drawing them together under force which is substantially proportional to the square of the field strength, and thus producing a frictional engagement between the two elements with corresponding driving effect between them. The clutch construction is such that when such field is discontinued by cessation of current flow the gripping effect is terminated, with corresponding declutching result. Normally the armature is slightly separated from the field element so that actual contact does not exist; but such separation is so small that only a slight axial movement is required to produce engagement for drive. Such axial movement occurs immediately that current flow through the field coil is produced, so that almost instantaneous engagement of the clutch takes place when the motor and clutch are electrified. Likewise, when current is cut off from said motor and said clutch the clutching engagement ceases at once, and there is no tendency for the clutch elements to "hang on" as is a serious detriment to use of the tooth type clutches in such installations. This combination of parts or elements constitutes an important part of my present invention.

I have hereinafter illustrated and shall describe one embodiment of such a clutch in the present combination, as illustrative of my present invention, and as constituting a good operating combination of the elements; but in so doing I wish it understood that I do not thereby intend to limit myself to this particular embodiment of such a clutch, except as I may do so in the claims to follow.

It is to be noted that when using the type of clutch herein disclosed for the present combination, the holding power of the two clutching elements is substantially proportional to the square of the exciting current, assuming that the magnetic elements of the clutch including its iron are being operated at a saturation below the "knee" of the magnetization curve. Accordingly, one feature of the present invention includes the provision of means to adjust the magnitude of this exciting current so that the holding power developed by the clutch will always be sufficient to ensure dependable operation under normal door closing operations, and to the complete door closed position, with corresponding reversal of the limit switch at the door closed position, but with assurance that excessive clutch holding power will not be developed. Thereby the benefits of both primary operating conditions will be satisfied. Sometimes the door closed limit switch may be functioned by the movement of the locking element to its door locked position, a condition which occurs after the door has actually reached its fully closed position. Accordingly, I have herein disclosed one arrangement in which such limit switch is caused to function when such locking element has actually moved to its door locked closed position, thus ensuring completion of all movements needed to produce door closed and locked condition prior to cutting off the motor and clutch current. Specifically, the presently illustrated embodiment is one in which the door locking is effected by down movement of a vertically movable locking bar; and the door closed and locked limit switch is caused to function by the vertical movement of this bar to its door closed locked position.

A further feature and object of the invention relates to the provision of means to enable convenient manual operation of the door controlling and operating elements when desired or required, as when the current supply fails. Under such conditions the clutch is de-energized and de-clutched, so that the necessary controlling and operating movements may be effected manually without need of driving the motor or the gear speed reducer (when one is used). In the present embodiment the clutch when clutched drives a shaft which in turn is operatively connected to the proper controlling and operating elements. Accordingly, by manually rotating this shaft in either direction when the current is off, either by failure of supply or by opening of the switch, such manual rotation of this shaft produces the desired operations. Such shaft extends normal to the face of the protective cover which encloses the clutch and various other elements. I have therefore provided an opening in such cover in alignment with such shaft so that, when manual operation is to be produced, a suitable hand grip element may be set onto the end of the shaft exposed through such opening, such hand grip element being outside of the enclosure, and then the rotation in proper direction may be conveniently produced. I have also provided a movable cover plate adjacent to the inside face of the enclosure at the location of such opening, which cover plate may be shifted between a normally closed position in which the opening is closed against insertion of the hand grip element or any other tool, and an open position in which such opening is uncovered. I have also provided a key locking device for effecting shift of such cover plate between its two positions, so that the opening can be uncovered only by use of a proper key.

Other objects and uses of the invention will appear from a detailed description of the same, which consists in the features of construction and combinations of parts hereinafter described and claimed.

In the drawings:

Figure 1 shows a front face view of the upper, door-closed portion of a door operating unit, including the clutch element which embodies the features herein described; and this figure also shows the limit switch for the door closed position;

Figure 2 shows a cross-section taken substantially on the line **2—2** of Figure 1, looking in the direction of the arrows; and this figure shows a longitudinal or side elevation of the clutch and adjacent parts;

Figure 3 shows a longitudinal section through the clutch and adjacent parts illustrated in Figure 2, and is also a section taken substantially on the lines **3—3** of Figures 1, 4, 5, 6, 7 and 8, looking in the directions of the arrows;

Figure 4 shows a front elevation, on reduced scale as compared to previous figures, showing the left-hand portion (door closed portion) of a cell door and the left-hand abutment or pilaster structure, with a portion of the structure cut away to reduce the height of the figure; and in this figure the cell door is in closed position against the pilaster, and the limit switch has functioned to cut off current to the motor and clutch;

Figure 5 shows a cross-section through the clutch element, substantially on the line **5—5** of Figure 3, looking in the direction of the arrows; and this figure shows the exciting field producing element;

Figure 6 shows a cross-section through the clutch element, substantially on the line **6—6** of Figure 3, looking in the direction of the arrows; and this figure shows the engaging and friction producing face of the field element of the clutch, which field element is drivingly connected to the shaft;

Figure 7 shows a cross-section through the clutch element, substantially on the line **7—7** of Figure 3, looking in the direction of the arrows; and this figure shows the smooth armature face which is drawn into engagement with the excited field element;

Figure 8 shows a cross-section through the clutch element, substantially on the line **8—8** of Figure 8, looking in the direction of the arrows;

Figure 9 shows more or less schematically, a typical

wiring diagram for a single cell installation embodying the features of the present invention;

Figure 10 shows a fragmentary face view of the upper left-hand portion of the structure shown in Figures 1 and 4, but with the protective cover in place; and this figure shows the opening in such cover plate through which a manually operated hand grip element may be inserted when such opening is uncovered by use of a special key, thus making it possible to manually operate the shaft and connected parts;

Figure 11 shows a plan view corresponding to Figure 10; and

Figure 12 shows a fragmentary vertical view of the upper portion of the right-hand upper portion of the structure, showing the upper portion of the vertically movable locking bar, and also showing the limit switch in position for operation by the vertical movements of such locking bar.

Referring first to Figures 1 and 4, I have therein shown the features of my present invention as applied to a typical installation of a cell door. To this end I have shown the left-hand or door closed end of a sliding door **10** the same being carried by rollers **11** (only one of which is shown) which are journalled to the upper portion of the door, and ride along a trackway **12** carried by the lower and horizontal flange **13** of an angle section **14**. The lower edge portion of this door is guided by suitable structural elements not herein shown as they constitute no portion of the present invention and combination of elements.

The door locking elements are partly shown herein, as they constitute no portion of the present invention. It may be stated, however, that in the type of structure to which my present improvements are generally applied such locking arrangements include a vertically movable locking bar, carried by the permanent structure, and normally occupying a lowered position in which the sliding door is lockable in either its closed or its open position. This locking bar generally occupies a location close to an abutment or pilaster passing which the door moves during opening and closing movements. Such pilaster and vertically movable locking bar are not shown in Figures 1 and 4 as they would occupy a position to the right of elements shown in said figures. During closing movement the door's left-hand edge comes to or close to the vertical abutment or pilaster **15** (see Figure 4) at which position the door is normally locked closed. In Figure 4 I have also shown a flange or bar **16** carried by the lower edge of the door and which is provided with a notch **17** in its lower edge. A suitable latch engages with this notch when the door is in its fully opened position to retain the door in such open position. This latch is connected to and moved by the vertical movements of the vertically movable locking bar to produce the desired locking of the lower edge of the door at the extremes of door movement.

The opening and closing movements of the door are directly produced in the following manner:

A sprocket wheel **18** is mounted on a shaft **19** located somewhat to the left of the leftward extreme of door movement. This shaft is suitably journalled as will be presently described. A companion sprocket wheel (or idler) is journalled to the structure at a location somewhat rightwardly of the fully opened door right-hand edge, such sprocket not being herein shown in order to shorten the figures. A chain or other tension element **20** passes over both of the sprockets and has its ends drivingly connected to the upper left-hand and right-hand corners of the door through suitable instrumentalities which need not be illustrated or described herein. However, these include a slide-bar lost-motion element which includes the bar **21**, conveniently in the form of an angle bar having its lower flange **22** projecting towards the observer in Figure 1. This angle bar is capable of a limited amount of horizontal shift with respect to the door to which it is attached so that when such shift in either direction has been fulfilled further driven movement of such bar in such direction will serve to move the door with the angle bar. The details of this lost-motion connection need not be illustrated here. Each end of such angle bar has connected to its lower flange face a downwardly extending block **23** (only the left one of which is illustrated in Figure 4), and a tension rod **24** is extended through such block. The outer projecting end of each such tension rod is connected to the proximate end of the chain or tension element **20**. The inner end of each such tension rod carries a nut **25** which is adjustable along such rod; and a compression spring **26** is located on the rod between the corresponding nut and the inner face of the corresponding block, so that by adjustment of such nut the compression of the spring may be adjusted. In other words, the pre-loading of such spring may be adjusted thereby. Thus it will be seen that a closed loop is provided including the upper run of the chain, the chain runs over the two end sprockets, the short chain runs between the sprockets and the proximate tension rods, and the upper portion of the door itself. It will also be seen that when pull is exerted on the chain in either direction by drive of the sprocket **18** some movement of the sprocket and chain may occur without and prior to corresponding door movement, such independent chain movement being permitted by compression of the spring **26** at the location or end at which force is being applied to the door; and such movements of compression of spring at such drive end being accompanied by corresponding expansion of the spring at the other end of the door. Thus such chain movement independently of the door is produced while at the same time permitting the chain to be kept taut and in good running condition over the two sprockets. It is noted that such movement of the chain produces its door drive through the instrumentality of the slide bar **21**, only to the permitted limit of such slide bar movement, after which door movement is produced; and such slide bar movement is also used to effect vertical movement upwardly of the locking bar for door unlocking. All of the foregoing structural features are fully disclosed in my aforesaid co-pending application Serial No. 386,231 and various of said features are claimed in that application.

Adjacent to the limit of movement of the door in each direction there is supported a limit switch by the structure. Only the left-hand or door closed limit switch is shown in Figures 1 and 4, there designated as **27**; but a right-hand or door opened limit switch **28** is also shown in Figure 9. This one is located at position to function properly when the door is fully opened. Each such limit switch conveniently comprises a form of microswitch having the light spring leaf element **29** carrying a roller **30**, and a plate **31** is hinged at **32** in position so that when such plate is raised it engages the roller and thus forces up the light spring leaf against its bias, thus also depressing the microswitch button and reversing such switch leaf contact for the desired function. The end of the slide bar **21** which approaches each limit switch is provided with a slanting or cam shaped plate **33** whose cam surface **34** is adapted to engage a stud projecting towards the observer in Figures 1 and 4, such stud being designated **35** and carried by the plate **31**. Any other suitable means may be provided for reversing the limit switches at the intended limits of door movement. These features are also disclosed in my aforesaid co-pending application, Serial No. 386,231.

The motor drive for the sprocket wheel **18** is best shown in Figure 1. The motor **36** is carried by a bracket **37** supported by the structure. This motor drives the gear speed reducer **38** through the shaft coupling **39**. The driven shaft **40** of the gear speed reducer carries a sprocket wheel or pulley **41**. The shaft **19** which carries the sprocket wheel **18** also carries the sprocket or pulley wheel **42** which is driven by the gear reducer wheel **41**

through the use of the chain or belt 43. Generally the gear speed reducer is of the worm and worm gear type and irreversible, so that drive backwardly from the shaft 41 to the shaft of the coupling 39 cannot be effected; but even if such gear reducer were not of irreversible quality such backward drive would entail drive of the motor's armature, with corresponding substantial load of drive imposed on the sprocket or wheel 18 when such drive might come from an attempt to move the door manually.

I have interposed a clutch element of special characteristics between the sprocket wheel or pulley 18 and the sprocket wheel or pulley 42 from which the drive of the chain 20 is derived, so that normally the sprocket 18 and chain 20 are disconnected from the sprocket 42 and motor drive, but so that when the motor is energized for drive in either direction such clutch element is also energized to effect drive from the sprocket wheel or pulley 42 to the sprocket wheel 18 and the chain 20. Such clutch arrangements are as follows:

Referring especially to Figures 2, 3, 4, 5, 6, 7 and 8, the shaft 19 is freely journalled in the bracket arms 44 and 45 which depend from the plate 46 secured to the bottom of the bracket arm 47 of the angle plate 48. This angle plate is in turn secured to the structural plate 49. The sprocket wheel 18 is secured to the shaft as shown in Figure 3. Conveniently such securing is produced by use of the flanged block 50 keyed to the shaft 19 by the key 51. The ring sprocket element 52 is then set onto the shouldered portion of such block 50 and secured in place by the screws as indicated. Thus the shaft 19 and sprocket wheel element 18 are locked together and rotate or stand idle as a unit.

A similar structure is shown in connection with the sprocket wheel 42. In this case, however, the flanged block 53 which carries the sprocket wheel ring is mounted for free rotation on the shaft, a bearing element 54 being located between such flanged block and the shaft. Such bearing element is indicated as a bushing, but evidently any suitable type of antifriction bearing might be used, such as a ball or roller bearing. Accordingly the drive from the sprocket wheel 42 to the shaft 19 is dependent on producing drive from the element 53 which carries the sprocket, to the shaft 19.

The element 53 may be considered as the armature of a magnetic clutch unit. The right-hand face of the element 53, especially the flanged portion thereof, is smooth, and comprises material of good magnetic permeability such as iron or one of the soft magnetic alloys. This element 53 is capable of slight shift rightwardly on the shaft (amounting to one or a few thousandths of an inch) when clutching is to occur, and like leftward shift when declutching is to occur. A field element 55 of generally flange form is secured to the shaft 19, being provided with a rightwardly extending sleeve portion 56 directly mounted on the shaft and keyed thereto by the key 57. Accordingly rotation of such field element must be accompanied by shaft rotation in the same direction. This field element's flange is provided with an encircling recess or groove 58 (see Figures 3 and 6) which faces the smooth face of the armature flange 53. This encircling or annular recess provides the inner and outer narrow flanges 59 and 60 which may be directly engaged by the surface of the armature element when that element is shifted slightly rightwardly under magnetic attraction. Or, preferably, a number of friction blocks of segmental form, 61, may be seated into the recess and secured in place by rivets 62, such friction blocks being of slightly greater depth than the flanges 59 and 60 so that when magnetic attraction between the flanges and the armature surface (element 53) occurs the friction material blocks will come into firm engagement with the armature surface before engagement occurs between the flanges 59 and 60 and the armature. Accordingly, the drive between the armature and field elements will be produced frictionally through the medium of the friction blocks. Also, since no actual metal to metal engagement occurs between the flanges 59 and 60 and the surface of the armature element 53 there is produced no magnetic "lock" such as would tend to retain the driving engagement between the parts after magnetization had ceased by termination of the electro-magnetic energization to be described presently. Thus, as soon as demagnetization occurs the armature element will be freed of drive to the element 55, which is the effect desired.

The magnetization of the field element 55 is produced by induction as follows:

A coil unit 61*a* is freely mounted on the sleeve 56 of the field element so that rotation of the field element may occur without corresponding rotation of the coil unit 61*a*. Preferably a bushing 62*a* is set between said elements as shown in Figure 3, or an anti-friction bearing such as a ball or roller bearing may be used at this location. This element 61*a* includes a deep annular recess 63 into which is set a coil 64 having its axis parallel to the shaft axis, so that magnetization flows through the central portion of the coil element in axial direction. The left face of this element 61*a* is provided with a deep but radially narrow recess 65 into which seats a rightwardly extending narrow flange 66 of the element 55, the parts being so proportioned that actual contact between the elements 55 and 61*a* does not occur during drive running. The element 61*a* is also provided with a radially narrow flange 67 which overlies the outer periphery of the element 55 with slight clearance between the parts. A thin ring 68 may be set between the inner flange of the element 61*a* and the proximate right-hand surface of the element 55 to prevent the elements 61*a* and 55 from being drawn into direct metal to metal engagement under magnetic attraction when the coil 64 is energized.

The energization of the coil 64 will serve to magnetize the element 55 by induction and without frictional engagement between the parts. It will be seen that the path of flux between the various elements will be as follows: From the flange 67 (of the element 61*a*) to and through the flange 60 of the element 55 to the face of the armature element 53. By providing the overlap between the flange 67 of the element 61*a* and the outer surface of the element 55 there is induced a direct flow of flux to the flange 60, and thence to the face of the armature element by a short path. If desired the flange portion of the element 55 may be formed by non-magnetic material between the flanges 59 and 60, such flanges, however, being of magnetic material, so that any magnetic short-circuiting tendency between said flanges 59 and 60 will be greatly reduced, and the flux strength delivered to the face of the armature plate will be correspondingly increased. In this connection, too, the provision of the rightwardly extending flange 66 of the field element reaching into the annular recess 65 of the coil element, will tend to induce direct flow of flux in such manner as to strengthen the flux delivered through the armature plate surface.

The coil element remains stationary while rotation is being produced of the elements 53 and 55, the magnetization being produced inductively as stated before. Accordingly, the two terminals of the coil 64 may be permanently connected to the proper current supply circuits without need of using slip-rings which would be seriously objectionable in such an installation as that for confining persons convicted of felonies. I have shown the element 61*a* as provided with the radially extending flange element 69 through which is extended a pin 70 carried by a bracket 71 secured to the underface of the element 46. Preferably the opening through which such pin passes is slightly enlarged radially, as shown in Figures 5 and 6 so that the element 61*a* is free to adjust and center itself with respect to the element 55.

A ring element 72 is placed on and locked to the shaft 19 just to the right of the element 61*a* so that all

of the clutch elements are retained in proper relative positions on the shaft, such ring element rotating with the shaft while the element 61a is stationary.

Now it is noted that the magnetic flux developed by the coil 64 will be generally proportionate to the current strength through such coil, assuming that the magnetization is occurring in amount below the knee of the saturation curve of the magnetic path. Since the magnetic attraction between the field and armature elements is proportional to the product of their strengths, and since the strengths of both elements of the field are the same, it follows that the attraction under the conditions existing in the clutch herein disclosed will be generally proportional to the square of the supplied current. I have provided means to adjust the value of that current to meet the operating conditions of the present installation, as will presently appear. The following comments are pertinent to a determination of what that current and the holding power of the clutch should be:

It is desired that the holding power of the clutch shall be sufficient to ensure dependable operation of the door for controlling and operating devices, but not sufficient to cause serious harm to objects which may be present between the door edge 73 and the abutment or pilaster 15 (Figure 4). Assuming that the door is in its fully opened and locked open position the vertical locking bar is lowered. As the door closing operation commences pull is exerted on the chain 20 towards the left on the lower chain run thus pulling on the rod 24 and compressing the spring 25 to some extent. This pull will urge the slide bar 21—22 leftwardly to take up the lost motion prior to commencing leftward door closing movement. This leftward movement of the slide bar will cause the cam edge 34 to raise the locking bar (said cam edge being then in its rightward or door open position, not illustrated in Figures 1 and 4). As soon as the locking bar has thus been raised to the door unlocking position the continued leftward travel of the slide bar under such pull of the chain's lower run will produce door closing movement under tension sufficient to meet the requirements of frictional resistance, inertia in starting the door, etc. Here it is noted that either the pull needed to raise the locking bar through cam action, or the pull needed to cause leftward door movement will be the higher depending on various conditions of design and lubrication, etc. In any case it is noted that the adjustment of current supply to the clutch coil 64 must be such as to ensure clutch holding during these operations; otherwise the needed functions of unlocking the door and moving it thereafter would not be produced. Of course similar conditions must be met when opening the door, being a rightward movement.

Now the door closed limit switch 27 will not be reversed until the door has been fully closed, or just prior to such full closing. Accordingly, any obstacle of appreciable size which may be found between the left-hand door edge and the abutment 15 will jam the door prior to actuation of the switch 27 to discontinue supply of current to the motor and clutch. But, it is desired to ensure that the presence of such an obstacle will not cause excessive pressure to be exerted thereagainst under such condition of continued current supply to the motor and the clutch; it benig understood that there must be a sufficient "factor of safety" provided in the sense that under all conditions of free door movement and normal operation the clutch will certainly hold and produce the required operations. The means to adjust the current value supplied to the clutch makes it possible to ensure the foregoing conditions, and at the same time ensure that under the excessive pull developed when the door is stopped by some obstacle the clutch will slip and continue to slip as long as such obstacle is present between the door edge and the abutment.

It is further noted at this point that signal means are provided for giving to the attendant or guard a signal when the door is actually closed and brought to its locked closed condition. Accordingly, when such signal fails to respond after the usual lapse of time needed for door closing the attendant may come to such door, examine it, and if needed, remove any obstacle which he finds in place to prevent the complete door closing movement.

It is found that clutches of the type herein illustrated admirably perform all of the required functions, and comply with the conditions explained above. This is because, among other things, such clutches produce drive from the driving to the driven element through facial engagement of surfaces normal to the axis of shaft rotation, and because the driving force which will be developed depends almost directly on the facial pressure exerted between such surfaces. It is further noted that the provision of the friction material inserts or blocks 61 carried by the field element 55 serve to produce a frictional contact of such nature that when slip is forced to occur by exerting a sufficient holding force against the driven element such slip will be a smooth sliding action, generally devoid of chatter, jerks and other objectionable irregularities of drive. Furthermore, such inserts or blocks are replaceable on occasion by simple operations.

As one example of such a clutch as just described, and which will respond to the conditions outlined hereinbefore, I refer to the clutches manufactured by the Warner Electric Brake & Clutch Company, of Beloit, Wisconsin, and shown in their "Service Manual" for electric stationary field clutch couplings, Models 160—250—400, which manual carries Form No. WEB 6174. However, I do not intend to limit myself to these particular manufactures of clutches, nor to any other particular manufacture or form thereof, except that the clutches shall respond to the requirements hereinbefore explained, and as I may limit myself in the claims to follow.

The circuit connections needed for operation of the clutch harmoniously with the motor operations for the jail door unit illustrated and to produce the intended operations may be designed largely to suit the specifications covering the installation and the views of the designer. However, fundamentally such connections should be such as to ensure energization of the clutch simultaneously with the supply of current to the motor 36, and to ensure discontinuance of current supply to the clutch simultaneously with discontinuance of current supply to the motor. Arrangements embodying these general requirements are disclosed in my aforesaid co-pending application, Serial No. 386,231. However, in order to show one circuit arrangement which has been found to be satisfactory for use in connection with the clutches herein disclosed, and the combinations of elements previously referred to reference may be had to Figure 9 in which I have shown one typical circuit arrangement, the same including circuit connections for operation and control of one cell door installation.

In Figure 9 I have shown the motor 36 for the unit of the door in question, the coil 64 for the corresponding clutch, the limit switch 27 for the door closed position, the limit switch 28 for the door open position, and the signal lamp 74 for the door closed position. I have also shown the signal lamps 75 and 76 which indicate respectively the lowered or locked position of the vertical locking bar, and the raised or unlocked position of such vertical locking bar. I have also shown the panel board 77 for the door unit in question, the same being provided with the "Open Push Button" 78, which, when pushed serves to bring into operation relays to start the motor, close the clutch, and ensure motor operation in direction for door opening, and being provided with the "Close Push Button" 79, which, when pushed serves to bring into operation relays to start the motor, close the clutch, and ensure motor operation in direction for door closing. This panel board is also provided with the "Stop Push Button" 80, which, when pushed serves to stop the operations immediately, as when an emergency arises

during a door movement operation. This panel board is also provided with the "Disconnect Switch" **81** whereby current supply to the complete unit is terminated.

In this figure I have also shown a relay panel board **82** which carries suitable relays to control the starting of the motor in proper direction corresponding to the button which has been pushed, and various other elements of control.

Since the current supply is generally A. C., and since it is desirable to use D. C. for energization of the clutch coil **64** I have shown in Figure 9, provision for providing D. C. supply for such clutch coil. In the arrangement illustrated I have shown the full wave rectifier **83**, conveniently of the selenium cell type. This rectifier has the A. C. input terminals **84** and **85** which are supplied with A. C. simultaneously with supply of current to the motor for motor operation in either direction, and said rectifier is also provided with the D. C. terminals **86** and **87** for D. C. output. Said D. C. output terminals **86** and **87** are connected to the terminals of the clutch coil **64** with a variable resistor **88** included in such circuit so that the current delivered to the clutch coil will thus be adjustable. Such adjustment is generally of a more or less permanent nature since it should be made when the equipment is installed and brought into operating condition. This adjustment of clutch coil current may thus be effected to ensure reliable operation of the door operating mechanism, according to the principles already set out at length, and yet to ensure that the clutch will slip when an obstruction is encountered during the door closing operation. As a matter of protection from tampering and the like, such variable resistor should be enclosed in an enclosure which cannot be opened except by a properly authorized person. I have indicated such an enclosure at **89** in Figure 9.

It is to be noted that when the door closed limit switch is actuated by the door itself or by some element connected to the door, the mere closing of the door to the switch operating position may not represent completion of the door locking operation. That operation depends on the movement of the vertically movable locking bar to its door locked position, generally its lowered position. In such case a signal may be given by the movement of such locking bar to its door locked position, for termination of the current supply to the motor and to the clutch.

In Figure 12 I have shown a fragmentary view, partly in section, of the vertical locking bar located adjacent to the right-hand end of the door when such door is in its closed position. This is the bar **90**. The pilaster within which or adjacent to which such bar is located is shown at **91**. The right-hand upper portion of the door is shown at **92**, and the rail **12** on which the door rollers travel is shown at **12**, being carried by the flange **13** of the angle bar **14**, right-hand portions of which are shown in Figure 12. This figure also shows the right-hand portion of the slide bar **21**, which portion carries the cam element **93** similar to but reversed from the cam element **34** previously described. The locking bar is provided with the stud **94** reaching towards the observer in Figure 12, and generally provided with a roller anti-friction element. The slide bar carries the block **95** similar to the block **23** previously described, through which block **95** extends the rod **96** to the outer end of which is connected the proximate end of the tension element for pull to the right when drive of the wheel **18** is executed in the proper direction, it being understood that the tension element passes over a wheel located to the right of the parts shown in Figure 12. A nut and spring corresponding to the elements **25** and **26** are also carried by the rod **96** so that the right-hand end of the tension element is tension connected to the block in manner similar to the left-hand connection previously described. Thus, during the first portion of the pull exerted on the tension element by drive of the wheel **18** in proper direction, the slide bar is drawn rightwardly with respect to the door until the lost-motion has been taken up, after which the pull is exerted on the door itself, the locking bar having been raised by the cam surface **93** high enough to bring the stud **94** above the end surface **96***a* of the door, so that the door has been unlocked by such slide-bar movement. Contrarily, when the door is being moved in the closing direction, the locking bar is retained in its raised and unlocked position by reason of the fact that the stud **94** rides on the upper edge of the slide-bar until almost the door closed position is reached, and during the final stages of door closing movement such stud rides on the door edge **97**. When the closing movement has been completed the stud (and locking bar) is allowed to fall past the end **96***a* of the door so as to produce the desired locking function.

It is now noted that although the door has completed its closing movement when the door edge **96***a* comes to the location of the stud, still actual locking does not occur until that stud (and the locking bar) has dropped. The presence of an obstruction in the down movement of the locking bar might thus prevent actual locking from ocurring. It is desirable that termination of current supply to the motor and the clutch shall not occur until the locking operation has occurred. In Figure 12 I have shown the limit switch **27***a* located adjacent to the locking bar provided with a recessed portion **98** into which the small roller **30***a* of such switch may move and be accommodated when the locking bar is in other than its door locked position. This switch is substituted for the switch **27** previously described and shown in Figures 1 and 9, when it is desired to terminate current supply to the motor and clutch by movement of the locking element to its door locked condition.

In Figures 3, 10 and 11 I have shown the protective cover plate **99** extending along the upper portion of the structure and enclosing the various operating mechanisms previously described. It is not deemed necessary to here describe the means to support such cover plate as such arrangements are well known in this art. It is to be noted, however, that in Figure 3 I have shown the upper portion of the door, the roller, the roller supporting rail, and certain other elements. Some of these are shown by dotted lines in that figure, as they actually lie to the right of the section line on which the section of that figure is taken; but they have been illustrated to better indicate the relations between the parts.

This cover plate **99** is provided with an opening **100** in alignment with the shaft **19** so that a suitable handle or hand grip element may be set through such opening and into driving engagement with the shaft when manual shaft rotation is desired. To this end I have shown the recess **101** formed in the end of the shaft, and located eccentrically with respect to the axis of shaft rotation. I have also shown the hand-grip element including the socket member **102** which can be set through the opening **100** and whose socket is set over the end portion of the shaft as shown in Figure 3. This device is provided with a stud **103** in its socket which stud will engage and seat into the recess **101** to thus provide a driving engagement from the hand-grip element and the shaft. The hand-grip element is provided with suitable lateral extensions **104** to facilitate the turning of the hand-grip and the shaft when so engaged.

It is noted that when current is off or not being delivered to the motor and clutch this shaft is de-clutched from the gear speed reducer and motor so that rotation of the shaft will effect the various door unlocking and opening and locked open, or door unlocking from open condition, door closing, and door locked closed operations manually performed. It is evident that all of these operations may thus be performed merely by setting the hand-grip element through the opening **100** and in proper engagement with the shaft end, after which rotation of the hand-grip will produce the desired operations.

I have provided means to normally close and lock closed the opening **100** so that such a hand-grip element may not be set through the opening **100**, nor may the

shaft be exposed through such opening, except by an authorized person provided with a suitable key. These arrangements are as follows:

A wing element **105** is swingingly pivoted to the cover plate for rock close to and parallel to the inside surface of such cover plate. Such wing element is pivotally connected to the cover plate at **106**. It normally stands in the position **105***a* shown in Figure 10, but may be raised to the position **105** of that figure. In its normal or lowered position this wing element covers the opening **100** so that it is impossible to set the hand-grip element or other implement through the opening **100** for rotation of the shaft. I have also provided the guard **107** secured to the inside face of the cover plate at location such that the left-hand end portion of the wing element is retained by such guard against being pushed backwardly or inwardly by force exerted through the opening. This guard is of vertical dimension sufficient to accommodate and protect the wing element during full rock of such element, so that, even when the wing element has been rocked to the raised position it cannot be distorted by pressure exerted through the opening **100**.

I have also provided a key operated locking element to shift the wing element between its raised and lowered positions as follows:

A conventional locking device, well known in the jail locking arts, **108** is secured to a mounting plate **109**, as by welding or the like. This locking device is provided with the bolt which, when projected fully extends to the line **110** in Figure 10, and when fully withdrawn retracts to the line **111** in said figure. This bolt is designated by the numeral **112**. Thus the bolt movement is shown by the line **113** in Figure 10. A pin **114** is secured to the face of the bolt and projects towards the cover plate far enough to extend through the transverse slot **115** formed in the wing element. This slot is of transverse dimension sufficient to accommodate angularity during the bolt movements, and during the swings of the wing. This locking device is provided with conventional internal elements, such as tumblers or other elements needed to ensure proper bolt movements for a key individual to such locking device. The key opening is shown at **116** in Figure 10; and a conventional escutcheon plate **117** is secured to the face of the cover plate as shown in Figure 10.

With the foregoing arrangement it is seen that when the lock **108** is key operated to project the bolt, the wing is lowered fully to cover and protect the opening **100**, and the bolt is locked in such projected position. Thus the uncovering of the opening **100** requires the use of the proper key to withdraw the bolt rightwardly, thus raising the wing element to expose the opening **100** for insertion of the hand-grip element for manual operation of the shaft **19**.

I claim:

1. A cell door installation of the linear door movement type and means to operate and control the operation of said door comprising in combination, a planar cell door for separating a confinement area from a non-confinement area, means to support said door permitting back and forth movement of the door in the plane of said door between a door closed and a door open position, a reversible motor individual to said door, means to mount said motor, a gear reducer having an input shaft and an output shaft, a driving connection from the motor to the input shaft aforesaid, a driving wheel shaft, means to journal said shaft for rotation about an axis substantially normal to the plane of the door, one end of said shaft being at the non-confinement area and accessible at said area, a driving wheel drivingly secured to said driving wheel shaft, a tension element having one end in tension engagement with the door, said tension element being in peripheral tensioning engagement with the driving wheel, a clutch including a driving element mounted on the driving wheel shaft for free rotation on said shaft and for movement on the shaft in axial direction, and said clutch also including a driven element mounted on and drivingly secured to said shaft, the axial direction movement of the driving element being towards and away from the driven element, driving connections from the output shaft of the gear reducer to the driving clutch element, both of said clutch elements being provided with opposing friction engageable surfaces lying in planes normal to the axis of the driving wheel shaft, said clutch element surfaces being in frictional driving engagement with each other during clutch drive and being disengaged from each other at times other than during clutch drive, electro-magnetic means to drivingly engage said clutch element surfaces for drive of the driving wheel in direction to tension the tension element for door movement, connections for supply of current simultaneously to the motor and to the electro-magnetic means of the clutch for simultaneous operation of the motor and driving engagement of the clutch elements, said current supply connections being constituted for supply of current to the electro-magnetic means of the clutch only during supply of current to the motor, the clutch element surfaces being in driving engagement with each other only while current is being supplied to the electro-magnetic means of the clutch, and means to vary the magnitude of current supply to the electro-magnetic means of the clutch to thereby vary the amount of the frictional engagement of the clutch element surfaces with each other during motor operation.

2. Means as defined in claim 1, wherein said electro-magnetic means comprises a magnetizing coil mounted stationary in position to generate a magnetic flux flowing axially between the opposing friction engageable surfaces.

3. Means as defined in claim 1, together with a stationary abutment located in the line of door travel and at the door closed position, and wherein the connections for supply of current to the motor include a limit switch for the door closed position of the door, said limit switch having a current on position and a current off position, and cooperating parts on the door and said limit switch, said parts being formed for engagement at the door closed position with the door in close proximity to the abutment and for disengagement when the door is at other than said door closed position, and said switch and said parts being constituted for movement of the switch to the current off position when the door is at the door closed position and for movement of the switch to the current on position when the door is at positions other than the door closed position.

4. A cell door installation of the linear door movement type and means to operate and control the operation of said door comprising in combination, a planar cell door, for separating a confinement area from a non-confinement area, means to support said door permitting back and forth movement of the door in the plane of said door between a door closed and a door open position, a reversible motor individual to said door, means to mount said motor, a gear reducer having an input shaft and an output shaft, a driving connection from the motor to the input shaft aforesaid, a driving wheel shaft, means to journal said shaft for rotation about an axis substantially normal to the plane of the door, one end of said shaft being at the non-confinement area and accessible at said area, a movable gate adjacent to the said end of said shaft, means to mount said gate for movement between a gate position of interference with said end of the shaft and a gate position of non-interference with said end of the shaft, manual locking means including a movable element movable between a gate locking position and a gate unlocking position, operative connections between said locking means movable element and said gate effective to move the gate to its shaft interference position when the locking means movable element is in its gate locking position and to move the gate to its shaft non-interference position when the locking means movable element is in its gate unlocking position, a driving wheel drivingly secured

to said driving wheel shaft, a tension element having one end in tension engagement with the door, said tension element being in peripheral tensioning engagement with the driving wheel, a clutch, including a driving element mounted on the driving wheel shaft for free rotation on said shaft and for movement on the shaft in axial direction, and said clutch also including a driven element mounted on and drivingly secured to said shaft, the axial direction movement of the driving element being towards and from the driven element, driving connections from the output shaft of the gear reducer to the driving clutch element, both of said clutch elements being provided with opposing friction engageable surfaces lying in planes normal to the axis of the driving wheel shaft, said clutch element surfaces being in frictional driving engagement with each other during clutch drive, and being disengaged from each other at times other than during clutch drive, electro-magnetic means to drivingly engage said clutch element surfaces for drive of the driving wheel in direction to tension the tension element for door movement, connnections for supply of current simultaneously to the motor and to the electro-magnetic means of the clutch for simultaneous operation of the motor and driving engagement of the clutch elements, and means to vary the magnitude of current supply to the electro-magnetic means of the clutch to thereby vary the amount of the frictional engagement of the clutch element surfaces with each other during motor operation.

5. Means as defined in claim 4, wherein said electro-magnetic means comprises a magnetizing coil mounted stationary in position to generate a magnetic flux flowing axially between the opposing friction engageable surfaces.

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